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Cell salvage for minimising perioperative allogeneic blood transfusion (Review)

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TABLE OF CONTENTS

[Intervention Review]

Cell salvage for minimising perioperative allogeneic blood transfusion

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ABSTRACT

Background

Concerns regarding the safety of transfused blood have prompted reconsideration of the use of allogeneic (from an unrelated donor) red blood cell (RBC) transfusion, and a range of techniques to minimise transfusion requirements.

Objectives

To examine the evidence for the efficacy of cell salvage in reducing allogeneic blood transfusion and the evidence for any effect on clinical outcomes.

Search methods

We identified studies by searching CENTRAL (*The Cochrane Library* 2009, Issue 2), MEDLINE (1950 to June 2009), EMBASE (1980 to June 2009), the internet (to August 2009) and bibliographies of published articles.

Selection criteria

Randomised controlled trials with a concurrent control group in which adult patients, scheduled for non-urgent surgery, were randomised to cell salvage (autotransfusion) or to a control group who did not receive the intervention.

Data collection and analysis

Data were independently extracted and the risk of bias assessed. Relative risks (RR) and weighted mean differences (WMD) with 95% confidence intervals (CIs) were calculated. Data were pooled using a random-effects model. The primary outcomes were the number of patients exposed to allogeneic red cell transfusion and the amount of blood transfused. Other clinical outcomes are detailed in the review.

Main results

A total of 75 trials were included. Overall, the use of cell salvage reduced the rate of exposure to allogeneic RBC transfusion by a relative 38% (RR 0.62; 95% CI 0.55 to 0.70). The absolute reduction in risk (ARR) of receiving an allogeneic RBC transfusion was 21% (95% CI 15% to 26%). In orthopaedic procedures the RR of exposure to RBC transfusion was 0.46 (95% CI 0.37 to 0.57) compared to 0.77 (95% CI 0.69 to 0.86) for cardiac procedures. The use of cell salvage resulted in an average saving of 0.68 units of allogeneic RBC per patient (WMD -0.68; 95% CI -0.88 to -0.49). Cell salvage did not appear to impact adversely on clinical outcomes.

Authors' conclusions

The results suggest cell salvage is efficacious in reducing the need for allogeneic red cell transfusion in adult elective cardiac and orthopaedic surgery. The use of cell salvage did not appear to impact adversely on clinical outcomes. However, the methodological quality of trials was poor. As the trials were unblinded and lacked adequate concealment of treatment allocation, transfusion practices may have been influenced by knowledge of the patients' treatment status potentially biasing the results in favour of cell salvage.

PLAIN LANGUAGE SUMMARY

Cell salvage (collecting a patient's own blood during surgery) for reducing transfusions with donated blood

Some patients who undergo surgery require blood transfusions to compensate for the blood loss that occurs during the procedure. Often the blood used for the transfusion has been donated by a volunteer. The risks associated with receiving volunteer donor blood that has been screened by a competently managed modern laboratory are considered minimal, with the risk of contracting diseases such as HIV and hepatitis C being extremely low. However there is concern in many developing countries, where there is a high prevalence of such infections and transfusion services are inadequately equipped to screen donor blood as thoroughly. Although in developed countries the risks of acquiring a disease from transfused blood are low, the financial costs associated with providing a safe and reliable blood product are escalating. Therefore there is much attention being placed on alternative strategies to minimise the need for transfusions of donor blood.

'Cell salvage' or 'autotransfusion' is one technique designed to reduce the use of such transfusions. It involves the collection of a patient's own blood from surgical sites which can be transfused back into the same person during or after surgery, as required.

The authors undertook this systematic review to examine the evidence for the effectiveness of cell salvage in reducing the need for blood transfusions of donor blood in adults (over 18 years) undergoing surgery.

The authors found 75 studies investigating the effectiveness of cell salvage in orthopaedic (36 studies), cardiac (33 studies), and vascular (6 studies) surgery. Overall, the findings show that cell salvage reduces the need for transfusions of donated blood. The authors conclude that there appears to be sufficient evidence to support the use of cell salvage in cardiac and orthopaedic surgery. Cell salvage does not appear to cause any adverse clinical outcomes.

As the methodological quality of the trials was poor, the findings may be biased in favour of cell salvage. Large trials of high methodological quality that assess the relative effectiveness, safety, and cost-effectiveness of cell salvage in different surgical procedures should be the focus of future research in this area.

BACKGROUND

Concerns regarding the safety of transfused blood, have prompted reconsideration of the use of allogeneic (blood from an unrelated donor) red cell transfusion. The risks associated with volunteer donor blood transfusion (allogeneic blood) that has been screened by a competently managed modern laboratory are generally considered minimal, with the risks of human immunodeficiency virus (HIV) and hepatitis C (HCV) being extremely low (Glynn 2000; Whyte 1997). However, of great concern is that in many developing countries there is a high prevalence of such infections and transfusion services are inadequately equipped to conduct universal antibody screening (Lackritz 1998; McFarland 1997). Meanwhile, in developed countries, although the risks of acquiring a transfusion-transmitted disease (TTD) are considered low, the costs associated with providing a safe and reliable blood product are escalating (Hadjianastassiou 2002).

Recent concerns that variant Creutzfeldt-Jakob disease (vCJD) could be transmitted by blood transfusion (Brown 2000; Houston 2000) have prompted blood transfusion services worldwide to adopt more stringent donor selection procedures and the deferral of current donors who may have been exposed to vCJD (Oliver 2002). The ramifications of such actions have been, in some cases, the elimination of a sizable proportion of blood donors from an already declining volunteer donor pool. Blood is now, more than ever, an incredibly scarce resource.

Concerns regarding blood safety, continual blood shortages, and spiraling health costs associated with blood bank operations, have collectively generated considerable enthusiasm for the use of technologies intended to reduce the use of allogeneic blood (Forgie 1998). However, some of the alternatives to allogeneic blood have their own risks and are highly expensive (Coyle 1999; Fergusson 1999a).

With early reports suggesting that between 60% and 70% of all red blood cell units are transfused in the surgical setting (Cook 1991; Lenfant 1992; Surgenor 1990; Wallace 1993) and more recently, that half of all the blood transfused in the United Kingdom is to surgical patients (Regan 2002), it is of no surprise that considerable interest has been shown in a range of interventions designed to reduce perioperative allogeneic red cell transfusion. Generally, such interventions fall into three groups: (1) the administration of agents to diminish blood loss (e.g. aprotinin, tranexamic acid, epsilon aminocaproic acid, fibrin sealant), (2) agents that promote red blood cell production (e.g. erythropoietin), and (3) techniques for re-infusing a patient's own blood (e.g. pre-operative autologous donation, acute normovolaemic haemodilution, cell salvage).

Cell salvage is one technique that has been used extensively in the surgical setting. Cell salvage (CS), alternatively known as 'auto-transfusion', is a term that covers a range of techniques that scavenge blood from operative fields or wound sites, and re-infuse the blood back into the patient. Cell salvage can be performed during the intra- and/or postoperative periods. To remove non-cellular matter prior to reinfusion, some of the devices use centrifugal washing of the salvaged blood (Huet 1999).

This review builds on the systematic review published by Huet et al (Huet 1999). It examines the evidence for the efficacy of cell salvage in reducing the need for perioperative allogeneic red blood cell transfusion in adult elective surgery and whether there is a greater reduction in allogeneic blood transfusion demonstrated in identifiable patient sub-groups. This review employs methods developed by the International Study of Perioperative Transfusion (ISPOT) study group (a ten country study of evidence, attitudes and practices relating to the use of alternatives to allogeneic blood transfusion) (Fergusson 1999b).

OBJECTIVES

To examine the effects of cell salvage in minimising perioperative allogeneic red blood cell transfusion and on other clinical outcomes.

METHODS

Criteria for considering studies for this review

Types of studies

Randomised controlled trials with a concurrent control group.

Types of participants

The study participants were adults (over 18 years). The surgery being conducted was elective or non-urgent.

Types of interventions

The intervention considered was cell salvage (CS). Studies with a combination of active comparisons were included if both the intervention and control groups were equally exposed to the active treatment (active plus cell salvage versus active comparisons).

Types of outcome measures

Primary outcomes

- The number of patients who were transfused with allogeneic or autologous blood, or both
- The amounts of allogeneic and/or autologous blood transfused

Secondary outcomes

- Re-operation for bleeding
- Post-operative complications (thrombosis, infection, renal failure, non-fatal myocardial infarction)
- Mortality
- Length of hospital stay (LOS)

Search methods for identification of studies

Electronic searches

This review drew on the literature searches that were constructed as part of the International Study of Perioperative Transfusion (ISPOT) (Huet 1999). The searches were last updated in June 2009.

We searched the following electronic databases:

- Cochrane Central Register of Controlled Trials (CENTRAL) (*The Cochrane Library 2009*, Issue 2);
- MEDLINE (1950 to June (Week 3) 2009);
- EMBASE (1980 to Week 26, 2009);
- Current Contents (ISI Web of Knowledge) (to June 2009).

The searches were based on the MEDLINE strategy shown in Appendix 1, and were modified as appropriate to the specifications of each database.

In MEDLINE and EMBASE two search filters were used to restrict electronic searches and improve the specificity of the searches. Firstly, the ISPOT filter (Laupacis 1997), which identifies blood transfusion trials, and secondly, a modified version of the Cochrane Collaboration filter (Dickersin 1996) which identifies randomised controlled trials. These search filters were coupled with the MeSH headings and relevant text-word terms for cell salvage.

Searching other resources

The internet site of the International Network of Agencies of Health Technology Assessment (INAHTA) was searched to June 2009. Reference lists of relevant reviews and identified articles were searched for additional studies. Contact was made with experts in the field to identify reports or projects in progress, relevant to the review. In addition, authors were contacted to identify any additional published or unpublished data.

Data collection and analysis

Selection of studies

The titles and/or abstracts of identified studies were screened by two independent authors. To be eligible for inclusion, studies had to include adult patients, scheduled for elective surgery, who were randomised to cell salvage or to a control group that did not receive cell salvage. Study reports had to provide data on the number of patients transfused with red cells, or the volume of blood transfused. Two authors independently selected trials that met the defined inclusion criteria with disagreements resolved by consensus.

Data extraction and management

Two authors independently extracted study characteristics and outcomes using an article extraction form. The extraction form was used to record information regarding; randomisation criteria, trial methodology, the presence of a transfusion protocol, the type of surgery involved, treatment outcomes, and general comments. Information regarding demographics (age, sex), the type of surgery, the presence or absence of a transfusion protocol, the timing of cell salvage, and the type of cell salvage (washed or unwashed) was also recorded. Data were extracted for allogeneic blood transfusion if it were expressed as whole blood or packed red cells. Transfusion data expressed in millilitres were converted to units by dividing by 300.

Data on the following outcomes were recorded:

- the number of patients transfused allogeneic and/or autologous blood;
- the volume of red cells transfused;
- post-operative complications (thrombosis, infection, haemorrhage, non-fatal myocardial infarction, renal failure);
- mortality;
- length of hospital stay (LOS).

Data were also recorded for blood loss and the number of patients requiring re-operation for bleeding.

Authors were contacted to provide missing data where possible.

Assessment of risk of bias in included studies

Studies were assessed for methodological quality using the Cochrane Collaboration's tool for assessing risk of bias presented in Higgins 2009. Disagreements were resolved by consensus.

The following domains were assessed for each study:

- sequence generation,
- allocation concealment,
- blinding.

We completed a risk of bias table for each study, incorporating a description of the study's performance against each of the above domains and our overall judgement of the risk of bias for each entry as follows; 'Yes' indicates a low risk of bias, 'Unclear' indicates unclear or unknown risk of bias, and 'No' indicates a high risk of bias.

Assessment of reporting biases

Funnel plots were inspected for evidence of publication bias.

Data synthesis

Data were extracted and then entered into Review Manager by one author. Articles identified as duplicate publications were combined to obtain one set of data. Dichotomous and continuous data were pooled across trials using a random effects model. If the standard deviation (SD) or the standard error of the mean (SEM) were not reported for continuous data the study was not included in the meta-analysis.

Subgroup analysis and investigation of heterogeneity

Statistical heterogeneity was examined by both the I-squared and chi-squared tests. The I-squared test describes the percentage of total variation across studies due to heterogeneity rather than chance. A value of 0% indicates no observed heterogeneity, whereas values >50% indicates substantial heterogeneity (Higgins 2009). The Q statistic, which has an approximate Chi^2 distribution with degrees of freedom equal to the number of studies minus one, was also used to assess heterogeneity of treatment effect (Der Simonian 1986). A P value less than or equal to 0.1 was used to define statistically significant heterogeneity.

Analysis of a priori subgroups was performed to determine whether effect sizes varied according to factors such as:

- the type of surgery;
- the use of transfusion protocols;
- the type of salvaged blood retransfused (washed or unwashed);
- the timing of cell salvage (intra- or post-operative, or both);
- trial methodological quality.

RESULTS

Description of studies

Seventy-five studies fulfilled the inclusion criteria. The majority of trials included in the analysis were conducted in the United Kingdom (n = 23) and the United States (n = 14). The remaining trials were conducted across a range of countries: the Netherlands (n =

6), Sweden (n = 5), China (n = 3), France (n = 3), Germany (n = 3), India (n = 3), Australia (n = 2), Canada (n = 2), Denmark (n = 2), Greece (n = 2), Croatia (n = 1), Hong Kong (n = 1), Italy (n = 1), Lithuania (n = 1), Norway (n = 1), Russia (n = 1) and Turkey (n = 1). Studies were published between 1978 and 2008. Five studies (Fragnito 1995; Lorentz 1991; Menges 1992; Rosencher 1994; Zhang 2008) were published in languages other than English. These studies were translated before being included in the analysis. The majority of trials were small with less than 100 patients in each arm of the trial. Only four trials included more than 100 patients in each trial arm (Gannon 1991; Klein 2008; McGill 2002; Ritter 1994). Of the 75 trials included in the analysis, 36 trials involved patients undergoing orthopaedic procedures, 33 involved patients undergoing cardiac procedures, and six involved vascular surgery.

Methods of cell savage

Of the 75 included trials, 48 studied cell salvage during the post-operative period, 16 studied intra-operative cell salvage, and 11 studied both intra-operative and post-operative cell salvage. One trial (Sait 1999) failed to describe the timing of cell salvage. Twenty-six trials studied cell salvage systems that reinfused washed salvaged blood, and 44 trials studied cell salvage systems that reinfused unwashed filtered salvaged blood. One trial (Rollo 1995) studied both washed and unwashed cell salvage (four-arm trial) and provided two comparisons of cell salvage (Rollo 1995a; Rollo 1995b). One trial (Klein 2008) studied intra-operative washed and post-operative unwashed cell salvage. For three trials (Mercer 2004; Sait 1999; Zhang 2008) the method used to process salvaged autologous blood prior to re-transfusion was unclear.

Types of cell salvage devices

Various types of cell salvage (autotransfusion) systems were studied. The following is a list of those systems used.

- ABTrans autologous re-transfusion system
- Atrium 2050
- Atrium 2550 in-line autotransfusion drainage system
- Autovac postoperative orthopaedic autotransfusion canister
- Bard cardiotomy reservoir
- Bellovac ABT autotransfusion system
- Beijing PerMed Biomedical Engineering Company
- Bentley Catr hard shell cardiotomy reservoir
- BIODREN autotransfusion system
- BRAT-2 Cell Saver
- CATR 3500 cardiotomy reservoir
- Cell Trans system (Summit Medical)
- ConstaVac CBC system
- ConstaVac CBCII system
- COBE Bayler rapid autotransfusion system
- Dideco Compact
- Dideco Electra system
- Dideco 742 cardiotomy reservoir
- Dideco 797 reinfusion system (Sorin Biomedical)
- DONOR system (Van Straten Medical)
- Electromedic Autotrans AT-100
- Electromedics BT-795
- Flow-Gard 6200 (Baxter)
- Frensenius continuous autotransfusion system (C.A.T.S)
- Gish Orthofuser Biomedical autotransfusion system
- Haemonetics Cell Saver
- Haemonetics Cell Saver 3
- Haemonetics Cell Saver 3 Plus
- Haemonetics Cell Saver 4
- Haemonetics Cell Saver 5
- Haemonetics Haemolite cell washer
- Haemonetics Haemolite-2
- Medtronic Autolog system
- Ortho-Evac system
- Pleur-evac autotransfusion system
- Shiley hardshell cardiotomy reservoir
- Solcotrans Cell Saver
- Solcotrans Orthopedic Plus system
- Solcotrans Orthopedic system
- Sorenson ATS (autotransfusion system)
- Terumo TE-171 system (Terumo)

Transfusion 'triggers' or thresholds

Of the 75 included trials, 60 reported the use of a transfusion protocol. Of these, 59 trials included a transfusion 'trigger' value, that being the haemoglobin (Hb) or haematocrit (Hct) value at which point a transfusion of red blood cells, was considered appropriate. However, there was significant variation between trials in the transfusion 'trigger' value used. The post-operative transfusion trigger for haemoglobin (Hb) ranged from 7.0 g/dL to 10.0 g/dL, whereas the intra-operative Hb transfusion trigger value ranged from 5.6 to 10.0 g/dL.

Of the 55 trials that reported a post-operative transfusion threshold,15 trials reported a Hb transfusion threshold of 10.0 g/dL, 15 trials reported a transfusion threshold of between 9.0 g/dL and 9.5 g/dL, 21 trials reported a transfusion threshold of between 8.0 g/dL and 8.9g/dL, two trials reported a transfusion threshold of 7.0 g/dL, one trial reported a transfusion threshold of 5.0 mmol/L and one trial transfused patients when the haematocrit value was less than 30%. Of the 21 trials that reported the use of an intra-operative transfusion threshold, the haemoglobin 'trigger' value ranged from as low as 5.6 g/dL to as high as 10.0 g/dL.

Risk of bias in included studies

The performance of the included trials against each domain is summarised in the 'Risk of bias' tables (Figure 1; Figure 2).

Figure 1. Methodological quality graph: review authors' judgements about each methodological quality item presented as percentages across all included studies.

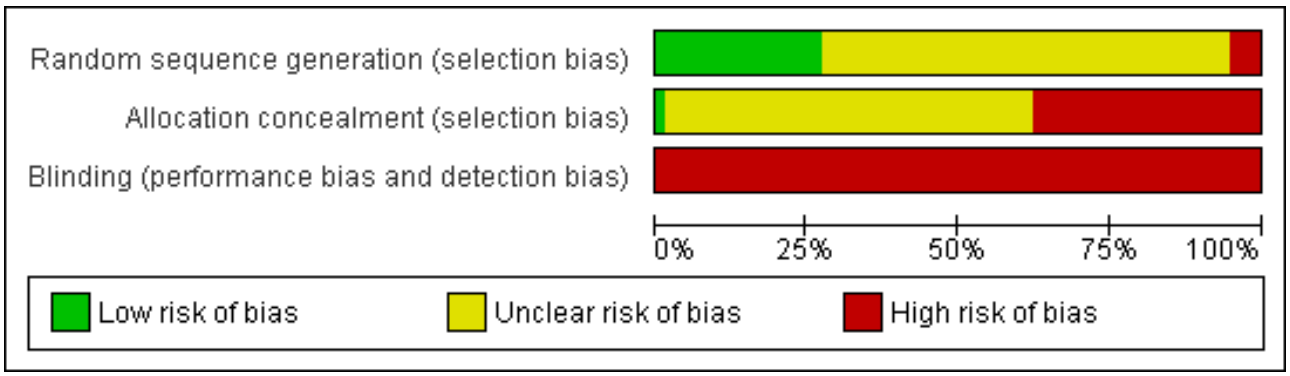


Figure 2. Methodological quality summary: review authors' judgements about each methodological quality item for each included study.

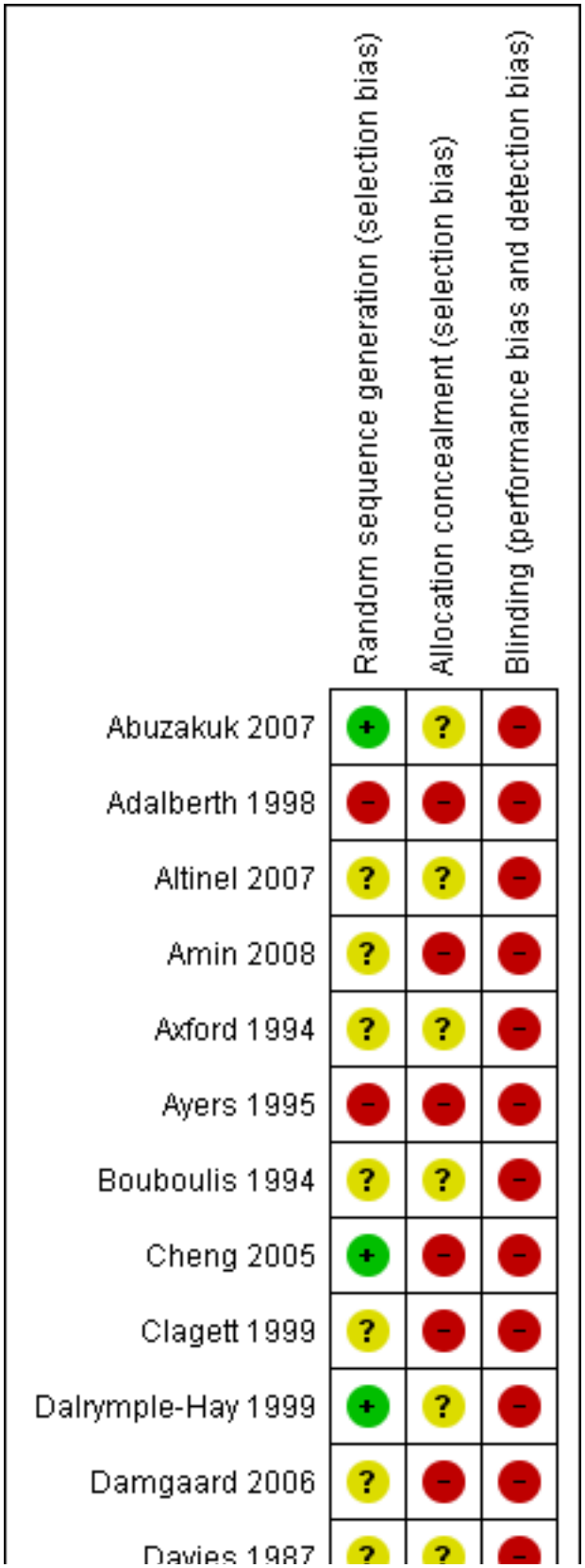
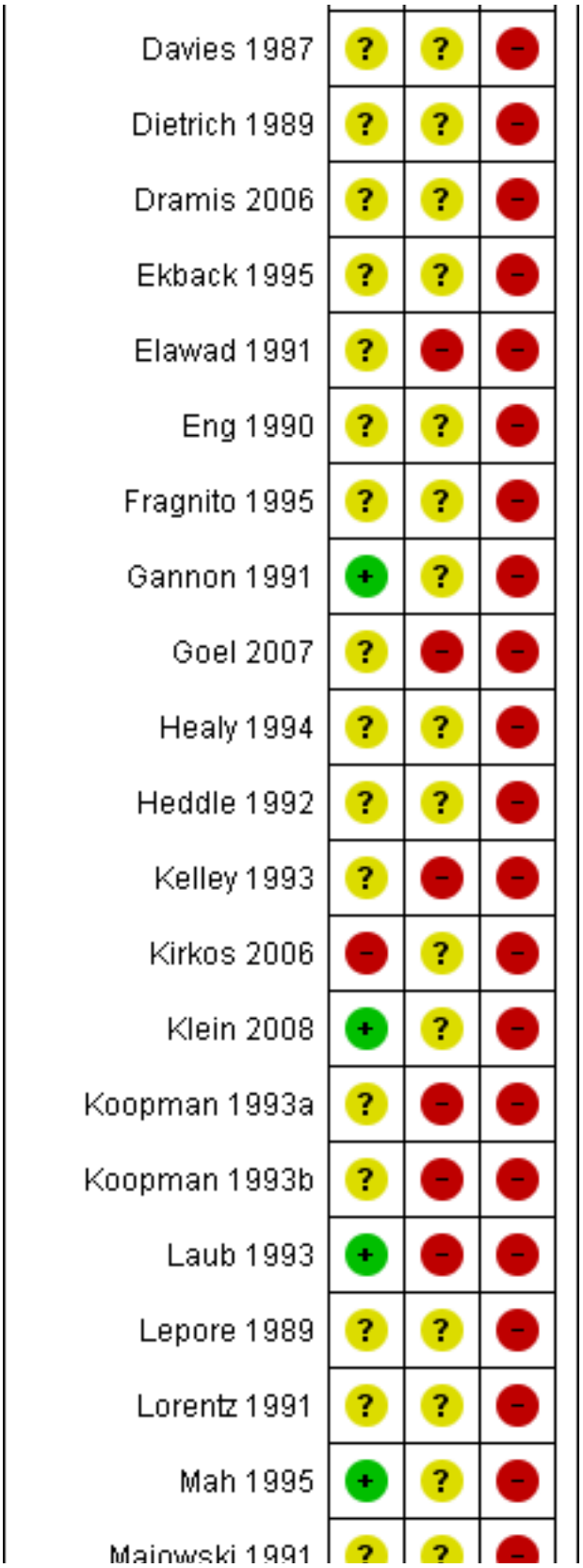


Figure 2. (Continued)



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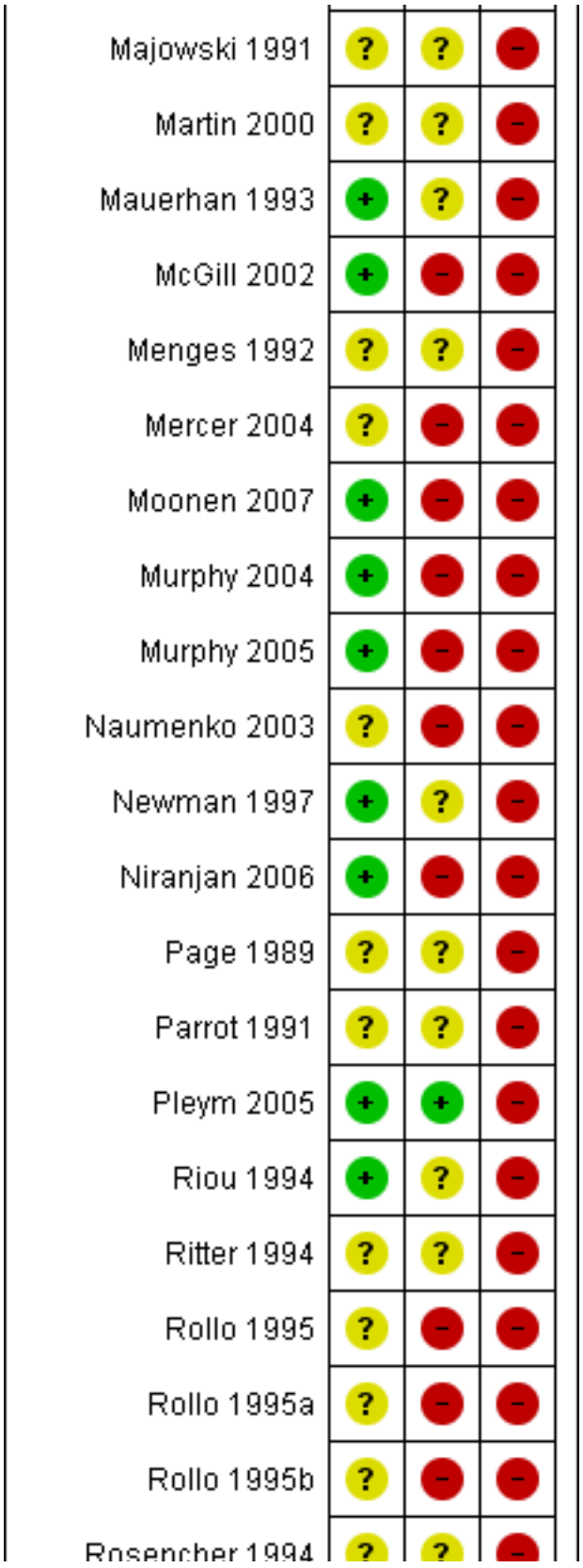

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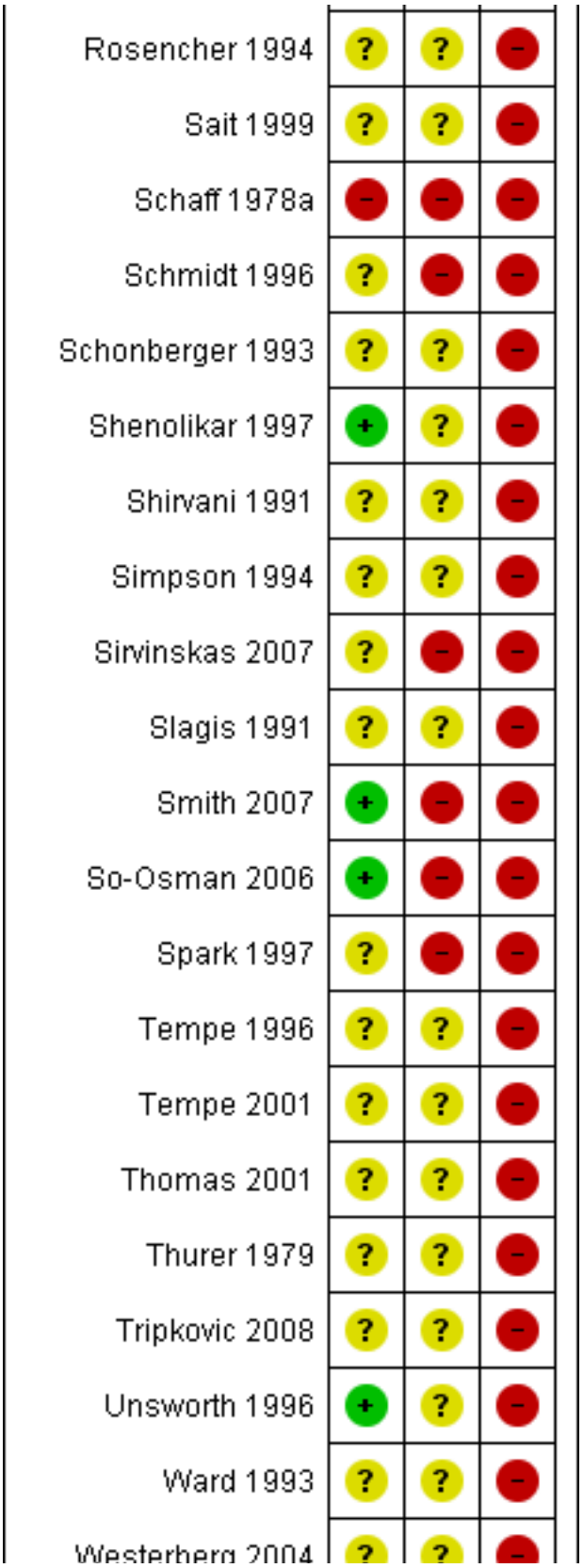


Figure 2. (Continued)

Adequate sequence generation

The risk of bias for this item was judged to be low for 21 trials. For four trials the method of sequence generation was judged to be inadequate. The remaining 50 trials presented no information regarding the method of sequence generation and were rated unclear.

Allocation concealment

The risk of bias for this item was judged to be low in one trial (Pleym 2005) which used central randomisation (off-site, computer-generated randomisation). For 27 trials the method used to conceal treatment allocation was judged to be inadequate (for example sealed envelopes). The remaining 47 trials presented no information regarding the method of allocation concealment and were rated unclear.

Blinding

None of the 75 included trials were judged to be double-blind. Given the nature of the intervention double-blinding is accepted as being problematic.

Effects of interventions

Aggregated analysis

Sixty-seven trials of cell salvage (autotransfusion) reported data on the number of subjects exposed to allogeneic blood transfusion. These trials included a total of 6025 patients of whom 3048 were randomised to cell salvage. Overall, the use of cell salvage reduced the rate of exposure to allogeneic RBC transfusion by a relative 38% (RR 0.61; 95% CI 0.55 to 0.70). Heterogeneity between these trials was statistically significant (P<0.00001, I^2=81%). The absolute reduction in risk (ARR) of exposure to allogeneic blood transfusion was 21% (risk difference (RD) -0.21; 95% CI -0.26 to -0.15) and, on average, 4.8 patients would need to undergo cell salvage so that one would avoid an allogeneic RBC transfusion (number needed to treat (NNT)).

Transfusion protocol

Of the 67 trials that reported data on the number of subjects exposed to allogeneic blood transfusion, 52 reported the use of transfusion protocols. These trials included a total of 4755 patients, of whom 2377 were randomised to cell salvage. The relative risk of exposure to allogeneic RBC transfusion in those patients treated with cell salvage was 0.62 (95% CI 0.54 to 0.71). Heterogeneity between these trials was statistically significant (P < 0.00001, I^2 = 81%). For the 15 trials that did not report the use of transfusion protocols, the relative risk of exposure to allogeneic RBC transfusion was 0.58 (95% CI 0.41 to 0.82). Heterogeneity between these trials was statistically significant (P < 0.00001, I^2 = 77%).

Type of surgery

Of the trials that reported data on the number of patients exposed to allogeneic RBC transfusion, 32 involved orthopaedic surgery, 31 involved cardiac procedures and four involved vascular surgery. A larger relative risk reduction (RRR) was observed in orthopaedic trials (RRR 54%; 95% CI 43% to 63%) than in cardiac trials (RRR 23%; 95% CI 14% to 31%). For those four trials that involved vascular surgery, the relative risk of exposure to allogeneic blood transfusion was not statistically significant (RR 0.63; 95% CI 0.34 to 1.15). For each of these three subgroup analyses, heterogeneity was statistically significant (I^2 = 72%, I^2 = 62%, and I^2 = 81%; respectively).

Type of cell salvage - washed versus unwashed

Twenty-seven trials studied washed cell salvage whilst 40 trials investigated unwashed cell salvage. One trial (Rollo 1995) studied both washed and unwashed cell salvage (four-arm trial) and provided two comparisons of cell salvage (Rollo 1995a; Rollo 1995b). One trial (Sait 1999) did not describe the method of cell salvage investigated.

Overall, when cell salvage was conducted with devices that washed salvaged blood, the relative risk of exposure to red cell transfusion was only slightly lower than that with unwashed cell salvage. For those trials that used washed cell salvage the relative risk of

exposure to allogeneic RBC transfusion was 0.60 (95% CI 0.51 to 0.70) compared to 0.66 (95% CI 0.57 to 0.77) for those trials that used unwashed cell salvage. For both these subgroup analyses, heterogeneity was statistically significant (I^2 = 68% and I^2 = 81%; respectively).

Timing of cell salvage

Eleven trials reported the use of intra-operative cell salvage. These trials included a total of 805 patients, of whom 402 were randomised to intra-operative cell salvage. The relative risk of exposure to allogeneic blood transfusion was 0.59 (95% CI 0.46 to 0.76). Heterogeneity between these trials was statistically significant (P = 0.002, I^2 = 64%). Forty-six trials reported the use of post-operative cell salvage. These trials included a total of 4361 patients, of whom 2209 were randomised to post-operative cell salvage. The risk of exposure to allogeneic blood transfusion was reduced on average by a relative 37% in those patients treated with post-operative cell salvage compared to control (RR =0.63; 95% CI 0.54 to 0.74). Heterogeneity between these trials was statistically significant (P < 0.00001, I^2 = 83%). Nine trials reported the use of both intra- and post-operative cell salvage. These trials included a total of 737 patients of whom 357 were randomised to intra- and post-operative cell salvage. The use of intra- and post-operative cell salvage decreased exposure to allogeneic red cell transfusion by a relative 30% (RR 0.70; 95% CI 0.54 to 0.92). Heterogeneity between these trials was statistically significant (P < 0.005, I^2 = 64%).

Volume of blood transfused

Thirty-two trials provided data for the volume of allogeneic RBC transfused. These trials included a total of 2321 patients, of whom 1172 were randomised to cell salvage. On average, the use of cell salvage reduced the volume of red cells transfused by 0.68 units per patient (WMD -0.68 units; 95% CI -0.88 to -0.49 units). Heterogeneity between these trials was statistically significant (P < 0.00001, I^2 = 75%). For those 27 trials that reported the use of a transfusion protocol the use of cell salvage reduced the amount of allogeneic blood transfused by an average of 0.69 units per patient (WMD -0.69 units; 95% CI -0.90 to -0.49 units). For those five trials that did not report the use of a transfusion protocol the use of cell salvage did not statistically significantly reduce the amount of allogeneic blood transfused (WMD -0.64 units; 95% CI -1.30 to 0.01 units). For both these subgroup analyses, heterogeneity between trials was statistically significant (P < 0.00001 and P < 0.0001, respectively).

When data were stratified by the type of surgery performed, greater reductions in the volume of allogeneic RBC transfused per patient were observed in trials that involved orthopaedic surgery (WMD -0.81 units; 95% CI -1.22 to -0.39 units) compared to cardiac surgery (WMD -0.67 units; 95% CI -0.89 to -0.44 units). For both these subgroup analyses, heterogeneity between trials was statistically significant (P < 0.00001 and P < 0.0001, respectively). Similar statistically significant reductions in the volume of RBC transfused was not observed in trials involving vascular surgery (WMD 0.02 units; 95% CI -0.34 to 0.38 units).

Type of cell salvage - washed versus unwashed - type of surgery

When the type of cell salvage was stratified by the type of surgery, the results indicated that the use of washed cell salvage in cardiac surgery was associated with an average 34% relative risk reduction in exposure to allogeneic red cell transfusion (RR 0.66; 95% CI = 0.55 to 0.80). Heterogeneity between these trials was statistically significant (P = 0.002, I^2 = 61%). Reduced exposure to red cell transfusion was also observed in those trials that used unwashed cell salvage in cardiac surgery, (RR 0.85; 95% CI 0.76 to 0.95), heterogeneity between these trials was statistically significant (P = 0.0001, I^2 = 65%). For orthopaedic trials both types of cell salvage were associated with significant reductions in transfusion exposure rates. For washed cell salvage the relative risk of exposure to red cell transfusion was reduced on average by 52% (RR 0.48; 95% CI 0.36 to 0.64) and for unwashed cell salvage there was a relative 53% reduction in risk of exposure (RR 0.47; 95% CI 0.36 to 0.63). For these subgroup analyses, heterogeneity was statistically significant (P = 0.03 and P = 0.0001, respectively). All four trials conducted in the setting of vascular surgery used washed cell salvage. For these trials, the relative risk of exposure to allogeneic red cell transfusion was not statistically significant (RR 0.63; 95% CI 0.34 to 1.15). Heterogeneity between these trials was statistically significant (P = 0.001, I^2 = 81%).

Blood loss

Thirty-two trials of cell salvage reported data for total blood loss. These trials included a total of 2311 patients of whom 1158 were randomised to cell salvage. The use of cell salvage did not appear to adversely impact on blood loss volumes (WMD -39.02 mls; 95% CI -85.10 to 7.05 mls). Heterogeneity between these trials was statistically significant (P = 0.01, I^2 = 41%).

Active versus control

Forty-three trials compared cell salvage alone to a control group who did not receive cell salvage (autotransfusion) or any other form of active treatment. These trials included a total of 3666 patients, of whom 1854 were randomised to cell salvage. The relative risk of receiving an allogeneic RBC transfusion was 0.61 (95% CI 0.52 to 0.71). Heterogeneity between these trials was statistically significant (P < 0.00001, I^2 = 83%).

Transfusion protocol

Thirty-four trials of cell salvage reported the use of transfusion protocols. These trials included a total of 3030 patients of whom 1525 were randomised to cell salvage. For those trials that used a transfusion protocol, the risk of receiving an allogeneic red cell transfusion was reduced on average by 39% (RR 0.61; 95% CI 0.51 to 0.73). For the nine trials that did not report the use of a transfusion protocol, the relative risk of receiving an allogeneic red cell transfusion was 0.56 (95% CI 0.35 to 0.89). For both these subgroup analyses, heterogeneity was statistically significant (P < 0.00001).

Type of surgery

Of the 43 trials that provided data for the number of patients exposed to allogeneic blood transfusion, 18 involved cardiac surgery, 21 involved orthopaedic surgery, and four involved vascular surgery. When cell salvage was used in orthopaedic surgery, the risk of exposure to red cell transfusion was reduced by a relative 55% (RR 0.45; 95%CI 0.34 to 0.60) compared to 22% (RR 0.78; 95% CI 0.68 to 0.91) in the case of cardiac surgery. For the four trials involving vascular surgery, the relative risk of receiving an allogeneic RBC transfusion was not statistically significant (RR 0.63; 95% CI 0.34 to 1.15). Heterogeneity was statistically significant for each of the subgroups analysed (P < 0.001).

Type of cell salvage - washed versus unwashed

When washed cell salvage was used, the relative risk of receiving an allogeneic RBC transfusion was 0.57 (95% CI 0.45 to 0.72) compared to 0.67 (95% CI 0.56 to 0.81) for unwashed cell salvage. Heterogeneity was statistically significant in the two subgroups analysed (P < 0.00001).

Timing of cell salvage

Eight trials of intra-operative cell salvage provided data for the number of patients exposed to allogeneic RBC transfusion. These trials included a total of 564 patients, of whom 281 were randomised to cell salvage. Intra-operative cell salvage was associated with a relative reduction in the risk of receiving an allogeneic RBC transfusion of 36% (RR 0.64; 95% CI 0.50 to 0.83). Heterogeneity between these trials was statistically significant (P = 0.07, I^2 = 46%). Twenty-nine trials of post-operative cell salvage provided data for the number of patients exposed to allogeneic RBC transfusion. These trials included a total of 2852 patients, of whom 1452 were randomised to cell salvage. The use of post-operative cell salvage reduced the risk of exposure to allogeneic red cell transfusion by a relative 41% (RR 0.59; 95% CI 0.48 to 0.73). Heterogeneity between these trials was statistically significant (P < 0.00001, I^2 = 87%). Six trials studied both intra- and post-operative cell salvage. These trials included a total of 250 patients of whom 121 were randomised to cell salvage. with The combined use of intra- and post-operative cell salvage reduced exposure to allogeneic RBC transfusion by a relative 42% (RR 0.58; 95% CI 0.35 to 0.95). Heterogeneity between these trials was statistically significant (P < 0.00001, I^2 = 84%).

Volume of blood transfused

Twenty-three trials reported data for the volume of allogeneic RBC transfused. These trials included a total of 1608 patients, of whom 818 were randomised to cell salvage. Overall, the use of cell salvage was associated with a modest reduction in the volume of red cells transfused. In those patients treated with cell salvage, there was an average saving of 0.81 units of RBC per patient (WMD -0.81 units; 95% CI -1.08 to -0.54 units). Heterogeneity between these trials was statistically significant (P < 0.00001, I^2 = 80%).

Volume of blood transfused - transfusion protocol

Stratifying the volume of blood transfused by the presence of a transfusion protocol, showed that greater reductions in the volume of red cells transfused were observed in those trials that reported the use of transfusion protocols (WMD -86; 95% CI -1.17 to -0.55 units) compared to those trials that did not use a transfusion protocol to guide transfusion practice (WMD -0.68 units; 95% CI -1.63 to 0.27 units). For both these subgroup analyses, heterogeneity was statistically significant (P < 0.00001).

Volume of blood transfused - type of surgery

There were 13 cardiac trials, including a total of 995 patients, that reported data for the volume of RBC transfused. The use of cell salvage in cardiac surgery provided, on average, a saving of around one unit of blood per patient (WMD -0.93 units; 95% CI -1.27 to -0.59 units). Heterogeneity between these trials was statistically significant (P < 0.0001, I^2 = 71%). There were seven orthopaedic trials, including a total of 427 patients, that reported data for the volume of blood transfused. For those patients randomised to cell salvage, there was an average saving of 0.82 units of RBC per patient (WMD -0.82 units; 95% CI -1.36 to -0.27 units). Heterogeneity between these trials was statistically significant (P < 0.00001, I^2 = 86%). For the three trials involving vascular surgery, the weighted mean difference in the volume of RBC transfused was not statistically significant (WMD 0.02 units; 95% CI -0.34 to 0.38 units).

Blood loss

Twenty-four trials of cell salvage reported data for total blood loss. These trials included a total of 1570 patients, of whom 789 were randomised to cell salvage. The use of cell salvage did not appear to adversely impact on total blood loss (WMD -38.98 mls; 95% CI -99.91 to 21.95 mls). Heterogeneity between these trials was statistically significant (P = 0.01, I^2 = 44%).

Active versus active

There were 25 trials that compared cell salvage, combined with another form of active treatment (blood conservation intervention), to a control group who received the same active treatment but did not receive cell salvage (autotransfusion). For these 25 trials the relative risk of exposure to allogeneic RBC transfusion was 0.63 (95% CI 0.53 to 0.76). Heterogeneity between these trials was statistically significant (P < 0.00001, I^2 = 76%).

Transfusion protocol

There were 19 trials of cell salvage that reported the use of transfusion protocols. For these trials, the relative risk of exposure to allogeneic blood transfusion was 0.64 (95% CI 0.52 to 0.77). Heterogeneity between these trials was statistically significant (P < 0.00001, I^2 = 79%). For those six trials that did not report the use of a transfusion protocol, the relative risk of exposure to allogeneic red cells was 0.59 (95% CI 0.35 to 1.00).

Type of surgery

Fourteen trials involving cardiac surgery provided data for the number of patients receiving allogeneic red cell transfusion. These trials included a total of 1304 patients, of whom 641 were randomised to cell salvage. For these trials, the risk of receiving an allogeneic red cell transfusion was reduced on average by a relative 27% (RR 0.73; 95% CI 0.61 to 0.87). Heterogeneity between these trials was statistically significant (P < 0.0001, I^2 = 72%). For the 11 trials involving orthopaedic surgery, the risk of receiving an allogeneic red cell transfusion was reduced by a relative 54% (RR 0.46; 95% CI 0.33 to 0.65). Heterogeneity between these trials was statistically significant (P = 0.03, I^2 = 50%).

Type of cell salvage - washed versus unwashed

When washed cell salvage was used, the relative risk of receiving an allogeneic red cell transfusion was 0.61 (95% CI 0.48 to 0.78) compared to 0.68 (95% CI 0.52 to 0.89) for unwashed cell salvage. For both of these subgroup analyses, heterogeneity was statistically significant (P = 0.01 and P < 0.00001, respectively).

Timing of cell salvage

Four trials of intra-operative cell salvage provided data on the number of patients receiving allogeneic red cell transfusion. These trials included a total of 281 patients, of whom 141 were randomised to cell salvage. Intra-operative cell salvage reduced the rate of exposure to allogeneic red cell transfusion by a relative 46% (RR 0.54; 95% CI 0.35 to 0.84). The 18 trials of post-operative cell salvage included a total of 1629 patients, of whom 817 were

randomised to cell salvage. For these trials, the risk of receiving an allogeneic red cell transfusion was reduced on average by a relative 35% (RR 70; 95% CI 0.50 to 0.85). Heterogeneity for both these subgroup analyses was statistically significant (P = 0.005 and P < 0.00001, respectively). For the four trials involving intra- and post-operative cell salvage, the relative risk of receiving an allogeneic RBC transfusion was 0.76 (95% CI 0.59 to 0.98; I^2 = 27%).

Volume of blood transfused

Eight trials of cell salvage reported data for the volume of allogeneic red cells transfused. On average there was a saving of 0.66 units of RBC per patient (WMD -0.66; 95% CI -1.02 to -0.30) when cell salvage was combined with another form of active treatment. Of these eight trials, six involved cardiac surgery and seven reported the use of transfusion protocols. For these two subgroup analyses, the volume of allogeneic red cells transfused was reduced on average by 0.39 units per patient (WMD -0.39; 95% CI -0.67 to -0.12) and by 0.67 units per patient (WMD -0.67; 95% CI -1.09 to -0.25), respectively. In the case of the two orthopaedic trials, the use of cell salvage reduced the amount of allogeneic red blood cells transfused on average by 1.1 units per patient (WMD -1.10; 95% CI -1.91 to -0.29; I^2 = 79%).

Blood loss

Eight trials of cell salvage reported data for total blood loss. These trials included a total of 741 patients of whom 369 were randomised to cell salvage. The use of cell salvage did not appear to adversely impact on total blood loss (WMD -48.32 mls; 95% CI -116.38 to 19.74 mls).

Adverse events and other outcomes

Mortality

In aggregate, 22 trials of cell salvage reported data for mortality. These trials included a total of 1788 patients, of whom 902 were randomised to cell salvage. For eight trials there were no reported deaths for either the intervention or control groups; therefore it was not possible to estimate the relative risks for these trials. Overall, the use of cell salvage did not statistically significantly impact on mortality (RR 0.96; 95% CI 0.49 to 1.88; I^2 = 0%). Similar non-significant results were observed for those 16 trials that compared cell salvage alone to untreated controls (RR 1.41; 95% CI 0.66 to 3.05; I^2 = 0%). It should be noted that two trials provided over 22% of the information in the analysis and six of the 16 trials reported no deaths in either the intervention or control groups. There were six trials of active versus active comparisons (cell salvage combined with another form of active treatment compared to an actively treated control group) that provided mortality data. These trials included a total of 656 patients, of whom 326 were randomised to cell salvage. For these trials there were nine recorded deaths; eight of which occurred in the control arms. The use of cell salvage in this subgroup of trials did not appear to impact significantly on the rate of mortality (RR 0.27; 95% CI 0.07 to 1.08; I^2 = 0%).

Re-operation for bleeding

In aggregate, 19 trials of cell salvage provided data for re-operation due to bleeding. These trials included a total of 1683 patients, of whom 841 were randomised to cell salvage. The use of cell salvage did not statistically significantly impact on the rates of re-operation for bleeding (RR 0.90; 95% CI 0.53 to 1.53; I^2 = 0%). Ten trials, comparing cell salvage to untreated controls (active versus control comparisons), reported data for re-operation due to bleeding. These trials included a total of 688 patients, of whom 349 were randomised to cell salvage. The relative risk of requiring a re-operation due to bleeding was not statistically significant (RR 1.00; 95% CI 0.45 to 2.24; I^2 = 0%). There were nine trials of active versus active comparisons (cell salvage combined with another form of active treatment compared to an actively treated control group) that provided data for re-operation due to bleeding. Cell salvage did not appear to statistically significantly impact on the rates of re-operation for bleeding in this subset of trials (RR 0.83; 95% CI 0.41 to 1.68; I^2 = 0%).

Any infection

In aggregate, 23 trials reported data for infection of any type. These trials included a total of 2892 patients, of whom 1474 were randomised to cell salvage. The use of cell salvage appeared to be associated with a slight decrease in the rate of infection compared to control (RR 0.68; 95% CI 0.46 to 0.99; I^2 = 0%). Sixteen trials, comparing cell salvage to untreated controls, reported data for infection of any type. These trials included a total of 1860 patients, of whom 942 were randomised to cell salvage. A statistically significant reduction in the rate of infection in those patients treated with cell salvage was observed (RR 0.63; 95% CI 0.41 to 0.96; I^2 = 1%). For the seven trials that investigated active versus active comparisons the relative risk of developing an infection was not statistically significant (RR 0.88; 95% CI 0.37 to 2.07; I^2=0%).

Wound complications

In aggregate, 16 trials of cell salvage reported data for a wound complication (for example haematoma, infection). These trials included a total of 1962 patients, of whom 1011 were randomised to cell salvage. The use of cell salvage did not statistically significantly impact on the rates of wound complication (RR 0.94; 95% CI 0.57 to 1.55; I^2 = 0%). Similar results were observed for the twelve trials that compared cell salvage alone to an untreated control group (RR 0.88; 95% CI 0.49 to 1.57; I^2 = 0%). For the four trials of active versus active comparisons, the relative risk of developing a wound complication was 1.13 (95% CI 0.43 to 2.99; I^2 = 0%).

Any thrombosis

In aggregate, 11 trials reported data for thrombosis of any type. These trials included a total of 925 patients, of whom 476 were randomised to cell salvage. For five of the 11 trials, there were no reported events of thrombosis in either the intervention or control groups. The relative risk of developing any thrombosis in those patients treated with cell salvage compared to control was not statistically significant (RR 1.13; 95% CI 0.48 to 2.66; I^2 = 0%). Of the 11 trials that reported data for this outcome 10 involved active versus untreated control comparisons.

Stroke

In aggregate, seven trials reported data for stroke. These trials included a total of 696 patients, of whom 347 were randomised to cell salvage. The relative risk of developing a stroke in those patients treated with cell salvage compared to control was not statistically significant (RR 0.65; 95% CI 0.21 to 1.98; I^2=0%).

Non-fatal myocardial infarction

In aggregate, 11 trials reported data for non-fatal myocardial infarction. These trials included a total of 951 patients, of whom

471 were randomised to cell salvage. The relative risk of non-fatal myocardial infarction in those patients treated with cell salvage compared to control was not statistically significant (RR 0.80; 95% CI 0.43 to 1.46; I^2 = 0%). Similar results were observed for the six trials that compared cell salvage alone to an untreated control group (RR 0.65; 95% CI 0.32 to 1.31; I^2 = 0%). For those five trials that investigated active versus active comparisons, the relative risk of non-fatal myocardial infarction was not statistically significant (RR 1.46; 95% CI 0.43 to 4.88; I^2 = 0%).

Deep vein thrombosis

Seven trials reported data for deep venous thrombosis. These trials included a total of 645 patients, of whom 320 were randomised to cell salvage. The relative risk of developing deep venous thrombosis in those subjects treated with cell salvage compared to control was not statistically significant (RR 0.83; 95% CI 0.31 to 2.23; I^2 = 0%).

Hospital length of stay

Ten trials reported data for hospital length of stay. These trials included a total of 772 patients, of whom 399 were randomised to cell salvage. In those patients treated with cell salvage hospital length of stay was not statistically significantly reduced compared to control (WMD -1.38 days; 95% CI -2.79 to 0.03 days; I^2 = 83%).

DISCUSSION

Principal findings

We identified 75 randomised trials of cell salvage, carried out over a 29-year period (1979 to 2008). Overall, the results of the meta-analysis indicated that the use of cell salvage reduced peri-operative allogeneic RBC transfusion exposure by a relative 38% (RR 0.62; 95% CI 0.55 to 0.70). The average absolute reduction in risk (ARR) of exposure to allogeneic red cell transfusion was 21% (RD -0.21; 95% CI -0.26 to -0.15), equating to a number needed to treat (NNT) of 4.8. The efficacy of cell salvage in reducing the need for allogeneic red cell transfusion appeared to be greatest in the setting of orthopaedic surgery. In this setting, cell salvage reduced the risk of exposure to allogeneic blood transfusion by a relative 54% compared to 23% in cardiac surgery. In orthopaedic surgery very little difference in treatment effects was observed between washed cell salvage (RR 0.48; 95% CI 0.36 to 0.64) and unwashed cell salvage (RR 0.47; 95% CI 0.36 to 0.63). This was not the case in cardiac surgery, where there were clear differences between washed cell salvage, which showed significant reductions in allogeneic red cell transfusion rates (RR 0.66; 95% CI 0.55 to 0.80), and unwashed cell salvage, which appeared to be only marginally effective (RR 0.85; 95% CI 0.76 to 0.95). However, significant variation in treatment effects was observed for all of the main study outcomes.

In the case of exposure to allogeneic blood transfusion, a relative risk reduction of 37% was observed when cell salvage was combined with another active intervention (for example pre-operative autologous donation (PAD), acute normovolaemic haemodilution (ANH), aprotinin) and compared with that intervention on its own. When cell salvage was compared to a non-active intervention (for example standard untreated control), a relative risk reduction of 39% was observed.

The use of cell salvage was also associated with only slight reductions in the volume of red cells transfused. Overall, in those patients treated with cell salvage, there was an average saving of 0.68 units of RBC per patient (WMD -0.68 units; 95% CI -0.88 to -0.49 units). When cell salvage was combined with another form of active intervention and compared with that intervention on its own, the reduction in the volume of RBC transfused was around 0.66 units of RBC per patient (WMD -0.66 units; 95% CI -1.02 to -0.30 units). Such a result may well have been expected as both groups were actively treated with some form of blood sparing intervention.

Sources of heterogeneity

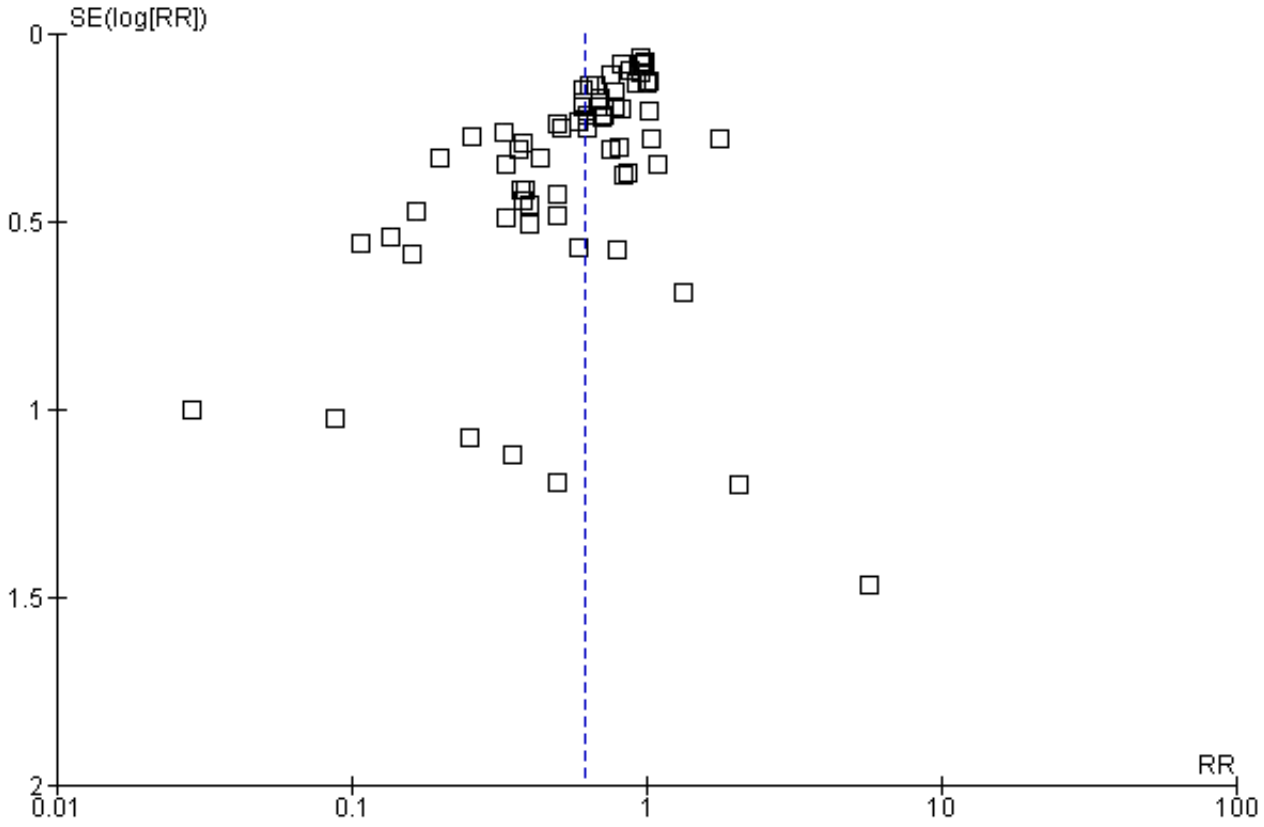
The observed variation in treatment effects was in terms of both the size and direction of effect with relative risk point estimates for red cell transfusion exposure for the individual trials, ranging from 0.03 to 5.64. Of the 67 trials that provided data for the number of patients exposed to allogeneic red cell transfusion, more than half of these trials (n = 36) found that cell salvage did not statistically significantly reduce the risk of receiving a red cell transfusion. None of the subgroup analyses performed established a clear reason for the observed variability in treatment effect. Statistically significant heterogeneity was observed for all of the subgroup analyses performed.

The impact that trial methodological quality had on treatment effects was difficult to determine, as the majority of trials were of poor quality. The most concerning feature of the trials reviewed here is that only one trial reported a method of concealing treatment allocation that was judged to be adequate. A lack of allocation concealment has been shown to significantly influence the estimate of treatment effect (Schulz 1995). When trials that reported data for the number of patients transfused allogeneic red blood cells were stratified by methodological quality (adequate allocation concealment: yes, unclear, or no), the relative risks of exposure to allogeneic blood transfusion varied only slightly. For those trials (n = 24) that were assessed as providing inadequate concealment of treatment allocation the relative risk of exposure to allogeneic red cell transfusion was 0.62 (95% CI 0.51 to 0.75), whereas for those trials (n=42) that did not report the method used to conceal treatment allocation or it was unclear what method was used to conceal treatment allocation, the relative risk was 0.62 (95% CI 0.53 to 0.72).

Sources of bias

The majority of trials reviewed here were small with less than 60 participants in each trial arm. Reliance on small trials raises concerns about the effects of publication bias. Funnel plot assessment revealed some evidence of this in the form of a 'missing' population of small negative studies (Figure 3). Although there is a clustering of trials around the null (RR = 1), there were very few trials that showed an overall negative result for cell salvage for allogeneic red cell transfusion exposure.

Figure 3. Funnel plot of comparison: 1 Cell Salvage - Blood Transfused (All Studies), outcome: 1.1 No. exposed to allogeneic blood (All Studies).



Although this review did not exclude studies on the basis of language, only six non-English studies fulfilled the inclusion criteria (Fragnito 1995; Lorentz 1991; Menges 1992; Naumenko 2003; Rosencher 1994; Zhang 2008). For those studies published in English language, the relative risk of exposure to allogeneic red cell transfusion was 0.61 (95% CI 0.54 to 0.70) compared to 0.63 (95% CI 0.50 to 0.79) for those studies published in languages other than English. Due to the lack of non-English language studies it is difficult to interpret these results with any degree of confidence. However, it is of interest to note, that although the heterogeneity in treatment effect for the English language studies was statistically significant ($P < 0.00001$, $I^2 = 83\%$) this was not the case with those studies published in non-English languages ($P = 0.89$, $I^2 = 0\%$).

The main study outcome used in these trials was a practice variable (the decision to transfuse a patient with allogeneic red cells) and, as such, may have been a major source of bias. The decision to transfuse a patient requires a degree of subjectivity on the part of the clinicians, and as all the trials reviewed here were unblinded and lacked adequate concealment of treatment allocation. This is a particularly important source of bias that may have potentially influenced the results in favour of cell salvage.

Adverse events and other outcomes

Mortality, re-operation for bleeding, infection, wound complication, non-fatal myocardial infarction, thrombosis, stroke, and hospital length of stay did not appear to be adversely affected by the use of cell salvage. Even though one of the known risks associated with cell salvage is infection (due to contamination of the autologous product during the salvaging and reinfusion process), fewer cell salvage patients experienced infection (RR 0.68; 95% CI 0.46 to 0.99). However, cell salvage did not appear to be associated with any significant reductions in wound complications (RR 0.94; 95% CI 0.57 to 1.55).

It should be noted that the event rates were small ranging for 1.2% in the case of stroke to 5.1% in the case of any infection. Therefore it is difficult to draw firm conclusions regarding the impact of cell salvage on important clinical outcomes. There were only two outcomes (any infection and non-fatal myocardial infarction) where the event rates in the control groups were greater than 3.5% (5.1% and 4.8%, respectively). From the very limited data, it appears that the potential benefit of cell salvage in reducing exposure to allogeneic blood transfusion, is not offset by serious adverse effects.

Clinical significance of the results

In an attempt to avoid allogeneic blood transfusion during the perioperative period, technologies such as cell salvage have been introduced without firm evidence to support their use. Although cell salvage provides peace of mind, knowing a patient's own blood will be transfused should it be needed, cell salvage is not without its own risks and costs (Forgie 1998). The risks associated with cell salvage are well documented, and include, bacterial contamination of the salvaged blood, air embolism, nephrotoxicity, and coagulation disorders (Faught 1998; Huet 1999; Semmens

2000; Spahn 2000). In its most simplistic form, unwashed cell salvage merely represents a very laborious means of obtaining an autologous volume expander, which is not necessarily advocated due to the potential serious side effects (Huet 1999). Although washed cell salvage provides a better quality blood product, the overall cost of this technology is rather substantial. However, a recent cost-effectiveness analysis indicated that cell salvage was cost-effective compared with all other transfusion strategies except ANH (Davies 2006). This study indicated that the net benefit of cell salvage was between £112 and £359 per person, compared with the allogeneic blood transfusion strategy, PAD, PAD plus erythropoietin (EPO), fibrin sealants, antifibrinolytics, and EPO. This study claimed that the use of cell salvage could result in net reductions in the volume of allogeneic blood transfused of between 6500 and 320,000 units per year, translating into annual savings to the National Health Service (NHS) of £0.73 million to £36 million (Davies 2006).

Any intervention that forms part of a blood conservation strategy needs to be critically examined in respect to its cost-effectiveness. On the basis of cost alone, cell salvage may appear to be an attractive alternative to the other currently available technologies, in particular aprotinin. However, as highlighted by Fergusson 1999a, in many instances neither the cost of the technologists needed to operate the device nor the cost of the cell saver device itself are considered in the overall calculations of cost. Further to this, Fergusson 1999a propose that the conclusions of studies that suggest cell salvage is cost saving should be interpreted with caution.

The true value of avoiding allogeneic blood transfusion remains debatable. Those concerned with the risks of transfusion transmitted disease (TTD) will be more interested in avoiding blood transfusion completely, rather than reducing the volume of blood transfused. However, the importance of avoiding transfusion depends on the probability of avoiding disease transmission, or other adverse effects that have been attributed to blood transfusion, such as alloimmunisation or febrile non-haemolytic transfusion reaction (FNHTR). The rate of HIV or viral hepatitis transmission in most developed countries is very low, due to the presence of quality blood screening programmes (Coyle 1999; Whyte 1997). However, this assumption does not equally apply to developing countries where allogeneic blood is frequently administered without adequate screening in an environment where there is a high prevalence of viral pathogens amongst donors (Kimball 1995; McFarland 1997). In these settings there may be much greater clinical value in a range of interventions that diminish or avoid the need for allogeneic blood. However, the costs associated with such interventions may be prohibitive in developing countries, a situation that may well apply to cell salvage.

Most of the data have been collected in the context of major cardiac and orthopaedic surgery, where blood loss is often substantial. Consequently the applicability of the results to clinical settings where blood loss is minor is questionable. This review has highlighted the fact that cell salvage is frequently used alongside other interventions designed to minimise the need for allogeneic blood transfusion. This is particularly evident in the area of cardiac surgery, where over the last 10-20 years there has been a steady increase in the use of anti-fibrinolytic drugs (for example aprotinin, tranexamic acid, epsilon aminocaproic acid), acute normovolaemic haemodilution (ANH), and pre-operative autologous donation (PAD). A meta-analysis (Henry 2007) of the aforementioned anti-fibrinolytic drugs showed that both aprotinin and tranexamic acid were highly efficacious in reducing surgical blood loss and allogeneic blood transfusion in cardiac surgery. However, the findings of a Canadian study (Fergusson 2008), which reported an increased risk of death in cardiac surgery patients treated with aprotinin compared with the lysine analogues (tranexamic acid and epsilon aminocaproic acid), led to the market suspension of aprotinin on November 5, 2007. The loss of aprotinin from the armamentarium of the cardiac surgeon has lead to a re-exploration of alternative approaches to haemostasis management (Baker 2009).

The evidence on the efficacy and safety of ANH and PAD has been reviewed by the International Study of perioperative Transfusion (ISPOT) group (Bryson 1998; Forgie 1998). The literature regarding these interventions is generally viewed as being of indifferent quality because of inadequate randomisation and lack of blinding of outcomes assessment. However, these techniques have been shown to have modest blood sparing effects. This and the growing evidence on the efficacy of transfusion triggers indicates that a more conservative approach to blood transfusion is generally desirable in patients without cardiovascular risk factors, such as ischaemic heart disease or cerebral vascular disease (Carson 1998; Hebert 1999). This conservative approach, combined with the use of anti-fibrinolytic drugs may well offer the best approach for managing the transfusion requirements of patients in high-risk settings such as cardiac surgery. However, in settings other than cardiac, such as vascular and orthopaedic surgery, the choice of intervention that best minimises patient exposure to allogeneic blood transfusion is not that clear cut, although a more conservative approach to transfusion practice has been shown to be efficacious across a range of clinical domains (Carson 2002; Hill 2003). The decision to use any of the current available technologies as an alternative to allogeneic blood transfusion, including cell salvage, will be primarily based on availability, cost, and surgeon preference. To delineate the efficacy of the various technologies used in non-cardiac settings is rather difficult as the current available evidence is equivocal.

AUTHORS' CONCLUSIONS

Implications for practice

The use of washed cell salvage appears justified in orthopaedic surgery. However, in situations where there are concerns about the safety of the blood supply, the use of unwashed, filtered cell salvage may well be justified. Although the use of washed or unwashed cell salvage in cardiac surgery may well be justified on the basis of the evidence reviewed here, due consideration needs to be given to those technologies (that is anti-fibrinolytic agents) that, unlike cell salvage, have been shown to significantly reduce peri-operative blood loss and re-operation due to bleeding in the context of cardiac surgery (Henry 2007). Re-operation alone is associated with substantial additional costs due to additional surgery and costs associated with increased length hospital stay (Ray 1999).

Implications for research

There is no need for further small randomised controlled trials of cell salvage in orthopaedic and cardiac surgery. The principal need is for large, methodologically rigorous, comparative trials to assess

the relative efficacy, safety, and cost-effectiveness of cell salvage in different surgical procedures.

REFERENCES

References to studies included in this review

Abuzakuk 2007 *{published data only}*

Abuzakuk T, Senthil KV, Shenava Y, Bulstrode C, Skinner JA, et al. Autotransfusion drains in total knee replacement. Are they alternatives to homologous transfusion?. *International Orthopaedics* 2007;**31**(2):235-9.

Adalberth 1998 *{published data only}*

Adalberth G, Bystrom S, Kolstad K, Mallmin H, Milbrink J. Postoperative drainage of knee arthroplasty is not necessary - A randomised study of 90 patients. *Acta Orthopaedica Scandinavica* 1998;**69**(5):475-8.

Altinel 2007 *{published data only}*

Altinel L, Kaya E, Kose KC, Fidan F, Ergan V, Fidan H. Effect of shed blood retransfusion on pulmonary perfusion after total knee arthroplasty: a prospective controlled study. *International Orthopaedics* 2007;**31**(6):837-44.

Amin 2008 *{published data only}*

Amin A, Watson A, Mangwani J, Nawabi D, Ahluwalia R, Loeffler M. A prospective randomised controlled trial of autologous retransfusion in total knee replacement. *Journal of Bone & Joint Surgery - British Volume* 2008;**90**(4):451-4.

Axford 1994 *{published data only}*

Axford TC, Dearani JA, Ragno G, MacGregor H, Patel MA, Valeri CR, Khuri SF. Safety and therapeutic effectiveness of reinfused shed blood after open heart surgery. *Annals of Thoracic Surgery* 1994;**57**(3):615-22.

Ayers 1995 *{published data only}*

Ayers DC, Murray DG, Duerr DM. Blood salvage after total hip arthroplasty. *The Journal of Bone and Joint Surgery. American Volume* 1995;**77**(9):1347-51.

Bouboulis 1994 *{published data only}*

Bouboulis N, Kardara M, Kesteven PJ, Jayakrishnan AG. Autotransfusion after coronary artery bypass surgery: is there any benefit?. *Journal of Cardiac Surgery* 1994;**9**(3):314-21.

Cheng 2005 *{published data only}*

Cheng SC, Hung TS, Tse PY. Investigation of the use of drained blood reinfusion after total knee arthroplasty: a prospective randomised controlled study. *Journal of Orthopaedic Surgery* 2005;**13**(2):120-4.

Clagett 1999 *{published data only}*

Clagett GP, Valentine RJ, Jackson MR, Mathison C, Kakish HB, Bengtson TD. A randomised trial of intraoperative autotransfusion during aortic surgery. *Journal of Vascular Surgery* 1999;**29**(1):22-31.

Dalrymple-Hay 1999 *{published data only}*

Dalrymple-Hay MJR, Pack L, Deakin CD, Shepherd S, Ohri SK, Haw MP, Livesey SA, Monro JL. Autotransfusion of washed shed mediastinal fluid decreases requirement for autologous blood transfusion following cardiac surgery: A prospective randomized trial. *European Journal of Cardio-thoracic Surgery* 1999;**15**:830-4.

Damgaard 2006 *{published data only}*

Damgaard S, Steinbruchel DA. Autotransfusion with cell saver for off-pump coronary artery bypass surgery: a randomized trial. *Scandinavian Cardiovascular Journal* 2006;**40**(3):194-8.

Davies 1987 *{published data only}*

Davies MJ, Cronin KC, Moran P, Mears L, Booth RJ. Autologous blood transfusion for major vascular surgery using the Sorenson Receptal Device. *Anaesthesia and Intensive Care* 1987;**15**(3):282-8.

Dietrich 1989 *{published data only}*

Dietrich W, Barankay A, Dilthey G, Mitto HP, Richter JA. Reduction of blood utilization during myocardial revascularization. *Journal of Thoracic and Cardiovascular Surgery* 1989;**97**(2):213-9.

Dramis 2006 *{published data only}*

Dramis A, Plewes J. Autologous blood transfusion after primary unilateral total knee replacement surgery. *Acta Orthopaedica Belgica* 2006;**72**(1):15-7.

Ekback 1995 *{published data only}*

Ekback G, Schott U, Axelsson K, Carberg M. Perioperative autotransfusion and functional coagulation analysis in total hip replacement. *Acta Anaesthesiologica Scandinavica* 1995;**39**:390-5. [MEDLINE: 1919270]

Elawad 1991 *{published data only}*

Elawad AA, Ohlin AK, Berntorp E, Nilsson IM, Fredin H. Intraoperative autotransfusion in primary hip arthroplasty. A randomized comparison with homologous blood. *Acta Orthopaedica Scandinavica* 1991;**62**(6):557-62.

Eng 1990 *{published data only}*

Eng J, Kay PH, Murday AJ, Shreiti I, Harrison DP, Norfolk DR, et al. Postoperative autologous transfusion in cardiac surgery. A prospective, randomised study. *European Journal of Cardiothorac Surgery* 1990;**4**(11):595-600.

Fragnito 1995 *{published data only}*

Fragnito C, Beghi C, Cavozza C, Saccani S, Contini SA, Barboso G. Autotransfusion of the blood drained from mediastinum in the course of myocardial revascularization. *Acta Bio-Medica de l Ateneo Parmense* 1995;**66**(5):195-201.

Gannon 1991 *{published data only}*

Gannon DM, Lombardi AV, Jr, Mallory TH, Vaughn BK, Finney, CR, Niemcryk S. An evaluation of the efficacy of postoperative blood salvage after total joint arthroplasty. A prospective randomized trial. *Journal of Arthroplasty* 1991;**6**(2):109-14.

Goel 2007 *{published data only}*

Goel P, Pannu H, Mohan D, Arora R. Efficacy of cell saver in reducing homologous blood transfusions during OPCAB

surgery: a prospective randomized trial. *Transfusion Medicine* 2007;**17**(4):285-9.

Healy 1994 *{published data only}*

Healy WL, Pfeifer BA, Kurtz SR, Johnson C, Johnson W, Johnston R, et al. Evaluation of autologous shed blood for autotransfusion after orthopaedic surgery. *Clinical Orthopaedics and Related Research* 1994;**299**:53-9.

Heddle 1992 *{published data only}*

Heddle NM, Brox WT, Klama LL, Dickson LL, Levine MN. A randomized trial on the efficacy of an autologous blood drainage and transfusion device in patients undergoing elective knee arthroplasty. *Transfusion* 1992;**32**:742-6.

Kelley 1993 *{published data only}*

Kelley-Patteson C, Ammar AD, Kelley H. Should the Cell Saver Autotransfusion Device be used routinely in all infrarenal abdominal aortic bypass operations?. *Journal of Vascular Surgery* 1993;**18**(2):261-5.

Kirkos 2006 *{published data only}*

Kirkos JM, Krystallis CT, Konstantinidis PA, Papavasiliou KA, Kyrkos MJ, Ikonomidis LG. Postoperative re-perfusion of drained blood in patients undergoing total knee arthroplasty: is it effective and cost-efficient?. *Acta Orthopaedica Belgica* 2006;**72**(1):18-23.

Klein 2008 *{published data only}*

Klein AA, Nashef SA, Sharples L, Bottrill F, Dyer M, Armstrong J, Vuylsteke A. A randomized controlled trial of cell salvage in routine cardiac surgery. *Anesthesia and Analgesia* 2008;**107**(5):1487-95.

Koopman 1993a *{published data only}*

Koopman-van Germert AWMM. Peri-operative autotransfusion by means of a blood cell separator. Processed autotransfusion and homologous red cell requirement in elective cardiac and orthopaedic surgery: a randomised prospective study. Den Haag: Cip-Data Koninklijke Bibliotheek. Vol. **Chapter 5**, 1993:96-112.

Koopman 1993b *{published data only}*

Koopman-van Germert AWMM. Peri-operative autotransfusion by means of a blood cell separator. Processed autotransfusion and homologous red cell requirement in elective cardiac and orthopaedic surgery: a randomised prospective study. Den Haag: Cip-Data Koninklijke Bibliotheek. Vol. **Chapter 5**, 1993:96-112.

Laub 1993 *{published data only}*

Laub GW, Dharan M, Riebman JB, Chen C, Moore R, Bailey BM, et al. The impact of intraoperative autotransfusion on cardiac surgery. A prospective randomized double-blind study. *Chest* 1993;**104**(3):686-9.

Lepore 1989 *{published data only}*

Lepore V, Radegran K. Autotransfusion of mediastinal blood in cardiac surgery. *Scandinavian Journal of Thoracic and Cardiovascular Surgery* 1989;**23**(1):47-9.

Lorentz 1991 *{published data only}*

Lorentz A, Osswald PM, Schilling M, Jani L. A comparison of autologous transfusion procedures in hip surgery. *Anaesthesist* 1991;**40**(4):205-13.

Mah 1995 *{published data only}*

Mah ET, Davis R, Seshadri P, Nyman TLM, Seshadri R. The role of autologous blood transfusion in joint replacement. *Anaesthesia and Intensive Care* 1995;**23**:472-7.

Majowski 1991 *{published data only}*

Majkowski RS, Currie IC, Newman JH. Postoperative collection and reinfusion of autologous blood in total knee arthroplasty. *Annals of the Royal College of Surgeons of England* 1991;**73**(6):381-4.

Martin 2000 *{published data only}*

Martin J, Robitaille D, Perrault LP, Pellerin M, Page P, Searle N, et al. Reinfusion of mediastinal blood after heart surgery. *Journal of Thoracic and Cardiovascular Surgery* 2000;**120**(3):499-504.

Mauerhan 1993 *{published data only}*

Mauerhan DR, Nussman D, Mokris JG, Beaver WB. Effect of postoperative reinfusion systems on hemoglobin levels in primary total hip and total knee arthroplasties. A prospective randomized study. *Journal of Arthroplasty* 1993;**8**(5):523-7.

McGill 2002 *{published data only}*

McGill N, O'Shaughnessy D, Pickering R, Herbertson M, Gill R. Mechanical methods of reducing blood transfusion in cardiac surgery: randomised controlled trial. [erratum appears in BMJ 2002 Jul 20;325(7356):142]. *BMJ* 2002;**324**(7349):1299.

Menges 1992 *{published data only}*

Menges T, Rupp D, van Lessen A, Hempelmann G. Effects on coagulation parameters of different methods of autologous blood transfusion. *Anaesthesist* 1992;**41**:27-33.

Mercer 2004 *{published data only}*

Mercer KG, Spark JI, Berridge DC, Kent PJ, Scott DJ. Randomized clinical trial of intraoperative autotransfusion in surgery for abdominal aortic aneurysm. *The British Journal of Surgery* 2004;**91**(11):1443-8.

Moonen 2007 *{published data only}*

Moonen AF, Knoors NT, van Os JJ, Verburg AD, Pilot P. Retransfusion of filtered shed blood in primary total hip and knee arthroplasty: a prospective randomized clinical trial. *Transfusion* 2007;**47**(3):379-84.

Murphy 2004 *{published data only}*

Murphy GJ, Allen SM, Unsworth-White J, Lewis CT, Dalrymple-Hay MJ. Safety and efficacy of perioperative cell salvage and autotransfusion after coronary artery bypass grafting: a randomized trial. *Annals of Thoracic Surgery* 2004;**77**(5):1553-9.

Murphy 2005 *{published data only}*

Murphy GJ, Rogers CS, Lansdowne WB, Channon I, Alwair H, Cohen A, et al. Safety, efficacy, and cost of intraoperative cell salvage and autotransfusion after off-pump coronary artery

bypass surgery: a randomized trial. *The Journal of Thoracic and Cardiovascular Surgery* 2005;**130**(1):20-8.

Naumenko 2003 *{published data only}*

Naumenko SE, Pokrovskii MG, Belavin AS, Kim SF. Blood-saving effectiveness of preoperative reservation of autoblood for surgical treatment of ischaemic heart disease. *Vestnik khirurgii imeni I. I. Grekova* 2003;**162**:59-64.

Newman 1997 *{published data only}*

Newman JH, Bowers M, Murphy J. The clinical advantages of autologous transfusion. A randomized, controlled study after knee replacement. *The Journal of Bone and Joint Surgery. British Volume* 1997;**79**(4):630-2.

Niranjan 2006 *{published data only}*

Niranjan G, Asimakopoulos G, Karagounis A, Cockerill G, Thompson M, Chandrasekaran V. Effects of cell saver autologous blood transfusion on blood loss and homologous blood transfusion requirements in patients undergoing cardiac surgery on- versus off-cardiopulmonary bypass: a randomised trial. *European Journal of Cardio-thoracic Surgery* 2006;**30**(2):271-7.

Page 1989 *{published data only}*

Page R, Russell GN, Fox MA, Fabri BM, Lewis I, Williets T. Hard-shell cardiotomy reservoir for reinfusion of shed mediastinal blood. *Annals of Thoracic Surgery* 1989;**48**(4):514-7.

Parrot 1991 *{published data only}*

Parrot D, Lancon JP, Merle JP, Rerolle A, Bernard A, Obadia JF, Caillard B. Blood salvage in cardiac surgery. *Journal of Cardiothoracic and Vascular Anesthesia* 1991;**5**(5):454-6.

Pleym 2005 *{published data only}*

Pleym H, Tjomsland O, Asberg A, Lydersen S, Wahba A, Bjella L, et al. Effects of autotransfusion of mediastinal shed blood on biochemical markers of myocardial damage in coronary surgery. *Acta Anaesthesiologica Scandinavica* 2005;**49**(9):1248-54.

Riou 1994 *{published data only}*

Riou B, Arock M, Guerrero M, Ramos M, Thoreux P, Guillosson JJ, et al. Haematological effects of postoperative autotransfusion in spinal surgery. *Acta Anaesthesiologica Scandinavica* 1994;**38**(4):336-41.

Ritter 1994 *{published data only}*

Ritter MA, Keating EM, Faris PM. Closed wound drainage in total hip or total knee replacement. A prospective, randomized study. *The Journal of Bone and Joint Surgery. American Volume* 1994;**76**(1):35-8.

Rollo 1995 *{published data only}*

Rollo VJ, Hozack WJ, Rothman RH, Chao W, Eng KO. Prospective randomized evaluation of blood salvage techniques for primary total hip arthroplasty. *Journal of Arthroplasty* 1995;**10**(4):532-9.

Rollo 1995a *{published data only}*

Rollo VJ, Hozack WJ, Rothman RH, Chao W, Eng KO. Prospective randomized evaluation of blood salvage techniques for primary total hip arthroplasty. *Journal of Arthroplasty* 1995;**10**(4):532-9.

Rollo 1995b *{published data only}*

Rollo VJ, Hozack WJ, Rothman RH, Chao W, Eng KO. Prospective randomized evaluation of blood salvage techniques for primary total hip arthroplasty. *Journal of Arthroplasty* 1995;**10**(4):532-9.

Rosencher 1994 *{published data only}*

Rosencher N, Vassilieff V, Tallet F, Toulon P, Leoni J, Tomeno B, Conseiller C. Comparison of Orth-Evac and Solcotrans Plus devices for the autotransfusion of blood drained after total knee joint arthroplasty. *Annales Francaises d Anesthesie et de Reanimation* 1994;**13**(3):318-25.

Sait 1999 *{published data only}*

Sait MS, Earnshaw P. Autotransfusion in total knee arthroplasty - Is it worth the effort?. *The Journal of Bone and Joint Surgery. British Volume* 1999;**81 Suppl 2**:244.

Schaff 1978a *{published data only}*

Schaff HV, Hauer JM, Bell WR, Gardner TJ, Donahoo JS, Gott VL, Brawley RK. Autotransfusion of shed mediastinal blood after cardiac surgery. A prospective study. *Journal of Thoracic and Cardiovascular Surgery* 1978;**75**(4):632-41.

Schmidt 1996 *{published data only}*

Schmidt H, Folsgaard S, Mortensen PE, Jensen E. Impact of autotransfusion after coronary artery bypass grafting on oxygen transport. *Acta Anaesthesiologica Scandinavica* 1997;**41**(8):995-1001.

Schonberger 1993 *{published data only}*

Schonberger JP, Bredee J, Speekenbrink RG, Everts PA, Wildevuur CR. Autotransfusion of shed blood contributes additionally to blood saving in patients receiving aprotinin (2 million KIU). *European Journal of Cardio-thoracic Surgery* 1993;**7**(9):474-7.

Shenolikar 1997 *{published data only}*

Shenolikar A, Wareham K, Newington D, Thomas D, Hughes J, Downes M. Cell salvage auto transfusion in total knee replacement surgery. *Transfusion Medicine* 1997;**7**(4):277-80.

Shirvani 1991 *{published data only}*

Shirvani R. An evaluation of clinical aspects of post-operative autotransfusion, either alone or in conjunction with pre-operative aspirin, in cardiac surgery. *British Journal of Clinical Practice* 1991;**45**(2):105-8.

Simpson 1994 *{published data only}*

Simpson MB, Murphy KP, Chambers HG, Bucknell AL. The effect of postoperative wound drainage reinfusion in reducing the need for blood transfusions in elective total joint arthroplasty: a prospective, randomized study. *Orthopedics* 1994;**17**(2):133-7.

Sirvinskas 2007 *{published data only}*

Sirvinskas E, Veikutiene A, Benetis R, Grybauskas P, Andrejaitiene J, Veikutis V, et al. Influence of early re-infusion

of autologous shed mediastinal blood on clinical outcome after cardiac surgery. *Perfusion* 2007;**22**(5):345-52.

Slagis 1991 *{published data only}*

Slagis SV, Benjamin JB, Volz RG, Giordano GF. Postoperative blood salvage in total hip and knee arthroplasty. A randomised controlled trial. *The Journal of Bone and Joint Surgery. British Volume* 1991;**73**(4):591-4.

Smith 2007 *{published data only}*

Smith LK, Williams DH, Langkamer VG. Post-operative blood salvage with autologous retransfusion in primary total hip replacement. *The Journal of Bone and Joint Surgery. British Volume* 2007;**89**(8):1092-7.

So-Osman 2006 *{published data only}*

So-Osman C, Nelissen RG, Eikenboom HC, Brand A. Efficacy, safety and user-friendliness of two devices for postoperative autologous shed red blood cell re-infusion in elective orthopaedic surgery patients: A randomized pilot study. *Transfusion Medicine* 2006;**16**(5):321-8.

Spark 1997 *{published data only}*

Spark JI, Chetter IC, Kester RC, Scott DJ. Allogeneic versus autologous blood during abdominal aortic aneurysm surgery. *European Journal of Vascular and Endovascular Surgery* 1997;**14**(6):482-6.

Tempe 1996 *{published data only}*

Tempe D, Bajwa R, Cooper A, Nag B, Tomar AS, Khanna SK, et al. Blood conservation in small adults undergoing valve surgery. *Journal of Cardiothoracic and Vascular Anesthesia* 1996;**10**(4):502-6.

Tempe 2001 *{published data only}*

Tempe DK, Banerjee A, Virmani S, Mehta N, Panwar S, Tomar AS, et al. Comparison of the effects of a cell saver and low dose aprotinin on blood loss and homologous blood usage in patients undergoing valve surgery. *Journal of Cardiothoracic and Vascular Anesthesia* 2001;**15**(3):326-30.

Thomas 2001 *{published data only}*

Thomas D, Wareham K, Cohen D, Hutchings H. Autologous blood transfusion in total knee replacement surgery. *British Journal of Anaesthesia* 2001;**86**(5):669-73.

Thurer 1979 *{published data only}*

Thurer RL, Lytle BW, Cosgrove DM, Loop FD. Autotransfusion following cardiac operations: a randomized, prospective study. *Annals of Thoracic Surgery* 1979;**27**(6):500-7.

Tripkovic 2008 *{published data only}*

Tripkovic B, Bukovic D, Sakic K, Sakic S, Bukovic N, Radakovic B. Quality of the blood sampled from surgical drainage after total hip arthroplasty. *Collegium Antropologicum* 2008;**32**(1):153-60.

Unsworth 1996 *{published data only}*

Unsworth-White MJ, Kallis P, Cowan D, Tooze JA, Bevan DH, Treasure T. A prospective randomised controlled trial of postoperative autotransfusion with and without a heparin-bonded circuit. *European Journal of Cardio-thoracic Surgery* 1996;**10**(1):38-47.

Ward 1993 *{published data only}*

Ward HB, Smith RR, Landis KP, Nemzek TG, Dalmasso AP, Swaim WR. Prospective, randomized trial of autotransfusion after routine cardiac operations. *Annals of Thoracic Surgery* 1993;**56**(1):137-41.

Westerberg 2004 *{published data only}*

Westerberg M, Bengtsson A, Jeppsson A. Coronary surgery without cardiotomy suction and autotransfusion reduces the postoperative systemic inflammatory response. *Annals of Thoracic Surgery* 2004;**78**(1):54-9.

Wiefferink 2007 *{published data only}*

Wiefferink A, Weerwind PW, van Heerde W, Teerenstra S, Noyez L, de Pauw BE, Brouwer R. Autotransfusion management during and after cardiopulmonary bypass alters fibrin degradation and transfusion requirements. *Journal of Extra-Corporeal Technology* 2007;**39**(2):66-70.

Zacharopoulos 2007 *{published data only}*

Zacharopoulos A, Apostolopoulos A, Kyriakidis A. The effectiveness of reinfusion after total knee replacement. A prospective randomised controlled study. *International Orthopaedics* 2007;**31**(3):303-8.

Zhang 2008 *{published data only}*

Zhang XF, Dong JM, Gong ML, Shen SM, Zhou Y, Pan YF, Mao J. Effectiveness of preoperative autologous plateletpheresis combined with intraoperative autotransfusion on the blood coagulation in orthopaedic patients. [Chinese]. *Chung-Hua Wai Ko Tsa Chih [Chinese Journal of Surgery]* 2008;**46**(2):118-21.

Zhao 1996 *{published data only}*

Zhao K, Xiao M, Deng S. Autotransfusion of shed medistinal blood after open heart operation. *Chinese Journal of Surgery* 1996;**34**(8):497-9.

Zhao 2003 *{published data only}*

Zhao K, Xu J, Hu S, Wu Q, Wei Y, Liu Y. Autotransfusion of shed mediastinal blood after open heart surgery. *Chinese Medical Journal* 2003;**116**:1179-82.

References to studies excluded from this review

Adan 1988 *{published data only}*

Adan A, Brutel de la Riviere A, Haas F, van Zalk A, de Nooij E. Autotransfusion of drained mediastinal blood after cardiac surgery: a reappraisal. *Thoracic and Cardiovascular Surgery* 1988;**36**(1):10-14.

Bartels 1996 *{published data only}*

Bartels C, Bechtel JV, Winkler C, Horsch S. Intraoperative autotransfusion in aortic surgery: comparison of whole blood autotransfusion versus cell separation. *Journal of Vascular Surgery* 1996;**24**(1):102-8.

Bell 1992 *{published data only}*

Bell K, Stott K, Sinclair CJ, Walker WS, Gillon J. A controlled trial of intra-operative autologous transfusion in cardiothoracic surgery measuring effect on transfusion requirements and clinical outcome. *Transfusion Medicine* 1992;**2**(4):295-300.

Breakwell 2000 *{published data only}*

Breakwell LM, Getty CJM, Dobson P. The efficacy of autologous blood transfusion in bilateral total knee arthroplasty. *Knee* 2000;**7**(3):145-7.

Dalrymple-Hay 2001 *{published data only}*

Dalrymple-Hay MJR, Dawkins S, Pack L, Deakin CD, Sheppard S, Ohri SK, et al. Autotransfusion decreases blood usage following cardiac surgery - A prospective randomized trial. *Cardiovascular Surgery* 2001;**9**(2):184-7.

Deramoudt 1991 *{published data only}*

Deramoudt V, Menestret P, Melledant Y, et al. Autologous transfusion in cardiac surgery [Transfusion autologue en chirurgie cardiaque (a propos de 74 patients)]. *Cahiers D Anesthesiologie* 1991;**39**(3):153-9.

Elawad 1992 *{published data only}*

Elawad AA, Ohlin AK, Berntorp E, Nilsson IM, Fredin H. Autologous blood transfusion in revision hip arthroplasty. A prospective, controlled study of 30 patients. *Acta Orthopaedica Scandinavica* 1992;**63**(4):373-6.

Farrer 1997 *{published data only}*

Farrer A, Spark JI, Scott DJ. Autologous blood transfusion: the benefits to the patient undergoing abdominal aortic aneurysm repair. *Journal of Vascular Nursing* 1997;**15**(4):111-5.

Jacobi 1997 *{published data only}*

Jacobi K, Walther A, Kuhn R, Dworak O, Neidhardt B, Rugheimer E. Advantages and limitations of intraoperative mechanical autotransfusion in radical prostatectomies. *Anaesthetist* 1997;**46**(2):101-7.

Kristensen 1992 *{published data only}*

Kristensen PW, Sorensen LS, Thyregod HC. Autotransfusion of drainage blood in arthroplasty. A prospective, controlled study of 31 operations. *Acta Orthopaedica Scandinavica* 1992;**63**(4):377-80.

Mac 1993 *{published data only}*

Mac HL, Reynolds MA, Treston-Aurand J, Henke JA. Comparison of autoreinfusion and standard drainage systems in total joint arthroplasty patients. *Orthopaedic Nursing* 1993;**12**(3):19-25.

Mayer 1985 *{published data only}*

Mayer ED, Welsch M, Tanzeem A, Saggau W, Spath J, Hummels R, Schmitz W. Reduction of postoperative donor blood requirement by use of the cell separator. *Scandinavian Journal of Thoracic Cardiovascular Surgery* 1985;**19**(2):165-71.

McShane 1987 *{published data only}*

McShane AJ, Power C, Jackson JF, Murphy DF, MacDonald A, Moriarty DC, Otridge BW. Autotransfusion: quality of blood prepared with a red cell processing device. *British Journal of Anaesthesia* 1987;**59**(8):1035-9.

Schaff 1978b *{published data only}*

Schaff HV, Hauer JM, Brawley RK. Autotransfusion in cardiac surgical patients after operation. *Surgery* 1978;**84**(5):713-8.

Schmidt 1997a *{published data only}*

Schmidt H, Folsgaard S, Mortensen PE, Jensen E. Impact of autotransfusion after coronary artery bypass grafting on oxygen transport. *Acta Anaesthesiologica Scandinavica* 1997;**41**:995-1001.

* Schmidt H, Lund JO, Nielsen SL. Autotransfused shed mediastinal blood has normal erythrocyte survival. *Annals of Thoracic Surgery* 1996;**62**(1):105-8.

Schmidt 1997b *{published data only}*

Schmidt H, Folsgaard S, Mortensen PE, Jensen E. Cardiac enzymes and autotransfusion of shed mediastinal blood after myocardial revascularization. *Annals of Thoracic Surgery* 1997;**63**:1288-92.

Skoura 1997 *{published data only}*

Skoura H, Anastasiou E, Moshou A, Katsioulas A, Kostaki S. Value of autologous blood for intra-operative massive bleeding. *European Journal of Anaesthesiology* 1997;**14**(1):103.

Thompson 1990 *{published data only}*

Thompson JF, Webster JH, Chant AD. Prospective randomised evaluation of a new cell saving device in elective aortic reconstruction. *European Journal of Vascular Surgery* 1990;**4**(5):507-12.

Trubel 1995 *{published data only}*

Trubel W, Gunen E, Wuppinger G, Tschernko E, Gunen-Frank A, Staudacher M, et al. Recovery of intraoperatively shed blood in aortoiliac surgery: comparison of cell washing with simple filtration. *The Thoracic and Cardiovascular Surgeon* 1995;**43**(3):165-70.

Vertrees 1996 *{published data only}*

Vertrees RA, Conti VR, Lick SD, Zwischenberger JB, McDaniel LB, Shulman G. Adverse effects of postoperative infusion of shed mediastinal blood. *Annals of Thoracic Surgery* 1996;**62**(3):717-23.

Additional references

Baker 2009

Baker RA. Suction, salvage, sutures, and potions: blood management post-aprotinin. *Seminars in Cardiothoracic and Vascular Anesthesia* 2009;**13**(2):122-6.

Brown 2000

Brown P. BSE and transmission through blood. *Lancet* 2000;**356**(September,16):955-6.

Bryson 1998

Bryson GL, Laupacis A, Wells GA. Does acute normovolemic hemodilution reduce perioperative allogeneic transfusion?

A meta-analysis. The International Study of Perioperative Transfusion. *Anesthesia and Analgesia* 1998;**86**(1):9-15.

Carson 1998

Carson JL, Terrin ML, Barton FB, Aaron R, Greenburg AG, Heck DA, et al. A pilot randomized trial comparing symptomatic vs. hemoglobin-level-driven red blood cell transfusions following hip fracture. *Transfusion* 1998;**38**(6):522-9.

Carson 2002

Carson JL, Hill S, Carless P, Hebert P, Henry D. Transfusion triggers: a systematic review of the literature. *Transfusion Medicine Reviews* 2002;**16**(3):187-99.

Cook 1991

Cook SS, Epps J. Transfusion practice in central Virginia. *Transfusion* 1991;**31**(4):355-60.

Coyle 1999

Coyle D, Lee KM, Fergusson DA, Laupacis A. Economic analysis of erythropoietin use in orthopaedic surgery. *Transfusion Medicine* 1999;**9**(1):21-30.

Davies 2006

Davies L, Brown TJ, Haynes S, Payne K, Elliott RA, McCollum C. Cost-effectiveness of cell salvage and alternative methods of minimising perioperative allogeneic blood transfusion: a systematic review and economic model. *Health Technology Assessment* 2006;**10**(44):1-228.

Der Simonian 1986

DerSimonian R, Laird N. Meta-analysis in clinical trials. *Controlled Clinical Trials* 1986;**7**(3):177-88.

Dickersin 1996 [Computer program]

Dickersin K, Larson K. Establishing and maintaining an international register of RCTs. Cochrane Collaboration. Oxford. United Kingdom. Oxford.United Kingdom.(UK): Cochrane Collaboration, 1996.

Faught 1998

Faught C, Wells P, Fergusson D, Laupacis A. Adverse effects of methods for minimizing perioperative allogeneic transfusion: a critical review of the literature. *Transfusion Medicine Reviews* 1998;**12**(3):206-25.

Fergusson 1999a

Fergusson D, van Walraven C, Coyle D, Laupacis A. Economic evaluations of technologies to minimize perioperative transfusion: a systematic review of published studies. International Study of Peri-operative Transfusion (ISPOT) Investigators. *Transfusion Medicine Reviews* 1999;**13**(2):106-17.

Fergusson 1999b

Fergusson D, Blair A, Henry D, Hisashige A, Huet C, Koopman-van Gemer A, et al. Technologies to minimize blood transfusion in cardiac and orthopedic surgery. Results of a practice variation survey in nine countries. International Study of Peri-operative Transfusion (ISPOT) Investigators. *International Journal of Technology Assessment in Health Care* 1999;**15**(4):717-28.

Fergusson 2008

Fergusson DA, Hebert PC, Mazer CD, Fremes SE, MacAdams C, Murkin JM, et al. A comparison aprotinin and lysine analogues in high-risk cardiac surgery. *New England Journal of Medicine* 2008;**358**(22):2319-31.

Forgie 1998

Forgie M, Wells P, Laupacis A, Fergusson D. Pre-operative autologous donation decreases allogeneic transfusion but increases exposure to all red cell transfusion - results of a meta analysis. Archives of Internal Medicine 1998; Vol. 158:610-6.

Glynn 2000

Glynn SA, Kleinman SH, Schreiber GB. Trends in incidence and prevalence of major transfusion - Transmissible viral infections in US blood donors, 1991 to 1996. *JAMA* 2000;**284**(2):229-35.

Hadjianastassiou 2002

Hadjianastassiou VG, Virich G, Lennox IA. Use of the blood transfusion service in total knee replacement arthroplasty. The cost implications. *Knee* 2002;**9**(2):145-8.

Hebert 1999

Hebert PC, Wells G, Blajchman MA, Marshall J, Martin C, Pagliarello G, et al. A multicenter, randomized, controlled clinical trial of transfusion requirements in critical care. Transfusion Requirements in Critical Care Investigators: Canadian Critical Care Trials Group. *New England Journal of Medicine* 1999;**340**(6):409-17.

Henry 2007

Henry DA, Carless PA, Moxey AJ, O'Connell D, Stokes BJ, McClelland B, Laupacis A, Fergusson D. Anti-fibrinolytic use for minimising perioperative allogeneic blood transfusion. *Cochrane Database of Systematic Reviews* 2007, Issue 3. [DOI: 10.1002/14651858.CD001886.pub2]

Higgins 2009

Higgins JPT, Green S. Cochrane Handbook for Systematic Reviews of Interventions. *The Cochrane Collaboration* 2009;**Version 5.0.2**.

Hill 2003

Hill SR, Carless PA, McClelland B, Henry DA, Henderson KM, Carson J, et al. Transfusion thresholds and other strategies for guiding alogeneic red blood cell transfusion. *Cochrane Database of Systematic Reviews* 2003, Issue 2. [DOI: 10.1002/14651858.CD002042]

Houston 2000

Houston F, Foster JD, Chong A, Hunter N, Bostock CJ. Transmission of BSE by blood transfusion in sheep. *Lancet* 2000;**356**(September 16):999-1000.

Huber 1997

Huber TS, McGorray SP, Carlton LC, Irwin PB, Flug RR, Flynn TC, et al. Intraoperative autologous transfusion during elective infrarenal aortic reconstruction: A decision analysis model. *Journal of Vascular Surgery* 1997;**25**:984-94.

Huet 1999

Huet C, Salmi LR, Fergusson D, Koopman-van Gemert AW, Rubens F, Laupacis A. A meta-analysis of the effectiveness of cell salvage to minimize perioperative allogeneic blood transfusion in cardiac and orthopedic surgery. International Study of Perioperative Transfusion (ISPOT) Investigators. *Anesthesia and Analgesia* 1999;**89**(4):861-9.

Kimball 1995

Kimball AM, Berkley S, Ngugi E, Gayle H. International aspects of the AIDS/HIV epidemic. *Annual Review of Public Health* 1995;**16**:253-82.

Lackritz 1998

Lackritz EM. Prevention of HIV transmission by blood transfusion in the developing world: achievements and continuing challenges. *AIDS* 1998;**12 Suppl A**:81-6.

Laupacis 1997

Laupacis A, Fergusson D. Drugs to minimize perioperative blood loss in cardiac surgery: meta-analyses using perioperative blood transfusion as the outcome. International Study of Peri-operative Transfusion (ISPOT) Investigators. *Anesthesia and Analgesia* 1997;**85**(6):1258-67.

Lenfant 1992

Lenfant C. Transfusion practice should be audited for both undertransfusion and overtransfusion. *Transfusion* 1992;**32**(9):873-4.

McFarland 1997

McFarland W, Mvere D, Shandera W, Reingold A. Epidemiology and prevention of transfusion-associated human immunodeficiency virus transmission in sub-Saharan Africa. *Vox Sanguinis* 1997;**72**(2):85-92.

Oliver 2002

Oliver AM. Strategies for handling a potentially diminished blood supply. The potential shortage. Transfusion Medicine 2002; Vol. 12:1-12.

Ray 1999

Ray MJ, Brown KF, Burrows CA, O'Brien MF. Economic evaluation of high-dose and low-dose aprotinin therapy during cardiopulmonary bypass. *Annals of Thoracic Surgery* 1999;**68**(3):940-5.

Regan 2002

Regan F, Taylor C. Blood transfusion medicine. *BMJ* 2002;**325**(7356):143-7.

Schulz 1995

Schulz KF, Chalmers I, Hayes RJ, Altman DG. Empirical evidence of bias. Dimensions of methodological quality associated with estimates of treatment effects in controlled trials. *JAMA* 1995;**273**(5):408-12.

Semmens 2000

Semmens JB, Lawrence-Brown MM, Miles LE, Hellings MJ. Intraoperative blood salvage: the missing link in providing a safe and effective blood transfusion service.[comment]. *Medical Journal of Australia* 2000;**173**(5):266-8.

Spahn 2000

Spahn DR, Casutt M. Eliminating blood transfusions: new aspects and perspectives. *Anesthesiology* 2000;**93**(1):242-55.

Surgenor 1990

Surgenor DM, Wallace EL, Hao SH, Chapman RH. Collection and transfusion of blood in the United States, 1982-1988. *New England Journal of Medicine* 1990;**322**(23):1646-51.

Wallace 1993

Wallace EL, Surgenor DM, Hao HS, An J, Chapman RH, Churchill WH. Collection and transfusion of blood and blood components in the United States, 1989. *Transfusion* 1993;**33**(2):139-44.

Whyte 1997

Whyte GS, Savoia HF. The risk of transmitting HCV, HBV or HIV by blood transfusion in Victoria. *Medical Journal of Australia* 1997;**166**(11):584-6.

* Indicates the major publication for the study

CHARACTERISTICS OF STUDIES

Characteristics of included studies *[ordered by study ID]*

Abuzakuk 2007

Methods	Patients were randomised to receive an autologous reinfusion drain or a standard suction drain using the computer program MINIM. The method used to conceal treatment allocation was not described.
Participants	104 consecutive patients undergoing primary cemented total knee arthroplasty were randomised to one of two groups: • Group 1 (Autotransfusion group): n=52 • Group 2 (Control group): n=52

Abuzakuk 2007 *(Continued)*

	NB: Of the 104 randomised patients 43 were male and 61 were female. The mean age of randomised subjects was 68.5 years.
Interventions	• Group 1: Autotransfusion group (Bellovac autotransfusion system) had one deep drain inserted at the end of the operation. The drain was opened in the recovery room 20 minutes after the tourniquet was released. If blood collected in the reinfusion drain was more than 150mls it was transfused back into the patient unwashed and a new bag was then attached to the drain. The process was repeated if the amount of blood collected again exceeded 150mls. • Group 2: Control group (Redivac standard suction drain) had their collected blood discarded.
Outcomes	***Outcomes reported:*** number of patients transfused allogeneic blood, amount of allogeneic blood transfused, blood loss, hospital length of stay, Hb & Hct levels, wound problems, knee range of motion.
Notes	***Transfusion threshold:*** allogeneic blood transfusion was given if the haemoglobin level was less than 9.0g/dL.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	The software program MINIM was used to randomise patients to intervention or control.
Allocation concealment (selection bias)	Unclear risk	The method used to conceal treatment allocation was not described.
Blinding (performance bias and detection bias) All outcomes	High risk	

Adalberth 1998

Methods	Concealment of treatment allocation was by use of sealed envelopes. Method of generating allocation sequences was not described.
Participants	90 patients undergoing primary total knee arthroplasty were randomised to one of three groups: • Group 1 (No drain group): n=30, M/F=11/13, mean age (95% CI) = 70 (67-74) years • Group 2 (Autotransfusion group): n=30, M/F=4/20, mean age (95% CI) = 71 (69-74) years • Group 3 (Control group): n=30, M/F=9/16, mean age (95% CI) = 72 (69-75) years
Interventions	• Group 1: No drain was used. • Group 2: Solcotrans autotransfusion system collected blood for 6 hours or until the unit was full. Acid citrate dextrose-anticoagulant (ACD-A) was not added to the collection unit. Continuous suction was applied at 20cm H2O. Drains were maintained for 24 hours post-operatively. • Group 3: A standard disposable closed suction drainage system (Redon) was used with two standard drains maintained for 24 hours post-operatively.
Outcomes	***Outcomes reported:*** number of patients transfused allogeneic blood, blood loss, hospital length of stay, Hb and Hct levels.
Notes	***Transfusion threshold:*** allogeneic blood transfusion was given if the haemoglobin level was less than 9.0g/dL.

Risk of bias

Adalberth 1998 *(Continued)*

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	High risk	Randomisation was carried out with sealed envelopes, opened just before closure of the wound. Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	High risk	Sealed envelopes were used to conceal treatment allocation.
Blinding (performance bias and detection bias) All outcomes	High risk	

Altinel 2007

Methods	Patients undergoing bi- or tri-compartmental total knee arthroplasties with a diagnosis of primary osteoarthritis were included in the study.
Participants	32 patients undergoing total knee arthroplasty were randomised to one of two groups: • Group 1 (Autotranfusion group): n=16, M/F=0/16, mean (sd) age = 66.9 (9.1) years • Group 2 (Control group): n=2/14, M/F=2/14, mean (sd) age = 66.2 (7.1) years
Interventions	• Group 1: Autotransfusion group (ConstaVac CBCII autotransfusion system) had wound drainged connected at the end of the operation. The drain fluid was collected during the first 6 hours. Collected blood was transfused at the end of the 6th hour. Reinfusion was performed using a standard 40um blood filter between the collection bag and the intravenous site. After the 6 hours any blood collected from the reinfusion drain was discarded. • Group 2: Control group received standard care without autotransfusion.
Outcomes	***Outcomes reported:*** number of patients transfused allogeneic blood, blood loss, hospital length of stay, adverse events.
Notes	***Transfusion threshold:*** allogeneic blood transfusion was given if the haemoglobin level was less than 9.0g/dL.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was not described.
Blinding (performance bias and detection bias) All outcomes	High risk	

Amin 2008

Methods	Between May 2005 and December 2005, 178 patients were entered into the study. All patients over 55 years with osteoarthritis and/or inflammatory arthritis of the knee, and awaiting total knee replacement (TKR), were considered for the study. In a pre-assessment clinic patients were randomly assigned into two groups by sealed envelopes.
Participants	178 patients undergoing total knee replacement were randomised to one of two groups: • Group 1 (Autologous retransfusion group): n=92, M/F=43/49, mean (range) age = 70.3 (55.2-88.5) years • Group 2 (Control group): n=86, M/F=39/47, mean (range) age = 70.4 (57.9-87.1) years
Interventions	• Group 1: Autologous retransfusion group (Bellovac ABT autotransfusion sytem) had the blood collection suction bellows connected to an autologous transfusion bag with a 200mm filter and a one-way valve. The transfusion bag was connected to a transfusion set with a 40um filter. The drain was opened 20 minutes after tourniquet release. The shed blood was returned to the patient after collecting up to 500mls and no later than 6 hours after surgery. A maximum of 1200mls was re-transfused. • Group 2: Control group (standard vacuum drain) had blood collected in the vacuum drains discarded.
Outcomes	***Outcomes reported:*** number of patients transfused allogeneic blood, hospital length of stay, adverse events.
Notes	***Transfusion threshold:*** allogeneic blood transfusion was given if the haemoglobin level was less than 8.0g/dL.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	High risk	Sealed envelopes were used to conceal treatment allocation.
Blinding (performance bias and detection bias) All outcomes	High risk	

Axford 1994

Methods	Between June 1988 and August 1989, 103 patients who gave informed consent to participate in the study underwent cardiopulmonary bypass. Of the initial 103 patients, 71 were excluded from the study. Method of randomisation and allocation concealment was not described.
Participants	32 patients undergoing cardiac surgery requiring cardiopulmonary bypass were randomised to one of two groups: • Group 1 (Autologous retransfusion group): n=16; mean (sd) age = 60 (8.0) years • Group 2 (Control group): n=16; mean (sd) age = 61 (8.0) years
Interventions	• Group 1: Autologous retransfusion group (Pleur-evac Autotransfusion System - A-5005-ATS) had their mediastinal shed blood collected in a polyvinyl chloride blood bag containing an inline 200um nylon mesh filter by means of a closed system with -20cmH2O suction applied. This collection system contained no anticoagulant and none was added. Mediastinal shed blood was transfused without washing by detaching the autotransfusion replacement bag and reinfusing the blood through a standard 40um screen blood filter (Pall SQ40S) via a peripheral intravenous line.

Axford 1994 *(Continued)*

	• Group 2: Control group received either autologous packed cells if available or allogeneic packed red blood cells (standard citrate-phosphate-dextrose ADSOL-preserved cross-matched packed RBCs units stored at 4 degrees celsius for up to 42 days).
Outcomes	***Outcomes reported:*** amount of allogeneic blood transfused, amount of autologous blood transfused, number of patients transfused autologous and/or allogeneic blood, complications, bleeding times, plasma protein variables, post transfusion febrile reactions.
Notes	***Transfusion threshold:*** the decision to transfuse a patient post-operatively was made by the clinician who was responsible for the patient's post-operative care, and who was not involved in the study. The clinical criteria used to determine the need for transfusion consisted of the following: systolic BP less than 80mmHg; mean arterial pressure less than 50mmHg; central venous pressure (CVP) less than 5mmHg; pulmonary capillary wedge pressure (PCWP) less than 5mmHg; cardiac index (CI) less than 2.0L/min/m2; evidence of inadequate end-organ perfusion (ie: urine output less than 20ml/hr), or anaemia (Hct less than 25%). Any patient who bled more than 400ml in the first 4 hours post-operatively and who met any of these criteria underwent transfusion.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	Unclear risk	Method used to concealment treatment allocation was unclear.
Blinding (performance bias and detection bias) All outcomes	High risk	

Ayers 1995

Methods	The study was conducted between October 15, 1991 through to January 1, 1993. The patients included 125 women and 107 men who were 20-89 years of age (mean age = 72 years). All patients were advised to donate blood pre-operatively. The 156 patients (67%) who were scheduled to have a primary procedure were advised to donate 2 units of autologous blood, and the 76 patients (33%) who were scheduled to have a revision procedure were a advised to donate 4 units of autologous blood.
Participants	232 patients undergoing total hip arthroplasties were randomly assigned to one of two groups: • Group 1 (Autotransfusion group): n=103 • Group 2 (Control group): n=129 NB: Demographic data were not reported.
Interventions	• Group 1: Autotransfusion group (Autovac Post-operative Orthopaedic Autotransfusion Canister) had blood loss collected for 4 hours post-operatively. The autotransfusion canister was injected with 40mls of acid-citrate-dextrose anticoagulant (ACD-A) before activation. The autotransfusion canister was connected to wall suction with use of an Autovac Autotranfusion Regulator that limited maximum collection pressure to 100mmHg. If at least 300mls of blood was collected within 4 hours, the unwashed blood was reinfused through a microaggregate filter; if less than 300mls of blood was collected, the blood was discarded. Any blood that had not been reinfused within 6 hours after the beginning of collection was discarded. • Group 2: Control group had a closed suction drainage system used (Hemovac system).

Ayers 1995 *(Continued)*

Outcomes	***Outcomes reported:*** number of patients transfused allogeneic and./or autologous blood, blood loss, Hb levels.
Notes	***Transfusion threshold:*** Transfusion protocol not reported. All revision patients were exposed to cell salvage intra-operatively. 85% of Group 1 patients pre-deposited blood pre-operatively (PAD). 77% of Group 2 patients pre-deposited blood pre-operatively (PAD).

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	High risk	Patients were randomly assigned on the basis of their hospital record number.
Allocation concealment (selection bias)	High risk	Inadequate allocation concealment.
Blinding (performance bias and detection bias) All outcomes	High risk	

Bouboulis 1994

Methods	Study was conducted between January 1993 and May 1993. Consecutive patients underwent elective or urgent coronary artery bypass surgery. All procedures were performed by the same cardiac surgeon. Method of randomisation and allocation concealment was not described.
Participants	75 consecutive patients undergoing coronary artery bypass graft surgery were randomised into one of two groups: • Group 1 (Autotransfusion group): n=42; mean (sd) age = 60 (7.0) years • Group 2 (Control group): n=33; mean (sd) age = 59 (8.0) years
Interventions	• Group 1: Autotransfusion group received autotransfusion of shed mediastinal blood using the cardiotomy reservoir, after the completion of the coronary artery bypass grafting (CABG). As soon as the chest was closed, the mediastinal tubes were attached to the inlet port of the cardiotomy reservoir, which allows the chest tube drainage to pass through a 20 micron filter. The filtered blood was collected in the bottom of the cardiotomy reservoir, ready for reinfusion. The vacuum port was attached to wall suction apparatus and negative pressure was instituted at 20cm H2O. The chest drains were milked every 30 minutes. The collected blood was reinfused using a standard infusion pump. The hourly volume of mediastinal drainage was measured and the infusion pump adjusted to deliver this amount of blood over the next hour. Reinfusion was continued until the drainage was less than or equal to 50ml per hour for two consecutive hours. • Group 2: Control group received standard chest drainage.
Outcomes	***Outcomes reported:*** amount of blood collected by the cell saver, amount of blood re-transfused from the cell saver, amount of allogeneic blood transfused, number of patients transfused allogeneic blood, complications, wound infection, re-operation for bleeding, hospital length of stay, fever, mortality.
Notes	***Transfusion threshold:*** allogeneic packed cells were transfused intra-operatively or post-operatively when the haematocrit fell below 30%.

Risk of bias

Bouboulis 1994 *(Continued)*

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was unclear.
Blinding (performance bias and detection bias) All outcomes	High risk	

Cheng 2005

Methods	Between June 2002 and May 2004, 60 patients undergoing unilateral total knee arthroplasty (TKA) were enrolled in this prospective randomised trial. Randomisation was by sealed opaque envelopes which were mixed by independent personnel and consecutively assigned a case number from 1 to 60. All surgeries were performed by specialists of the joint and reconstruction team using an identical surgical approach and technique. Near the end of the operation the corresponding envelope was opened and the surgeon was informed at the time of drain insertion to achieve a single-blind effect.
Participants	60 patients undergoing unilateral total knee arthroplasty (TKA) were randomly allocated to one of two groups: • Group 1 (Autotransfusion group): n=26; M/F=6/20; mean (range) age = 72 (57-84) years • Group 2 (Control group): n=34; M/F=12/22; mean (range) age = 69.4 (55-78) years
Interventions	• Group 1: Autotransfusion group (DONOR system) had their blood reinfused from drains using a 40um blood filter between the collection bag and the intravenous site within 6 hours of surgery. All patients had their drains removed on post-operative day 2 or 3. The DONOR system is an integrated, closed system designed for the collection and reinfusion of drained wound blood. It consists of an 800ml chlorine-free, pre-evacuated collection vessel, a vacuum regulator, and a 40um integrated filter for salvaged blood. • Group 2: Control group received no post-operative autotransfusion.
Outcomes	***Outcomes reported:*** amount of allogeneic blood transfused, number of patients transfused allogeneic blood, febrile complications, adverse events, blood loss.
Notes	***Transfusion threshold:*** allogeneic blood transfusion was given if the haemoglobin level was less than 9.0g/dL.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Method used to generate allocation sequences was adequate.
Allocation concealment (selection bias)	High risk	Sealed opaque envelopes were used to conceal treatment allocation.
Blinding (performance bias and detection bias) All outcomes	High risk	Single-blind design.

Clagett 1999

Methods	Patients undergoing elective abdominal aortic aneurysm (AAA) repair or aortofemoral bypass (AFB) for occlusive disease were eligible for entrance into the study. Randomisation was carried out in blocks of 10 stratified for AAA repair or AFB. Patients were randomised by means of drawing sealed envelopes that contained prescriptions for either intra-operative autotransfusion (IAT) or control therapy. The study was unblinded.
Participants	100 patients undergoing aortic surgery were randomly allocated to one of two groups: • Group 1 (Autotransfusion group): n=50; M/F=41/9; mean (sd) age = 63 (11.0) years • Group 2 (Control group): n=50; M/F=43/7; mean (sd) age = 65 (9.0) years
Interventions	• Group1: Intra-operative autotransfusion group had their blood processed by either a Cell Saver 3 Plus or Cell Saver 5 device. Both systems consist of polyvinyl aspiration tubing with a separate channel for introducing small amounts of heparised saline solution to anticoagulate aspirated blood, a plastic cardiotomy reservoir with microaggregate filter, a continuous flow, disposable washing bowl driven by a centrifuge, and a transfusion setup that consists of a plastic transfer pack passed to the anaesthesiologist for administration. The maximum allowable amount of IAT-PRBCs administered to a single patient was 1500mls. • Group 2: Control group did not receive autotransfusion.
Outcomes	***Outcomes reported:*** number of patients transfused allogeneic blood, amount of allogeneic blood transfused, blood loss, hospital length of stay, ICU length of stay, adverse events.
Notes	***Transfusion threshold:*** patients were transfused allogeneic RBCs intra-operatively if the haemoglobin level was less than 10.0g/dL. Post-operatively patients were transfused allogeneic RBCs if the haemoglobin level was less than 8.0g/dL.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	High risk	Treatment allocation was inadequately concealed.
Blinding (performance bias and detection bias) All outcomes	High risk	

Dalrymple-Hay 1999

Methods	Patients undergoing either coronary artery bypass grafting, valve replacement/repair operations or a combination of the two were randomised pre-operatively into two groups using a binary random number table. Method used to conceal treatment allocation was not described.
Participants	112 patients undergoing cardiac surgery were randomised to one of two groups: • Group 1 (Autotransfusion group): n=56; M/F=36/20; mean (sd) age = 67.4 (9.0) years • Group 2 (Control group): n=56; M/F=41/15; mean (sd) age = 65.3 (10.5) years
Interventions	• Group 1: Autotransfusion group were transfused with washed post-operative drained blood processed by a Fresenius Continuous Autotransfusion System (C.A.T.S).

Dalrymple-Hay 1999 *(Continued)*

	• Group 2: Control group received usual care management without autotransfusion.
Outcomes	***Outcomes reported:*** amount of allogeneic blood transfused, number of patients transfused allogeneic blood, mortality, re-operation for bleeding, blood loss, coagulopathy, Hb levels.
Notes	***Transfusion threshold:*** patients were transfused allogeneic RBCs intra-operatively if the haemoglobin level was less than 7.0g/dL. Post-operatively patients were transfused allogeneic RBCs if the haemoglobin level was less than 10.0g/dL.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was not described.
Blinding (performance bias and detection bias) All outcomes	High risk	

Damgaard 2006

Methods	The study was conducted between September 2003 to October 2004. Patients admitted for elective or sub-acute coronary bypass surgery without the use of the cardiopulmonary bypass (CPB) machine were included. If the CPB machine became necessary during the operation the patient was excluded. Patients were randomised to intervention or control by means of sealed opaque envelopes numbered in sequence.
Participants	60 patients undergoing 'off-pump' coronary artery bypass surgery were randomly allocated to one of two groups: • Group 1 (Autotransfusion group): n=30; M/F=11/19; mean (IQR) age = 77 (74-79) years • Group 2 (Control group): n=30; M/F=14/16; mean (IQR) age = 76 (70-79) years
Interventions	• Group 1: Autortransfusion group (Medtronic Autolog system) received intra-operative autotransfusion. Immediately after surgery the suctioned blood was processed by the cell saver device and autotransfused before the patient was transferred to the intensive care unit (ICU). • Group 2: Control group had their intra-operative suctioned blood discarded. NB: The cell saver reservoir with a 40um filter was used in the ICU for mediastinal drained blood collection and for post-operative autotransfusion in both groups. A maximum of 12 hours of post-operative unwashed autotransfusion from the drains was routine practice.
Outcomes	***Outcomes reported:*** amount of allogeneic blood transfused, number of patients transfused allogeneic blood, blood loss, Hb levels, adverse events, costs.
Notes	***Transfusion threshold:*** patients were transfused allogeneic RBCs if the haematocrit level was less than 30%.

Risk of bias

Bias	Authors' judgement	Support for judgement

Damgaard 2006 *(Continued)*

Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	High risk	Method used to conceal treatment allocation was inadequate.
Blinding (performance bias and detection bias) All outcomes	High risk	

Davies 1987

Methods	Fifty patients having aortic surgery for either abdominal aortic aneurysm or aorto-iliac occlusive disease were selected for study. Method of randomisation and allocation concealment was not described.
Participants	50 patients undergoing aortic surgery were randomly allocated to one of two groups: • Group 1 (Autotransfusion group): n=25; M/F=21/4; mean (sd) age = 68 (8.0) years • Group 2 (No intraoperative salvage group): n=25; M/F=22/3; mean (sd) age = 70 (8.0) years
Interventions	• Group 1: Autotransfusion group (Sorenson autotransfusion system) had their blood loss from the surgical site suctioned into the Sorenson receptacle device and then retransfused at the time of surgery. Additional blood loss which was not able to be collected was replaced according to haematocrit levels, 3.5% polygeline being given if the haematocrit was above 30% and allogeneic blood if the haematocrit was below 30%. The collected blood was anticoagulated with an acid citrate dextrose solution and administered via a burette at a rate of 70ml for every 430ml of autologous blood collected. The scavenged blood was collected in a 1900ml sterile disposable Sorenson receptal ATS trauma liner contained within the rigid reusable receptal canister. When approximately 1 litre of autologous blood had been scavenged the liner was removed and this blood then administered to the patients after being filtered through a Pall 40um filter. • Group 2: intraoperative blood loss was replaced with either 3.5% polygeline or allogeneic blood according to the measured Hct. If the Hct was above 30% then polygeline was used; if the Hct was below 30% then allogeneic blood was administered.
Outcomes	***Outcomes reported:*** amount of blood re-transfused from the cell saver, amount of allogeneic blood transfused, number of patients transfused allogeneic blood, mortality, re-operation for bleeding, haemodialysis, blood loss, coagulopathy, Hb levels, organisms cultured from autologous vs allogeneic blood.
Notes	***Transfusion threshold:*** patients received allogeneic RBC transfusion if the haematocrit level fell below 30%.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was unclear.
Blinding (performance bias and detection bias) All outcomes	High risk	

Dietrich 1989

Methods	The efficacy of four different blood conservation techniques in decreasing allogeneic blood transfusion in different cardiac operations were studied in 100 patients undergoing myocardial revascularisation. Method of randomisation and allocation concealment was not described.
Participants	100 patients undergoing myocardial revascularisation were randomly assigned to one of four groups: • Group 1 (Control group): n=25; mean (sd) age = 56.0 (6.6) years • Group 2 (Intra-operative autotransfusion group): n=25; mean (sd) age = 54.1 (6.8) years • Group 3 (Acute normovolaemic haemodilution + intra-operative autotransfusion group): n=25; mean (sd) age = 55.0 (9.4) years • Group 4 (Acute normovolaemic haemodilution + intra- and post-operative autotransfusion group): n=25; mean (sd) age = 55.7 (6.3) years
Interventions	• Group 1: patients received unprocessed oxygenator blood after the termination of extracorporeal circulation (ECC). • Group 2: the blood remaining in the oxygenator after ECC was processed to packed cells with a cell separator (Haemonetics Cell Saver) and re-transfused until the end of the operation. • Group 3: after the induction of anaesthesia and before the start of the operation, isovolumetric hemodilution (harvesting of 10ml/kg autologous blood) was performed under electrocardiographic and haemodynamic control. The blood loss was replaced with hydroxyethyl starch. After termination of ECC, the blood remaining in the oxygenator was processed by a cell separator. The preoperatively drawn blood and the packed cells were retransfused before the end of the operation. • Group 4: patients in Group 4 were managed as in Group 3. In addition, the shed mediastinal blood was retransfused in the Intensive Care Unit (ICU). The cardiotomy reservoir of the heart lung machine was used to collect this blood. The drained blood was retransfused intermittently according to the circulatory state of the patient and when at least 250ml of blood had been collected in the reservoir. The last retransfusion was performed 6 hours post-operatively.
Outcomes	***Outcomes reported:*** amount of blood re-transfused from the cell saver, amount of allogeneic blood transfused, number of patients transfused allogeneic blood, complications, mortality, ICU length of stay, blood loss, re-exploration for bleeding, operation time, haematological variables, Hct levels.
Notes	***Transfusion threshold:*** in all patients signs of hypovolaemia and haematocrit values below 30% were indications for allogeneic blood transfusion.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was unclear.
Blinding (performance bias and detection bias) All outcomes	High risk	

Dramis 2006

Methods	Patients undergoing primary unilateral total knee arthroplasty over a consecutive 30-day period were studied to assess the efficacy and financial cost of post-operative reperfusion of drained blood.

Dramis 2006 *(Continued)*

Participants	49 patients undergoing primary unilateral total knee arthroplasty were randomly allocated to one of two groups: • Group 1 (Autotransfusion group): n=32; M/F=11/21; mean (range) age = 69 (49-83) years • Group 2 (Control group): n=17; M/F=4/13; mean (range) age = 72 (62-91) years
Interventions	• Group 1: Autotranfusion group (CellTrans system) had their drained blood filtered through a 40um filter before being reinfused. Before closure of the wound two drainage tubes were inserted. The tubes were connected through a Y-connector to the CellTrans assembly which contains two transfusion bags. The clamps remained closed for 20 minutes after the wound had been closed off. The drainage was started in the recovery room and collected for 6 hours or until 600mls of blood had accumulated at which point reinfusion took place. Collection up to a maximum of 12 hours - thereafter the blood collected in the drains was discarded. • Group 2: Control group received a standard vacuum drain (Redivac high vacuum drainage system). Drains were removed routinely at 48 hours. Contents were discarded.
Outcomes	***Outcomes reported:*** number of patients transfused allogeneic blood, amount of allogeneic blood transfused, Hb levels, cost.
Notes	***Transfusion threshold:*** the trigger for transfusing allogeneic blood was a post-operative haemoglobin level of less than 9.0g/dL or clinical symptoms of anaemia.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was unclear.
Blinding (performance bias and detection bias) All outcomes	High risk	

Ekback 1995

Methods	Patients with severe hip arthrosis undergoing total hip arthroplasty were studied to evaluate the efficacy of different peri-operative blood saving techniques to reduce allogeneic blood transfusion. Method of randomisation and allocation concealment was not described.
Participants	45 patients undergoing total hip arthroplasty were randomly allocated to one of three groups: • Group 1 (Control group): n=15 • Group 2 (Autotransfusion group): n=15 • Group 3 (Autologous predonation + autotransfusion group): n=15 NB: Demographic data were not reported.
Interventions	• Group 1 (Control group): blood loss was replaced with heterologous erythrocyte concentrate (SAGM-ERC) and 3% dextran 60 in a ratio of 1:1. If necessary, additional SAGM-ERC was transfused to correct erythrocyte volume fraction (EVF)>27%. • Group 2 (Autotransfusion group): blood loss was replaced with 3% dextran and by autotransfusion of washed and haemconcentrated blood salvaged by intraoperative suction and from wound drains up

Ekback 1995 *(Continued)*

	to 4 hours postoperatively. As in Group 1, additional SAGM-ERC was transfused to correct erythrocyte volume fraction (EVF)>27%. • Group 3 (Autologous predonation + Cell Saver group): blood loss was replaced with 3% dextran and by autotransfusion of washed and haemconcentrated blood salvaged by intraoperative suction and from wound drains up to 4 hours postoperatively. Predonated autologous SAGM-ERC was used instead of heterologous blood to maintain erythrocyte volume fraction (EVF)>27%. In 2-3 sessions within 6 weeks prior to the operation, 2 to 3 units of SAGM-ERC had been withdrawn. If necessary, heterologous SAGM-ERC was used if transfusion of all predonated autologous blood failed to maintain EVF>27%. ***Autotransfusion technique:*** Haemonetic Cell Saver 4, Althin model AT 1000, or Shiley/Dideco STAT were used. Blood was retrieved from the operation site by suction through a double lumen catheter and was then anticoagulated with heparin (30,000 IU heparin in 1000ml of physiological saline). The blood was collected into a reservoir where a macrofilter removed debris. Thereafter, the blood was pumped into a spinning centrifuge bowl (125ml of blood) and washed with 1500ml of physiological saline. The erythrocytes were concentrated to an EVF of about 50-60% and pumped into an infusion bag. The effluent containing platelets, free haemoglobin and anticoagulants was disposed.
Outcomes	***Outcomes reported:*** amount of allogeneic blood transfused, amount of autologous blood transfused, number of patients transfused allogeneic blood, complications, adverse events.
Notes	***Transfusion threshold:*** patients were transfused allogeneic blood to maintain the erythrocyte volume fraction (EVF) >27%.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was unclear.
Blinding (performance bias and detection bias) All outcomes	High risk	

Elawad 1991

Methods	Randomised trial to study the quality and effect of blood produced by the cell saver compared with allogeneic blood in primary total hip arthroplasty.
Participants	40 patients undergoing primary total hip arthroplasty were randomly allocated to one of two groups: • Group 1 (Autotransfusion group): n=20; M/F=9/11; mean (range) age = 68 (59-89) years • Group 2 (Control group): n=20; M/F=8/12; mean (range) age = 74 (48-89) years
Interventions	• Group 1: Autotransfusion group received autologous blood processed intra-operatively by a cell saver device (Electromedic Autotrans AT1000 autotransfusion system). Blood was retrieved from the operative field with a double lumen suction catheter. The blood was immediately anticoagulated with sodium citrate. Larger debris was removed by a 240um filter in the cardiotomy reservoir. The filtered blood was pumped into a bowl centrifuge and washed with 1500mls of saline. The supernatant was discarded. The erythrocyte concentrate was pumped into a reinfusion bag and then reinfused into the patient. • Group 2: Control group received allogeneic blood and no autotransfusion.

Elawad 1991 *(Continued)*

	NB: Thromboprophylaxis was given to all patients using dextran 70, 6% in saline (Macrodex) 500mls during the operation, another 500mls during the remainder of the operation day, and 500mls on post-operative days 1,3 and 5.
Outcomes	***Outcomes reported:*** amount of allogeneic units transfused, number of patients receiving allogeneic blood, complications, blood loss, haematological variables.
Notes	***Transfusion threshold:*** a transfusion of allogeneic blood was given if the haemoglobin was less than 8.5g/dL or if there were symptoms of anaemia.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	High risk	Method used to conceal treatment allocation was inadequate.
Blinding (performance bias and detection bias) All outcomes	High risk	

Eng 1990

Methods	Prospective randomised trial to investigate the safety and efficacy of post-operative autologous blood transfusion carried out in two matched groups of twenty patients undergoing elective coronary artery bypass surgery. Method of randomisation and allocation concealment were not described.
Participants	40 patients (33 males and 7 females) undergoing elective coronary artery bypass surgery were randomised to one of two groups: • Group 1 (Autologous blood transfusion group): n=20 • Group 2 (Control group): n=20 Mean (range) age for both groups = 55.75 (33-69) years.
Interventions	• Group 1: received postoperative autologous blood transfusion (AT) using the Shiley hardshell venous reservoir. At the end of the operation in theatre, the chest drains were connected to the Shiley hardshell venous reservoir using the Shiley drainage set. After the system was primed and specimens obtained for haematological, biochemical, and bacteriological analyses, transfusion of the shed blood was commenced, the rate depending on the amount of drainage, reinfusing the previous hours blood loss over the subsequent hour. At the end of 6 hours the AT was discontinued and further specimens were obtained. • Group 2: patients were managed in the same manner without the use of autologous blood transfusion.
Outcomes	***Outcomes reported:*** amount of blood re-transfused from the cell saver, amount of allogeneic blood transfused, number of patients transfused allogeneic blood, hospital length of stay, mortality, blood loss, haematological variables, adverse events.
Notes	***Transfusion threshold:*** allogeneic blood transfusion was used only when the haematocrit fell below 25%, haemoglobin below 9.0g/dL or the blood loss exceeded 500mls in the first 4 hours.

Risk of bias

Eng 1990 *(Continued)*

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was unclear.
Blinding (performance bias and detection bias) All outcomes	High risk	

Fragnito 1995

Methods	To determine if autotransfusion of unwashed shed mediastinal blood led to a reduction in post-operative banked blood requirements a prospective randomised study of 82 patients undergoing myocardial revascularisation was conducted in 1994 at the Cardiovascular Center of Parma. Method of randomisation and allocation concealment were not described [Italian article].
Participants	82 patients undergoing myocardial revascularisation were randomised to one of two groups: • Group 1 (Autotransfusion group): n=41; M/F=37/4; mean (sd) age = 60.2 (9.3) years • Group 2 (No Autotransfusion group): n=41; M/F=33/8; mean (sd) age = 62.7 (8.9) years
Interventions	• Group 1: Autotransfusion group (Atrium 2550 autotransfusion system) had their drained blood processed using the autotransfusion system. • Group 2: Control group did not receive autotransfusion.
Outcomes	***Outcomes reported:*** amount of blood collected by the cell saver, number of patients transfused allogeneic blood, amount of allogeneic blood transfused, blood loss, mortality.
Notes	***Transfusion threshold:*** allogeneic blood transfusion was given during surgery if the haemoglobin level fell below 7.5g/dL.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was unclear.
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was unclear
Blinding (performance bias and detection bias) All outcomes	High risk	

Gannon 1991

Methods	Consecutive patients undergoing total hip or total knee replacement procedures between January 1989 and April 1989 were included in this study. A computer-generated random number list was used to

Gannon 1991 *(Continued)*

	pre-operatively assign patients to intervention or control groups. Method used to conceal treatment allocation was not described.
Participants	239 consecutive patients undergoing total knee replacement procedures were randomly assigned to one of two groups: • Group 1 (Autotransfusion group): n=124; M/F=59/65; mean age = 65 years • Group 2 (Control group): n=115; M/F=46/69; mean age = 69 years
Interventions	• Group 1: Autotranfusion group (Solcotrans autotransfusion system) had their wounds drained into post-operative blood salvage canisters. There was a 6 hour total time limit for collection and reinfusion of blood. Because 40ml of citrate ACD-A was entered in each Solcotrans canister prior to use, a minimum of 320mls of blood and citrate volume was necessary before reinfusion to prevent citrate toxicity. If wound drainage was slow and an adequate volume had not been collected before the 6-hour time limit, the canister and blood were discarded, and a standard collection canister was attached to the drainage tube for the duration. If wound drainage was rapid, the canister was allowed to fill completely (500mls volume). The blood was then infused at an appropriate rate as long as the 6-hour pre-canister limit was not exceeded. Another Solcotrans canister could then be attached, beginning a new 6-hour time interval. Intra-operative blood salvage was not used. • Group 2: Control group had their wounds drained into standard 400ml suction canisters. Autotransfusion was not performed.
Outcomes	***Outcomes reported:*** amount of blood re-transfused from the cell saver, number of patients transfused allogeneic blood, adverse events.
Notes	***Transfusion threshold:*** All patients whose post-operative haemoglobin value was less than 9.0g/dL were transfused allogeneic blood. The decision to transfuse patients with haemoglobin values greater than 9.0g/dL was made by the internist on the basis of each patient's medical condition.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	A computer-generated random number list was used to pre-operatively assign patients to either intervention or control.
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was unclear.
Blinding (performance bias and detection bias) All outcomes	High risk	

Goel 2007

Methods	Between March 2004 and June 2004, all patients admitted for elective or urgent first-time coronary artery bypass grafting (CABG) were enrolled in the study.
Participants	50 patients undergoing 'off-pump' first-time coronary artery bypass grafting (CABG) were randomised to one of two groups: • Group 1 (Autotransfusion group): n=24; M/F=21/3; mean (sd) age = 58.2 (8.7) years • Group 2 (Control group): n=25; M/F=21/4; mean (sd) age = 61.9 (10.0) years NB: One patient in the autotransfusion group (intervention group) was excluded from the final analysis due to conversion to cardiopulmonary bypass ('on'pump').

Goel 2007 *(Continued)*

Interventions	• Group 1: Autotransfusion group (Dideco autotransfusion system) had all intra-operative shed blood from the time of incision till skin closure collected by means of a single lumen high-pressure suction cannula flushed with heparinised saline and was collected in the reservoir of the cell saver device. The collected blood was then subjected to washing and centrifugation. The processed red blood cells were collected in sterile blood bags and were made available to the anaesthetic staff for autotransfusion. • Group 2: Control group had their intra-operative shed blood discarded.
Outcomes	***Outcomes reported:*** amount of allogeneic blood transfused, volume of blood re-transfused from the cell saver, blood loss, adverse events.
Notes	***Transfusion threshold:*** the indication for allogeneic blood transfusion in the intra-operative period was a haemoglobin level less than 9.0g/dL or a haematocrit level less than 27%. In the autotransfusion group, all the processed red blood cells collected during surgery were re-transfused as required. Banked allogeneic blood was used only if the haemoglobin level remained less than 9.0g/dL despite autotransfusion.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	High risk	Sealed envelopes were used to conceal treatment allocation.
Blinding (performance bias and detection bias) All outcomes	High risk	

Healy 1994

Methods	The efficacy of autologous shed blood in reducing allogeneic blood transfusion was evaluated at four medical centres in a prospective randomised study. Method of randomisation and allocation concealment was not described.
Participants	128 patients undergoing total hip arthroplasty, total knee arthroplasty, or spine fusion were randomly allocated to one of three groups: • Group 1 (Autotransfusion - Orth-Evac group): n=44; M/F=18/26; mean (range) age = 67.9 (41-82) years • Group 2 (Autotransfusion - Solcotrans group): n=40; M/F=20/20; mean (range) age = 66.3 (54-82) years • Group 3 (Control group): n=44; M/F=23/21; mean age = 62.5 years.
Interventions	• Group 1: Autotransfusion group received autologous shed blood reinfusion collected from wound drainage by an Orth-evac device. • Group 2: Autotransfusion group received autologous shed blood reinfusion collected from wound drainage by a Solcotrans device. • Group 3: Control group received either autologous predonated blood or allogeneic banked blood. In control patients a standard wound drainage system (Hemovac) was used, and these patients received liquid-preserved autologous predonated blood or allogeneic blood filtered with a standard 170 micron screen filter. NB: Patients randomised to the autologous shed blood groups (Group 1 and Group 2) were randomly assigned to one of two infusion filters (Pall 40 micron screen filter or Pall RC100 polyester filter) for the

Healy 1994 *(Continued)*

	transfusion phase of the study. With the Solcotrans drainage system, 40ml acid citrate detrose (ACD) was used. No anticoagulant was added with the Ortho-evac drainage system.
Outcomes	***Outcomes reported:*** amount of blood collected by the cell saver, amount of blood re-transfused from the cell saver, number of patients transfused allogeneic blood, amount of allogeneic blood transfused, adverse events.
Notes	***Transfusion threshold:*** transfusion protocol was not reported.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was unclear.
Blinding (performance bias and detection bias) All outcomes	High risk	

Heddle 1992

Methods	Consecutive patients undergoing elective knee arthroplasty at two institutions were enrolled in the study. Method of randomisation and allocation concealment was not described.
Participants	81 patients undergoing elective knee arthroplasty were randomly assigned to one of two groups: • Group 1 (Autotransfusion group): n=39; M/F=14/25; mean (sd) age = 69.3 (6.9) years • Group 2 (Control group): n=40; M/F=14/26; mean (sd) age = 71.0 (9.0) years
Interventions	• Group 1: Autotransfusion group underwent drainage and autotransfusion transfusion using a Solcotrans system. The autologous blood collected into the drainage and transfusion device was transfused if specific transfusion guidelines were met. Patients were transfused the initial unit of Solcotrans blood if 350ml or more had been collected within 3 hours of the patients entry to the recovery room. The 3-hour collection time provided for collection and transfusion of the blood within the maximum interval of 6 hours. After successful collection and transfusion of the first autologous blood unit, a second autologous blood collection device was attached. For this and subsequent collections, autologous blood was transfused if 150ml or more was collected within 3 hours. When the rate of drainage was less than 250ml of blood within a 3 hour period, a subsequent drainage and transfusion device was not attached. The first Solcotrans device attached to the drain contained 40ml of ACD-A. • Group 2: Control group had their drained blood collected by a Davol suction unit and discarded. The Davol unit was the current standard practice in the two study centres. Patients assigned to the Davol suction group received 1 unit of allogeneic red cells if more than 500ml of blood drained from the surgical site within a 2 hour period. Subsequently, whenever drainage exceeded 500ml within a 2 hour period, 1 unit of allogeneic blood was transfused.
Outcomes	***Outcomes reported:*** amount of allogeneic blood transfused, number of patients transfused allogeneic blood, adverse events, blood loss, coagulation variables, venogram tests.
Notes	***Transfusion thresholds:*** on postoperative Day 2 through to Day 5, the criteria for allogeneic red cell transfusions were identical for both groups. Patients were given one unit of red cell concentrate if their haemoglobin was within the range of 8.0 to 8.9g/dL, two units when the value was from 7.0 to 7.9g/dL, three units when the value was from 6.0 to 6.9g/dL, and four units if the value was from 5.0 to 5.9g/dL.

Heddle 1992 *(Continued)*

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was unclear.
Blinding (performance bias and detection bias) All outcomes	High risk	

Kelley 1993

Methods	This study was prospectively performed on the cases of a single vascular surgeon operating at two institutions from January 1989 to January 1990. Patients undergoing elective infrarenal abdominal aortic bypass for either occlusive or aneurysmal disease were included in the study sample. Patients were randomised on an alternating basis to either intervention or control. Method of randomisation was not described.
Participants	36 patients undergoing aortobifemoral or aortobi-iliac bypass for occlusive disease were randomised to one of two groups: • Group 1 (Autotransfusion group): n=18 • Group 2 (Control group): n=18 NB: Demographic data were not reported.
Interventions	• Group 1: Autotransfusion group (Haemonetics Cell Saver) was monitored and operated by a technician-member of the perfusion team. The Haemonetics Cell Saver delivers washed red blood cells at an average haematocrit level of 55% to 60%. • Group 2: Control group did not receive autotransfusion.
Outcomes	***Outcomes reported:*** amount of blood re-transfused from the cell saver, amount of allogeneic blood transfused, adverse events, hospital length of stay, blood loss, haemoglobin levels.
Notes	***Transfusion threshold:*** after the operation allogeneic red cell transfusions were not given to patients who were haemodynamically stable, and had haemoglobin values greater than 8.0g/dL.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	High risk	Method used to conceal treatment allocation was inadequate.
Blinding (performance bias and detection bias) All outcomes	High risk	

Kirkos 2006

Methods	This prospective randomised trial evaluated the safety and efficacy of post-operative blood retrieval and re-infusion in patients undergoing total knee arthroplasty for primary knee osteoarthritis during 2002. Method of randomisation and allocation concealment was not described.
Participants	155 patients undergoing total knee arthroplasty were randomly allocated to one of two groups: • Group 1 (Autotransfusion group): n=78; M/F=18/60; mean (sd) age = 69.08 (5.45) years • Group 2 (Control group): n=77; M/F=10/67; mean (sd) age = 68.88 (5.11) years
Interventions	• Group 1: Autotransfusion group had their drained blood that was collected within the first 6 hours post-operatively, transfused through a standard blood transfusion set with a standard blood transfusion set with a 40um microaggregate filter. A standard 1000ml blood transfer bag was connected to the system in order to collect and re-transfuse the blood by gravity. • Group 2: Control group received standard vacuum drains without autotransfusion.
Outcomes	***Outcomes reported:*** amount of allogeneic blood transfused, days with fever, fever, volume of blood re-transfused, haemoglobin levels.
Notes	***Transfusion threshold:*** patients were transfused allogeneic blood if the haemoglobin level fell to less than 10.0g/dL.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	High risk	Study allocated patients to intervention or control on an alternating basis. The first patient to participate in the study was classified in Group B, the second patient in Group A, and so on. If a Group B patient was discarded from the study during the operation the next patient to participate in the study was again classified in Group B.
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was not described.
Blinding (performance bias and detection bias) All outcomes	High risk	

Klein 2008

Methods	All patients scheduled for non-emergency first-time coronary artery bypass graft surgery (CABG), valve surgery or combined CABG and valve procedures requiring cardiopulmonary bypass (CPB) were eligible for enrolment. Operations associated with a high risk of transfusion, such as transplantation and operations on the thoracic aorta were excluded.
Participants	213 patients undergoing first-time CABG and/or cardiac valve surgery were randomised to one of two groups: • Group 1 (Autotransfusion group): n=102; M/F=78/24; mean (sd) age = 68.6 (9.6) years • Group 2 (Control group): n=111; M/F=84/27; mean (sd) age = 67.4 (10.2) years
Interventions	• Group 1: Autotransfusion group (C.A.T.S Fresenius Hemocare system) had their suctioned blood processed before and after CPB with the cell salvage apparatus. After weaning from CPB blood remaining in the CPB circuit was processed by the cell saver device. All recovered blood, with no mini-

Klein 2008 *(Continued)*

	mum volume due to the design of the cell salvage device, was transfused to the patient. Post-operatively the cell saver was transferred with the patient to the ICU and connected to the chest tubes. All blood lost during the first 6 hours was processed and autotransfused. Cell salvage was disconnected after 6 hours. • Group 2: Control group had all blood suctioned before and after CPB discarded. After CPB any remaining blood in the bypass machine tubing and reservoir was collected in the bag and transfused directly to the patient.
Outcomes	***Outcomes reported:*** number of patients transfused allogeneic blood, amount of allogeneic blood transfused, number of patients transfused fresh frozen plasma, number of patients transfused platelets, blood loss, adverse events, re-operation for bleeding.
Notes	***Transfusion threshold:*** patients were transfused allogeneic blood when the haemoglobin level fell below 7.0g/dL during surgery, and fell below 8.0g/dL post-operatively.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Patients were allocated to intervention or control by simple randomisation generated by an independent statistician using a computer random number function, stratified by type of surgery.
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was not described.
Blinding (performance bias and detection bias) All outcomes	High risk	

Koopman 1993a

Methods	A randomised controlled trial was undertaken to investigate the efficacy of cell salvage during cardiac surgery at the University Hospital Sint Radboud, Nijmegen. Patients undergoing elective coronary bypass graft (CABG) surgery allocated on an alternating basis to one of two groups. The method of randomisation was not described.
Participants	40 patients undergoing elective coronary artery bypass graft surgery (CABG) were randomised to one of two groups: • Group 1 (Autotransfusion group): n=20; M/F=14/3; mean (sd) age = 64 (7.0) years • Group 2 (Control group): n=20; M/F=17/3; mean (sd) age = 62 (10.0) years
Interventions	• Group 1: Autotransfusion group received peri-operative autotransfusion of blood processed by means of the Cell-Saver III-plus system. The blood collected before going on cardiopulmonary bypass (CPB) and the remnant from the CPB machine were transferred into the cardiotomy reservoir through a 170um filter. Drain blood was collected during the first 6 hours post-operatively. Blood cell processing was performed by personnel in the Red Cross Blood Bank. Before transport to the blood bank the blood was transferred into labelled sterile one-litre bottles. After processing, the washed erythrocyte suspension was collected into labelled sterile bags and returned to the Operating Theatre (OT) or Intensive Care Unit (ICU) for re-infusion through a 40um blood filter. Blood was transfused up to 10 hours after the end of the operation. This allowed a maximum of 6 hours for collection, and an extra 4 hours for transport, processing and re-infusion to the patient. • Group 2: Control group did not receive autotransfusion.

Koopman 1993a *(Continued)*

Outcomes	***Outcomes reported:*** amount of blood collected by the cell saver, amount of blood re-transfused from the cell saver, amount of allogeneic blood transfused, number of patients transfused allogeneic blood, adverse events, blood loss, Hb & Hct levels.
Notes	***Transfusion threshold:*** allogeneic packed cells were transfused to maintain an Hct at 30%.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	High risk	Method used to conceal treatment allocation was inadequate.
Blinding (performance bias and detection bias) All outcomes	High risk	

Koopman 1993b

Methods	Patients undergoing total hip arthroplasty or dorsal lumbo-sacral spinal fusion (implantation of a H-frame) were entered into this randomised study. Each patient was allocated on an alternating basis to one of two groups. The method of randomisation was not described.
Participants	60 patients undergoing total hip arthroplasty or dorsal lumbo-sacral fusion surgery were randomised to one of two groups: • Group 1 (Autotransfusion group): n=30; M/F=6/23; mean (sd) age = 51 (18) years • Group 2 (Control group): n=30; M/F=7/23; mean (sd) age = 53 (18) years
Interventions	• Group 1: Autotransfusion group received peri-operative autotransfusion by means of the Haemonetics Haemolite-2 system. The blood shed intra-operatively and during the first six post-operative hours was collected and heparinised. The blood was processed in the Haemolite-2 by personnel of the Intensive Care Unit (ICU). The erythrocyte suspension produced was transfused to the patient within 4 hours after collection through a 40 micron blood filter. Blood cultures were taken before re-transfusion to the patient. • Group 2: Control group did not receive autotransfusion.
Outcomes	***Outcomes reported:*** amount of blood collected by the cell saver, amount of blood re-transfused from the cell saver, amount of allogeneic blood transfused, number of patients transfused allogeneic blood, adverse events, blood loss, Hb & Hct levels.
Notes	***Transfusion threshold:*** allogeneic packed cells were transfused to maintain an Hct at 30%.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	High risk	Method used to conceal treatment allocation was inadequate.

Koopman 1993b *(Continued)*

Blinding (performance bias and detection bias) All outcomes	High risk

Laub 1993

Methods	Patients undergoing isolated primary coronary revascularisation between July and December 1989 were enrolled in this randomised control trial. Patients were randomised by coded instruction packets which specified the processing and administration of the patient's salvaged intra-operative blood. Sealed instruction packets were randomised using a shuffle deck procedure, serially numbered, and assigned sequentially to patients in order of enrolment. The sealed instruction packets were sent with the patients to the operating room.
Participants	50 patients undergoing primary coronary revascularisation were randomised to one of two groups: • Group 1 (Autotransfusion group): n=19; M/F=15/4; mean (sd) age = 65.0 (10.5) years • Group 2 (Control group): n=19; M/F=14/5; mean (sd) age = 64.4 (9.2) years
Interventions	• Group 1: Autotransfusion group had their blood scavenged from the surgical field using an autologous blood scavenging system (Cell Saver 4, Haemonetics). The shed blood collected from the operative field and the pump blood were washed and then re-infused. • Group 2: Control group blood had their blood scavenged from the surgical field using an autologous blood scavenging system (Cell Saver 4, Haemonetics). The shed blood collected from the operative field was discarded. Only the pump blood was reinfused.
Outcomes	***Outcomes reported:*** amount of blood re-transfused from the cell saver, number of patients transfused allogeneic blood, amount of allogeneic blood transfused, amount of any blood product transfused.
Notes	***Transfusion threshold:*** packed red blood cell transfusions were given if the patients haemoglobin was less than 7.0g/dL or if the patient was haemodynamically unstable due to volume loss.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	
Allocation concealment (selection bias)	High risk	Method used to conceal treatment allocation was inadequate.
Blinding (performance bias and detection bias) All outcomes	High risk	Single-blinded.

Lepore 1989

Methods	Randomised controlled trial of 135 adults undergoing primary cardiac surgery. Method of randomisation and allocation concealment was not described.
Participants	135 patients undergoing cardiac surgery were randomised to one of two groups: • Group 1 (Autotransfusion group): n=67; M/F=52/15; mean (sd) age = 60 (12) years

Lepore 1989 *(Continued)*

	• Group 2 (Control group): n=68; M/F=51/17; mean (sd) age = 61 (10) years
Interventions	• Group 1: Autotransfusion group had the cardiotomy reservoir (Dideco 742), after use in extracorporeal circulation, reconfigured to serve as a receptacle for post-operative mediastinal drainage. One of the inlet ports was connected to the tubes draining the mediastinum. In this way the drainage from the chest passed through the 20um filter of the cardiotomy reservoir. The cardiotomy outlet tubing was replaced with an adapter connecting with standard intravenous tubing. A standard infusion pump was used to reinfuse the collected blood. The filtered blood collecting in the reservoir was reinfused at hourly intervals. No blood was reinfused after the 6th post-operative hour. Thereafter the reservoir served only as a receptacle for shed mediastinal blood. Reservoir blood was sampled at 6 hours for bacteriologic study. • Group 2: Control group received no autotransfusion.
Outcomes	***Outcomes reported:*** amount of blood re-transfused from the cell saver, amount of allogeneic blood transfused, number of patients transfused allogeneic blood, adverse events, mortality, blood loss.
Notes	***Transfusion threshold:*** Transfusion protocol was not reported.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was unclear.
Blinding (performance bias and detection bias) All outcomes	High risk	

Lorentz 1991

Methods	The efficiency of pre-operative deposit, pre-operative haemodilution, and intra- and post-operative autotransfusion in reducing allogeneic blood transfusions was studied in this randomised trial. Method of randomisation and allocation concealment was not clear [German article].
Participants	64 patients scheduled for total hip arthroplasty were randomly divided into one of four groups: • Group 1 (Pre-operative autologous donation group): n=16 • Group 2 (Pre-operative haemodilution group): n=16 • Group 3 (Autotransfusion group): n=16 • Group 4 (Control group): n=15 NB: Demographic data were not reported.
Interventions	• Group 1: Pre-operative autologous donation group had their pre-operative blood donations stored in CPDA-1 buffer. Three units of 450mls were requested. A pre-donation haemoglobin (Hb) concentration of 11.0g/dL was required. Surgery was carried out in the 5th week after the first donation. • Group 2: Pre-operative haemodilution group had their blood collected to a haemoglobin of 9.0g/dL after the induction of anaesthesia and initial circulatory stabilisation. • Group 3: Autotransfusion group had a cell separator used for intra-operative and post-operative autotransfusion. Post-operative autotransfusion of drainage blood was continued until 6 hours after the beginning of the operation. Autologous blood collected with the cell separator was re-transfused at

Lorentz 1991 *(Continued)*

	the end of the operation and after the autotransfusion period irrespective of the actual Hb concentration. • Group 4: Control group received standard care.
Outcomes	***Outcomes reported:*** amount of allogeneic blood transfused, number of patients transfused allogeneic blood, blood loss.
Notes	***Transfusion threshold:*** polygeline was used for volume resuscitation. If the Hb concentration fell below 9.0g/dL in the operating room and the intensive care unit or below 10.0g/dL in the general ward, autologous or allogeneic packed red cells were transfused.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was unclear.
Blinding (performance bias and detection bias) All outcomes	High risk	

Mah 1995

Methods	Patients admitted for elective primary joint replacement surgery were enrolled in this randomised controlled trial. Patients were randomised using a computer-generated randomisation table. Method of allocation concealment was not described.
Participants	99 patients undergoing elective primary total knee replacement surgery were randomly allocated to one of two groups: • Group 1 (Autotransfusion group): n=44 • Group 2 (Control group): n=55 NB: Demographic data not reported.
Interventions	• Group 1: Autotransfusion group had blood salvage performed using a semi-automated autotransfuser (Electromedics BT-795) according to the manufacturer's instructions. Intra-operative blood salvage was performed by a nurse in conjunction with an anaesthetist. Post-operative blood salvage was a continuation of the intra-operative salvage for a duration not exceeding 6 hours after the tourniquet was released. On completion of salvage, the wound drains were connected to two vacuum-charged Redivac bottles and the drains were removed at 48 hours post operation. The average volume of blood salvaged in each patient was calculated after adjusting the haematocrit to 40%. • Group 2: Control group received no autotransfusion. NB: In total knee replacement patients, standard surgical technique using a midline incision and medial parapatellar approach under tourniquet control was followed, and lateral release of the quadriceps expansion was not routinely performed.
Outcomes	***Outcomes reported:*** number of patients transfused allogeneic blood, blood loss.
Notes	***Transfusion threshold:*** allogeneic blood transfusions were used intra/post-operatively to maintain a safe blood volume and a haemoglobin level around 10.0g/dL.

Mah 1995 *(Continued)*

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Patients were randomised using a computer-generated randomisation table.
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was unclear.
Blinding (performance bias and detection bias) All outcomes	High risk	

Majowski 1991

Methods	A series of 40 patients undergoing primary unilateral total knee arthroplasty were entered into this randomised controlled trial to assess the safety and efficacy of post-operative autologous blood salvage and reinfusion. Method of randomisation and allocation concealment were not described.
Participants	40 patients undergoing primary unilateral total knee arthroplasty were randomised to one of two groups: • Group 1 (Autotransfusion groups): n=20; M/F=6/14; mean age = 71.3 years • Group 2 (Control group): n=20; M/F=6/14; mean age = 70.3 years
Interventions	• Group 1: Autotransfusion group (Solcotrans orthopaedic reinfusion system) had the two deep intra-articular drains connected to a Solcotrans reservoir and a suction pressure of 80mmHg applied for an initial period of 10 minutes, after which the wound was allowed to drain by gravity alone. Two Solcotrans reservoirs were attached sequentially to each patient regardless of the volume drained. Blood was re-infused if a sufficient volume had been collected. Drains were removed at 48 hours. • Group 2: Control group had all drains attached to Redivac bottles. Autotransfusion was not used.
Outcomes	***Outcomes reported:*** amount of blood collected by the cell saver, amount of blood re-transfused from the cell saver, amount of allogeneic blood transfused, adverse events, haematological variables.
Notes	***Transfusion threshold:*** allogeneic blood was given to patients if the haemoglobin level fell below 9.5g/dL or if indicated haemodynamically.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was unclear.
Blinding (performance bias and detection bias) All outcomes	High risk	

Martin 2000

Methods	A prospective randomised clinical trial was undertaken to compare the current approach of mediastinal drainage without reinfusion to a system specifically designed for reinfusion. From September 1998 to January 1999, patients admitted for coronary artery bypass grafting operations, valvular replacement, or both procedures under cardiopulmonary bypass (CPB) were offered the option to participate in the study. Method of randomisation and allocation concealment were not described.
Participants	198 patients undergoing cardiac surgery were randomised to one of two groups: • Group 1 (Autotransfusion group): n=98; M/F= 75/23; mean (sd) age = 62 (19.8) years • Group 2 (Control group): n=100; M/F=70/30; mean (sd) age = 66 (20.0) years
Interventions	• Group 1: Autotransfusion group were treated with an autotransfusion system (Atrium Medical Corporation) consisting of 28F thoracic tubes connected to a three chamber system. All collected blood was filtered and autotransfused until no drainage was present or for a maximum period of 12 hours. Transfusion began one hour after the patient arrived in the Intensive Care Unit (ICU). • Group 2: Control group had their post-operative mediastinal drainage discarded.
Outcomes	***Outcomes reported:*** number of patients transfused allogeneic blood, amount of allogeneic blood transfused, blood loss, adverse events.
Notes	***Transfusion threshold:*** during CPB allogeneic red blood cells were transfused for haemoglobin concentrations below 6.0g/dL. In the post-operative period the threshold for allogeneic red blood cell transfusion was Hb<8.0g/dL.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was unclear.
Blinding (performance bias and detection bias) All outcomes	High risk	

Mauerhan 1993

Methods	A prospective randomised study was undertaken to quantify the effect of reinfusion of post-operative shed blood drainage on the haemoglobin levels in patients undergoing elective primary total hip arthroplasty (THA) and total knee arthroplasty (TKA). Patients were enrolled between December 1990 and August 1991. Randomisation was performed using a random number table. Allocation concealment was not described.
Participants	111 patients undergoing elective primary total hip arthroplasty and total knee arthroplasty were randomly assigned to one of two groups: • Group 1 (Autotransfusion system): n=57 • Group 2 (Control group): n=54 NB: Mean age of TKA patients was 68 years (range 39-88 years). Mean age of THA patients was 62 years (range 27-85 years).

Mauerhan 1993 *(Continued)*

Interventions	• Group 1: Autotransfusion group (CBC ConstaVac) had their post-operative drainage collected and filtered. The unwashed red blood cells were reinfused within a 6-hour period. The blood was reinfused through a 20um macroaggregate filter. The CBC ConstaVac system has an umbrella valve that ensures that the top 100mls of fluid containing serum fat, and bone debris does not leave the reservoir. • Group 2: Control group were treated with a standard post-operative collection system. NB: All patients were encouraged to donate two units of autologous blood prior to both THA and TKA procedures.
Outcomes	***Outcomes reported:*** number of patients transfused allogeneic or autologous blood, post-operative drainage, Hb levels.
Notes	***Transfusion threshold:*** intra-operative blood transfusion was left to the discretion of the operating surgeon. No transfusion threshold or trigger was reported.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Randomisation was performed using a random number table.
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was unclear.
Blinding (performance bias and detection bias) All outcomes	High risk	

McGill 2002

Methods	A randomised controlled trial was conducted to assess the effectiveness of two mechanical methods of blood conservation in reducing the need for allogeneic red blood cells or coagulation products during cardiac surgery. Patient allocations were generated from random number tables by an independent observer and concealed in sealed opaque envelopes.
Participants	256 patients undergoing elective coronary artery bypass surgery were randomly allocated to one of three groups: • Group 1 (Autotransfusion group): n=84; M/F=75/9; mean (sd) age = 63.8 (7.8) years • Group 2 (Combined intervention group): n=84; M/F=74/10; mean (sd) age = 63.1 (8.2) years • Group 3 (Control group): n=84; M/F=74/10; mean (sd) age = 63.4 (9.1) years
Interventions	• Group 1: during surgery blood from the operation site was collected in a storage system. At the termination of cardiopulmonary bypass, blood remaining in the bypass circuit was added to the storage system. This blood was then centrifuged using a cell salvage system (Dideco Compact cell saver) leaving a concentrated solution of red blood cells with a haematocrit of 50-60%. This autologous blood was then re-transfused to the patient during the intra-operative period. • Group 2: were treated with cell salvage and acute normovolaemic haemodilution (ANH). After induction of anaesthesia 10ml/kg of blood was removed from a central venous line while being replaced at the same time with an equivalent volume of modified gelatin (Gelofusine). The Harvest Blood Stream Recovery System, an autologous recovery system, was used to remove blood. The recovered blood was stored at room temperature. • Group 3: were treated without the use of cell salvage or acute normovolaemic haemodilution (ANH).

McGill 2002 *(Continued)*

Outcomes	***Outcomes reported:*** number of patients transfused allogeneic blood, number of patients receiving any blood product, amount of allogeneic blood transfused, blood loss, re-operation for bleeding, hospital length of stay, infection, stroke, renal failure, myocardial infarction.
Notes	***Transfusion threshold:*** allogeneic red blood cells were transfused in all groups when the haemoglobin level fell below 9.0g/dL.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Patient allocations were generated from random number tables by an independent observer.
Allocation concealment (selection bias)	High risk	Allocation concealment was inadequate.
Blinding (performance bias and detection bias) All outcomes	High risk	

Menges 1992

Methods	The influence of two different methods of autologous transfusion were investigated in a prospective randomised controlled trial. Method of randomisation and allocation concealment was not described [German article].
Participants	42 patients undergoing total hip surgery and pre-operative plasmapheresis (Abbott Autotrans) were randomised to one of three groups: • Group 1 (Autotransfusion group): n=14; mean (sd) age = 55.9 (18.2) years • Group 2 (Autotransfusion + FFP group): n=16; mean (sd) age = 70.6 (7.0) years • Group 3 (Control group): n=12; mean (sd) age = 66.7 (12.7) years.]
Interventions	• Group 1: Autotransfusion group for the substitution of blood loss, received in addition to crystalloids and colloids, only autologous packed red blood cells (erythrocyte concentrate) collected by the Autotrans BT 795 P, Dideco system. • Group 2: Autotransfusion + FFP group received additionally, intra-operative and post-operative autologous fresh frozen plasma (FFP). • Group 3: Control group for the substitution of blood loss, received in addition to crystalloids and colloids, only allogeneic red blood cells (erythrocyte concentrate). Autotransfusion was not used. NB: Study investigated the influence of two different methods of autotransfusion on the intravascular haemostatic system.
Outcomes	***Outcomes reported:*** amount of blood re-transfused from the cell saver, number of patients transfused allogeneic blood, blood loss, Hb & Hct levels, clotting status (PT/TT/PTT/ATIII).
Notes	***Transfusion threshold:*** patients were transfused if haemoglobin fell below 9.0g/dL or haematocrit fell below 28%.

Risk of bias

Bias	Authors' judgement	Support for judgement

Menges 1992 *(Continued)*

Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was unclear.
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was unclear.
Blinding (performance bias and detection bias) All outcomes	High risk	

Mercer 2004

Methods	This was a single-centre randomised clinical trial of intra-operative autotransfusion (IAT) in surgery for abdominal aortic aneurysm (AAA). Patients were randomised using sealed envelopes. Patients were blinded to the transfusion group allocation. Members of the operating surgical team were responsible for the continuing care of patients, decision to use blood transfusion and investigation of post-operative complications. They were independent of the research team, but were not blinded to the use of IAT.
Participants	81 patients undergoing elective repair of infrarenal abdominal aortic aneurysm were randomised to one of two groups: • Group 1 (Autotransfusion group): n=40; M/F=34/6; median (interquartile range) age = 72 (69-76) years.] • Group 2 (Control group): n=41; M/F=29/2; median (interquartile range) age = 73 (67-78) years.]
Interventions	• Group 1: Autotransfusion group (Haemonetics Cell Saver) had their shed blood collected and processed by the autologous blood recovery system. Processed blood was returned to the patient as soon as haemostasis had been achieved. • Group 2: Control group received standard care without autotransfusion.
Outcomes	***Outcomes reported:*** number of patients transfused allogeneic blood, amount of allogeneic blood transfused, blood loss, adverse events, mortality, hospital length of stay.
Notes	***Transfusion threshold:*** patients received allogeneic blood transfusion to maintain haemoglobin levels above 8.0g/dL.

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	High risk	Method of allocation concealment was inadequate.
Blinding (performance bias and detection bias) All outcomes	High risk	Single-blind.

Moonen 2007

Methods	This randomised clinical trial was designed to evaluate the clinical efficacy of retransfusion of filtered shed blood in patients undergoing consecutively scheduled primary total knee arthroplasty (TKA) or total hip arthroplasty (THA). The use of alternatives other than post-operative cell salvage (autotransfu-

Moonen 2007 *(Continued)*

	sion) to reduce allogeneic blood transfusions were excluded. A treatment allocation schedule was randomly generated and then concealed in sealed envelopes that were labelled with a consecutive case number from 1 to 160. Blocking and stratification were not used.
Participants	160 patients undergoing elective total knee arthroplasty (TKA) or total hip arthroplasty (THA) were randomly allocated to one of two groups: • Group 1 (Autotransfusion group): n=80; M/F=10/70; mean (sd) age = 69.0 (9.5) years.] • Group 2 (Control group): n=80; M/F=13/67; mean (sd) age = 69.5 (7.3) years.]
Interventions	• Group 1: Autotransfusion group (Bellovac ABT, AstraTech AB) had two Redon lines connected to the Bellovac retransfusion system. This system consists of a collection suction bellow (-90mmHg), vacuumed for 6 hours after surgery, and an autologous transfusion bag with a 200um filter to entrap blood clots and debris. Before re-transfusion the blood was let through a 40um filter. Reinfusion of shed blood was started 6 hours after the end of surgery when the collected blood exceeded 100mls or when the transfusion bag was full (500mls). After 6 hours post-operatively the system was used as a regular low-vacuum drain in which drained blood was discarded. • Group 2: Control group received regular post-operative low-vacuum drainage (Abdovac, AstraTech, AB) without autotransfusion.
Outcomes	***Outcomes reported:*** number of patients transfused allogeneic blood, amount of allogeneic blood transfused, volume of blood re-transfused, adverse events.
Notes	***Transfusion threshold:*** after surgery the anaesthesiologist determined the Hb transfusion trigger, that is, 8.1, 8.9, or 9.7g/dL, depending on comorbidity classified in the ASA (American Society of Anesthesiologists) classification and according to hospital policy. When the Hb level dropped below this trigger an allogeneic blood transfusion was given.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Method used to generate allocation sequences was adequate.
Allocation concealment (selection bias)	High risk	Method used to conceal treatment allocation was inadequate.
Blinding (performance bias and detection bias) All outcomes	High risk	

Murphy 2004

Methods	This randomised controlled trial was designed to ascertain whether cell salvage and autotransfusion after first time elective coronary artery bypass grafting (CABG) is associated with a significant reduction in the use of allogeneic blood, a clinically significant derangement of post-operative clotting profiles, or an increased risk of post-operative bleeding. Between March 2002 and January 2003, patients admitted for CABG operations utilising cardiopulmonary bypass (CPB) were enrolled in the study.
Participants	200 patients undergoing first time elective coronary artery bypass grafting (CABG) were randomised to one of two groups: • Group 1 (Autotransfusion group): n=99; M/F=86/13; mean (sd) age = 64.35 (9.23) years • Group 2 (Control group): n=97; M/F=74/23; mean (sd) age = 62.3 (18.73) years

Murphy 2004 *(Continued)*

	NB: A total of 16 patients failed to complete the study. In 4 patients (Autotransfusion n=1; Control n=3) it was decided intra-operatively to perform the grafts off-pump. These patients were excluded from further analysis. The remaining 12 patients were included in the analysis on the basis of intention to treat.
Interventions	• Group 1: Autotransfusion group (Autolog, Medtronic) had all blood loss, from skin incision to commencement of CPB and then after administration of protamine to skin closure, salvaged via a single lumen suction tube flushed with heparinised saline (0.9%) connected to the closed rigid collection chamber of the Autolog autotransfusion device at high pressure suction. During CPB all spilt blood was aspirated by the CPB machine cardiotomy suckers and returned to the venous reservoir. All blood remaining in the CPB circuit after discontinuation of bypass was retransfused via the aortic cannula before decannulation and was never transferred to the autotransfuser. Shed mediastinal blood for the first 12 hours post-operatively was collected and autotransfused. • Group 2: Control group had all spilt blood before commencement of CPB and after the administration of protamine was discarded. Post-operative mediastinal drainage was discarded.
Outcomes	***Outcomes reported:*** number of patients transfused allogeneic blood, number of patients transfused fresh frozen plasma (FFP), number of patients transfused platelets, volume of blood autotransfused, blood loss, adverse events, mortality, hospital length of stay.
Notes	***Transfusion threshold:*** patients were transfused allogeneic red blood cells when the haemoglobin level fell below 7.0g/dL or if clinically indicated in patients with excessive blood loss and cardiovascular instability at the discretion of intensive care staff.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Patients were randomised to the two treatment arms in a 1:1 ratio by using a block randomisation procedure. Allocations were generated by card system.
Allocation concealment (selection bias)	High risk	Allocations were concealed in sealed opaque envelopes.
Blinding (performance bias and detection bias) All outcomes	High risk	

Murphy 2005

Methods	A randomised controlled trial was conducted to evaluate the safety and effectiveness of intra-operative cell salvage and autotransfusion of washed salvaged red blood cells after first-time coronary artery bypass grafting (CABG) performed on the beating heart. Patients were assigned to one of two randomised group, in a 1:1 ratio by using block randomisation. Allocations were generated by a card system and concealed in sealed opaque envelopes. Patients who had given consent were randomised immediately before surgery.
Participants	61 patients undergoing cardiac surgery were randomly allocated to one of two groups: • Group 1 (Autotransfusion group): n=30; M/F=25/5; mean (sd) age = 62.3 (9.3) years • Group 2 (Control group): n=31; M/F=23/8; mean (sd) age = 66.4 (7.6) years
Interventions	• Group 1: Autotransfusion group (Dideco Compact autotransfusion system) underwent intra-operative cell salvage with autotransfusion of washed salvaged red blood cells at the completion of the operative procedure. All blood lost, from skin incision to skin closure, was salvaged via a single-lumen suction tube flushed with heparinised saline and connected to the closed rigid collection chamber of the Dideco Compact autotransfusion device at high-pressure suction. Before autotransfusion, the heparinised salvaged intra-operative blood underwent a washing process, with resuspension of the

Murphy 2005 *(Continued)*

	red blood cells in saline, to a Hct of approximately 0.6. This red blood cell suspension was then transferred to a sterile collecting bag that was disconnected from the autotransfuser and administered via a standard blood giving set. Salvaged washed red blood cells were autotransfused at the time of skin closure. • Group 2: Control group received standard care without autotransfusion.
Outcomes	***Outcomes reported:*** number of patients transfused allogeneic blood, volume of blood collected by the cell saver, volume of blood re-transfused from the cell saver, number of patients transfused fresh frozen plasma (FFP), number of patients transfused platelets, blood loss, mortality, adverse events.
Notes	***Transfusion threshold:*** the threshold for transfusion of allogeneic blood was a haemoglobin level less than 8.0g/dL or a haematocrit less than 0.23. In patients with excessive blood loss and cardiovascular instability, blood was given at the discretion of anaesthetic or intensive care unit staff.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Method used to generate allocation sequences was adequate.
Allocation concealment (selection bias)	High risk	Method used to conceal treatment allocation was inadequate.
Blinding (performance bias and detection bias) All outcomes	High risk	

Naumenko 2003

Methods	Method of randomisation was not reported and allocation concealment was unclear. Baseline comparability was unclear. However the study reported that, "no significant difference between groups were detected at any stage of the study." Participants were not blind to treatment allocation and blinding of the outcome assessor was unclear [Russian article].
Participants	66 patients undergoing elective coronary artery bypass surgery (CABG) were randomly allocated to one of two groups: • Group 1 (Autotransfusion group): n=33 • Group 2 (Control group): n=33 NB: Demographic data not reported. Inclusion criteria: patients with an uneventful postoperative period (discharge of less than 800mls through draining tubes during first 8 hours post operation).
Interventions	• Group 1: Autotransfusion group had drainage discharge collected for 8 hours post-operatively and reinfused using a BRAT-2 Cell Saver. Drainage discharge collected for 8 hours post-operatively and erythrocytes reinfused post-operatively after washing. The volume of autologous blood collected was up to 800mls. • Group 2: Control group received no retransfusion of drainage discharge.
Outcomes	***Outcomes reported:*** number of patients transfused allogeneic blood.
Notes	***Transfusion threshold:*** transfusion protocol not reported. Russian study. English abstract only.

Risk of bias

Naumenko 2003 *(Continued)*

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	High risk	Allocation concealment was not used.
Blinding (performance bias and detection bias) All outcomes	High risk	

Newman 1997

Methods	A prospective, randomised controlled trial of consecutive osteoarthritic patients undergoing unilateral total knee replacement was conducted. Randomisation was by random-number tables. Method of allocation concealment was not described.
Participants	70 consecutive patients undergoing unilateral total knee replacement with a cruciate-sparing Kinemax Plus prosthesis were randomly allocated to one of two groups: • Group 1 (Autotransfusion group): n=35 • Group 2 (Control group): n=35 NB: Mean age of patients enrolled in study was 72 years. Demographic data were not reported.
Interventions	• Group 1: Autotransfusion group (Dideco 797 reinfusion system) had deep and superficial drains inserted before skin closure and connected to the Dideco 797 reinfusion system which maintains a constant suction of -25mmHg. The drainage collected was mixed with citrate in a ratio of 12:1, filtered during collection and again during reinfusion through a 40um filter. No washing took place. Drainage was collected for 6 hours or until 500mls had accumulated, at which point reinfusion of the unwashed salvaged blood took place. • Group 2: Control group had deep and superficial drains inserted before skin closure and connected to a standard Haemovac system which maintains a constant suction of -25mmHg. Autotransfusion was not available to this group.
Outcomes	***Outcomes reported:*** amount of blood re-transfused from cell saver, amount of allogenic blood transfused, number of patients transfused allogeneic blood, adverse events, hospital length of stay.
Notes	***Transfusion threshold:*** transfusion protocol was not reported.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Method used to generate allocation sequences was adequate.
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was unclear.
Blinding (performance bias and detection bias) All outcomes	High risk	

Niranjan 2006

Methods	Consecutive patients undergoing first-time coronary artery bypass grafting (CABG) requiring at least three bypass grafts with moderate-good left ventricular function were invited to participate in the randomised trial. Randomisation was achieved by mixing non-transparent envelopes containing cards marked with the code of each group. Randomisation was done the day before surgery.
Participants	80 patients undergoing first-time isolated CABG surgery were randomly allocated to one of four groups: • Group 1 (Autotransfusion - 'on-pump' group): n=20; M/F=16/4; mean (sd) age = 66.3 (7.3) years • Group 2 (Control - 'on-pump' group): n=20; 16/4; mean (sd) age = 66.1 (10.8) years • Group 3 (Autotransfusion - 'off-pump' group): n=20; M/F=15/5; mean (sd) age = 67.25 (11.2) years • Group 4 (Control - 'off-pump' group): n=20; M/F=19/1; mean (sd) age = 67.9 (9.5) years
Interventions	• Group 1: Autotransfusion ('on-pump') group (Dideco Electa autotranfusion device) underwent intra-operative cell salvage with autotransfusion of washed salvaged red blood cells (RBCs) at the conclusion of the procedure. The cell saver was used to collect blood lost from skin incision to the commencement of cardiopulmonary bypass (CPB) and then again after the administration of protamine to skin closure. • Group 2: Control ('on-pump') group had all blood lost from skin incision to commencement of CPB and protamine reversal to skin closure aspirated into a waste sucker. • Group 3: Autotransfusion ('off-pump') group (Dideco Electa autotransfusion device) underwent intra-operative cell salvage with autotransfusion of washed salvaged RBCs at the conclusion of the procedure. The cell saver was used to collect blood lost from skin incision to skin closure. • Group 4: Control ('off-pump') group had all lost blood from skin incision to closure suctioned with a high-pressure sucker into a waste container. NB: Prior to autotransfusion the salvaged blood was washed and centrifuged with resuspension of the RBCs in saline to a haematocrit of approximately 0.6. This blood was then transferred to a sterile collecting bag and re-transfused into the patient via a standard blood giving set at the time of skin closure.
Outcomes	***Outcomes reported:*** amount of allogeneic blood transfused, volume of blood collected by the cell saver, blood loss, mortality, hospital length of stay, adverse events.
Notes	***Transfusion threshold:*** allogeneic blood was only transfused if the haemoglobin concentration was than 8.0g/dL.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Method used to generate allocation sequences was adequate.
Allocation concealment (selection bias)	High risk	Method used to conceal treatment allocation was inadequate.
Blinding (performance bias and detection bias) All outcomes	High risk	Single-blind.

Page 1989

Methods	Consecutive patients having elective coronary artery or valvular operations were enrolled in a prospective, randomised controlled trial comparing allogeneic blood consumption between conventional me-

Page 1989 *(Continued)*

	diastinal drainage and reinfusion of shed mediastinal blood using a hard-shell cardiotomy reservoir. Method of randomisation and allocation concealment was not described.
Participants	100 consecutive patients undergoing elective coronary artery or valvular operations were randomly allocated to one of two groups: • Group 1 (Autotransfusion group): n=48; M/F=38/11; mean (sd) age = 58.3 (8.9) years • Group 2 (Control group): n=51; M/F=38/14; mean (sd) age = 56.9 (9.4) years
Interventions	• Group 1: Autotransfusion group had a Bentley Catr hard-shell cardiotomy reservoir (Bentley-Edwards CVS Division) used during bypass. Both drains were connected to the top of the cardiotomy reservoir, previously used during bypass, and suction of 50cmH2O was applied. Patients had their shed mediastinal blood reinfused for up to 18 hours post-operatively. • Group 2: Control group had a Polystan soft-shell cardiotomy reservoir (Polystan A/S Walgerholm 8) used during bypass. Blood was drained into conventional drainage bottles with an applied suction of 25cmH_2O. NB: After bypass, any residual blood left in the perfusion circuit was saved and infused through a peripheral vein. Both groups of patients had pericardial and mediastinal drains (Axiom). A variety of both membrane and bubble oxygenators were used in both groups.
Outcomes	***Outcomes reported:*** amount of blood re-transfused from the cell saver, amount of allogeneic blood transfused, number of patients transfused allogeneic blood, adverse events, re-exploration for bleeding.
Notes	***Transfusion threshold:*** allogeneic blood or hetastarch was infused to maintain cardiovascular stability and a haematocrit of 30%.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was unclear.
Blinding (performance bias and detection bias) All outcomes	High risk	

Parrot 1991

Methods	Randomised controlled trial was undertaken to evaluate blood salvage using an intra-operative blood recovery system and a mediastinal drainage blood recovery system during and after cardiac surgery. Method of randomisation and allocation concealment was not described.
Participants	66 patients undergoing aortocoronary bypass surgery were randomly assigned to one of three groups: • Group 1 (Autologous group): n=22; mean age = 60 years • Group 2 (Autologous group): n=22; mean age = 55 years • Group 3 (Control group): n=22; mean age = 61 years
Interventions	• Group 1: Autologous group received intra-operative autologous blood. Intra-operative autologous blood consisted of the blood contents of the oxygenator after concentration but without any washing, by the Haemonetics Cell Saver III autologous transfusion system.

Parrot 1991 *(Continued)*

	• Group 2: Autologous group received intra-operative and post-operative autologous blood. Post-operative autologous blood consisted of the mediastinal blood shed during the first 6 hours, into a heparinised drainage system (PLEUR-EVACA 4005) which was concentrated and washed by a Haemonetics Haemolite system. • Group 3: Control group patients
Outcomes	***Outcomes reported:*** amount of blood re-transfused from the cell saver, amount of allogeneic blood transfused, number of patients transfused allogeneic blood, adverse events, mortality, blood loss, Hct levels.
Notes	***Transfusion threshold:*** allogeneic blood transfusions were given if the haematocrit dropped below 20% during bypass, 28% at the end of the procedure, 30% within 24 hours, or if the haemoglobin level was less than 10.0g/dL while on the cardiac surgery ward (8 to 10 days).

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was unclear.
Blinding (performance bias and detection bias) All outcomes	High risk	

Pleym 2005

Methods	Prospective randomised controlled trial of autotransfusion of mediastinal shed blood in patients with unstable angina pectoris scheduled for first-time coronary artery bypass graft (CABG) surgery. The Unit for Applied Clinical Research at the Norwegian University of Science and Technology randomised patients into two groups by means of a computer program. At the end of uneventful surgery, the Unit for Applied Clinical Research was contacted by telephone and the randomisation was done.
Participants	50 patients scheduled for first-time CABG surgery were randomly allocated to one of two groups: • Group 1 (Autotransfusion group): n=23; M/F=21/2; mean (sd) age = 63.8 (9.9) years • Group 2 (Control group): n=24; M/F=21/3; mean (sd) age = 63.6 (7.9) years NB: Three patients were excluded from the final analysis (Autologous group n=2; Control group n=1).
Interventions	• Group 1: Autologous group had their shed mediastinal blood infused continuously by means of an autotransfusion pump (Flow-Gard 6200, Baxter OR Terumo TE-171, Terumo) until the post-operative bleeding was less than 20ml/hr for a maximum of 8 hours. • Group 2: Control group did not receive autotransfusion of shed mediastinal blood.
Outcomes	***Outcomes reported:*** number of patients transfused allogeneic blood, volume of blood re-transfused from the cell saver, amount of fresh frozen plasma and platelets transfused, blood loss, adverse events, mortality.
Notes	***Transfusion threshold:*** transfusion protocol was not reported.

Risk of bias

Pleym 2005 *(Continued)*

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Method of generating allocation sequences was adequate.
Allocation concealment (selection bias)	Low risk	Method used to conceal treatment allocation was adequate.
Blinding (performance bias and detection bias) All outcomes	High risk	

Riou 1994

Methods	Prospective, randomised controlled study was performed to determine the haematological and biochemical changes, and clinical safety of post-operative autotransfusion in patients undergoing elective, non-emergency spinal surgery. A random number table was used to assign patients in equal numbers to two groups. Method of allocation concealment was not described.
Participants	50 patients undergoing elective spinal surgery were randomly assigned to one of two groups: • Group 1 (Autotransfusion group): n=25; M/F=7/18; mean (sd) age = 52 (16) years • Group 2 (Control group): n=25; M/F=12/13; mean (sd) age = 52 (17) years
Interventions	• Group 1: Autotransfusion group had their post-operatively drained blood collected into a Solcotrans Orthopedic Plus system. The salvaged blood was considered for re-infusion. No anticoagulation was added to the Solcotrans system. The duration of drainage was limited to the first 5-hours of the post-operative period. At the end of this period, patients from the Solcotrans group whose drained blood volume was greater than 200mls had this blood re-infused. • Group 2: Control group had their post-operatively drained blood collected into a Solcotrans Orthopedic Plus system but the salvaged blood was not considered for re-infusion.
Outcomes	***Outcomes reported:*** amount of blood re-transfused from the cell saver, amount of allogeneic blood transfused, number of patients transfused allogeneic blood, haematological variables.
Notes	***Transfusion threshold:*** blood transfusion (allogeneic and/or autologous) was given if the haematocrit level was below 25% during the peri-operative period.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Method used to generate allocation sequences was adequate.
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was unclear.
Blinding (performance bias and detection bias) All outcomes	High risk	

Ritter 1994

Methods	A randomised, prospective study of patients undergoing primary total hip or total knee replacement over a six-month period. Method of randomisation and allocation concealment were not described.
Participants	415 patients undergoing primary total hip or total knee replacement were randomly allocated to one of two groups: • Group 1 (Autotransfusion group): n=215 • Group 2 (Control group): n=200 NB: Demographic data were not reported.
Interventions	• Group 1: Autotransfusion group received unwashed, filtered autologous blood processed by the Solcotrans autotransfusion system. • Group 2: Control group had no drainage system.
Outcomes	***Outcomes reported:*** number of patients transfused allogeneic blood, amount of transfused blood, adverse events, knee flexion.
Notes	***Transfusion threshold:*** allogeneic blood was transfused if the haemoglobin level fell below 9.0g/dL.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was not described.
Blinding (performance bias and detection bias) All outcomes	High risk	

Rollo 1995

Methods	A controlled, randomised, prospective study was performed evaluating the need for peri-operative blood salvage for primary total hip arthroplasty patients who had donated autologous blood before surgery. Patients were randomised by month of birth into four groups.
Participants	153 patients undergoing primary total hip arthroplasty were randomised to one of four groups: • Group 1 (Autotransfusion group - Haemonetics system): n=35; M/F=19/16; mean age = 68 years (range 50-86 years) • Group 2 (Autotransfusion group - Solcotrans system): n=40; M/F=24/16; mean age = 68 years (range 28-87) • Group 3 (Control group - Hemovac drainage system): n=38; M/F=20/20; mean age = 64 years (range 39-85 years) • Group 4 (Control group - No drainage system): n=38; M/F=20/18; mean age = 61 years (range 38-86)
Interventions	• Group 1: Autotransfusion group (Haemonetics system) had intra-operative salvage of red blood cells performed with the Haemonetics Cell-Saver. A paediatric bowl was used for the processing of salvaged, shed blood. This collection was continued after surgery through two medium drains while the patient remained in the recovery room. A closed-suction standard Hemovac drain was placed when salvage was discontinued.

Rollo 1995 *(Continued)*

	• Group 2: Autotransfusion group (Solcotrans system) were treated with a Solcotrans drainage infusion system at the completion of surgery. This system consists of a 500ml collection canister with 260 micron pre-transfusion filter for collection and a 40 micron filter for transfusion. A minimum of 300 mls of blood had to be collected within a 4 hour period. Total collection/infusion time could not exceed 6 hours. A maximum of 2 units could be reinfused. After the completion of the transfusions, the Solcotrans unit was discarded and replaced with a closed-suction drain. • Group 3: Control group (Hemovac drainage system) were treated with a standard 400ml Hemovac closed-suction drain. • Group 4: Control group did not receive drains at the completion of surgery.
Outcomes	***Outcomes reported:*** amount of allogeneic and/or autologous blood transfused, number of patients transfused allogeneic blood, adverse events, Hb & Hct levels, thigh circumference measures, wound drainage.
Notes	***Transfusion threshold:*** all decisions for allogeneic blood transfusion were based on the clinical condition of the patient. The absolute value of the haemglobin or haematocrit was not considered in isolation. Patients who were able to donate at least 2 units of autologous blood pre-operatively were included in the study.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	High risk	Method used to conceal treatment allocation was inadequate.
Blinding (performance bias and detection bias) All outcomes	High risk	

Rollo 1995a

Methods	A controlled, randomised, prospective study was performed evaluating the need for peri-operative blood salvage for primary total hip arthroplasty patients who had donated autologous blood before surgery. Patients were randomised by month of birth into four groups.
Participants	153 patients undergoing primary total hip arthroplasty were randomised to one of four groups: • Group 1 (Autotransfusion group - Haemonetics system): n=35; M/F=19/16; mean age = 68 years (range 50-86 years) • Group 2 (Autotransfusion group - Solcotrans system): n=40; M/F=24/16; mean age = 68 years (range 28-87) • Group 3 (Control group - Hemovac drainage system): n=38; M/F=20/20; mean age = 64 years (range 39-85 years) • Group 4 (Control group - No drainage system): n=38; M/F=20/18; mean age = 61 years (range 38-86)
Interventions	• Group 1: Autotransfusion group (Haemonetics system) had intra-operative salvage of red blood cells performed with the Haemonetics Cell-Saver. A paediatric bowl was used for the processing of salvaged, shed blood. This collection was continued after surgery through two medium drains while the patient remained in the recovery room. A closed-suction standard Hemovac drain was placed when salvage was discontinued. • Group 2: Autotransfusion group (Solcotrans system) were treated with a Solcotrans drainage infusion system at the completion of surgery. This system consists of a 500ml collection canister with 260 mi-

Rollo 1995a *(Continued)*

	cron pre-transfusion filter for collection and a 40 micron filter for transfusion. A minimum of 300 mls of blood had to be collected within a 4 hour period. Total collection/infusion time could not exceed 6 hours. A maximum of 2 units could be reinfused. After the completion of the transfusions, the Solcotrans unit was discarded and replaced with a closed-suction drain. • Group 3: Control group (Hemovac drainage system) were treated with a standard 400ml Hemovac closed-suction drain. • Group 4: Control group did not receive drains at the completion of surgery.
Outcomes	***Outcomes reported:*** amount of allogeneic and/or autologous blood transfused, number of patients transfused allogeneic blood, adverse events, Hb & Hct levels, thigh circumference measures, wound drainage.
Notes	***Transfusion threshold:*** all decisions for allogeneic blood transfusion were based on the clinical condition of the patient. The absolute value of the haemglobin or haematocrit was not considered in isolation. Patients who were able to donate at least 2 units of autologous blood pre-operatively were included in the study. NB: Data from Rollo 1995 has been used to formulate Rollo 1995/a which represents a comparison of Haemonetics Cell-Saver group vs No drainage group (Control).

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	High risk	Method used to conceal treatment allocation was inadequate.
Blinding (performance bias and detection bias) All outcomes	High risk	

Rollo 1995b

Methods	A controlled, randomised, prospective study was performed evaluating the need for peri-operative blood salvage for primary total hip arthroplasty patients who had donated autologous blood before surgery. Patients were randomised by month of birth into four groups.
Participants	153 patients undergoing primary total hip arthroplasty were randomised to one of four groups: • Group 1 (Autotransfusion group - Haemonetics system): n=35; M/F=19/16; mean age = 68 years (range 50-86 years) • Group 2 (Autotransfusion group - Solcotrans system): n=40; M/F=24/16; mean age = 68 years (range 28-87) • Group 3 (Control group - Hemovac drainage system): n=38; M/F=20/20; mean age = 64 years (range 39-85 years) • Group 4 (Control group - No drainage system): n=38; M/F=20/18; mean age = 61 years (range 38-86)
Interventions	• Group 1: Autotransfusion group (Haemonetics system) had intra-operative salvage of red blood cells performed with the Haemonetics Cell-Saver. A paediatric bowl was used for the processing of salvaged, shed blood. This collection was continued after surgery through two medium drains while the patient remained in the recovery room. A closed-suction standard Hemovac drain was placed when salvage was discontinued.

Rollo 1995b *(Continued)*

	• Group 2: Autotransfusion group (Solcotrans system) were treated with a Solcotrans drainage infusion system at the completion of surgery. This system consists of a 500ml collection canister with 260 micron pre-transfusion filter for collection and a 40 micron filter for transfusion. A minimum of 300 mls of blood had to be collected within a 4 hour period. Total collection/infusion time could not exceed 6 hours. A maximum of 2 units could be reinfused. After the completion of the transfusions, the Solcotrans unit was discarded and replaced with a closed-suction drain. • Group 3: Control group (Hemovac drainage system) were treated with a standard 400ml Hemovac closed-suction drain. • Group 4: Control group did not receive drains at the completion of surgery.
Outcomes	***Outcomes reported:*** amount of allogeneic and/or autologous blood transfused, number of patients transfused allogeneic blood, adverse events, Hb & Hct levels, thigh circumference measures, wound drainage.
Notes	***Transfusion threshold:*** all decisions for allogeneic blood transfusion were based on the clinical condition of the patient. The absolute value of the haemglobin or haematocrit was not considered in isolation. Patients who were able to donate at least 2 units of autologous blood pre-operatively were included in the study. NB: Data from Rollo 1995 has been used to formulate Rollo 1995/b which represents a comparison of the Solcotrans group vs No drainage group (Control).

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	High risk	Method used to conceal treatment allocation was inadequate.
Blinding (performance bias and detection bias) All outcomes	High risk	

Rosencher 1994

Methods	Randomised controlled trial of autotransfusion devices in patients undergoing knee-joint replacement surgery. Method of randomisation and allocation concealment was not described. [French article]
Participants	30 patients undergoing total knee arthroplasty were randomised to one of three groups: • Group 1 (Autotransfusion group - Ortho-evac system): n=10; mean (sd) age = 68 (10) years • Group 2 (Autotranfusion group - Solcotrans system): n=10; mean (sd) age = 70 (10) years • Group 3 (Control group): n=10; mean (sd) age = 68 (15) years
Interventions	• Group 1: Autotransfusion group (Ortho-evac system - not containing an anticoagulant) had their autotransfusion system connected to the deep suction drains in the operating room, after skin closure and before tourniquet removal. The salvaged blood was reinfused in the subsequent six hours via a 40 micron filter. The volume of collected blood was measured and allogeneic blood was added as required, to maintain a haematocrit of 30%. The Ortho-evac system had a 1000ml capacity. • Group 2: Autotransfusion group (Solcotrans system - not containing an anticoagulant) had their autotransfusion system connected to the deep suction drains in the operating room, after skin closure and before tourniquet removal. The salvaged blood was reinfused in the subsequent six hours via a 40 micron filter. The volume of collected blood was measured and allogeneic blood was added as required, to maintain a haematocrit of 30%. The Solcotrans system had a 500ml capacity.

Rosencher 1994 *(Continued)*

	• Group 3: Control group did not receive autotransfusion.
Outcomes	***Outcomes reported:*** amount of blood collected by the cell saver, number of patients transfused allogeneic blood, composition of drainage blood.
Notes	***Transfusion threshold:*** allogeneic blood was transfused to maintain a haematocrit of 30%.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was unclear.
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was unclear.
Blinding (performance bias and detection bias) All outcomes	High risk	

Sait 1999

Methods	A prospective, randomised study of consecutive total knee arthroplasties was carried out over a period of 2 years. Method of randomisation and allocation concealment was not described. [Abstract]
Participants	120 patients undergoing total knee arthroplasty were randomised to one of two groups: • Group 1 (Autotransfusion group): n=60. • Group 2 (Control group): n=60. NB: Demographic data were not reported.
Interventions	• Group 1: Autotransfusion group had a tourniquet used throughout the procedure until the dressing was applied. Two drains were inserted and connected to a blood conservation system. In this system the unfiltered blood could be transfused back to the patient. • Group 2: Control group received standard care without the use of autotransfusion. A tourniquet was used throughout the procedure until the dressing was applied. Two drains were inserted and retained for 24 hours post-operatively.
Outcomes	***Outcomes reported:*** number of patients transfused allogeneic blood.
Notes	***Transfusion threshold:*** transfusion protocol was not reported.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was unclear.
Blinding (performance bias and detection bias)	High risk	

Sait 1999 *(Continued)*

All outcomes	

Schaff 1978a

Methods	During a 3-month period from January 1977 to April 1977, adult patients undergoing cardiac surgery at the John Hopkins Hospital were randomised by odd or even history numbers to receive in the post-operative period either conventional blood bank transfusion therapy or autotransfusion of shed mediastinal blood.
Participants	114 patients undergoing cardiac surgery were randomised to one of two groups: • Group 1 (Autotransfusion group): n=63; M/F=41/22; mean (sd) age = 53.6 (10.3) years • Group 2 (Control group): n=51; M/F=32/19; mean (sd) age = 53.4 (10.0) years
Interventions	• Group 1: Autotransfusion group (Sorenson autotransfusion system) received shed mediastinal blood processed by the Sorenson autotransfusion system (ATS). Blood collected in the ATS bags was considered suitable for autotransfusion only if 400mls or more was collected within 4 hours. If the rate of mediastinal bleeding was slow and 4 hours passed without 400mls volume being collected, this blood was not reinfused. Shed mediastinal blood was given in preference to stored bank blood when volume replacement was necessary. • Group 2: Control group received only transfusions of stored bank blood. Autotransfusion was not performed.
Outcomes	***Outcomes reported:*** amount of allogeneic blood transfused, total blood and blood component replacement, mediastinal blood loss, haematological variables, adverse events.
Notes	***Transfusion threshold:*** if Hct values were below 35% and left ventricular filling was judged to be adequate, whole blood and/or packed red blood cells were infused to restore intravascular volume. With higher haematocrit values and with low left ventricular filling pressures, patients received an infusion of colloid solution or crystalloid solution (Ringer's lactate).

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	High risk	Method used to generate allocation sequences was inadequate.
Allocation concealment (selection bias)	High risk	Method used to conceal treatment allocation was inadequate.
Blinding (performance bias and detection bias) All outcomes	High risk	

Schmidt 1996

Methods	Between November 1992 and October 1993, adult patients undergoing primary elective coronary artery bypass grafting entered the prospective, randomised, controlled study. Method of randomisation was not described. Allocation concealment was by means of sealed envelopes.
Participants	120 adult patients undergoing primary elective coronary artery bypass grafting were randomly allocated to one of two groups:

Schmidt 1996 *(Continued)*

- Group 1 (Autotransfusion group): n=53; M/F=46/7; mean (sd) age = 58.5 (7.4) years
- Group 2 (Control group): n=56; M/F=51/5; mean (sd) age = 57.5 (8.9) years

Interventions	• Group 1: Autotransfusion group had at the end of the operation, the mediastinal and pleural tubes attached to the inlet port of the Bard cardiotomy/autotransfusion reservoir. Shed mediastinal blood from the cardiotomy reservoir was transfused every hour for the first 18 post-operative hours if more than 20mls of blood had accumulated. Prior to transfusion the shed mediastinal blood was filtered through a 40um filter in the cardiotomy reservoir. • Group 2: Control group had the cardiotomy reservoir used for mediastinal drainage only. Autotransfusion was not performed.
Outcomes	***Outcomes reported:*** amount of blood re-transfused from the cell saver, amount of allogeneic blood transfused, number of patients transfused allogeneic blood, adverse events, sternal infections, myocardial infarction, sepsis, mortality, blood loss.
Notes	***Transfusion threshold:*** patients were transfused allogeneic blood if the haemoglobin concentration was less than 5.0mmol/L in the intensive care unit and less than 5.5mmol/L during the rest of the hospital stay.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	High risk	Method used to conceal treatment allocation was inadequate.
Blinding (performance bias and detection bias) All outcomes	High risk	

Schonberger 1993

Methods	A prospective, randomised study evaluated the effect of autotransfusion of shed blood on the reduction and avoidance of donor blood requirements in patients undergoing internal mammary artery bypass (IMA) surgery and treatment with low-dose aprotinin (2 million KIU). Method of randomisation and allocation concealment was not described.
Participants	40 patients undergoing elective primary unilateral internal mammary (IMA) artery bypass grafting were randomly assigned to one of two groups: • Group 1 (Autotransfusion group): n=20; M/F=15/5; mean (sd) age = 64 (10.7) years • Group 2 (Control group): n=20; M/F=15/5; mean (sd) age = 63 (6.3) years
Interventions	• Group 1: Autotransfusion group underwent internal mammary artery (IMA) surgery with pre-bypass removal of autologous blood, reinfusion of the remaining volume in the extracorporeal circuit (ECC) after aortic decannulation, administration of 200mls aprotinin containing 280mg of aprotinin (2 million kallikrein inactivator units) added to the pump prime, acceptance of normovolemic anaemia (Hct greater than or equal to 25%) and autotransfusion of the shed blood post-operatively. • Group 2: Control group patients underwent IMA surgery under the same conditions as Group 1 with the exclusion of autotransfusion (AT).

Schonberger 1993 *(Continued)*

Outcomes	***Outcomes reported:*** amount of blood re-transfused from the cell saver, amount of allogeneic blood transfused, number of patients transfused allogeneic blood, adverse events, re-exploration for bleeding, blood loss.
Notes	***Transfusion threshold:*** allogeneic packed red cells were transfused when the post-operative Hct fell below 25%.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was unclear.
Blinding (performance bias and detection bias) All outcomes	High risk	

Shenolikar 1997

Methods	A prospective, randomised study to assess the impact of cell salvage autotransfusion on the requirements for allogeneic blood in patients undergoing a total knee replacement was conducted. Patients were allocated to groups according to a computer generated randomisation schedule. Method of allocation concealment was not described.
Participants	100 consecutive patients undergoing total knee replacement were randomised to one of two groups: • Group 1 (Autotransfusion group): n=50; M/F=21/29; mean age males = 70.4 years (range 47-78 years); mean age females = 69.3 years (range 52-81 years) • Group 2 (Control group): n=50; M/F=24/26; mean age males = 67.9 years (range 51-82 years); mean age females = 70.8 years (range 46-88)
Interventions	• Group 1: Autotransfusion group patients had post-operative drainage blood processed by a Haemonetics Cell Saver 3. Blood was collected via the wound drains following the release of the tourniquet. The collected blood was anticoagulated with heparinised saline. The machine aspirated the wound drainage into the centrifuge bowl via roller pumps. The blood underwent accelerated sedimentation, being spun at 5600 revs/per/minute. The supernatant was discarded and the resulting red cells washed and resuspended in normal saline. The machines produced a product with a haematocrit of over 55% and a volume of 250mls. • Group 2: Control group did not receive autotransfusion.
Outcomes	***Outcomes reported:*** amount of blood collected by the cell saver, amount of allogeneic blood transfused, number of patients transfused allogeneic blood, adverse events, hospital length of stay.
Notes	***Transfusion threshold:*** allogeneic blood was given in the post-operative period when the haemoglobin fell below 9.0g/dL. Routine procedure of crossmatching two units of packed cells was performed for all patients in the study.

Risk of bias

Bias	Authors' judgement	Support for judgement

Shenolikar 1997 *(Continued)*

Random sequence generation (selection bias)	Low risk	Method used to generate allocation sequences was adequate.
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was unclear.
Blinding (performance bias and detection bias) All outcomes	High risk	

Shirvani 1991

Methods	Randomised controlled trial was conducted to evaluate the advantages and disadvantages of post-operative autotranfusion in patients undergoing first-time coronary artery bypass grafting (CABG). Method of randomisation and allocation concealment were not described.
Participants	40 patient undergoing first-time coronary artery bypass graft sugery were randomly divided into one of two groups. The two groups were further subdivided according to whether the patients received aspirin preoperatively or not: • Group 1 (Autotransfusion group - aspirin): n=10 • Group 2 (Autotransfusion group - no aspirin): n=11 • Group 3 (Control group - aspirin): n=12 • Group 4 (Control group - no aspirin): n=9 NB: Demographic data were not reported.
Interventions	• Group 1: Autotransfusion group (aspirin) patients were autotransfused using an IMED 960 Volumetric Infusion Pump but donor blood was also available if needed. Patients from this group received 75mg of aspirin daily pre-operatively. • Group 2: Autotransfusion group (no aspirin) patients were autotransfused using an IMED 960 Volumetric Infusion Pump but donor blood was also available if needed. Patients from this group did not receive 75mg of aspirin daily pre-operatively. • Group 3: Control group (aspirin) patients were transfused post-operatively with allogeneic blood. Patients from this group received 75mg of aspirin daily pre-operatively. Autotransfusion was not used. • Group 4: Control group (no aspirin) patients were transfused post-operatively with allogeneic blood. Patients from this group did not receive 75mg of aspirin daily pre-operatively. Autotransfusion was not used.
Outcomes	***Outcomes reported:*** amount of allogeneic blood transfused, number of patients transfused allogeneic blood, adverse events, re-operation for bleeding, blood loss.
Notes	***Transfusion threshold:*** the indication for allogeneic blood transfusion was the maintenance of a haematocrit (Hct) level of 30% to 35%.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was unclear.

Shirvani 1991 *(Continued)*

Blinding (performance bias and detection bias) All outcomes	High risk

Simpson 1994

Methods	Consecutive patients scheduled to undergo elective primary total joint arthroplasty was entered into a randomised controlled trial. Method of randomisation and allocation concealment was not described.
Participants	24 patients undergoing elective total joint arthroplasty were randomly assigned to one of two groups: • Group 1 (Autotransfusion group): n=12; M/F=5/7; mean (range) age = 64.7 (53-76) years • Group 2 (Control group): n=12; M/F=5/7; mean (range) age = 59.6 (41-76) years
Interventions	• Group 1: Autotransfusion group had a Solcotrans drain inserted in the operating room and connected to the collection unit and placed under continuous suction (-20cmH2O) once wound closure was complete. Collection continued for 6 hours or until the unit was full. At that time, the amount of drainage was noted. If greater than 350mls, the drainage was reinfused and a new Solcotrans unit connected. ACD-A (citrate-based anticoagulant) was used in each unit (40mls). If the drainage was greater than 150mls but less than 350mls, the drainage was reinfused and a standard, spring loaded, closed intermittent suction canister was connected. If the drainage was less than 150mls, the drainage was not reinfused and collection continued, either in the Solcotrans canister or a closed suction drain. • Group 2: Control group had drains inserted in the operating room that were connected to a standard, closed system, spring loaded, intermittent suction device. NB: Drains for both patient groups were discontinued once drainage was less than 40mls per 8 hour shift.
Outcomes	***Outcomes reported:*** amount of blood collected by the cell saver, average collection times, blood loss, Hb & Hct levels, coagulation variables.
Notes	***Transfusion threshold:*** post-operative transfusions were given when the haemoglobin level was less than 10.0g/dL or the haematocrit was less than 30%.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was unclear.
Blinding (performance bias and detection bias) All outcomes	High risk	

Sirvinskas 2007

Methods	Randomised controlled trial was conducted from 2005 to 2006 to evaluate the efficacy of re-infusion of autologous shed mediastinal blood in patients undergoing either coronary artery bypass graft surgery,

Sirvinskas 2007 *(Continued)*

	valve replacement/repair operations or a combination of both, in the Clinic of Cardiothoracic and Vascular Surgery, Kaunas University of Medicine.
Participants	90 patients undergoing cardiac surgery were randomly allocated to one of two groups: • Group 1 (Autotransfusion group): n=41; M/F=27/14; mean (sd) age = 64.3 (9.72) years • Group 2 (Control group): n=49; M/F=33/16; mean (sd) years = 61.73 (11.78) years
Interventions	• Group 1: Autotransfusion group received re-infusion of centrifuged autologous red blood cells (RBCs) processed from the shed mediastinal blood after the first four post-operative hours. The collected blood was processed in a K70D Beckman centrifuge (Beckman Coulter, Germany) at 2600rpm for 15 minutes at room temperature. Plasma was separated and manually pumped out into a second empty bag using a plasma-extractor and discarded. The remaining autologous red cells were immediately re-infused to the patients through the disposable intravenous infusion system designed for the transfusion of blood components. • Group 2: Control group had all shed mediastinal blood discarded.
Outcomes	***Outcomes reported:*** number of patients transfused allogeneic blood, blood loss, hospital length of stay, adverse events.
Notes	***Transfusion threshold:*** post-operatively the indication for allogeneic blood transfusion was a haemoglobin level of less than 8.0g/dL.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	High risk	Method used to conceal treatment allocation was inadequate.
Blinding (performance bias and detection bias) All outcomes	High risk	

Slagis 1991

Methods	A prospective, randomised, clinical trial was undertaken to determine whether post-operative blood salvage in patients undergoing total hip or knee arthroplasty decreased the need for transfusion with banked blood. The groups included all patients undergoing hip or knee arthroplasty at the University of Arizona Medical Centre between August 1, 1988 and June 1, 1989. Method of randomisation and allocation concealment were not described.
Participants	109 patients undergoing total hip or knee arthroplasty were randomly assigned to one of two groups: • Group 1 (Autotransfusion group): n=51 • Group 2 (Control group): n=51 NB: The average age of the patients was 70 years; the study and the control groups were evenly matched for age and sex. Demographic data for each study group were not reported. Of the 109 patients who entered the study seven were excluded.
Interventions	• Group 1: Autotransfusion group (Hemolite cell saver) had the wound drainage tubes connected in the operating room to a sterile reservoir which contained 200mls of a heparin saline solution. The reservoir was connected to wall suction (120mmHg) in the operating suite. Collection was continued in

Slagis 1991 *(Continued)*

	the post-anaesthetic care unit and the surgical ward. At the end of the 4 hour period the collected wound drainage was processed. Under sterile conditions the blood was washed with 2 litres of saline and processed in the Hemolite cell washer to remove heparin, cellular debris, platelets and clotting factors. After processing, the wound drainage consisted of concentrated red blood cells suspended in saline. This product was transfused back to the patient. After wound drainage collection was completed, the drains were attached to standard Hemovac suction and output was monitored at 8 hour intervals until the drains were disconnected at 48 hours. • Group 2: Control group received a Hemovac standard drainage system. At the termination of the operative procedure the control group underwent Hemovac wound drainage only. Autotransfusion was not performed.
Outcomes	***Outcomes reported:*** amount of blood collected by the cell saver, amount of blood re-transfused from the cell saver, amount of allogeneic blood transfused, number of patients transfused allogeneic blood, adverse events, coagulopathy, blood loss, costs.
Notes	***Transfusion threshold:*** transfusion protocol was not reported. Patients who were transfused only one unit of blood received only pre-banked autologous blood.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was unclear.
Blinding (performance bias and detection bias) All outcomes	High risk	

Smith 2007

Methods	A prospective, randomised study was conducted to analyse differences in post-operative haemoglobin levels and allogeneic blood requirements in patients undergoing primary total hip replacement (THR). Between December 2003 and December 2005, consecutive patients undergoing elective primary THR for arthritis at Weston General Hospital were enrolled. The patients were block randomised (computer-generated) to one of two groups from sealed envelopes opened by a nurse after reduction of the prosthesis.
Participants	190 patients undergoing elective primary total hip replacement were randomised to one of two groups: • Group 1 (Autotransfusion group): n=76; M/F=36/40; mean (range) age = 73.5 (52-87) years • Group 2 (Control group): n=82; M/F=40/42; mean (range) age = 75.5 (46-91) years NB: From the 190 patients who agreed to participate, 158 sets of complete data were obtained. There were 22 incomplete haemoglobin (Hb) values and 10 patients did not fulfil the inclusion criteria.
Interventions	• Group 1: Autotransfusion group had wound drainage processed by the ABTrans autologous re-transfusion system. The autologous closed circuit system included two drains and a 125 micron filter through which the blood passes through before entering the 1200ml reservoir. Autologous re-transfusion was given at 4 hourly intervals from opening of the drain or when 400mls had collected in the reservoir. The maximum time between collection and completion of each transfusion was six hours. The system was used for 24 hours or up to a total of 1600mls.

Smith 2007 *(Continued)*

	• Group 2: Control group received two standard Medinorm vacuum drains. The Medinorm vacuum drains were removed 48 hours after surgery.
Outcomes	***Outcomes reported:*** number of patients transfused allogeneic blood, amount of allogeneic blood transfused, volume of blood re-transfused from the cell saver, hospital length of stay, adverse events.
Notes	***Transfusion threshold:*** the individual orthopaedic team decided whether to give allogeneic blood transfusion. Local practice was to give two units if the post-operative Hb was less than 8.0g/dL or if patients were symptomatic with Hb in the range of 8.0g/dL to 10.0g/dL.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Method used to generate allocation sequences was adequate.
Allocation concealment (selection bias)	High risk	Method used to conceal treatment allocation was inadequate.
Blinding (performance bias and detection bias) All outcomes	High risk	

So-Osman 2006

Methods	In 2003, patients ≥18 years of age who were scheduled for a primary or revision total hip replacement or total knee replacement at the Leiden University Medical Centre were included in this randomised controlled trial. All patients were of American Society of Anaesthesiologists (ASA) 2 or 3 category. A randomisation list was generated by a statistical software package. Sealed envelopes were made which contained the randomisation group. Pre-operatively, the patient was allocated to one of the groups by opening a sealed envelope.
Participants	70 patients undergoing a primary or revision total hip replacement or total knee replacement were randomised to one of three groups: • Group 1 (Autotransfusion group I): n=23; M/F=9/14; mean (sd) age = 66 (15.6) years • Group 2 (Autotransfusion group II): n=24; M/F=10/14; mean (sd) age = 58 (17.2) years • Group 3 (Control group): n=22; M/F=7/15; mean (sd) age = 58 (14.3) years NB: Of the 70 patients included in the study, one patient was not operated, leaving 69 evaluable patients.
Interventions	• Group 1: Autotransfusion group (I) had their drainage processed by the DONOR system. The re-infusion system uses continuous suction at a vacuum pressure of 120mmHg and just prior to re-infusion a double-shielded 40um filter (Pall Lipiguard VS filter) entrapping lipids larger than 10um and 2 log of leukocytes. • Group 2: Autotransfusion group (II) had their drainage processed by the Bellovac A.B.T. system. The re-infusion system uses intermittent suction pressure by a manually expandable bag at a maximum pressure of 90mmHg and three filters, a 200um filter, a secondary 80um filter and prior to re-infusion a third 40um filter. • Group 3: Control group received standard closed suction wound drainage.
Outcomes	***Outcomes reported:*** number of patients transfused allogeneic blood, amount of allogeneic blood transfused, volume of blood re-transfused from the cell saver, blood loss, hospital length of stay, adverse events.

So-Osman 2006 *(Continued)*

Notes	***Transfusion threshold:*** during the study, a restrictive transfusion trigger according to the Dutch guidelines was used (CBO consensus guidelines, 2004).

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Method used to generate allocation sequences was adequate.
Allocation concealment (selection bias)	High risk	Method used to conceal treatment allocation was inadequate.
Blinding (performance bias and detection bias) All outcomes	High risk	

Spark 1997

Methods	A prospective, randomised study was conducted to determine if cell-salvaged autologous blood can serve as an alternative to allogeneic blood in patients undergoing elective infra-renal abdominal aortic surgery. Method of randomisation not described. Allocation concealment was by sealed envelopes.
Participants	50 patients undergoing elective infrarenal abdominal aortic aneurysm surgery were randomised to one of two groups: • Group 1 (Autotransfusion group): n=23; M/F=19/4; median (IQR) age = 71 (54-78) years • Group 2 (Control group): n=27; M/F=20/7; median (IQR) age = 68 (54-82) years
Interventions	• Group 1: Autotransfusion group patients received autologous blood via intra-operative autotransfusion (IAT). A COBE Baylor rapid autologous transfusion system was employed for intra-operative cell salvage. Blood was retrieved from the operative site by suctioning into a double lumen catheter at less than 150mmHg, to minimise haemolysis. Blood was anticoagulated with heparin (30,000 units/1 litre 0.9% saline). The salvaged blood was then collected in a reservoir where a macrofilter of 150 microns removed larger particles of debris. When 500mls of blood was collected, it was pumped to a spinning centrifuge bowl. The red cells were washed with 0.9% saline, and concentrated to a Hct above 50%. The effluent containing plasma fractions, platelets, leukocytes, free haemoglobin, anticoagulant and saline was discarded. The washed red cells, suspended in saline were pumped from the centrifuge to the patient through a microfilter of either 20 or 40 microns. • Group 2: Control group did not receive autotransfusion.
Outcomes	***Outcomes reported:*** amount of allogeneic blood transfused, number of patients transfused allogeneic blood, adverse events, hospital length of stay, blood loss, mortality.
Notes	***Transfusion threshold:*** patients were transfused allogeneic blood if the Hct fell below 25%.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	High risk	Method used to conceal treatment allocation was inadequate.

Spark 1997 *(Continued)*

Blinding (performance bias and detection bias) All outcomes	High risk

Tempe 1996

Methods	A prospective, randomised study was performed in a New Delhi tertiary care hospital involving consecutive patients undergoing elective cardiac valve surgery using cardiopulmonary bypass. Method of randomisation and allocation concealment were not described.
Participants	150 consecutive patients undergoing elective valve surgery using cardiopulmonary bypass were randomly allocated to one of three groups: • Group 1 (Autotransfusion + ANH group): n=50; M/F=35/15; mean (sd) age = 29.1 (11.8) years • Group 2 (ANH group): n=50; M/F=25/25; mean (sd) age = 28.1 (9.2) years • Group 3 (Control group): n=50; M/F=15/35; mean (sd) age = 26.1 (9.3) years ANH = acute normovolaemic haemodilution.
Interventions	• Group 1: Autotransfusion + ANH group received autologous fresh blood donated before bypass, and both cell saver and membrane oxygenator were used. Autologous blood was removed by a central venous catheter after induction of anaesthesia and collected in citrate phosphate preservative at room temperature for subsequent transfusion. Blood volume was maintained with a simultaneous infusion of Ringer's lactate solution. A Dideco, Shiley cell saver system was used to collect all blood at the operation site. This system heparinises, washes, and centrifuges the blood to produce a red cell concentrate for transfusion. At the conclusion of CPB, all the blood remaining in the oxygenator was also processed by the cell saver in preparation for subsequent transfusion. A "Maxima" membrane oxygenator was used for this group. • Group 2: ANH group were reinfused with autologous blood only. Blood was withdrawn as in Group 1 patients and was stored for subsequent transfusion. • Group 3: Control group underwent routine management, using a Bentley bubble oxygenator without specific blood conservation techniques. NB: In Groups 2 and 3, the blood remaining in the oxygenator at the termination of CPB was returned to the patient before decannulation, or collected in a bag for immediate use to provide optimum filling pressures and haemodynamic stability in the post-bypass period.
Outcomes	***Outcomes reported:*** amount of allogeneic blood transfused, number of patients transfused allogeneic blood, adverse events, re-exploration for bleeding, blood loss, Hct levels.
Notes	***Transfusion threshold:*** bank blood (whole blood) was used in all groups if the haematocrit was less than 25%.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was unclear.
Blinding (performance bias and detection bias) All outcomes	High risk	

Tempe 2001

Methods	A prospective, randomised study was performed in a tertiary care hospital involving adult patients undergoing elective cardiac valve surgery using cardiopulmonary bypass. Method of randomisation and allocation concealment were not described.
Participants	60 patients undergoing cardiac valve surgery were randomised to one of three groups: • Group 1 (Autotransfusion group): n=20; M/F=14/6; mean (sd) age = 27.7 (10.1) years • Group 2 (Aprotinin group): n=20; M/F=12/8; mean (sd) age = 25.9 (11.1) years • Group 3 (Control group): n=20; M/F=12/8; mean (sd) age = 26.6 (7.35) years
Interventions	• Group 1: Autotransfusion group patients were treated with cell salvage using a Dideco system before heparin and after protamine administration. • Group 2: Aprotinin group patients were treated with aprotinin at the dose of 30,000KIU/kg added to the pump prime with a further 15,000 KIU/kg added at the end of each hour of CPB. • Group 3: Control group patients underwent routine management which included the collection of autologous blood during the pre-CPB period. NB: Groups 1 and 3 had blood remaining in the oxygenator at the conclusion of CPB returned before decannulation or collected in a bag for immediate use to provide optimal filling pressures and hemodynamic stability in the post-CPB period.
Outcomes	***Outcomes reported:*** amount of allogeneic blood transfused, re-exploration for bleeding.
Notes	***Transfusion threshold:*** bank blood (whole blood) was used in all groups if the haemoglobin level fell below 8.0g/dL.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was unclear.
Blinding (performance bias and detection bias) All outcomes	High risk	

Thomas 2001

Methods	A single-centre, randomised controlled study was conducted of patients undergoing total knee replacement (TKR). Method of randomisation and allocation concealment were not described.
Participants	231 patients undergoing elective total knee replacement surgery were randomly allocated to one of two groups: • Group 1 (Autotransfusion group): n=115; M/F=44/71; mean age of males = 67.4 years; mean age of females = 70.5 years • Group 2 (Control group): n=116; M/F=55/61; mean age of males = 69.7 years; mean age of females = 70.2 years

Thomas 2001 *(Continued)*

Interventions	• Group 1: Autotransfusion group patients received autotransfusion of wound drainage if the volume of blood collected was greater than 125mls post-operatively. The collected blood was washed and re-suspended in saline before re-infusion using a centrifugal cell washing machine (Haemonetics Cell Saver 5). Patients in the cell salvage group were transfused allogeneic red blood cells if their haemoglobin fell below a haemoglobin level of 9.0 g/dL after autotransfusion was completed. • Group 2: Control group were treated without the use of cell salvage (autotransfusion). All drainage blood was discarded.
Outcomes	***Outcomes reported:*** number of patients transfused allogeneic blood, amount of allogeneic blood transfused, adverse events.
Notes	***Transfusion threshold:*** allogeneic blood was transfused if the haemoglobin level fell below 9.0g/dL.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was unclear.
Blinding (performance bias and detection bias) All outcomes	High risk	

Thurer 1979

Methods	A randomised controlled trial was conducted to evaluate the safety and effectiveness of the collection and re-transfusion of post-operatively shed mediastinal blood in patients undergoing cardiac surgery. Method of randomisation and allocation concealment were not described.
Participants	113 consecutive adult patients undergoing cardiac surgical procedures requiring cardiopulmonary bypass were randomised to one of two groups: • Group 1 (Autotransfusion group): n=54; M/F=48/6; mean (range) age = 55.9 (24-72) years • Group 2 (Control group): n=59; M/F=55/4; mean (range) age = 54.8 (38-73) years
Interventions	• Group 1: Autotransfusion group had their shed mediastinal blood collected post-operatively by an autotransfusion system (Sorenson). Suction was applied (-20cmH2O), allowing shed blood to flow into the upper bag of the system and then through two 170 micron filters into a lower 800ml collection bag. The lower bag was then disconnected from the system and its contents infused, the collected blood being transfused through an in-line 40 micron filter. No blood was allowed to remain in the system longer than 4 hours. Shed blood that was not utilised during this time period was discarded. When notable bleeding ceased (4-8 hours) retransfusion was no longer employed. • Group 2: Control group received usual care without the use of cell salvage. NB: Intra-operative and post-operative haemodilution was performed in all patients but not equally distributed between groups.
Outcomes	***Outcomes reported:*** amount of blood collected by the cell saver, amount of blood re-transfused from the cell saver, amount of allogeneic blood transfused, adverse events, myocardial infarction, mortality, post-operative infections, renal function impairment, fluid replacement, blood loss.

Thurer 1979 *(Continued)*

Notes	***Transfusion threshold:*** intra-operative blood replacement was left to the discretion of the staff surgeon and anaesthesiologist. In patients who were unstable haemodynamically and in those patients whom complete revascularisation was not possible the haematocrit was raised to 30% or higher.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was unclear.
Blinding (performance bias and detection bias) All outcomes	High risk	

Tripkovic 2008

Methods	A prospective, randomised controlled study was conducted to analyse the effect of post-operative autotransfusion on the need for allogeneic transfusion and to determine the quality of post-operatively collected drainage blood and to compare it with other blood sources in patients undergoing primary total hip replacement. Method of randomisation and allocation concealment were not described.
Participants	60 patients undergoing primary total hip replacement were randomly allocated to one of two groups: • Group 1 (Autotransfusion group): n=30; M/F=14/16; mean (sd) age = 68 (12) years • Group 2 (Control group): n=30; M/F=12/18; mean (sd) age = 71 (11) years
Interventions	• Group 1: Autotransfusion group had their shed blood processed by the BIODREN system. This system is a closed autologous blood recovery system. The vacuum pump provides an adjustable constant vacuum kept below 100mmHg. The system is connected to two CH14 drains during the final stage of the operation and active suction is initiated after skin closure. When collection of shed blood in the reservoir is completed (600mls of blood is collected or after maximum of 360 minutes of collection is passed) the blood flows through a 260 micron filter to the blood bag, from which autotransfusion through a 40 micron filter (Pall blood transfusion set) is done. • Group 2: Control group did not receive autotransfusion.
Outcomes	***Outcomes reported:*** number of patients transfused allogeneic blood, amount of allogeneic blood transfused, blood loss, haematological variables.
Notes	***Transfusion threshold:*** patients received allogeneic blood to maintain a haemoglobin level of 10.0g/dL or haematocrit level of 30%.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was not described.

Tripkovic 2008 *(Continued)*

Blinding (performance bias and detection bias) All outcomes	High risk

Unsworth 1996

Methods	A randomised controlled trial was conducted between January 1993 and June 1993 of patients undergoing primary elective coronary artery bypass graft surgery. Patients were randomised on the day before surgery using a computer randomisation programme. Method of allocation concealment was not described.
Participants	105 patients undergoing primary elective coronary artery bypass graft surgery were randomised to one of three groups: • Group 1 (Autotransfusion group - uncoated circuit): n=36; M/F=30/6; median (range) age = 64 (58-67) years • Group 2 (Autotransfusion group - heparin coated circuit): n=35; M/F=31/4; median (range) age = 62 (55-67) years • Group 3 (Control group): n=34; M/F=30/4; median (range) age = 63 (58-67) years
Interventions	• Group 1: Autotransfusion group (uncoated circuit) had their chest drains connected to a cardiotomy reservoir (CATR 3500) to which suction at 10Kpa was applied. This reservoir contained a 20 micron filter which removed debris and clot from the drained blood. From there blood was carried via an infusion pump which incorporated an air-in-line detector to a peripheral line. Autotransfusion commenced when there was more than 100mls in the cardiotomy reservoir and continued thereafter for 10 hours. Infusion was in hourly pulses according to the previous hours drainage. • Group 2: Autotransfusion group (heparin coated circuit) had the autotransfusion circuit bonded with heparin. The heparin-bonded circuit comprised an identical system of drains and tubes except that all surfaces, including the cardiotomy reservoir and connector but excluding the piston chamber of the infusion pump and the intravenous cannula, were coated with heparin by the Duraflow II methodology. • Group 3: Control group had their chest drains connected to underwater sealed drainage bottles with suction applied at 10Kpa. Autotransfusion was not performed.
Outcomes	***Outcomes reported:*** amount of blood re-transfused from the cell saver, amount of allogeneic blood transfused, number of patients receiving allogeneic blood, adverse events, re-exploration for bleeding, blood loss, mortality, haematological variables, coagulation variables.
Notes	***Transfusion threshold:*** allogeneic blood was transfused to maintain the haematocrit level greater than 25%.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Method used to generate allocation sequences was adequate.
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was unclear.
Blinding (performance bias and detection bias) All outcomes	High risk	

Ward 1993

Methods	A randomised controlled trial was conducted to study the effectiveness of autotransfusion of shed mediastinal blood in decreasing the need for allogeneic blood transfusion in routine cardiac surgery. Method of randomisation and allocation concealment were not described. The operative team was blinded to the randomisation until the patient arrived in the surgical intensive care unit. No patient in either group donated autologous blood.
Participants	35 consecutive male patients undergoing elective myocardial revascularisation or valve replacement were randomised to one of two groups: • Group 1 (Autotransfusion group): n=18; mean (sd) age = 64 (8.5) years • Group 2 (Control group): n=17; mean (sd) age = 63 (8.2) years
Interventions	• Group 1: Autotransfusion group patients received autotransfusion of mediastinal shed blood for the first 12 hours post-operatively. Autotransfusion involved reinfusion within 4 hours, a minimum of 100mls of chest drainage in the reservoir before initiation of autotransfusion, and discontinuation of autotransfusion for core temperatures greater than 39.5 degrees celsius. A two-filter system was employed to minimise emboli. • Group 2: Control group were treated with standard chest drainage and fluid replacement. NB: Mediastinal chest drainage tubes were placed in all patients and connected to an in-line autotransfusion system. The chest drainage system was placed on suction (20cm H20), and the tubes were milked every 15 minutes. Haemodilution was tolerated to a haemoglobin level of 8.0g/dL.
Outcomes	***Outcomes reported:*** amount of blood re-transfused from the cell saver, amount of allogeneic blood transfused, number of patients transfused allogeneic blood, adverse events, re-operation for bleeding, blood loss, mortality, myocardial infarction, wound infection.
Notes	***Transfusion threshold:*** patients in both groups received transfusions intra-operatively and post-operatively with packed red blood cells when the haemoglobin level fell to less than 8.0g/dL.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was unclear.
Blinding (performance bias and detection bias) All outcomes	High risk	

Westerberg 2004

Methods	Prospective, randomised controlled trial of patients undergoing coronary artery surgery to compare inflammatory response, myocardial injury, and post-operative bleeding when cardiotomy suction blood and mediastinal shed blood were either discarded or re-transfused. Method of randomisation and allocation concealment were not described.
Participants	35 patients undergoing cardiac surgery were randomly allocated to one of two groups: • Group 1 (Autotransfusion group): n=12; M/F=9/3; mean (sd) age = 64 (7.0) years

Westerberg 2004 *(Continued)*

	• Group 2 (Control group): n=17; M/F=16/1; mean (sd) age = 67 (8.3) years NB: Six patients were excluded from the final analysis.
Interventions	• Group 1: Autotransfusion group had their cardiotomy suction blood during cardiopulmonary bypass (CPB) and mediastinal shed blood during the first 12 hours post-operatively re-transfused. • Group 2: Control group had their cardiotomy suction blood and mediastinal shed blood discarded. NB: All patients received intravenous tranexamic acid (TXA) 2g before surgery and 2g after skin closure.
Outcomes	***Outcomes reported:*** number of patients transfused allogeneic blood, volume of shed mediastinal blood, blood loss.
Notes	***Transfusion threshold:*** transfusion protocol was not reported.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was not described.
Blinding (performance bias and detection bias) All outcomes	High risk	

Wiefferink 2007

Methods	Randomised controlled trial was conducted to investigate the influence of processing both shed mediastinal blood and residual cardiopulmonary bypass (CPB) blood in patients undergoing isolated primary elective myocardial re-vascularisation. Patients were randomly allocated to intervention or control using sealed, opaque, sequentially numbered envelopes. The sequence of allocations was obtained from a computer-generated random number list. Clinicians in the Intensive Care Unit were blinded to the group.
Participants	30 patients undergoing isolated primary elective myocardial re-vascularisation were randomly allocated to one of two groups: • Group 1 (Autotransfusion group): n=15; M/F=13/2; mean (sd) age = 62 (11.0) years • Group 2 (Control group): n=15; M/F=11/4; mean (sd) age = 66 (8.0) years
Interventions	• Group 1: Autotransfusion group had their mediastinal and residual CPB blood processed by a continuous autotransfusion system (C.A.T.S. Frensenius, HemoCare) before reinfusion using the quality wash protocol. • Group 2: Control group did not receive autotransfusion.
Outcomes	Outcomes reported: number of patients transfused allogeneic blood, plasma D-dimer levels.
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement

Wiefferink 2007 *(Continued)*

Random sequence generation (selection bias)	Low risk	Method used to generate allocation sequences was adequate.
Allocation concealment (selection bias)	High risk	Method used to conceal treatment allocation was inadequate.
Blinding (performance bias and detection bias) All outcomes	High risk	Single-blind.

Zacharopoulos 2007

Methods	Prospective, randomised controlled trial was conducted to determine the effectiveness of a post-operative autologous blood re-infusion system as an alternative to allogeneic, banked blood in patients undergoing unilateral total knee replacement between January 2002 to November 2004.
Participants	60 patients undergoing unilateral total knee replacement were randomly allocated to one of two groups: • Group 1 (Autotransfusion group): n=30; M/F=6/24; mean age = 69.2 years • Group 2 (Control group): n=30; M/F=7/23; mean age = 70.2 years
Interventions	• Group 1: Autotransfusion group (Gish Orthofuser system) had their shed blood collected and re-infused within 6 hours after the collection was initiated. Allogeneic blood transfused was supplied post-operatively when required. No banked blood was given intra-operatively. • Group 2: Control group had a standard wound drainage system. Allogeneic blood transfused was supplied post-operatively when required. One unit of banked blood was given intra-operatively.
Outcomes	***Outcomes reported:*** number of patients transfused allogeneic blood, amount of allogeneic blood transfused, volume of blood re-transfused from the cell saver, blood loss, Hb & Hct levels.
Notes	***Transfusion threshold:*** the criteria for allogeneic blood transfusion post-operatively were the values of haemoglobin (lower than 9.0g/dL) in correlation with the clinical signs of the patient.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was not described.
Blinding (performance bias and detection bias) All outcomes	High risk	

Zhang 2008

Methods	Randomised controlled trial was conducted to investigate the effectiveness of pre-operative plateletpheresis combined with intra-operative autotransfusion on the blood coagulation of orthopaedic patients.[Chinese]

Zhang 2008 *(Continued)*

Participants	60 patients undergoing orthopaedic procedures were randomly allocated to one of three groups: • Group 1 (Autotransfusion group): n=20 • Group 2 (Platelet-rich plasmapheresis + autotransfusion group): n=20 • Group 3 (Control group): n=20 NB: Demographic data not reported for each trial arm.
Interventions	• Group 1: Autotransfusion group received intra-operative autotransfusion of shed blood using the Haemonetics Cell Saver 5 system. • Group 2: Platelet-rich plasmapheresis group received platelet-rich plasma (PRP)and autotransfusion with the use of the Haemonetics Cell Saver 5 system. • Group 3: Control group received standard care without PRP and autotransfusion.
Outcomes	***Outcomes reported:*** number of patients transfused allogeneic blood, blood loss.
Notes	***Transfusion threshold:*** uncertain.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was unclear.
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was unclear.
Blinding (performance bias and detection bias) All outcomes	High risk	

Zhao 1996

Methods	Prospective, randomised controlled trial was conducted to determine whether the autotransfusion of shed mediastinal blood after open heart surgery is safe and effective. Method of randomisation and allocation concealment were not described.
Participants	42 patients undergoing cardiac operations were randomised to one of two groups: • Group 1 (Autotransfusion group): n=22; mean (sd) age = 49 (11.0) years • Group 2 (Control group): n=20; mean (sd) age = 45 (12.0) years
Interventions	• Group 1: Autotransfusion group patients received non-washed shed mediastinal blood during the post-operative period. • Group 2: Control group received banked blood only. Autotransfusion was not performed.
Outcomes	***Outcomes reported:*** amount of blood re-transfused from the cell saver, amount of allogeneic blood transfused, blood loss, Hb levels.
Notes	***Transfusion threshold:*** transfusion protocol was not reported. English abstract only.

Risk of bias

Bias	Authors' judgement	Support for judgement

Zhao 1996 *(Continued)*

Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was not described.
Blinding (performance bias and detection bias) All outcomes	High risk	

Zhao 2003

Methods	Randomised controlled trial was conducted to determine the safety and effectiveness of autotransfusion of shed mediastinal blood after open heart surgery. Between January 2000 and October 2000, patients undergoing primary elective coronary artery bypass graft (CABG) surgery were enrolled in this randomised controlled trial. Method of randomisation and allocation concealment were unclear. Participants were not blind to treatment allocation and blinding of the outcome assessor was unclear.
Participants	60 patients undergoing elective primary coronary artery bypass graft surgery were randomly allocated to one of two groups: • Group 1 (Autotransfusion group): n=30; M/F=26/4; mean (sd) age = 59.5 (8.0) years • Group 2 (Control group): n=30; M/F=27/3; mean (sd) age = 59.2 (8.2) years Exclusion criteria: bleeding time more than 10 minutes due to anti-coagulant use; pre-operative left ventricular ejection fraction (LVEF) less than 0.40; diabetes; pulmonary or renal disease.
Interventions	• Group 1: Autotransfusion group patients received non-washed shed mediastinal blood re-transfused post-operatively after CABG using a cell saver device (Beijing PerMed Biomedical Engineering Company) up to 18 hours post-surgery. Shed blood not returned within 4 hours was discarded and a new bag attached. When more than 200mls of shed mediastinal blood was collected within 4 hours the patients received autologous blood if volume replacement was considered necessary. Extracorporeal blood was routinely returned to patients after CABG. • Group 2: Control group received banked allogeneic blood only. Autotransfusion was not used. Extracorporeal blood was routinely returned to patients after CABG.
Outcomes	***Outcomes reported:*** number of patients transfused allogeneic blood, volume of allogeneic blood transfused, number of patients transfused autologous blood, volume of autologous blood transfused, blood loss.
Notes	***Transfusion threshold:*** transfusion protocol for allogeneic blood transfusion was not reported.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was not described.
Blinding (performance bias and detection bias) All outcomes	High risk	

Characteristics of excluded studies *[ordered by study ID]*

Study	Reason for exclusion
Adan 1988	Insufficient data.
Bartels 1996	Compared two active interventions. No control group.
Bell 1992	Insufficient data.
Breakwell 2000	Insufficient data.
Dalrymple-Hay 2001	Duplicate article.
Deramoudt 1991	Insufficient data.
Elawad 1992	Inappropriate control group.
Farrer 1997	Duplicate article.
Jacobi 1997	Insufficient data.
Kristensen 1992	Insufficient data.
Mac 1993	Insufficient data.
Mayer 1985	Insufficient data.
McShane 1987	Insufficient data.
Schaff 1978b	Duplicate article.
Schmidt 1997a	Duplicate article.
Schmidt 1997b	Duplicate article.
Skoura 1997	Insufficient data.
Thompson 1990	Insufficient data.
Trubel 1995	Compared two active interventions. No control group.
Vertrees 1996	Inappropriate control group.

DATA AND ANALYSES

Comparison 1. Cell salvage - blood transfused (all studies)

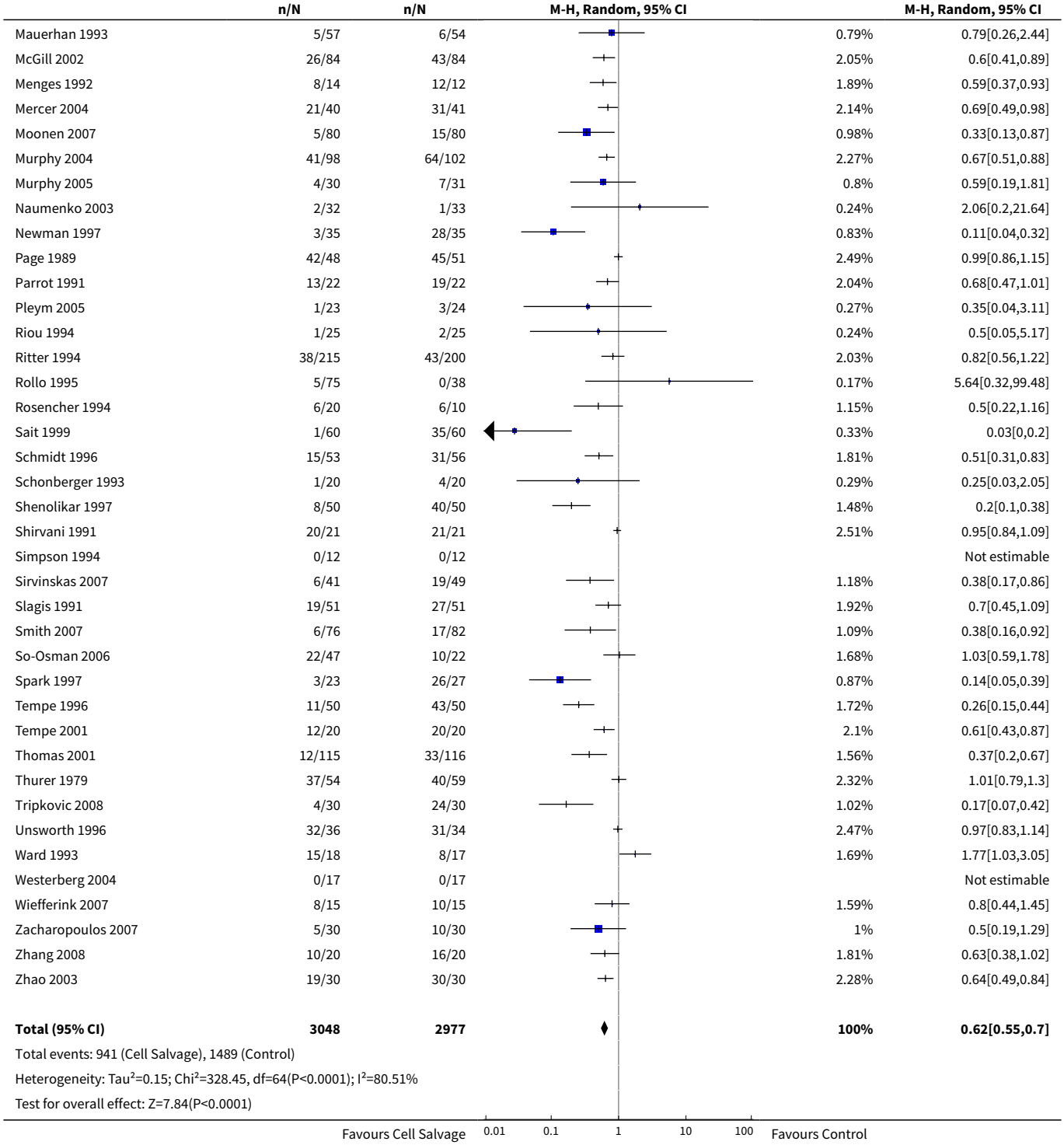
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 No. exposed to allogeneic blood (All Studies)	67	6025	Risk Ratio (M-H, Random, 95% CI)	0.62 [0.55, 0.70]
2 No. exposed to allogeneic blood (Transfusion Protocol)	67		Risk Ratio (M-H, Random, 95% CI)	Subtotals only
2.1 Transfusion Protocol	52	4755	Risk Ratio (M-H, Random, 95% CI)	0.62 [0.54, 0.71]
2.2 No Transfusion Protocol	15	1270	Risk Ratio (M-H, Random, 95% CI)	0.58 [0.41, 0.82]
3 No. exposed to allogeneic blood (Type of Surgery)	67		Risk Ratio (M-H, Random, 95% CI)	Subtotals only
3.1 Cardiac	31	2518	Risk Ratio (M-H, Random, 95% CI)	0.77 [0.69, 0.86]
3.2 Orthopaedic	32	3240	Risk Ratio (M-H, Random, 95% CI)	0.46 [0.37, 0.57]
3.3 Vascular	4	267	Risk Ratio (M-H, Random, 95% CI)	0.63 [0.34, 1.15]
4 No. exposed to allogeneic blood - (Washed vs Unwashed)	67		Risk Ratio (M-H, Random, 95% CI)	Subtotals only
4.1 Washed	27	2225	Risk Ratio (M-H, Random, 95% CI)	0.60 [0.51, 0.70]
4.2 Unwashed	40	3717	Risk Ratio (M-H, Random, 95% CI)	0.66 [0.57, 0.77]
5 No. exposed to allogeneic blood (Timing)	66		Risk Ratio (M-H, Random, 95% CI)	Subtotals only
5.1 Intra-operative cell salvage	11	805	Risk Ratio (M-H, Random, 95% CI)	0.59 [0.46, 0.76]
5.2 Post-operative cell salvage	46	4361	Risk Ratio (M-H, Random, 95% CI)	0.63 [0.54, 0.74]
5.3 Intra & post-operative cell salvage	9	737	Risk Ratio (M-H, Random, 95% CI)	0.70 [0.54, 0.92]
6 Units of allogeneic blood transfused (All Studies)	32	2321	Mean Difference (IV, Random, 95% CI)	-0.68 [-0.88, -0.49]
7 Units of allogeneic blood transfused (Transfusion Protocol)	32		Mean Difference (IV, Random, 95% CI)	Subtotals only
7.1 Transfusion Protocol	27	1950	Mean Difference (IV, Random, 95% CI)	-0.69 [-0.90, -0.49]

Outcome or subgroup title	No. of studies	No. of partici-pants	Statistical method	Effect size
7.2 No Transfusion Protocol	5	371	Mean Difference (IV, Random, 95% CI)	-0.64 [-1.30, 0.01]
8 Units of allogeneic blood transfused (Type of Surgery)	32		Mean Difference (IV, Random, 95% CI)	Subtotals only
8.1 Cardiac	19	1497	Mean Difference (IV, Random, 95% CI)	-0.67 [-0.89, -0.44]
8.2 Orthopaedic	10	638	Mean Difference (IV, Random, 95% CI)	-0.81 [-1.22, -0.39]
8.3 Vascular	3	186	Mean Difference (IV, Random, 95% CI)	0.02 [-0.34, 0.38]

Analysis 1.1. Comparison 1 Cell salvage - blood transfused (all studies), Outcome 1 No. exposed to allogeneic blood (All Studies).

Study or subgroup	Cell Salvage n/N	Control n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
Abuzakuk 2007	13/52	12/52		1.41%	1.08[0.55,2.15]
Adalberth 1998	8/24	10/25		1.31%	0.83[0.4,1.75]
Amin 2008	12/92	13/86		1.33%	0.86[0.42,1.79]
Axford 1994	10/16	14/16		1.96%	0.71[0.47,1.09]
Ayers 1995	1/67	15/89		0.32%	0.09[0.01,0.65]
Bouboulis 1994	34/42	28/33		2.4%	0.95[0.78,1.17]
Cheng 2005	4/26	13/34		0.93%	0.4[0.15,1.09]
Clagett 1999	33/50	36/50		2.3%	0.92[0.7,1.19]
Dalrymple-Hay 1999	28/56	46/56		2.25%	0.61[0.46,0.81]
Damgaard 2006	17/30	21/29		2.04%	0.78[0.53,1.15]
Dietrich 1989	17/25	22/25		2.21%	0.77[0.57,1.05]
Dramis 2006	3/32	10/17		0.77%	0.16[0.05,0.5]
Elawad 1991	6/20	18/20		1.41%	0.33[0.17,0.66]
Eng 1990	17/20	17/20		2.3%	1[0.77,1.3]
Fragnito 1995	17/41	27/41		1.95%	0.63[0.41,0.96]
Gannon 1991	16/124	45/115		1.77%	0.33[0.2,0.55]
Healy 1994	20/75	23/43		1.86%	0.5[0.31,0.8]
Heddle 1992	10/39	27/40		1.63%	0.38[0.21,0.68]
Kelley 1993	4/18	3/18		0.61%	1.33[0.35,5.13]
Klein 2008	31/102	33/111		1.99%	1.02[0.68,1.54]
Koopman 1993a	15/17	20/20		2.41%	0.88[0.72,1.07]
Koopman 1993b	5/29	13/30		1.07%	0.4[0.16,0.97]
Laub 1993	5/19	13/19		1.19%	0.38[0.17,0.87]
Lepore 1989	50/67	62/68		2.47%	0.82[0.7,0.96]
Lorentz 1991	8/16	10/15		1.56%	0.75[0.41,1.38]
Mah 1995	9/44	26/55		1.48%	0.43[0.23,0.83]
Majowski 1991	7/20	19/20		1.56%	0.37[0.2,0.68]
Martin 2000	54/98	73/100		2.39%	0.75[0.61,0.94]

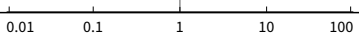
Favours Cell Salvage Favours Control



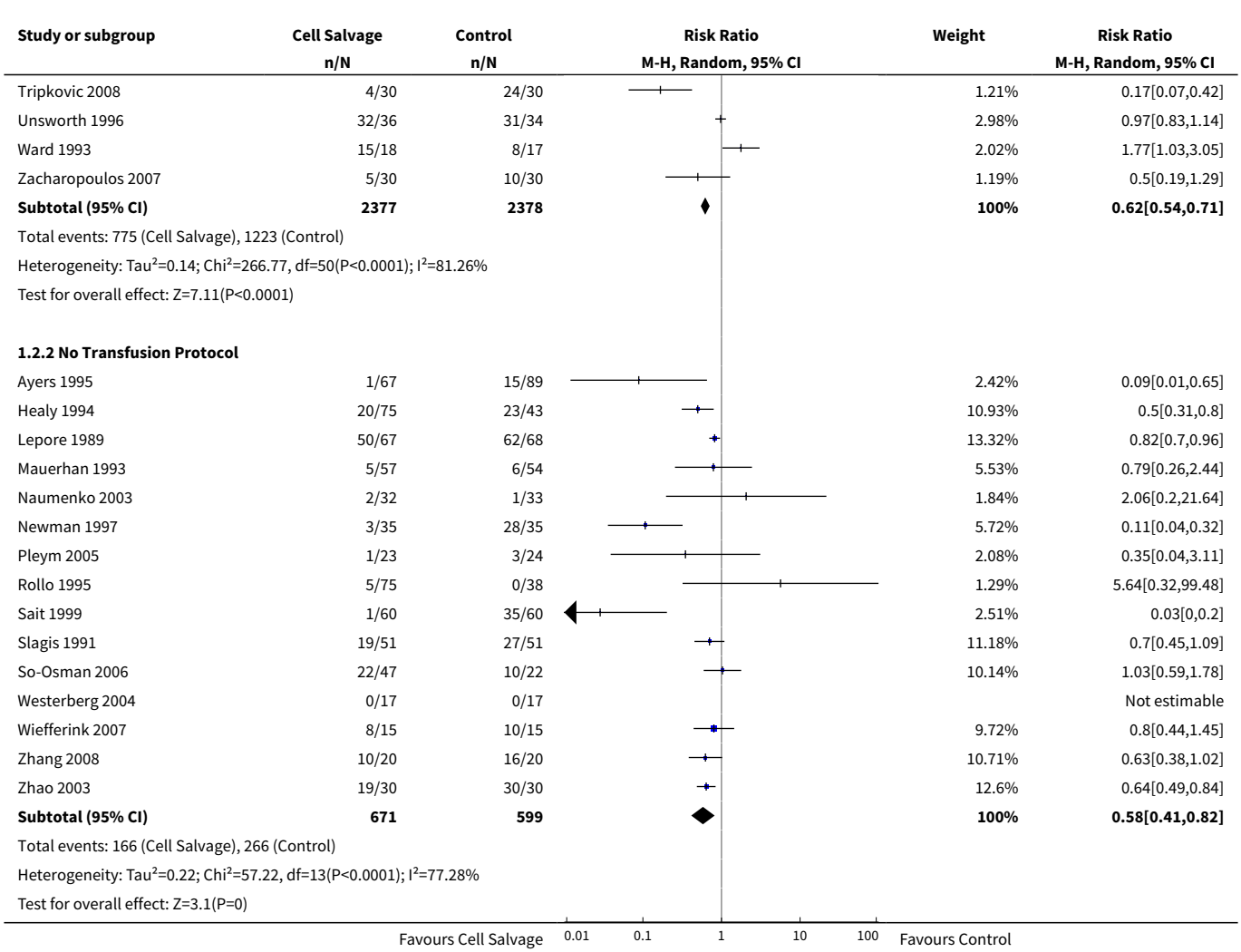
Study or subgroup	Cell Salvage n/N	Control n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
Mauerhan 1993	5/57	6/54		0.79%	0.79[0.26,2.44]
McGill 2002	26/84	43/84		2.05%	0.6[0.41,0.89]
Menges 1992	8/14	12/12		1.89%	0.59[0.37,0.93]
Mercer 2004	21/40	31/41		2.14%	0.69[0.49,0.98]
Moonen 2007	5/80	15/80		0.98%	0.33[0.13,0.87]
Murphy 2004	41/98	64/102		2.27%	0.67[0.51,0.88]
Murphy 2005	4/30	7/31		0.8%	0.59[0.19,1.81]
Naumenko 2003	2/32	1/33		0.24%	2.06[0.2,21.64]
Newman 1997	3/35	28/35		0.83%	0.11[0.04,0.32]
Page 1989	42/48	45/51		2.49%	0.99[0.86,1.15]
Parrot 1991	13/22	19/22		2.04%	0.68[0.47,1.01]
Pleym 2005	1/23	3/24		0.27%	0.35[0.04,3.11]
Riou 1994	1/25	2/25		0.24%	0.5[0.05,5.17]
Ritter 1994	38/215	43/200		2.03%	0.82[0.56,1.22]
Rollo 1995	5/75	0/38		0.17%	5.64[0.32,99.48]
Rosencher 1994	6/20	6/10		1.15%	0.5[0.22,1.16]
Sait 1999	1/60	35/60		0.33%	0.03[0,0.2]
Schmidt 1996	15/53	31/56		1.81%	0.51[0.31,0.83]
Schonberger 1993	1/20	4/20		0.29%	0.25[0.03,2.05]
Shenolikar 1997	8/50	40/50		1.48%	0.2[0.1,0.38]
Shirvani 1991	20/21	21/21		2.51%	0.95[0.84,1.09]
Simpson 1994	0/12	0/12			Not estimable
Sirvinskas 2007	6/41	19/49		1.18%	0.38[0.17,0.86]
Slagis 1991	19/51	27/51		1.92%	0.7[0.45,1.09]
Smith 2007	6/76	17/82		1.09%	0.38[0.16,0.92]
So-Osman 2006	22/47	10/22		1.68%	1.03[0.59,1.78]
Spark 1997	3/23	26/27		0.87%	0.14[0.05,0.39]
Tempe 1996	11/50	43/50		1.72%	0.26[0.15,0.44]
Tempe 2001	12/20	20/20		2.1%	0.61[0.43,0.87]
Thomas 2001	12/115	33/116		1.56%	0.37[0.2,0.67]
Thurer 1979	37/54	40/59		2.32%	1.01[0.79,1.3]
Tripkovic 2008	4/30	24/30		1.02%	0.17[0.07,0.42]
Unsworth 1996	32/36	31/34		2.47%	0.97[0.83,1.14]
Ward 1993	15/18	8/17		1.69%	1.77[1.03,3.05]
Westerberg 2004	0/17	0/17			Not estimable
Wiefferink 2007	8/15	10/15		1.59%	0.8[0.44,1.45]
Zacharopoulos 2007	5/30	10/30		1%	0.5[0.19,1.29]
Zhang 2008	10/20	16/20		1.81%	0.63[0.38,1.02]
Zhao 2003	19/30	30/30		2.28%	0.64[0.49,0.84]
Total (95% CI)	**3048**	**2977**		**100%**	**0.62[0.55,0.7]**
Total events: 941 (Cell Salvage), 1489 (Control)					
Heterogeneity: Tau²=0.15; Chi²=328.45, df=64(P<0.0001); I²=80.51%					
Test for overall effect: Z=7.84(P<0.0001)					

Analysis 1.2. Comparison 1 Cell salvage - blood transfused (all studies), Outcome 2 No. exposed to allogeneic blood (Transfusion Protocol).

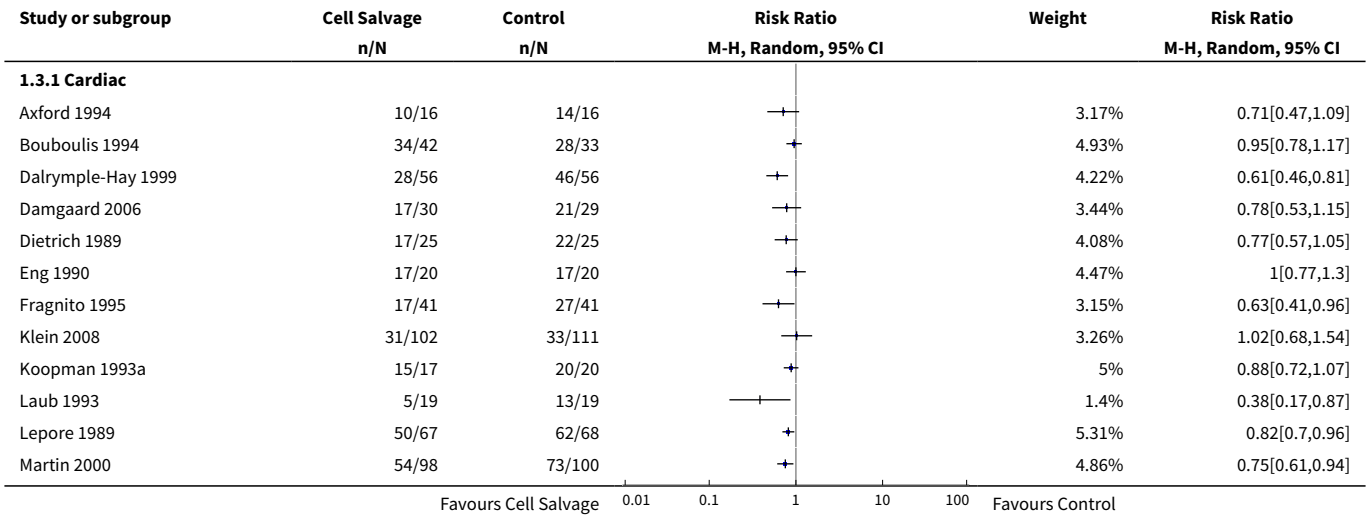
Study or subgroup	Cell Salvage n/N	Control n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
1.2.1 Transfusion Protocol					
Abuzakuk 2007	13/52	12/52		1.69%	1.08[0.55,2.15]
Adalberth 1998	8/24	10/25		1.56%	0.83[0.4,1.75]
Amin 2008	12/92	13/86		1.59%	0.86[0.42,1.79]
Axford 1994	10/16	14/16		2.35%	0.71[0.47,1.09]
Bouboulis 1994	34/42	28/33		2.89%	0.95[0.78,1.17]
Cheng 2005	4/26	13/34		1.11%	0.4[0.15,1.09]
Clagett 1999	33/50	36/50		2.76%	0.92[0.7,1.19]
Dalrymple-Hay 1999	28/56	46/56		2.7%	0.61[0.46,0.81]
Damgaard 2006	17/30	21/29		2.45%	0.78[0.53,1.15]
Dietrich 1989	17/25	22/25		2.66%	0.77[0.57,1.05]
Dramis 2006	3/32	10/17		0.92%	0.16[0.05,0.5]
Elawad 1991	6/20	18/20		1.68%	0.33[0.17,0.66]
Eng 1990	17/20	17/20		2.77%	1[0.77,1.3]
Fragnito 1995	17/41	27/41		2.34%	0.63[0.41,0.96]
Gannon 1991	16/124	45/115		2.11%	0.33[0.2,0.55]
Heddle 1992	10/39	27/40		1.94%	0.38[0.21,0.68]
Kelley 1993	4/18	3/18		0.73%	1.33[0.35,5.13]
Klein 2008	31/102	33/111		2.39%	1.02[0.68,1.54]
Koopman 1993a	15/17	20/20		2.91%	0.88[0.72,1.07]
Koopman 1993b	5/29	13/30		1.27%	0.4[0.16,0.97]
Laub 1993	5/19	13/19		1.42%	0.38[0.17,0.87]
Lorentz 1991	8/16	10/15		1.87%	0.75[0.41,1.38]
Mah 1995	9/44	26/55		1.77%	0.43[0.23,0.83]
Majowski 1991	7/20	19/20		1.87%	0.37[0.2,0.68]
Martin 2000	54/98	73/100		2.87%	0.75[0.61,0.94]
McGill 2002	26/84	43/84		2.46%	0.6[0.41,0.89]
Menges 1992	8/14	12/12		2.26%	0.59[0.37,0.93]
Mercer 2004	21/40	31/41		2.57%	0.69[0.49,0.98]
Moonen 2007	5/80	15/80		1.16%	0.33[0.13,0.87]
Murphy 2004	41/98	64/102		2.73%	0.67[0.51,0.88]
Murphy 2005	4/30	7/31		0.95%	0.59[0.19,1.81]
Page 1989	42/48	45/51		2.99%	0.99[0.86,1.15]
Parrot 1991	13/22	19/22		2.45%	0.68[0.47,1.01]
Riou 1994	1/25	2/25		0.29%	0.5[0.05,5.17]
Ritter 1994	38/215	43/200		2.44%	0.82[0.56,1.22]
Rosencher 1994	6/20	6/10		1.37%	0.5[0.22,1.16]
Schmidt 1996	15/53	31/56		2.17%	0.51[0.31,0.83]
Schonberger 1993	1/20	4/20		0.35%	0.25[0.03,2.05]
Shenolikar 1997	8/50	40/50		1.76%	0.2[0.1,0.38]
Shirvani 1991	20/21	21/21		3.02%	0.95[0.84,1.09]
Simpson 1994	0/12	0/12			Not estimable
Sirvinskas 2007	6/41	19/49		1.41%	0.38[0.17,0.86]
Smith 2007	6/76	17/82		1.3%	0.38[0.16,0.92]
Spark 1997	3/23	26/27		1.03%	0.14[0.05,0.39]
Tempe 1996	11/50	43/50		2.05%	0.26[0.15,0.44]
Tempe 2001	12/20	20/20		2.52%	0.61[0.43,0.87]
Thomas 2001	12/115	33/116		1.86%	0.37[0.2,0.67]
Thurer 1979	37/54	40/59		2.79%	1.01[0.79,1.3]



Favours Cell Salvage | Favours Control

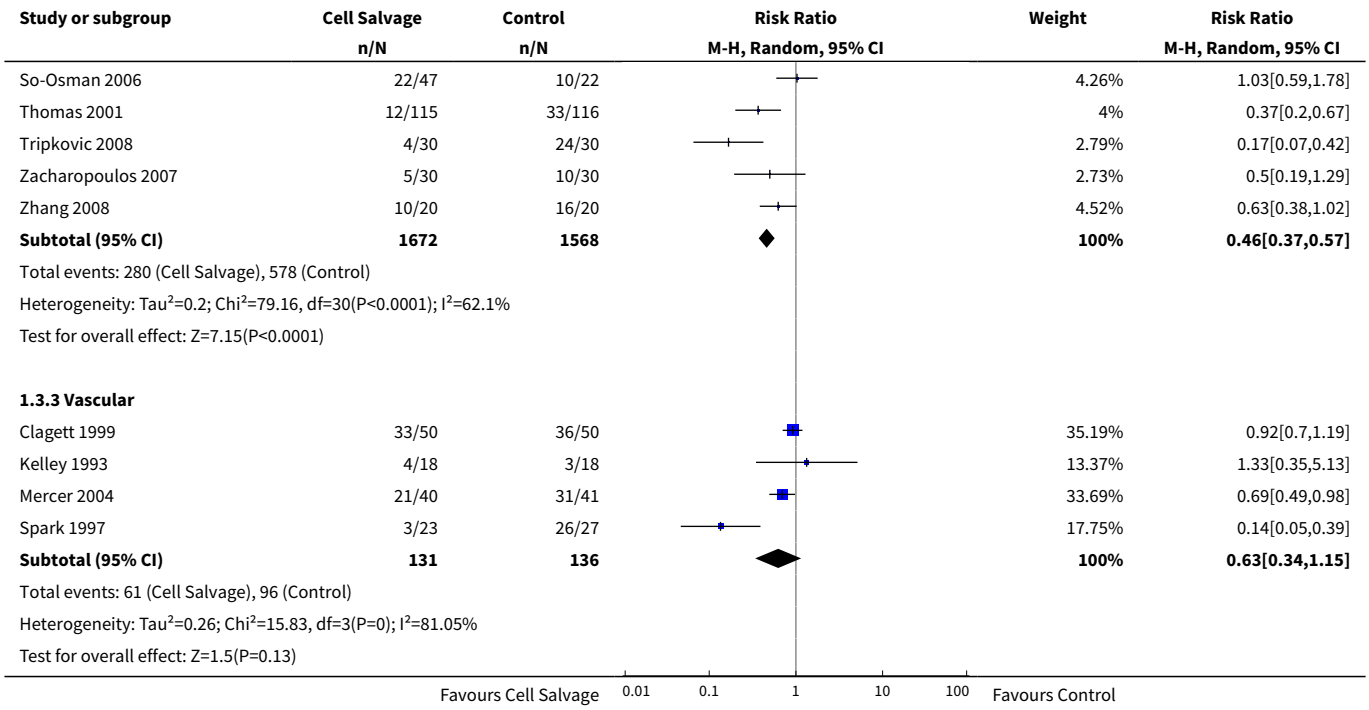


Analysis 1.3. Comparison 1 Cell salvage - blood transfused (all studies), Outcome 3 No. exposed to allogeneic blood (Type of Surgery).

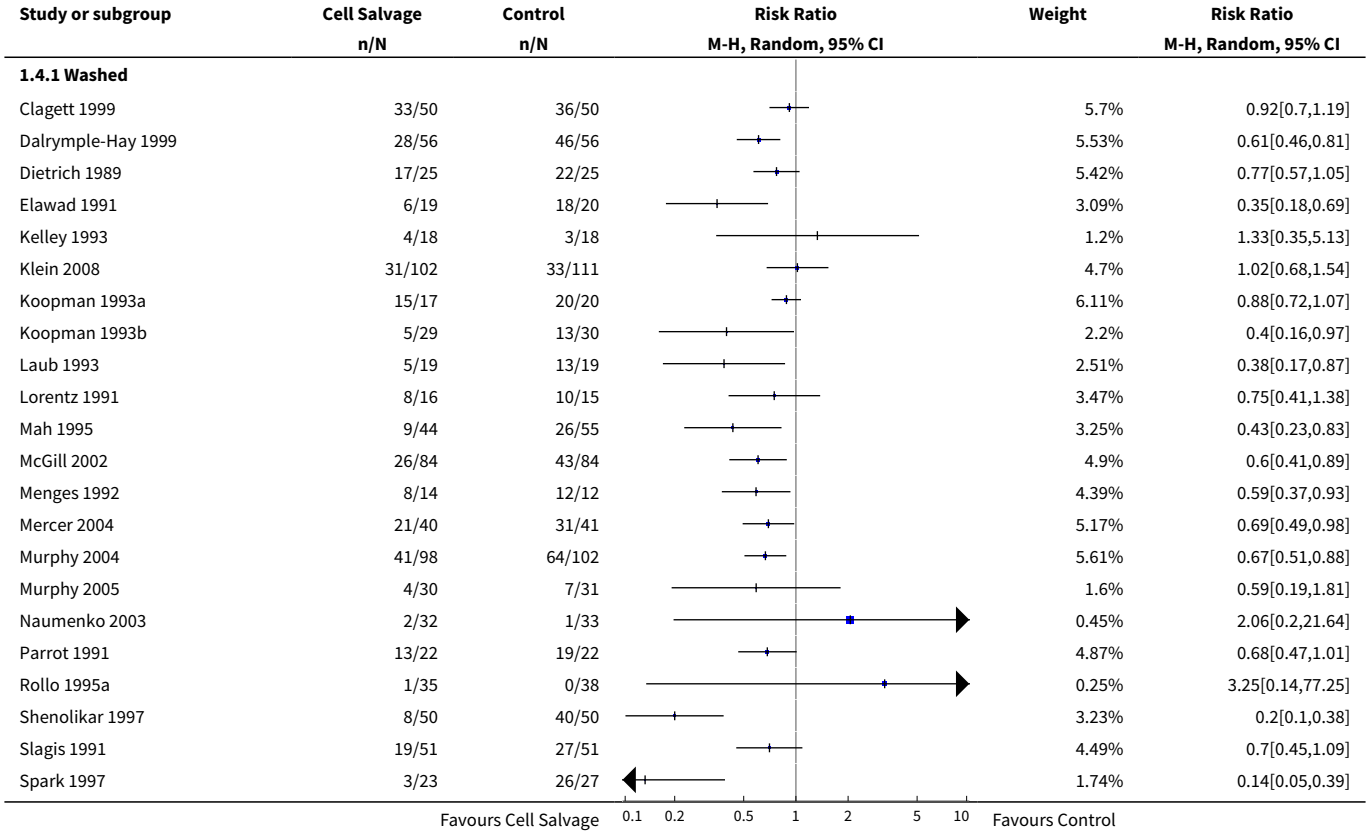


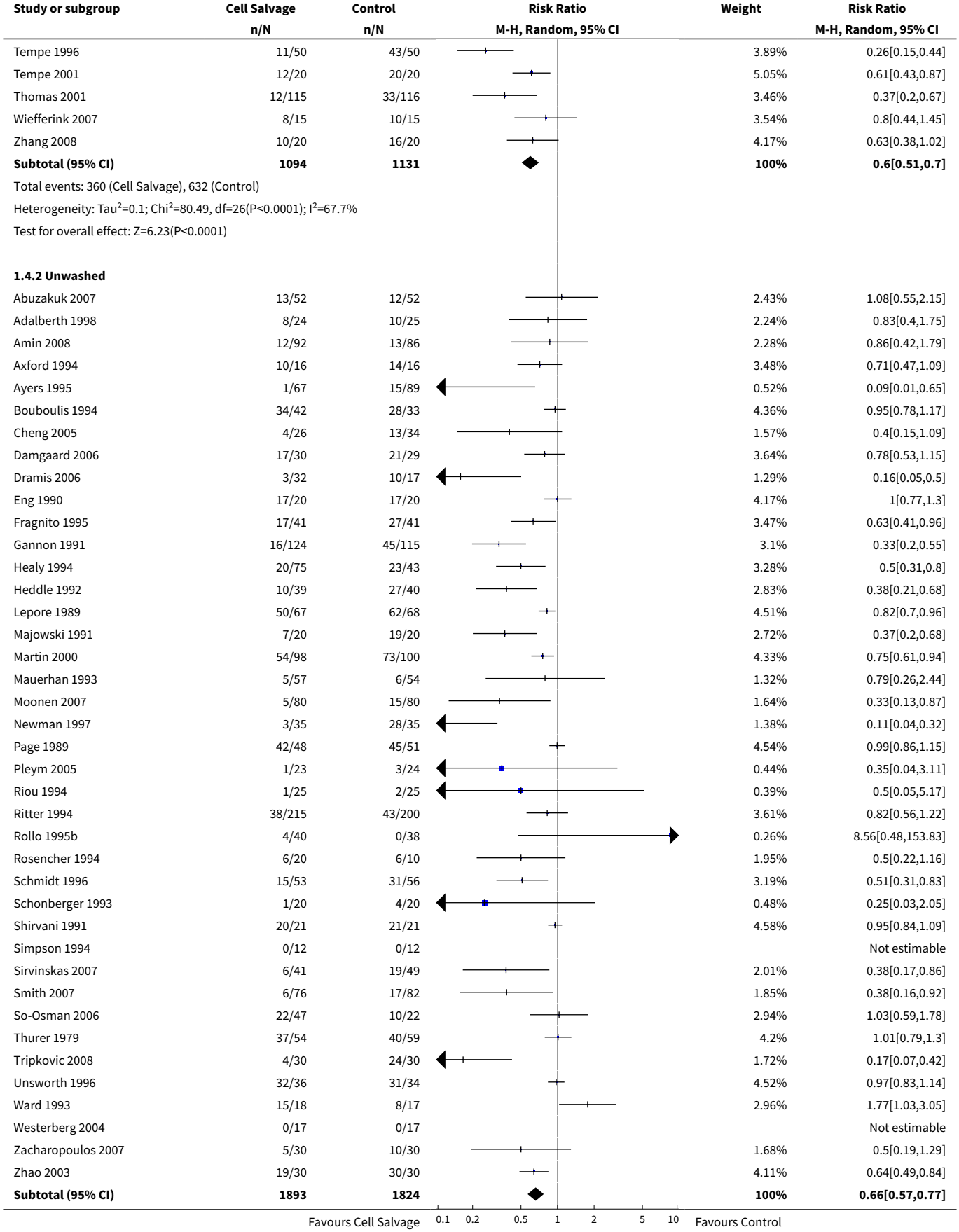
Study or subgroup	Cell Salvage n/N	Control n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
McGill 2002	26/84	43/84		3.47%	0.6[0.41,0.89]
Murphy 2004	41/98	64/102		4.32%	0.67[0.51,0.88]
Murphy 2005	4/30	7/31		0.83%	0.59[0.19,1.81]
Naumenko 2003	2/32	1/33		0.21%	2.06[0.2,21.64]
Page 1989	42/48	45/51		5.39%	0.99[0.86,1.15]
Parrot 1991	13/22	19/22		3.44%	0.68[0.47,1.01]
Pleym 2005	1/23	3/24		0.24%	0.35[0.04,3.11]
Schmidt 1996	15/53	31/56		2.73%	0.51[0.31,0.83]
Schonberger 1993	1/20	4/20		0.26%	0.25[0.03,2.05]
Shirvani 1991	20/21	21/21		5.51%	0.95[0.84,1.09]
Sirvinskas 2007	6/41	19/49		1.38%	0.38[0.17,0.86]
Tempe 1996	11/50	43/50		2.48%	0.26[0.15,0.44]
Tempe 2001	12/20	20/20		3.64%	0.61[0.43,0.87]
Thurer 1979	37/54	40/59		4.54%	1.01[0.79,1.3]
Unsworth 1996	32/36	31/34		5.32%	0.97[0.83,1.14]
Ward 1993	15/18	8/17		2.42%	1.77[1.03,3.05]
Westerberg 2004	0/17	0/17			Not estimable
Wiefferink 2007	8/15	10/15		2.18%	0.8[0.44,1.45]
Zhao 2003	19/30	30/30		4.35%	0.64[0.49,0.84]
Subtotal (95% CI)	**1245**	**1273**		**100%**	**0.77[0.69,0.86]**
Total events: 600 (Cell Salvage), 815 (Control)					
Heterogeneity: Tau^2=0.05; Chi^2=104.12, df=29(P<0.0001); I^2=72.15%					
Test for overall effect: Z=4.74(P<0.0001)					
1.3.2 Orthopaedic					
Abuzakuk 2007	13/52	12/52		3.69%	1.08[0.55,2.15]
Adalberth 1998	8/24	10/25		3.45%	0.83[0.4,1.75]
Amin 2008	12/92	13/86		3.51%	0.86[0.42,1.79]
Ayers 1995	1/67	15/89		0.95%	0.09[0.01,0.65]
Cheng 2005	4/26	13/34		2.58%	0.4[0.15,1.09]
Dramis 2006	3/32	10/17		2.18%	0.16[0.05,0.5]
Elawad 1991	6/20	18/20		3.68%	0.33[0.17,0.66]
Gannon 1991	16/124	45/115		4.43%	0.33[0.2,0.55]
Healy 1994	20/75	23/43		4.62%	0.5[0.31,0.8]
Heddle 1992	10/39	27/40		4.14%	0.38[0.21,0.68]
Koopman 1993b	5/29	13/30		2.9%	0.4[0.16,0.97]
Lorentz 1991	8/16	10/15		4.01%	0.75[0.41,1.38]
Mah 1995	9/44	26/55		3.84%	0.43[0.23,0.83]
Majowski 1991	7/20	19/20		4.02%	0.37[0.2,0.68]
Mauerhan 1993	5/57	6/54		2.23%	0.79[0.26,2.44]
Menges 1992	8/14	12/12		4.67%	0.59[0.37,0.93]
Moonen 2007	5/80	15/80		2.68%	0.33[0.13,0.87]
Newman 1997	3/35	28/35		2.31%	0.11[0.04,0.32]
Riou 1994	1/25	2/25		0.73%	0.5[0.05,5.17]
Ritter 1994	38/215	43/200		4.95%	0.82[0.56,1.22]
Rollo 1995	5/75	0/38		0.5%	5.64[0.32,99.48]
Rosencher 1994	6/20	6/10		3.09%	0.5[0.22,1.16]
Sait 1999	1/60	35/60		0.99%	0.03[0,0.2]
Shenolikar 1997	8/50	40/50		3.83%	0.2[0.1,0.38]
Simpson 1994	0/12	0/12			Not estimable
Slagis 1991	19/51	27/51		4.74%	0.7[0.45,1.09]
Smith 2007	6/76	17/82		2.96%	0.38[0.16,0.92]

Favours Cell Salvage — Favours Control



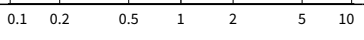
Analysis 1.4. Comparison 1 Cell salvage - blood transfused (all studies), Outcome 4 No. exposed to allogeneic blood - (Washed vs Unwashed).





Study or subgroup	Cell Salvage n/N	Control n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
Tempe 1996	11/50	43/50		3.89%	0.26[0.15,0.44]
Tempe 2001	12/20	20/20		5.05%	0.61[0.43,0.87]
Thomas 2001	12/115	33/116		3.46%	0.37[0.2,0.67]
Wiefferink 2007	8/15	10/15		3.54%	0.8[0.44,1.45]
Zhang 2008	10/20	16/20		4.17%	0.63[0.38,1.02]
Subtotal (95% CI)	**1094**	**1131**		**100%**	**0.6[0.51,0.7]**
Total events: 360 (Cell Salvage), 632 (Control)					
Heterogeneity: Tau²=0.1; Chi²=80.49, df=26(P<0.0001); I²=67.7%					
Test for overall effect: Z=6.23(P<0.0001)					
1.4.2 Unwashed					
Abuzakuk 2007	13/52	12/52		2.43%	1.08[0.55,2.15]
Adalberth 1998	8/24	10/25		2.24%	0.83[0.4,1.75]
Amin 2008	12/92	13/86		2.28%	0.86[0.42,1.79]
Axford 1994	10/16	14/16		3.48%	0.71[0.47,1.09]
Ayers 1995	1/67	15/89		0.52%	0.09[0.01,0.65]
Bouboulis 1994	34/42	28/33		4.36%	0.95[0.78,1.17]
Cheng 2005	4/26	13/34		1.57%	0.4[0.15,1.09]
Damgaard 2006	17/30	21/29		3.64%	0.78[0.53,1.15]
Dramis 2006	3/32	10/17		1.29%	0.16[0.05,0.5]
Eng 1990	17/20	17/20		4.17%	1[0.77,1.3]
Fragnito 1995	17/41	27/41		3.47%	0.63[0.41,0.96]
Gannon 1991	16/124	45/115		3.1%	0.33[0.2,0.55]
Healy 1994	20/75	23/43		3.28%	0.5[0.31,0.8]
Heddle 1992	10/39	27/40		2.83%	0.38[0.21,0.68]
Lepore 1989	50/67	62/68		4.51%	0.82[0.7,0.96]
Majowski 1991	7/20	19/20		2.72%	0.37[0.2,0.68]
Martin 2000	54/98	73/100		4.33%	0.75[0.61,0.94]
Mauerhan 1993	5/57	6/54		1.32%	0.79[0.26,2.44]
Moonen 2007	5/80	15/80		1.64%	0.33[0.13,0.87]
Newman 1997	3/35	28/35		1.38%	0.11[0.04,0.32]
Page 1989	42/48	45/51		4.54%	0.99[0.86,1.15]
Pleym 2005	1/23	3/24		0.44%	0.35[0.04,3.11]
Riou 1994	1/25	2/25		0.39%	0.5[0.05,5.17]
Ritter 1994	38/215	43/200		3.61%	0.82[0.56,1.22]
Rollo 1995b	4/40	0/38		0.26%	8.56[0.48,153.83]
Rosencher 1994	6/20	6/10		1.95%	0.5[0.22,1.16]
Schmidt 1996	15/53	31/56		3.19%	0.51[0.31,0.83]
Schonberger 1993	1/20	4/20		0.48%	0.25[0.03,2.05]
Shirvani 1991	20/21	21/21		4.58%	0.95[0.84,1.09]
Simpson 1994	0/12	0/12			Not estimable
Sirvinskas 2007	6/41	19/49		2.01%	0.38[0.17,0.86]
Smith 2007	6/76	17/82		1.85%	0.38[0.16,0.92]
So-Osman 2006	22/47	10/22		2.94%	1.03[0.59,1.78]
Thurer 1979	37/54	40/59		4.2%	1.01[0.79,1.3]
Tripkovic 2008	4/30	24/30		1.72%	0.17[0.07,0.42]
Unsworth 1996	32/36	31/34		4.52%	0.97[0.83,1.14]
Ward 1993	15/18	8/17		2.96%	1.77[1.03,3.05]
Westerberg 2004	0/17	0/17			Not estimable
Zacharopoulos 2007	5/30	10/30		1.68%	0.5[0.19,1.29]
Zhao 2003	19/30	30/30		4.11%	0.64[0.49,0.84]
Subtotal (95% CI)	**1893**	**1824**		**100%**	**0.66[0.57,0.77]**

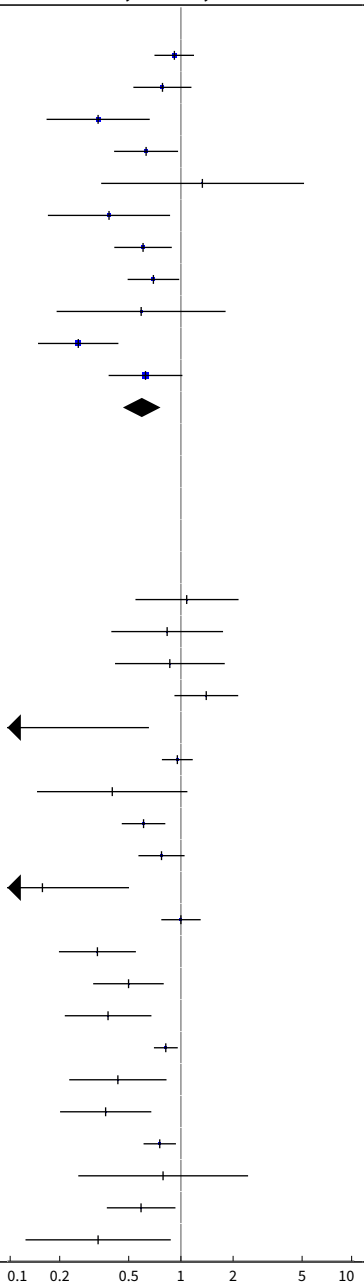
Study or subgroup	Cell Salvage n/N	Control n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
Total events: 580 (Cell Salvage), 822 (Control)					
Heterogeneity: Tau^2=0.13; Chi^2=190.48, df=37(P<0.0001); I^2=80.58%					
Test for overall effect: Z=5.31(P<0.0001)					



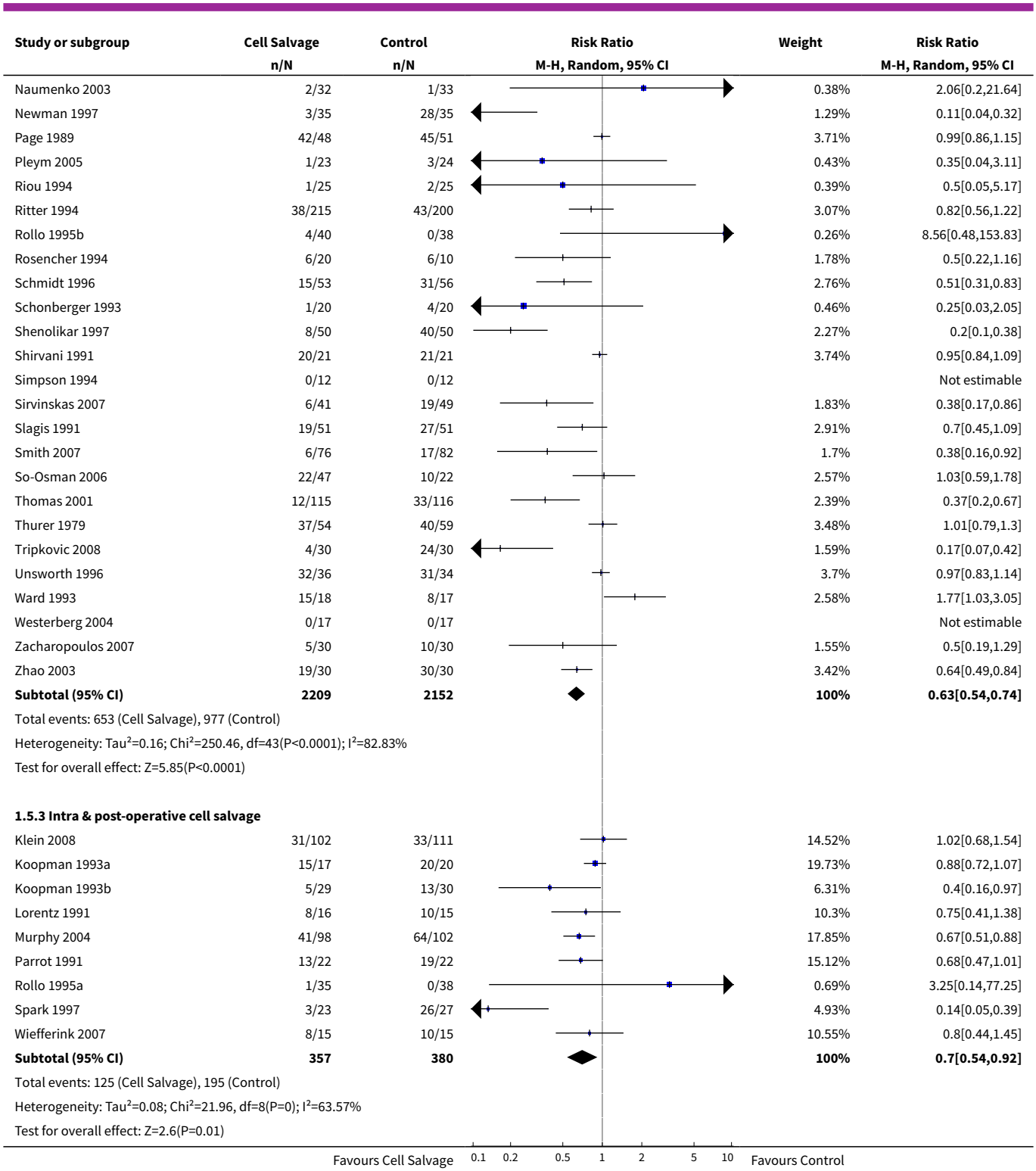
Favours Cell Salvage — Favours Control

Analysis 1.5. Comparison 1 Cell salvage - blood transfused (all studies), Outcome 5 No. exposed to allogeneic blood (Timing).

Study or subgroup	Cell Salvage n/N	Control n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
1.5.1 Intra-operative cell salvage					
Clagett 1999	33/50	36/50		13.77%	0.92[0.7,1.19]
Damgaard 2006	17/30	21/29		11.72%	0.78[0.53,1.15]
Elawad 1991	6/20	18/20		7.3%	0.33[0.17,0.66]
Fragnito 1995	17/41	27/41		11.05%	0.63[0.41,0.96]
Kelley 1993	4/18	3/18		2.83%	1.33[0.35,5.13]
Laub 1993	5/19	13/19		5.97%	0.38[0.17,0.87]
McGill 2002	26/84	43/84		11.78%	0.6[0.41,0.89]
Mercer 2004	21/40	31/41		12.46%	0.69[0.49,0.98]
Murphy 2005	4/30	7/31		3.79%	0.59[0.19,1.81]
Tempe 1996	11/50	43/50		9.32%	0.26[0.15,0.44]
Zhang 2008	10/20	16/20		10%	0.63[0.38,1.02]
Subtotal (95% CI)	**402**	**403**		**100%**	**0.59[0.46,0.76]**
Total events: 154 (Cell Salvage), 258 (Control)					
Heterogeneity: Tau^2=0.1; Chi^2=27.84, df=10(P=0); I^2=64.09%					
Test for overall effect: Z=4.08(P<0.0001)					
1.5.2 Post-operative cell salvage					
Abuzakuk 2007	13/52	12/52		2.17%	1.08[0.55,2.15]
Adalberth 1998	8/24	10/25		2.02%	0.83[0.4,1.75]
Amin 2008	12/92	13/86		2.05%	0.86[0.42,1.79]
Axford 1994	14/16	10/16		2.97%	1.4[0.92,2.14]
Ayers 1995	1/67	15/89		0.51%	0.09[0.01,0.65]
Bouboulis 1994	34/42	28/33		3.59%	0.95[0.78,1.17]
Cheng 2005	4/26	13/34		1.46%	0.4[0.15,1.09]
Dalrymple-Hay 1999	28/56	46/56		3.38%	0.61[0.46,0.81]
Dietrich 1989	17/25	22/25		3.33%	0.77[0.57,1.05]
Dramis 2006	3/32	10/17		1.21%	0.16[0.05,0.5]
Eng 1990	17/20	17/20		3.46%	1[0.77,1.3]
Gannon 1991	16/124	45/115		2.69%	0.33[0.2,0.55]
Healy 1994	20/75	23/43		2.83%	0.5[0.31,0.8]
Heddle 1992	10/39	27/40		2.49%	0.38[0.21,0.68]
Lepore 1989	50/67	62/68		3.69%	0.82[0.7,0.96]
Mah 1995	9/44	26/55		2.28%	0.43[0.23,0.83]
Majowski 1991	7/20	19/20		2.4%	0.37[0.2,0.68]
Martin 2000	54/98	73/100		3.57%	0.75[0.61,0.94]
Mauerhan 1993	5/57	6/54		1.24%	0.79[0.26,2.44]
Menges 1992	8/14	12/12		2.87%	0.59[0.37,0.93]
Moonen 2007	5/80	15/80		1.52%	0.33[0.13,0.87]



Favours Cell Salvage — Favours Control

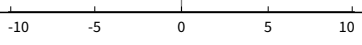


Analysis 1.6. Comparison 1 Cell salvage - blood transfused (all studies), Outcome 6 Units of allogeneic blood transfused (All Studies).

Study or subgroup	Cell Salvage N	Cell Salvage Mean(SD)	Control N	Control Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
Adalberth 1998	24	0.8 (1.1)	25	0.9 (1.3)		3.33%	-0.13[-0.8,0.54]
Altinel 2007	16	1 (1.1)	16	2.3 (1.2)		2.81%	-1.29[-2.1,-0.48]
Axford 1994	16	1.7 (2)	16	2.2 (2.3)		1.36%	-0.52[-1.98,0.94]
Bouboulis 1994	42	1.9 (1.5)	33	2.2 (2)		2.79%	-0.32[-1.14,0.5]
Clagett 1999	50	2.1 (2.1)	50	2.3 (2.1)		2.78%	-0.2[-1.02,0.62]
Dalrymple-Hay 1999	56	1 (1.2)	56	1.7 (1.2)		4.2%	-0.7[-1.15,-0.25]
Davies 1987	25	4 (3.4)	25	5.5 (5.8)		0.51%	-1.5[-4.14,1.14]
Dietrich 1989	25	1.4 (1.9)	25	2.8 (2)		2.08%	-1.42[-2.49,-0.35]
Ekback 1995	15	1.9 (1.6)	15	2.7 (1.2)		2.31%	-0.8[-1.78,0.18]
Elawad 1991	20	0.7 (0.9)	20	2.7 (0.9)		3.82%	-2.04[-2.58,-1.5]
Fragnito 1995	41	2.4 (0.8)	41	2.5 (0.9)		4.53%	-0.04[-0.41,0.33]
Goel 2007	24	1.5 (1.1)	25	2.4 (1.3)		3.32%	-0.86[-1.53,-0.19]
Heddle 1992	39	0.4 (0.8)	40	1.2 (1)		4.41%	-0.8[-1.2,-0.4]
Kelley 1993	18	0.3 (0.7)	18	0.2 (0.6)		4.38%	0.11[-0.3,0.52]
Kirkos 2006	78	0.5 (0.9)	77	1.1 (1.2)		4.7%	-0.52[-0.84,-0.2]
Koopman 1993a	17	4.9 (3.4)	20	6.2 (6)		0.38%	-1.3[-4.39,1.79]
Koopman 1993b	29	0.3 (0.8)	30	1.1 (1.4)		3.67%	-0.8[-1.38,-0.22]
Laub 1993	19	0.6 (1.2)	19	1.3 (1.5)		2.74%	-0.66[-1.49,0.17]
Lepore 1989	67	2.7 (2.8)	68	3.3 (2.7)		2.45%	-0.6[-1.53,0.33]
Martin 2000	98	1.8 (0.7)	100	2.2 (0.5)		5.18%	-0.4[-0.57,-0.23]
McGill 2002	84	0.7 (1.6)	84	1.1 (1.6)		4.12%	-0.39[-0.86,0.08]
Niranjan 2006	40	0.5 (0.7)	40	1.4 (1.3)		4.19%	-0.85[-1.3,-0.4]
Page 1989	48	3.2 (2.1)	51	3.8 (2.6)		2.49%	-0.68[-1.6,0.24]
Parrot 1991	22	1.4 (1.5)	22	2.2 (1.3)		2.76%	-0.8[-1.63,0.03]
Schaff 1978a	63	2.4 (2.4)	51	4.8 (4.3)		1.59%	-2.4[-3.71,-1.09]
Schonberger 1993	20	0.1 (1.3)	20	0.6 (1.3)		2.75%	-0.5[-1.33,0.33]
Shirvani 1991	21	2.6 (1.7)	21	2.5 (1)		2.71%	0.03[-0.81,0.87]
Slagis 1991	51	0.8 (1.2)	51	1.5 (1.4)		3.98%	-0.69[-1.2,-0.18]
So-Osman 2006	22	2.4 (0.9)	10	1.9 (0.7)		3.71%	0.46[-0.11,1.03]
Tripkovic 2008	30	0.2 (1)	30	1.7 (1.2)		3.83%	-1.52[-2.06,-0.98]
Zhao 1996	22	3.6 (2.4)	20	5.9 (3.5)		0.96%	-2.3[-4.13,-0.47]
Zhao 2003	30	1.2 (0.3)	30	2.2 (0.4)		5.17%	-1.02[-1.19,-0.85]
Total * **	**1172**		**1149**			**100%**	**-0.68[-0.88,-0.49]**

Heterogeneity: Tau^2=0.19; Chi^2=125.2, df=31(P<0.0001); I^2=75.24%

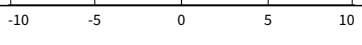
Test for overall effect: Z=6.8(P<0.0001)



Favours Cell Salvage — Favours Control

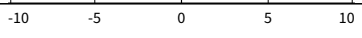
Analysis 1.7. Comparison 1 Cell salvage - blood transfused (all studies), Outcome 7 Units of allogeneic blood transfused (Transfusion Protocol).

Study or subgroup	Cell Salvage N	Cell Salvage Mean(SD)	Control N	Control Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
1.7.1 Transfusion Protocol							
Adalberth 1998	24	0.8 (1.1)	25	0.9 (1.3)		3.96%	-0.13[-0.8,0.54]
Altinel 2007	16	1 (1.1)	16	2.3 (1.2)		3.31%	-1.29[-2.1,-0.48]
Axford 1994	16	1.7 (2)	16	2.2 (2.3)		1.56%	-0.52[-1.98,0.94]



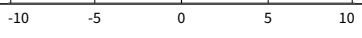
Favours Cell Salvage — Favours Control

Study or subgroup	Cell Salvage N	Cell Salvage Mean(SD)	Control N	Control Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
Bouboulis 1994	42	1.9 (1.5)	33	2.2 (2)		3.28%	-0.32[-1.14,0.5]
Clagett 1999	50	2.1 (2.1)	50	2.3 (2.1)		3.26%	-0.2[-1.02,0.62]
Dalrymple-Hay 1999	56	1 (1.2)	56	1.7 (1.2)		5.11%	-0.7[-1.14,-0.26]
Davies 1987	25	4 (3.4)	25	5.5 (5.8)		0.57%	-1.5[-4.14,1.14]
Dietrich 1989	25	1.4 (1.9)	25	2.8 (2)		2.41%	-1.42[-2.49,-0.35]
Ekback 1995	15	1.9 (1.6)	15	2.7 (1.2)		2.69%	-0.8[-1.78,0.18]
Elawad 1991	20	0.7 (0.9)	20	2.7 (0.9)		4.59%	-2.04[-2.58,-1.5]
Fragnito 1995	41	2.4 (0.8)	41	2.5 (0.9)		5.51%	-0.04[-0.41,0.33]
Goel 2007	24	1.5 (1.1)	25	2.4 (1.3)		3.94%	-0.86[-1.53,-0.19]
Heddle 1992	39	0.4 (0.8)	40	1.2 (1)		5.35%	-0.8[-1.2,-0.4]
Kelley 1993	18	0.3 (0.7)	18	0.2 (0.6)		5.3%	0.11[-0.3,0.52]
Kirkos 2006	78	0.5 (0.9)	77	1.1 (1.2)		5.73%	-0.52[-0.84,-0.2]
Koopman 1993a	17	4.9 (3.4)	20	6.2 (6)		0.43%	-1.3[-4.39,1.79]
Koopman 1993b	29	0.3 (0.8)	30	1.1 (1.4)		4.39%	-0.8[-1.38,-0.22]
Laub 1993	19	0.6 (1.2)	19	1.3 (1.5)		3.22%	-0.66[-1.49,0.17]
Martin 2000	98	1.8 (0.7)	100	2.2 (0.5)		6.37%	-0.4[-0.57,-0.23]
McGill 2002	84	0.7 (1.6)	84	1.1 (1.6)		4.97%	-0.39[-0.86,0.08]
Niranjan 2006	40	0.5 (0.7)	40	1.4 (1.3)		5.06%	-0.85[-1.3,-0.4]
Page 1989	48	3.2 (2.1)	51	3.8 (2.6)		2.91%	-0.68[-1.6,0.24]
Parrot 1991	22	1.4 (1.5)	22	2.2 (1.3)		3.25%	-0.8[-1.63,0.03]
Schaff 1978a	63	2.4 (2.4)	51	4.8 (4.3)		1.83%	-2.4[-3.71,-1.09]
Schonberger 1993	20	0.1 (1.3)	20	0.6 (1.3)		3.23%	-0.5[-1.33,0.33]
Shirvani 1991	21	2.6 (1.7)	21	2.5 (1)		3.18%	0.03[-0.81,0.87]
Tripkovic 2008	30	0.2 (1)	30	1.7 (1.2)		4.59%	-1.52[-2.06,-0.98]
Subtotal ***	**980**		**970**			**100%**	**-0.69[-0.9,-0.49]**
Heterogeneity: Tau²=0.17; Chi²=86.56, df=26(P<0.0001); I²=69.96%							
Test for overall effect: Z=6.53(P<0.0001)							
1.7.2 No Transfusion Protocol							
Lepore 1989	67	2.7 (2.8)	68	3.3 (2.7)		17.77%	-0.6[-1.53,0.33]
Slagis 1991	51	0.8 (1.2)	51	1.5 (1.4)		23.65%	-0.69[-1.2,-0.18]
So-Osman 2006	22	2.4 (0.9)	10	1.9 (0.7)		22.77%	0.46[-0.11,1.03]
Zhao 1996	22	3.6 (2.4)	20	5.9 (3.5)		8.82%	-2.3[-4.13,-0.47]
Zhao 2003	30	1.2 (0.3)	30	2.2 (0.4)		26.99%	-1.02[-1.19,-0.85]
Subtotal ***	**192**		**179**			**100%**	**-0.64[-1.3,0.01]**
Heterogeneity: Tau²=0.41; Chi²=26.86, df=4(P<0.0001); I²=85.11%							
Test for overall effect: Z=1.92(P=0.06)							

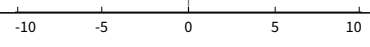


Analysis 1.8. Comparison 1 Cell salvage - blood transfused (all studies), Outcome 8 Units of allogeneic blood transfused (Type of Surgery).

Study or subgroup	Cell Salvage N	Cell Salvage Mean(SD)	Control N	Control Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
1.8.1 Cardiac							
Axford 1994	16	1.7 (2)	16	2.2 (2.3)		2.01%	-0.52[-1.98,0.94]
Bouboulis 1994	42	1.9 (1.5)	33	2.2 (2)		4.62%	-0.32[-1.14,0.5]
Dalrymple-Hay 1999	56	1 (1.2)	56	1.7 (1.2)		7.99%	-0.7[-1.14,-0.26]
Dietrich 1989	25	1.4 (1.9)	25	2.8 (2)		3.25%	-1.42[-2.49,-0.35]



Study or subgroup	Cell Salvage N	Cell Salvage Mean(SD)	Control N	Control Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
Fragnito 1995	41	2.4 (0.8)	41	2.5 (0.9)		8.83%	-0.04[-0.41,0.33]
Goel 2007	24	1.5 (1.1)	25	2.4 (1.3)		5.76%	-0.86[-1.53,-0.19]
Koopman 1993a	17	4.9 (3.4)	20	6.2 (6)		0.52%	-1.3[-4.39,1.79]
Laub 1993	19	0.6 (1.2)	19	1.3 (1.5)		4.52%	-0.66[-1.49,0.17]
Lepore 1989	67	2.7 (2.8)	68	3.3 (2.7)		3.95%	-0.6[-1.53,0.33]
Martin 2000	98	1.8 (0.7)	100	2.2 (0.5)		10.8%	-0.4[-0.57,-0.23]
McGill 2002	84	0.7 (1.6)	84	1.1 (1.6)		7.71%	-0.39[-0.86,0.08]
Niranjan 2006	40	0.5 (0.7)	40	1.4 (1.3)		7.9%	-0.85[-1.3,-0.4]
Page 1989	48	3.2 (2.1)	51	3.8 (2.6)		4.03%	-0.68[-1.6,0.24]
Parrot 1991	22	1.4 (1.5)	22	2.2 (1.3)		4.57%	-0.8[-1.63,0.03]
Schaff 1978a	63	2.4 (2.4)	51	4.8 (4.3)		2.38%	-2.4[-3.71,-1.09]
Schonberger 1993	20	0.1 (1.3)	20	0.6 (1.3)		4.55%	-0.5[-1.33,0.33]
Shirvani 1991	21	2.6 (1.7)	21	2.5 (1)		4.46%	0.03[-0.81,0.87]
Zhao 1996	22	3.6 (2.4)	20	5.9 (3.5)		1.37%	-2.3[-4.13,-0.47]
Zhao 2003	30	1.2 (0.3)	30	2.2 (0.4)		10.78%	-1.02[-1.19,-0.85]
Subtotal * **	**755**		**742**			**100%**	**-0.67[-0.89,-0.44]**
Heterogeneity: Tau²=0.12; Chi²=54.36, df=18(P<0.0001); I²=66.89%							
Test for overall effect: Z=5.72(P<0.0001)							
1.8.2 Orthopaedic							
Adalberth 1998	24	0.8 (1.1)	25	0.9 (1.3)		9.51%	-0.13[-0.8,0.54]
Altinel 2007	16	1 (1.1)	16	2.3 (1.2)		8.52%	-1.27[-2.08,-0.46]
Ekback 1995	15	1.9 (1.6)	15	2.7 (1.2)		7.42%	-0.8[-1.78,0.18]
Elawad 1991	20	0.7 (0.9)	20	2.7 (0.9)		10.36%	-2.04[-2.58,-1.5]
Heddle 1992	39	0.4 (0.8)	40	1.2 (1)		11.26%	-0.8[-1.2,-0.4]
Kirkos 2006	78	0.5 (0.9)	77	1.1 (1.2)		11.67%	-0.52[-0.84,-0.2]
Koopman 1993b	29	0.3 (0.8)	30	1.1 (1.4)		10.11%	-0.8[-1.38,-0.22]
Slagis 1991	51	0.8 (1.2)	51	1.5 (1.4)		10.6%	-0.69[-1.2,-0.18]
So-Osman 2006	22	2.4 (0.9)	10	1.9 (0.7)		10.17%	0.46[-0.11,1.03]
Tripkovic 2008	30	0.2 (1)	30	1.7 (1.2)		10.37%	-1.52[-2.06,-0.98]
Subtotal * **	**324**		**314**			**100%**	**-0.81[-1.22,-0.39]**
Heterogeneity: Tau²=0.36; Chi²=53.66, df=9(P<0.0001); I²=83.23%							
Test for overall effect: Z=3.79(P=0)							
1.8.3 Vascular							
Clagett 1999	50	2.1 (2.1)	50	2.3 (2.1)		19.32%	-0.2[-1.02,0.62]
Davies 1987	25	4 (3.4)	25	5.5 (5.8)		1.89%	-1.5[-4.14,1.14]
Kelley 1993	18	0.3 (0.7)	18	0.2 (0.6)		78.79%	0.11[-0.3,0.52]
Subtotal * **	**93**		**93**			**100%**	**0.02[-0.34,0.38]**
Heterogeneity: Tau²=0; Chi²=1.74, df=2(P=0.42); I²=0%							
Test for overall effect: Z=0.11(P=0.91)							

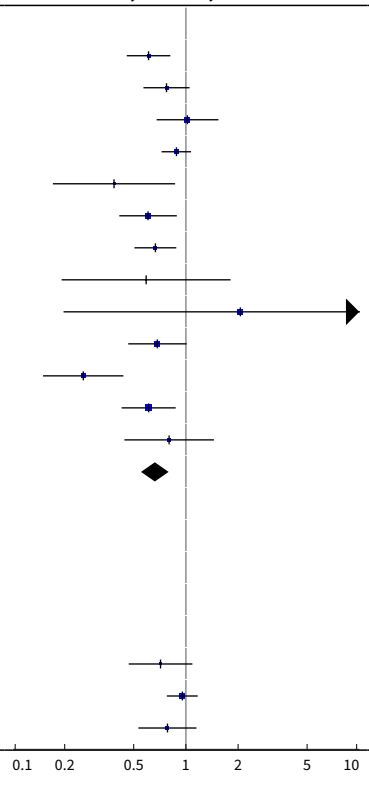


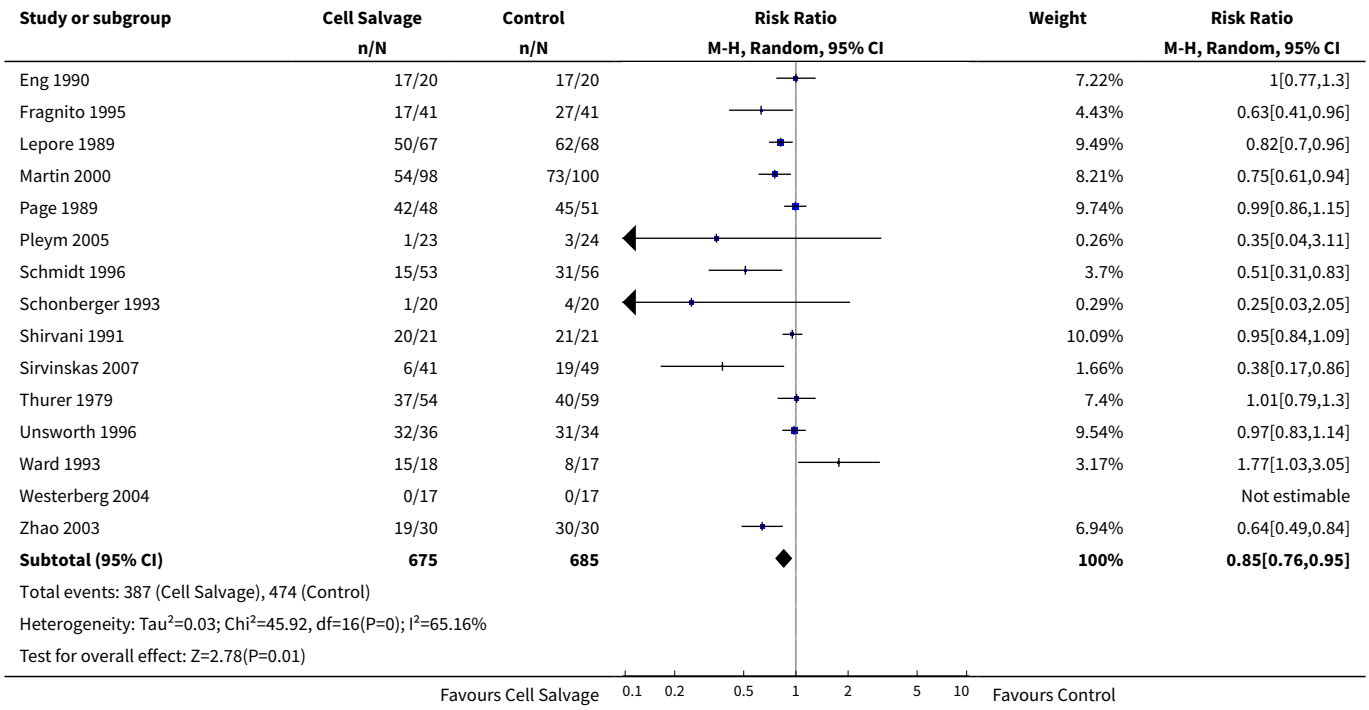
Comparison 2. Cell salvage - blood transfused (washed versus unwashed)

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 No. exposed to allogeneic blood (Cardiac)	31		Risk Ratio (M-H, Random, 95% CI)	Subtotals only
1.1 Washed	13	1158	Risk Ratio (M-H, Random, 95% CI)	0.66 [0.55, 0.80]
1.2 Unwashed	18	1360	Risk Ratio (M-H, Random, 95% CI)	0.85 [0.76, 0.95]
2 No. exposed to allogeneic blood (Orthopaedic)	32		Risk Ratio (M-H, Random, 95% CI)	Subtotals only
2.1 Washed	10	800	Risk Ratio (M-H, Random, 95% CI)	0.48 [0.36, 0.64]
2.2 Unwashed	22	2357	Risk Ratio (M-H, Random, 95% CI)	0.47 [0.36, 0.63]
3 No. exposed to allogeneic blood (Vascular)	4		Risk Ratio (M-H, Random, 95% CI)	Subtotals only
3.1 Washed	4	267	Risk Ratio (M-H, Random, 95% CI)	0.63 [0.34, 1.15]

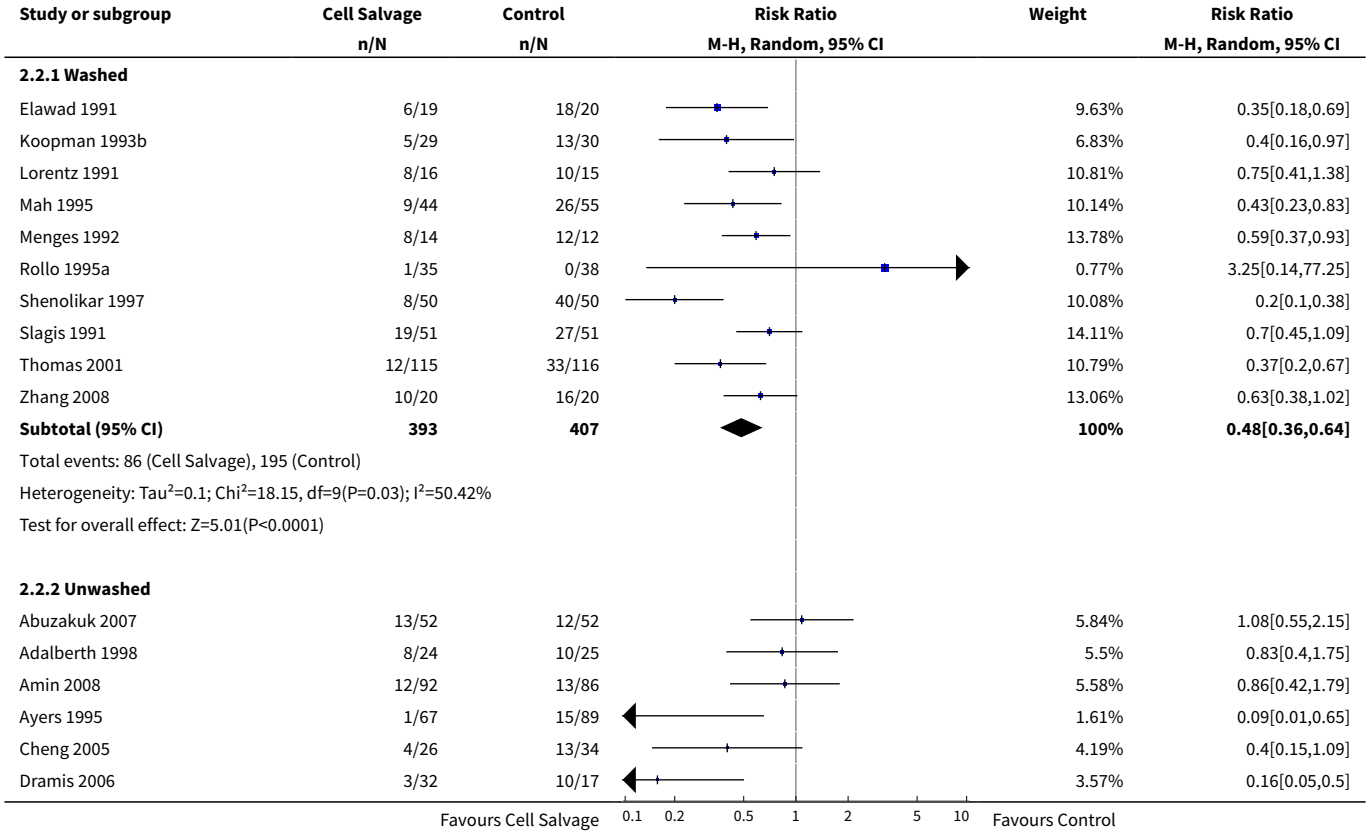
Analysis 2.1. Comparison 2 Cell salvage - blood transfused (washed versus unwashed), Outcome 1 No. exposed to allogeneic blood (Cardiac).

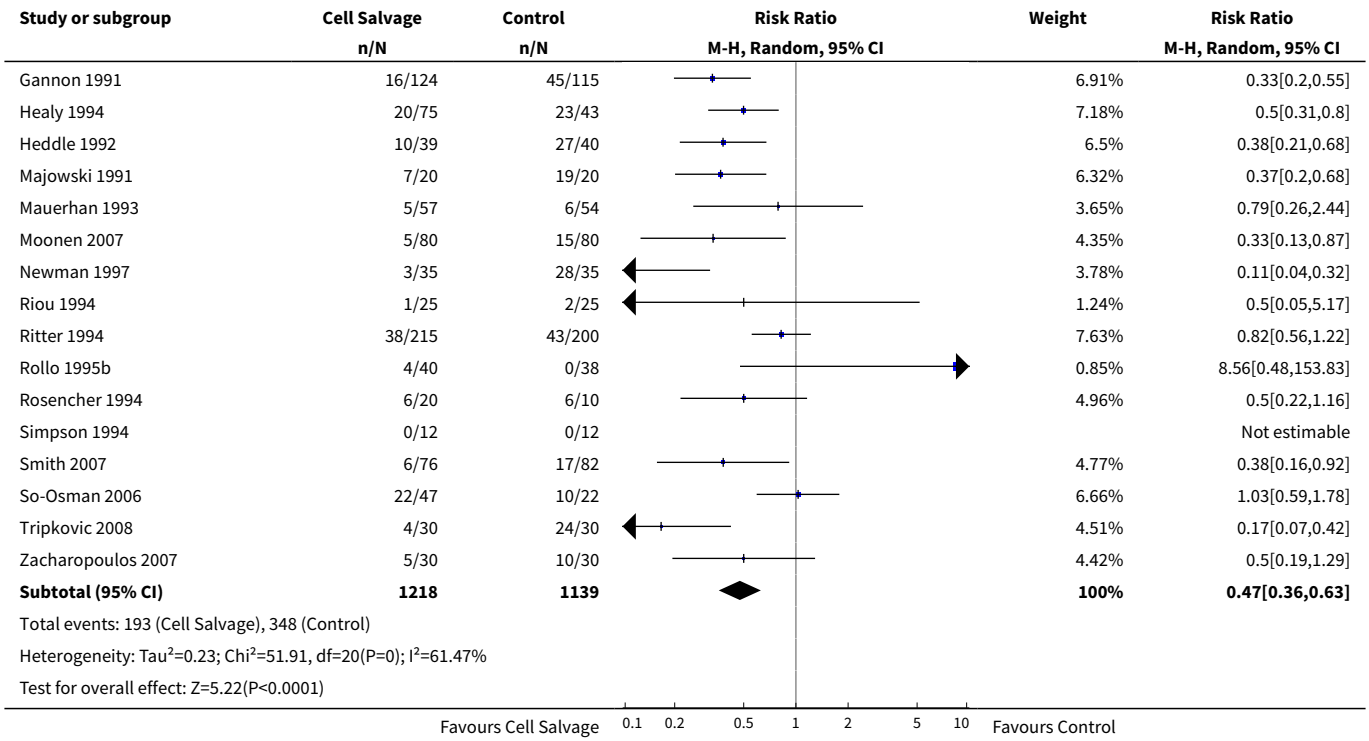
Study or subgroup	Cell Salvage n/N	Control n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
2.1.1 Washed					
Dalrymple-Hay 1999	28/56	46/56		10.83%	0.61[0.46,0.81]
Dietrich 1989	17/25	22/25		10.5%	0.77[0.57,1.05]
Klein 2008	31/102	33/111		8.51%	1.02[0.68,1.54]
Koopman 1993a	15/17	20/20		12.66%	0.88[0.72,1.07]
Laub 1993	5/19	13/19		3.79%	0.38[0.17,0.87]
McGill 2002	26/84	43/84		9.02%	0.6[0.41,0.89]
Murphy 2004	41/98	64/102		11.07%	0.67[0.51,0.88]
Murphy 2005	4/30	7/31		2.26%	0.59[0.19,1.81]
Naumenko 2003	2/32	1/33		0.58%	2.06[0.2,21.64]
Parrot 1991	13/22	19/22		8.95%	0.68[0.47,1.01]
Tempe 1996	11/50	43/50		6.56%	0.26[0.15,0.44]
Tempe 2001	12/20	20/20		9.45%	0.61[0.43,0.87]
Wiefferink 2007	8/15	10/15		5.8%	0.8[0.44,1.45]
Subtotal (95% CI)	**570**	**588**		**100%**	**0.66[0.55,0.8]**
Total events: 213 (Cell Salvage), 341 (Control)					
Heterogeneity: Tau^2=0.06; Chi^2=31.04, df=12(P=0); I^2=61.35%					
Test for overall effect: Z=4.41(P<0.0001)					
2.1.2 Unwashed					
Axford 1994	10/16	14/16		4.47%	0.71[0.47,1.09]
Bouboulis 1994	34/42	28/33		8.42%	0.95[0.78,1.17]
Damgaard 2006	17/30	21/29		4.98%	0.78[0.53,1.15]



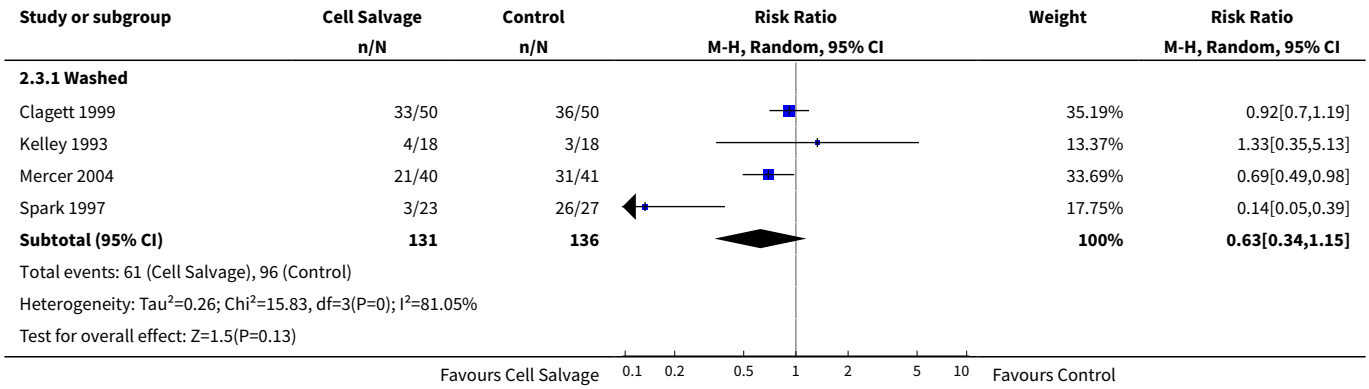


Analysis 2.2. Comparison 2 Cell salvage - blood transfused (washed versus unwashed), Outcome 2 No. exposed to allogeneic blood (Orthopaedic).





Analysis 2.3. Comparison 2 Cell salvage - blood transfused (washed versus unwashed), Outcome 3 No. exposed to allogeneic blood (Vascular).



Comparison 3. Cell salvage - blood transfused (active versus control)

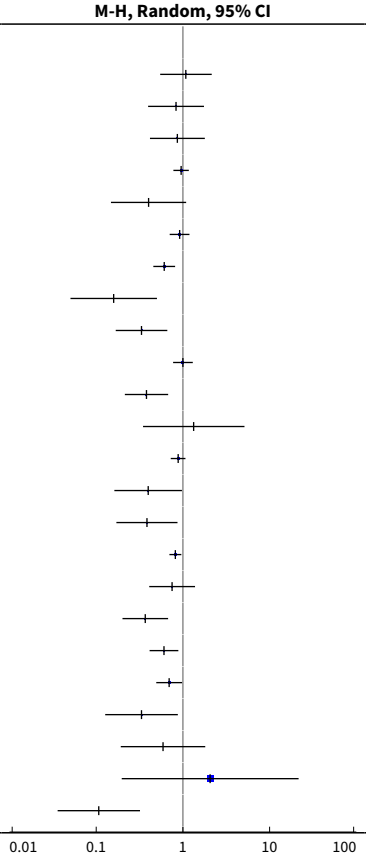
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 No. exposed to allogeneic blood (Active vs Control)	43		Risk Ratio (M-H, Random, 95% CI)	Subtotals only

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1.1 Cell Salvage vs Control	43	3666	Risk Ratio (M-H, Random, 95% CI)	0.61 [0.52, 0.71]
2 No. exposed to allogeneic blood (Transfusion Protocol)	43		Risk Ratio (M-H, Random, 95% CI)	Subtotals only
2.1 Transfusion Protocol	34	3030	Risk Ratio (M-H, Random, 95% CI)	0.61 [0.51, 0.73]
2.2 No Transfusion Protocol	9	636	Risk Ratio (M-H, Random, 95% CI)	0.56 [0.35, 0.89]
3 No. exposed to allogeneic blood (Type of Surgery)	43		Risk Ratio (M-H, Random, 95% CI)	Subtotals only
3.1 Cardiac	18	1257	Risk Ratio (M-H, Random, 95% CI)	0.78 [0.68, 0.91]
3.2 Orthopaedic	21	2142	Risk Ratio (M-H, Random, 95% CI)	0.45 [0.34, 0.60]
3.3 Vascular	4	267	Risk Ratio (M-H, Random, 95% CI)	0.63 [0.34, 1.15]
4 No. exposed to allogeneic blood (Washed vs Unwashed)	42		Risk Ratio (M-H, Random, 95% CI)	Subtotals only
4.1 Washed	18	1322	Risk Ratio (M-H, Random, 95% CI)	0.57 [0.45, 0.72]
4.2 Unwashed	24	2224	Risk Ratio (M-H, Random, 95% CI)	0.67 [0.56, 0.81]
5 No. exposed to allogeneic blood (Timing)	43		Risk Ratio (M-H, Random, 95% CI)	Subtotals only
5.1 Intra-operative cell salvage	8	564	Risk Ratio (M-H, Random, 95% CI)	0.64 [0.50, 0.83]
5.2 Post-operative cell salvage	29	2852	Risk Ratio (M-H, Random, 95% CI)	0.59 [0.48, 0.73]
5.3 Intra & post-operative cell salvage	6	250	Risk Ratio (M-H, Random, 95% CI)	0.58 [0.35, 0.95]
6 Units of allogeneic blood transfused (Active vs Control)	23		Mean Difference (IV, Random, 95% CI)	Subtotals only
6.1 Cell Salvage vs Control	23	1608	Mean Difference (IV, Random, 95% CI)	-0.81 [-1.08, -0.54]
7 Units of allogeneic blood transfused (Transfusion Protocol)	23		Mean Difference (IV, Random, 95% CI)	Subtotals only

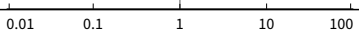
Outcome or subgroup title	No. of studies	No. of partici-pants	Statistical method	Effect size
7.1 Transfusion Protocol	19	1339	Mean Difference (IV, Random, 95% CI)	-0.86 [-1.17, -0.55]
7.2 No Transfusion Protocol	4	269	Mean Difference (IV, Random, 95% CI)	-0.68 [-1.63, 0.27]
8 Units of allogeneic blood transfused (Type of Surgery)	23		Mean Difference (IV, Random, 95% CI)	Subtotals only
8.1 Cardiac	13	995	Mean Difference (IV, Random, 95% CI)	-0.93 [-1.27, -0.59]
8.2 Orthopaedic	7	427	Mean Difference (IV, Random, 95% CI)	-0.82 [-1.36, -0.27]
8.3 Vascular	3	186	Mean Difference (IV, Random, 95% CI)	0.02 [-0.34, 0.38]

Analysis 3.1. Comparison 3 Cell salvage - blood transfused (active versus control), Outcome 1 No. exposed to allogeneic blood (Active vs Control).

Study or subgroup	Cell Salvage n/N	Control n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
3.1.1 Cell Salvage vs Control					
Abuzakuk 2007	13/52	12/52		2.23%	1.08[0.55,2.15]
Adalberth 1998	8/24	10/25		2.08%	0.83[0.4,1.75]
Amin 2008	12/92	13/86		2.11%	0.86[0.42,1.79]
Bouboulis 1994	34/42	28/33		3.54%	0.95[0.78,1.17]
Cheng 2005	4/26	13/34		1.52%	0.4[0.15,1.09]
Clagett 1999	33/50	36/50		3.42%	0.92[0.7,1.19]
Dalrymple-Hay 1999	28/56	46/56		3.35%	0.61[0.46,0.81]
Dramis 2006	3/32	10/17		1.28%	0.16[0.05,0.5]
Elawad 1991	6/20	18/20		2.22%	0.33[0.17,0.66]
Eng 1990	17/20	17/20		3.42%	1[0.77,1.3]
Heddle 1992	10/39	27/40		2.53%	0.38[0.21,0.68]
Kelley 1993	4/18	3/18		1.02%	1.33[0.35,5.13]
Koopman 1993a	15/17	20/20		3.56%	0.88[0.72,1.07]
Koopman 1993b	5/29	13/30		1.72%	0.4[0.16,0.97]
Laub 1993	5/19	13/19		1.91%	0.38[0.17,0.87]
Lepore 1989	50/67	62/68		3.63%	0.82[0.7,0.96]
Lorentz 1991	8/16	10/15		2.44%	0.75[0.41,1.38]
Majowski 1991	7/20	19/20		2.44%	0.37[0.2,0.68]
McGill 2002	26/84	43/84		3.1%	0.6[0.41,0.89]
Mercer 2004	21/40	31/41		3.21%	0.69[0.49,0.98]
Moonen 2007	5/80	15/80		1.59%	0.33[0.13,0.87]
Murphy 2005	4/30	7/31		1.32%	0.59[0.19,1.81]
Naumenko 2003	2/32	1/33		0.41%	2.06[0.2,21.64]
Newman 1997	3/35	28/35		1.36%	0.11[0.04,0.32]

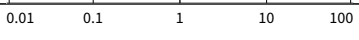


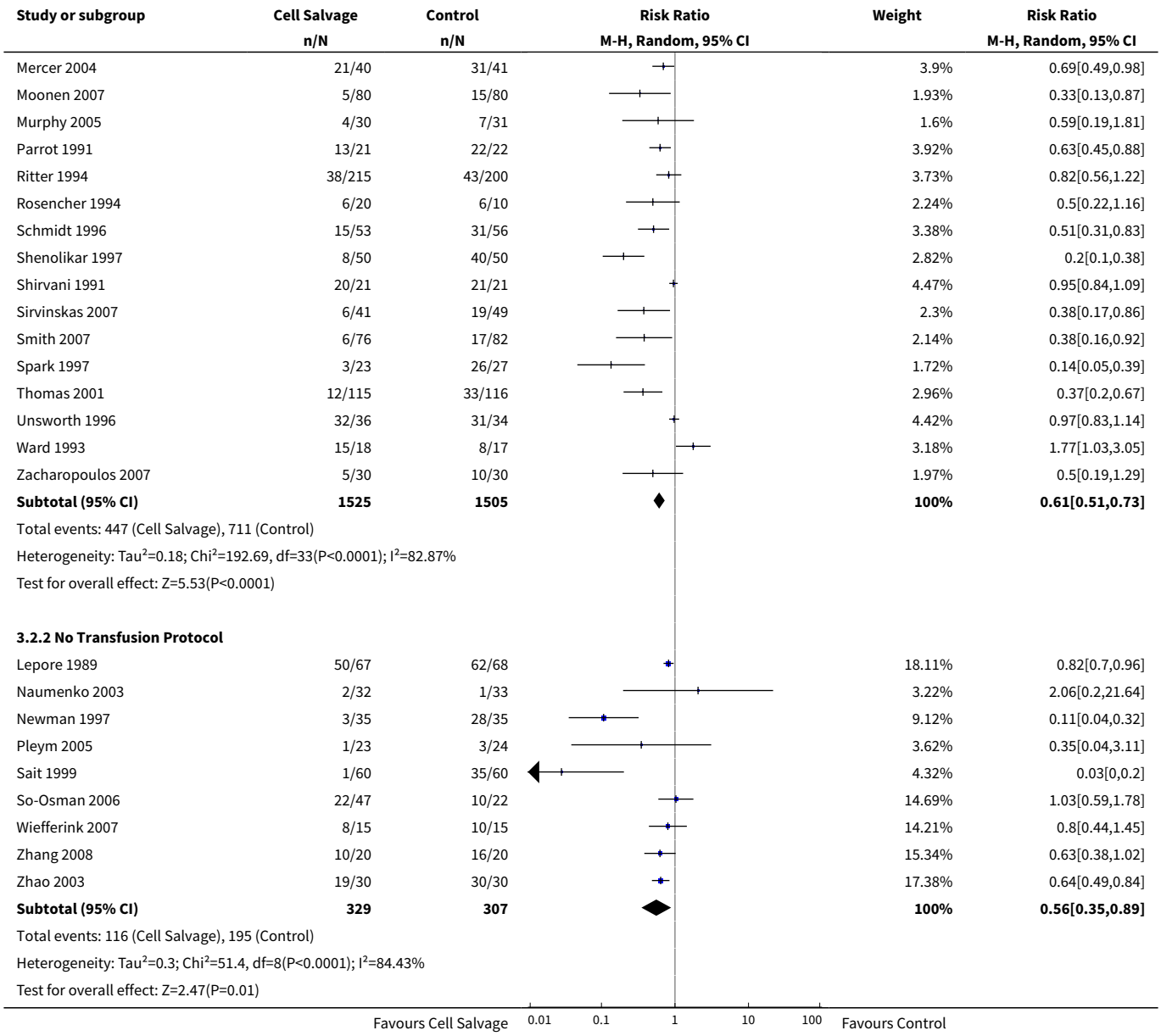
Study or subgroup	Cell Salvage n/N	Control n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
Parrot 1991	13/21	22/22		3.22%	0.63[0.45,0.88]
Pleym 2005	1/23	3/24		0.47%	0.35[0.04,3.11]
Ritter 1994	38/215	43/200		3.07%	0.82[0.56,1.22]
Rosencher 1994	6/20	6/10		1.85%	0.5[0.22,1.16]
Sait 1999	1/60	35/60		0.57%	0.03[0,0.2]
Schmidt 1996	15/53	31/56		2.78%	0.51[0.31,0.83]
Shenolikar 1997	8/50	40/50		2.32%	0.2[0.1,0.38]
Shirvani 1991	20/21	21/21		3.67%	0.95[0.84,1.09]
Sirvinskas 2007	6/41	19/49		1.89%	0.38[0.17,0.86]
Smith 2007	6/76	17/82		1.76%	0.38[0.16,0.92]
So-Osman 2006	22/47	10/22		2.6%	1.03[0.59,1.78]
Spark 1997	3/23	26/27		1.42%	0.14[0.05,0.39]
Thomas 2001	12/115	33/116		2.43%	0.37[0.2,0.67]
Unsworth 1996	32/36	31/34		3.64%	0.97[0.83,1.14]
Ward 1993	15/18	8/17		2.62%	1.77[1.03,3.05]
Wiefferink 2007	8/15	10/15		2.48%	0.8[0.44,1.45]
Zacharopoulos 2007	5/30	10/30		1.62%	0.5[0.19,1.29]
Zhang 2008	10/20	16/20		2.78%	0.63[0.38,1.02]
Zhao 2003	19/30	30/30		3.39%	0.64[0.49,0.84]
Subtotal (95% CI)	**1854**	**1812**		**100%**	**0.61[0.52,0.71]**
Total events: 563 (Cell Salvage), 906 (Control)					
Heterogeneity: Tau^2=0.18; Chi^2=245.96, df=42(P<0.0001); I^2=82.92%					
Test for overall effect: Z=6.15(P<0.0001)					



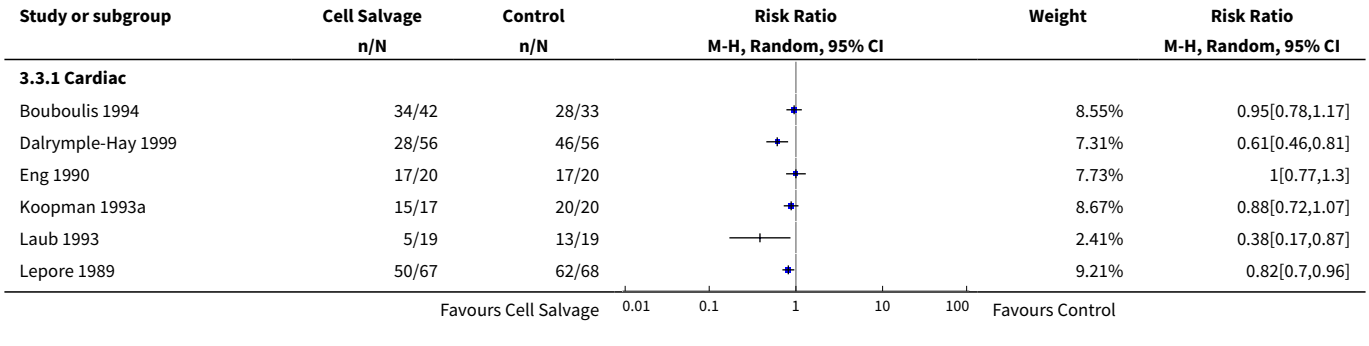
Analysis 3.2. Comparison 3 Cell salvage - blood transfused (active versus control), Outcome 2 No. exposed to allogeneic blood (Transfusion Protocol).

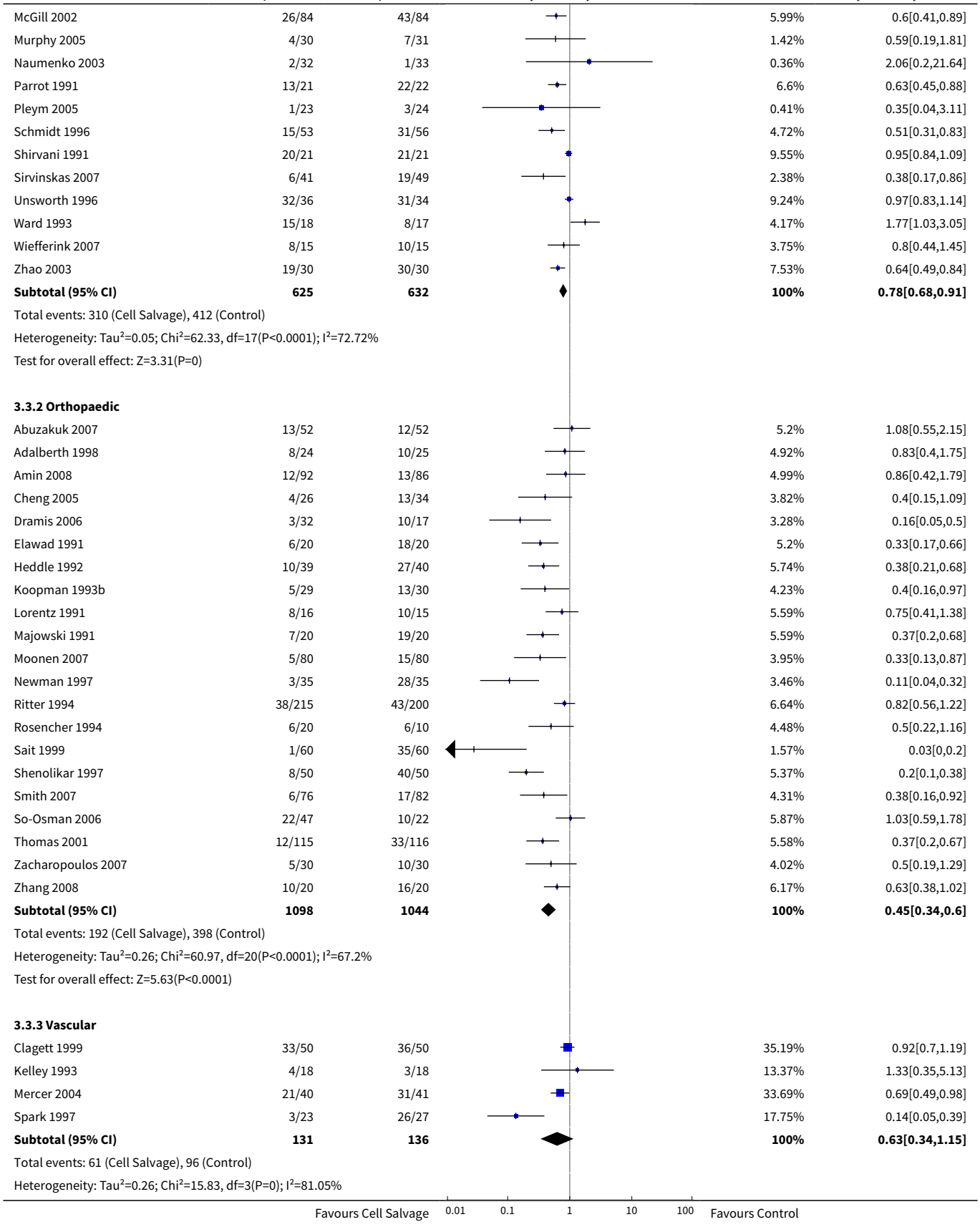
Study or subgroup	Cell Salvage n/N	Control n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
3.2.1 Transfusion Protocol					
Abuzakuk 2007	13/52	12/52		2.7%	1.08[0.55,2.15]
Adalberth 1998	8/24	10/25		2.52%	0.83[0.4,1.75]
Amin 2008	12/92	13/86		2.57%	0.86[0.42,1.79]
Bouboulis 1994	34/42	28/33		4.31%	0.95[0.78,1.17]
Cheng 2005	4/26	13/34		1.85%	0.4[0.15,1.09]
Clagett 1999	33/50	36/50		4.15%	0.92[0.7,1.19]
Dalrymple-Hay 1999	28/56	46/56		4.07%	0.61[0.46,0.81]
Dramis 2006	3/32	10/17		1.55%	0.16[0.05,0.5]
Elawad 1991	6/20	18/20		2.7%	0.33[0.17,0.66]
Eng 1990	17/20	17/20		4.16%	1[0.77,1.3]
Heddle 1992	10/39	27/40		3.07%	0.38[0.21,0.68]
Kelley 1993	4/18	3/18		1.24%	1.33[0.35,5.13]
Koopman 1993a	15/17	20/20		4.33%	0.88[0.72,1.07]
Koopman 1993b	5/29	13/30		2.09%	0.4[0.16,0.97]
Laub 1993	5/19	13/19		2.32%	0.38[0.17,0.87]
Lorentz 1991	8/16	10/15		2.96%	0.75[0.41,1.38]
Majowski 1991	7/20	19/20		2.97%	0.37[0.2,0.68]
McGill 2002	26/84	43/84		3.77%	0.6[0.41,0.89]





Analysis 3.3. Comparison 3 Cell salvage - blood transfused (active versus control), Outcome 3 No. exposed to allogeneic blood (Type of Surgery).





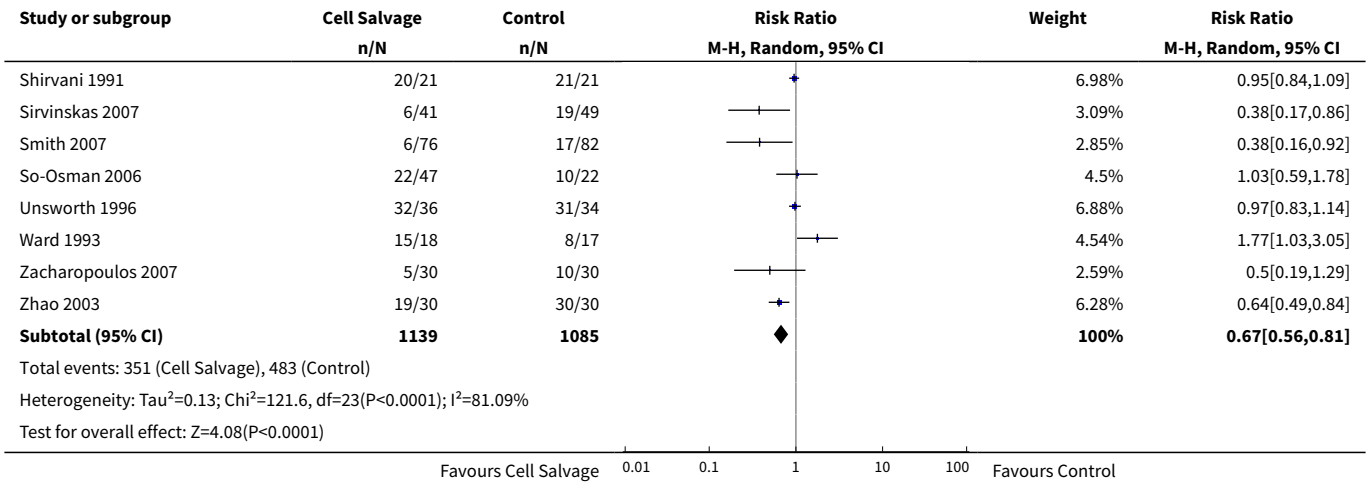
Study or subgroup	Cell Salvage n/N	Control n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
Test for overall effect: Z=1.5(P=0.13)					

Favours Cell Salvage 0.01 0.1 1 10 100 Favours Control

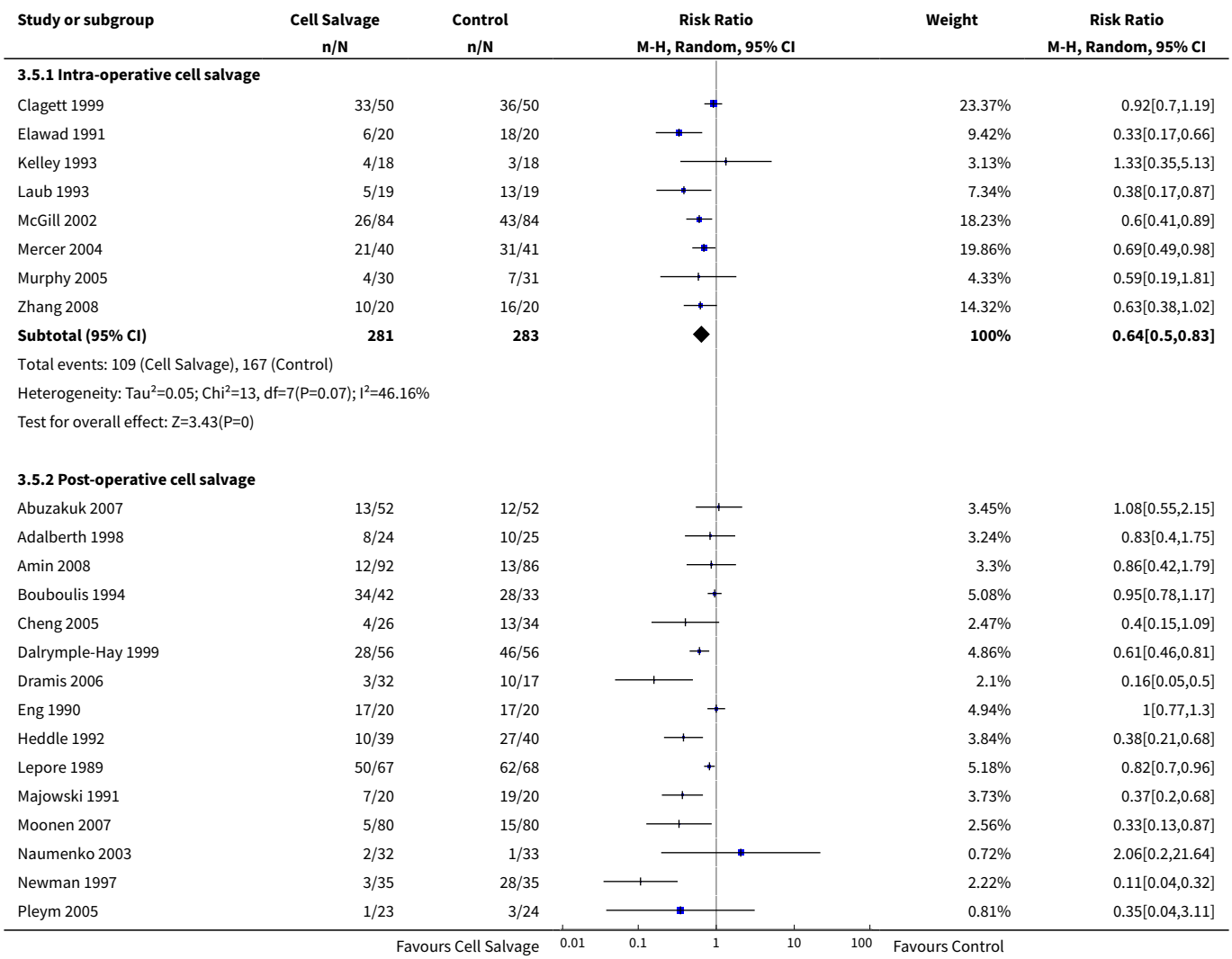
Analysis 3.4. Comparison 3 Cell salvage - blood transfused (active versus control), Outcome 4 No. exposed to allogeneic blood (Washed vs Unwashed).

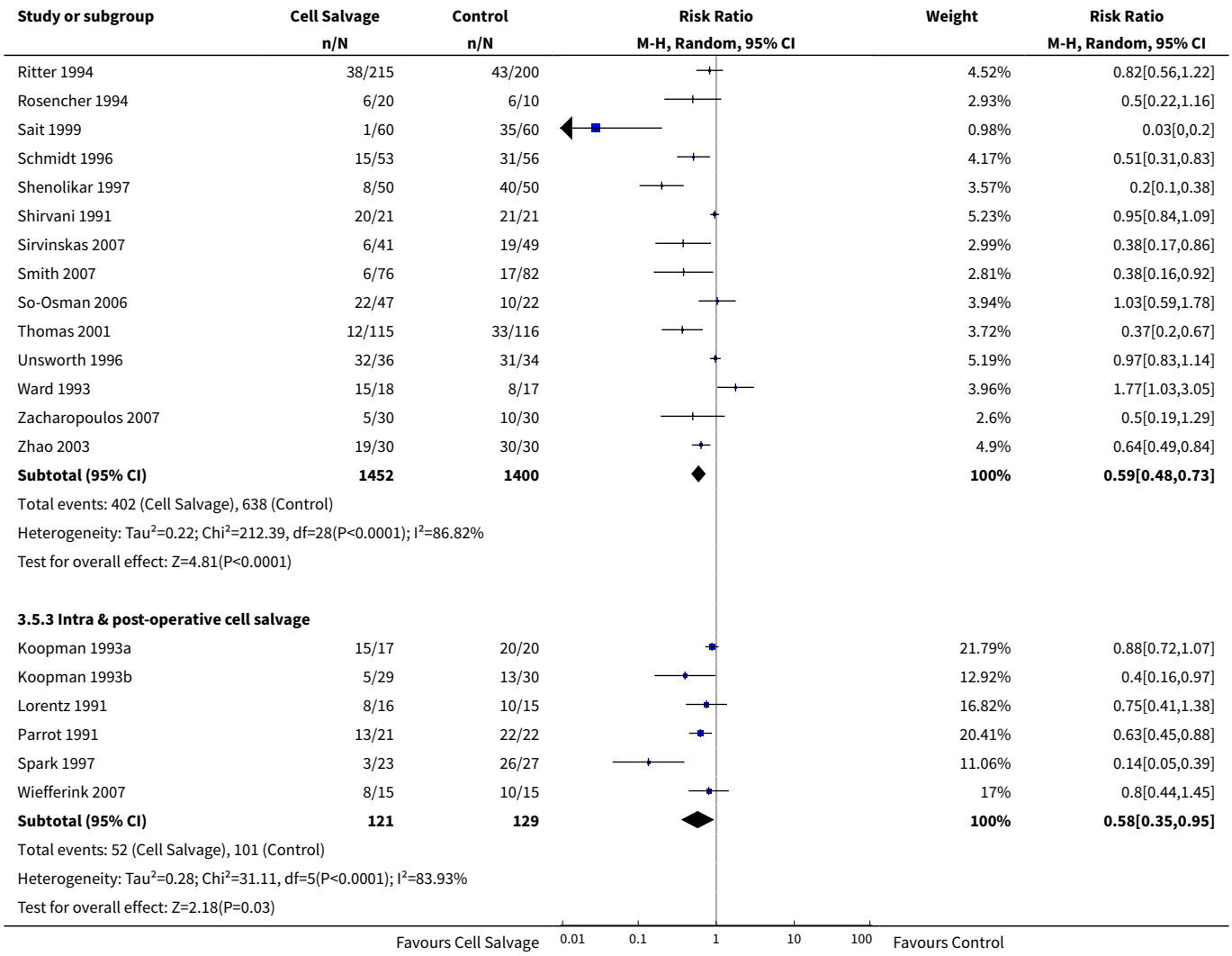
Study or subgroup	Cell Salvage n/N	Control n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
3.4.1 Washed					
Clagett 1999	33/50	36/50		8.4%	0.92[0.7,1.19]
Dalrymple-Hay 1999	28/56	46/56		8.21%	0.61[0.46,0.81]
Elawad 1991	6/20	18/20		5.11%	0.33[0.17,0.66]
Kelley 1993	4/18	3/18		2.21%	1.33[0.35,5.13]
Koopman 1993a	15/17	20/20		8.83%	0.88[0.72,1.07]
Koopman 1993b	5/29	13/30		3.86%	0.4[0.16,0.97]
Laub 1993	5/19	13/19		4.31%	0.38[0.17,0.87]
Lorentz 1991	8/16	10/15		5.68%	0.75[0.41,1.38]
McGill 2002	26/84	43/84		7.48%	0.6[0.41,0.89]
Mercer 2004	21/40	31/41		7.8%	0.69[0.49,0.98]
Murphy 2005	4/30	7/31		2.89%	0.59[0.19,1.81]
Naumenko 2003	2/32	1/33		0.86%	2.06[0.2,21.64]
Parrot 1991	13/21	22/22		7.84%	0.63[0.45,0.88]
Shenolikar 1997	8/50	40/50		5.36%	0.2[0.1,0.38]
Spark 1997	3/23	26/27		3.13%	0.14[0.05,0.39]
Thomas 2001	12/115	33/116		5.66%	0.37[0.2,0.67]
Wiefferink 2007	8/15	10/15		5.78%	0.8[0.44,1.45]
Zhang 2008	10/20	16/20		6.59%	0.63[0.38,1.02]
Subtotal (95% CI)	**655**	**667**		**100%**	**0.57[0.45,0.72]**
Total events: 211 (Cell Salvage), 388 (Control)					
Heterogeneity: Tau^2=0.14; Chi^2=64.37, df=17(P<0.0001); I^2=73.59%					
Test for overall effect: Z=4.83(P<0.0001)					
3.4.2 Unwashed					
Abuzakuk 2007	13/52	12/52		3.74%	1.08[0.55,2.15]
Adalberth 1998	8/24	10/25		3.44%	0.83[0.4,1.75]
Amin 2008	12/92	13/86		3.51%	0.86[0.42,1.79]
Bouboulis 1994	34/42	28/33		6.66%	0.95[0.78,1.17]
Cheng 2005	4/26	13/34		2.42%	0.4[0.15,1.09]
Dramis 2006	3/32	10/17		1.99%	0.16[0.05,0.5]
Eng 1990	17/20	17/20		6.36%	1[0.77,1.3]
Heddle 1992	10/39	27/40		4.35%	0.38[0.21,0.68]
Lepore 1989	50/67	62/68		6.87%	0.82[0.7,0.96]
Majowski 1991	7/20	19/20		4.17%	0.37[0.2,0.68]
Moonen 2007	5/80	15/80		2.53%	0.33[0.13,0.87]
Newman 1997	3/35	28/35		2.13%	0.11[0.04,0.32]
Pleym 2005	1/23	3/24		0.68%	0.35[0.04,3.11]
Ritter 1994	38/215	43/200		5.53%	0.82[0.56,1.22]
Rosencher 1994	6/20	6/10		3%	0.5[0.22,1.16]
Schmidt 1996	15/53	31/56		4.89%	0.51[0.31,0.83]

Favours Cell Salvage 0.01 0.1 1 10 100 Favours Control

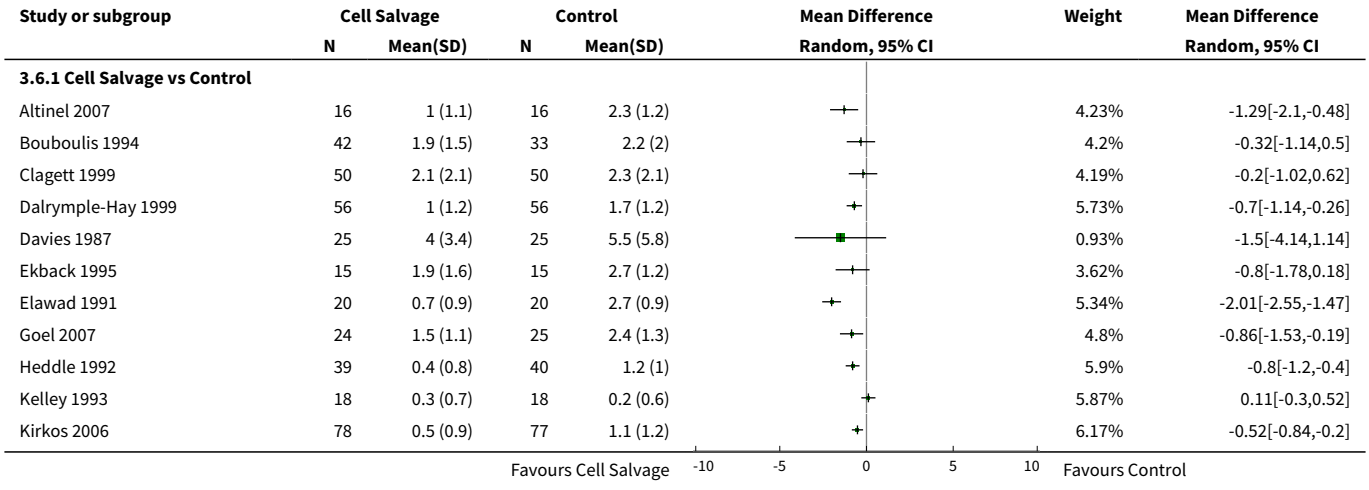


Analysis 3.5. Comparison 3 Cell salvage - blood transfused (active versus control), Outcome 5 No. exposed to allogeneic blood (Timing).

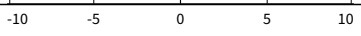




Analysis 3.6. Comparison 3 Cell salvage - blood transfused (active versus control), Outcome 6 Units of allogeneic blood transfused (Active vs Control).

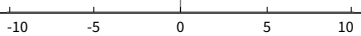


Study or subgroup	Cell Salvage N	Cell Salvage Mean(SD)	Control N	Control Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
Koopman 1993a	17	4.9 (3.4)	20	6.2 (6)		0.7%	-1.3[-4.39,1.79]
Koopman 1993b	29	0.3 (0.8)	30	1.1 (1.4)		5.18%	-0.8[-1.38,-0.22]
Laub 1993	19	0.6 (1.2)	19	1.3 (1.5)		4.14%	-0.66[-1.49,0.17]
Lepore 1989	67	2.7 (2.8)	68	3.3 (2.7)		3.8%	-0.6[-1.53,0.33]
McGill 2002	84	0.7 (1.6)	84	1.1 (1.6)		5.63%	-0.39[-0.86,0.08]
Niranjan 2006	40	0.5 (0.7)	40	1.4 (1.3)		5.7%	-0.85[-1.3,-0.4]
Parrot 1991	21	1.4 (1.5)	22	4.5 (1.8)		3.64%	-3.12[-4.09,-2.15]
Schaff 1978a	63	2.4 (2.4)	51	4.8 (4.3)		2.64%	-2.4[-3.71,-1.09]
Shirvani 1991	21	2.6 (1.7)	21	2.5 (1)		4.11%	0.03[-0.81,0.87]
So-Osman 2006	22	2.4 (0.9)	10	1.9 (0.7)		5.21%	0.46[-0.11,1.03]
Zhao 1996	22	3.6 (2.4)	20	5.9 (3.5)		1.68%	-2.3[-4.13,-0.47]
Zhao 2003	30	1.2 (0.3)	30	2.2 (0.4)		6.57%	-1.02[-1.19,-0.85]
Subtotal * **	**818**		**790**			**100%**	**-0.81[-1.08,-0.54]**
Heterogeneity: Tau²=0.29; Chi²=108.47, df=22(P<0.0001); I²=79.72%							
Test for overall effect: Z=5.8(P<0.0001)							



Analysis 3.7. Comparison 3 Cell salvage - blood transfused (active versus control), Outcome 7 Units of allogeneic blood transfused (Transfusion Protocol).

Study or subgroup	Cell Salvage N	Cell Salvage Mean(SD)	Control N	Control Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
3.7.1 Transfusion Protocol							
Altinel 2007	16	1 (1.1)	16	2.3 (1.2)		5.17%	-1.29[-2.1,-0.48]
Bouboulis 1994	42	1.9 (1.5)	33	2.2 (2)		5.14%	-0.32[-1.14,0.5]
Clagett 1999	50	2.1 (2.1)	50	2.3 (2.1)		5.12%	-0.2[-1.02,0.62]
Dalrymple-Hay 1999	56	1 (1.2)	56	1.7 (1.2)		6.83%	-0.7[-1.14,-0.26]
Davies 1987	25	4 (3.4)	25	5.5 (5.8)		1.2%	-1.5[-4.14,1.14]
Ekback 1995	15	1.9 (1.6)	15	2.7 (1.2)		4.47%	-0.8[-1.78,0.18]
Elawad 1991	20	0.7 (0.9)	20	2.7 (0.9)		6.4%	-2.04[-2.58,-1.5]
Goel 2007	24	1.5 (1.1)	25	2.4 (1.3)		5.81%	-0.86[-1.53,-0.19]
Heddle 1992	39	0.4 (0.8)	40	1.2 (1)		7.02%	-0.8[-1.2,-0.4]
Kelley 1993	18	0.3 (0.7)	18	0.2 (0.6)		6.98%	0.11[-0.3,0.52]
Kirkos 2006	78	0.5 (0.9)	77	1.1 (1.2)		7.3%	-0.52[-0.84,-0.2]
Koopman 1993a	17	4.9 (3.4)	20	6.2 (6)		0.91%	-1.3[-4.39,1.79]
Koopman 1993b	29	0.3 (0.8)	30	1.1 (1.4)		6.23%	-0.8[-1.38,-0.22]
Laub 1993	19	0.6 (1.2)	19	1.3 (1.5)		5.07%	-0.66[-1.49,0.17]
McGill 2002	84	0.7 (1.6)	84	1.1 (1.6)		6.72%	-0.39[-0.86,0.08]
Niranjan 2006	40	0.5 (0.7)	40	1.4 (1.3)		6.79%	-0.85[-1.3,-0.4]
Parrot 1991	21	1.4 (1.5)	22	4.5 (1.8)		4.49%	-3.12[-4.09,-2.15]
Schaff 1978a	63	2.4 (2.4)	51	4.8 (4.3)		3.31%	-2.4[-3.71,-1.09]
Shirvani 1991	21	2.6 (1.7)	21	2.5 (1)		5.03%	0.03[-0.81,0.87]
Subtotal * **	**677**		**662**			**100%**	**-0.86[-1.17,-0.55]**
Heterogeneity: Tau²=0.32; Chi²=80.31, df=18(P<0.0001); I²=77.59%							
Test for overall effect: Z=5.37(P<0.0001)							
3.7.2 No Transfusion Protocol							
Lepore 1989	67	2.7 (2.8)	68	3.3 (2.7)		24.63%	-0.6[-1.53,0.33]
So-Osman 2006	22	2.4 (0.9)	10	1.9 (0.7)		28.81%	0.46[-0.11,1.03]



Study or subgroup	Cell Salvage N	Cell Salvage Mean(SD)	Control N	Control Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
Zhao 1996	22	3.6 (2.4)	20	5.9 (3.5)		14.76%	-2.3[-4.13,-0.47]
Zhao 2003	30	1.2 (0.3)	30	2.2 (0.4)		31.8%	-1.02[-1.19,-0.85]
Subtotal ***	**141**		**128**			**100%**	**-0.68[-1.63,0.27]**
Heterogeneity: Tau²=0.74; Chi²=26.27, df=3(P<0.0001); I²=88.58%							
Test for overall effect: Z=1.4(P=0.16)							

Favours Cell Salvage -10 -5 0 5 10 Favours Control

Analysis 3.8. Comparison 3 Cell salvage - blood transfused (active versus control), Outcome 8 Units of allogeneic blood transfused (Type of Surgery).

Study or subgroup	Cell Salvage N	Cell Salvage Mean(SD)	Control N	Control Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
3.8.1 Cardiac							
Bouboulis 1994	42	1.9 (1.5)	33	2.2 (2)		7.65%	-0.32[-1.14,0.5]
Dalrymple-Hay 1999	56	1 (1.2)	56	1.7 (1.2)		11.25%	-0.7[-1.14,-0.26]
Goel 2007	24	1.5 (1.1)	25	2.4 (1.3)		8.99%	-0.86[-1.53,-0.19]
Koopman 1993a	17	4.9 (3.4)	20	6.2 (6)		1.09%	-1.3[-4.39,1.79]
Laub 1993	19	0.6 (1.2)	19	1.3 (1.5)		7.51%	-0.66[-1.49,0.17]
Lepore 1989	67	2.7 (2.8)	68	3.3 (2.7)		6.78%	-0.6[-1.53,0.33]
McGill 2002	84	0.7 (1.6)	84	1.1 (1.6)		10.99%	-0.39[-0.86,0.08]
Niranjan 2006	40	0.5 (0.7)	40	1.4 (1.3)		11.16%	-0.85[-1.3,-0.4]
Parrot 1991	21	1.4 (1.5)	22	4.5 (1.8)		6.45%	-3.12[-4.09,-2.15]
Schaff 1978a	63	2.4 (2.4)	51	4.8 (4.3)		4.47%	-2.4[-3.71,-1.09]
Shirvani 1991	21	2.6 (1.7)	21	2.5 (1)		7.44%	0.03[-0.81,0.87]
Zhao 1996	22	3.6 (2.4)	20	5.9 (3.5)		2.73%	-2.3[-4.13,-0.47]
Zhao 2003	30	1.2 (0.3)	30	2.2 (0.4)		13.5%	-1.02[-1.19,-0.85]
Subtotal ***	**506**		**489**			**100%**	**-0.93[-1.27,-0.59]**
Heterogeneity: Tau²=0.21; Chi²=41.76, df=12(P<0.0001); I²=71.27%							
Test for overall effect: Z=5.42(P<0.0001)							
3.8.2 Orthopaedic							
Altinel 2007	16	1 (1.1)	16	2.3 (1.2)		12.53%	-1.29[-2.1,-0.48]
Ekback 1995	15	1.9 (1.6)	15	2.7 (1.2)		11.1%	-0.8[-1.78,0.18]
Elawad 1991	20	0.7 (0.9)	20	2.7 (0.9)		14.85%	-2.04[-2.58,-1.5]
Heddle 1992	39	0.4 (0.8)	40	1.2 (1)		15.94%	-0.8[-1.2,-0.4]
Kirkos 2006	78	0.5 (0.9)	77	1.1 (1.2)		16.43%	-0.52[-0.84,-0.2]
Koopman 1993b	29	0.3 (0.8)	30	1.1 (1.4)		14.54%	-0.8[-1.38,-0.22]
So-Osman 2006	22	2.4 (0.9)	10	1.9 (0.7)		14.61%	0.46[-0.11,1.03]
Subtotal ***	**219**		**208**			**100%**	**-0.82[-1.36,-0.27]**
Heterogeneity: Tau²=0.44; Chi²=42.69, df=6(P<0.0001); I²=85.94%							
Test for overall effect: Z=2.96(P=0)							
3.8.3 Vascular							
Clagett 1999	50	2.1 (2.1)	50	2.3 (2.1)		19.32%	-0.2[-1.02,0.62]
Davies 1987	25	4 (3.4)	25	5.5 (5.8)		1.89%	-1.5[-4.14,1.14]
Kelley 1993	18	0.3 (0.7)	18	0.2 (0.6)		78.79%	0.11[-0.3,0.52]
Subtotal ***	**93**		**93**			**100%**	**0.02[-0.34,0.38]**
Heterogeneity: Tau²=0; Chi²=1.74, df=2(P=0.42); I²=0%							
Test for overall effect: Z=0.11(P=0.91)							

Favours Cell Salvage -10 -5 0 5 10 Favours Control

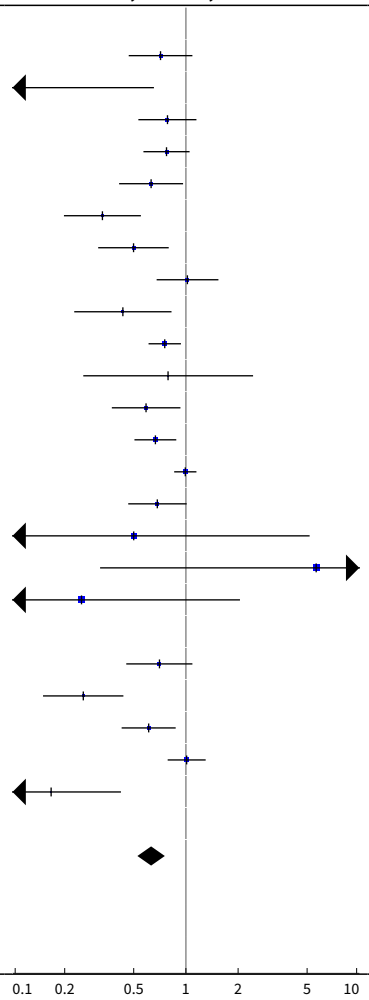
Comparison 4. Cell salvage - blood transfused (active versus active)

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 No. exposed to allogeneic blood (Active vs Active)	25		Risk Ratio (M-H, Random, 95% CI)	Subtotals only
1.1 Cell Salvage (Active vs Active)	25	2402	Risk Ratio (M-H, Random, 95% CI)	0.63 [0.53, 0.76]
2 No. exposed to allogeneic blood (Transfusion Protocol)	25		Risk Ratio (M-H, Random, 95% CI)	Subtotals only
2.1 Transfusion Protocol	19	1768	Risk Ratio (M-H, Random, 95% CI)	0.64 [0.52, 0.77]
2.2 No Transfusion Protocol	6	634	Risk Ratio (M-H, Random, 95% CI)	0.59 [0.35, 1.00]
3 No. exposed to allogeneic blood (Type of Surgery)	25		Risk Ratio (M-H, Random, 95% CI)	Subtotals only
3.1 Cardiac	14	1304	Risk Ratio (M-H, Random, 95% CI)	0.73 [0.61, 0.87]
3.2 Orthopaedic	11	1098	Risk Ratio (M-H, Random, 95% CI)	0.46 [0.33, 0.65]
4 No. exposed to allogeneic blood (Washed vs Unwashed)	26		Risk Ratio (M-H, Random, 95% CI)	Subtotals only
4.1 Washed	9	897	Risk Ratio (M-H, Random, 95% CI)	0.61 [0.48, 0.78]
4.2 Unwashed	17	1543	Risk Ratio (M-H, Random, 95% CI)	0.68 [0.52, 0.89]
5 No. exposed to allogeneic blood (Timing of cell salvage)	26		Risk Ratio (M-H, Random, 95% CI)	Subtotals only
5.1 Intra-operative cell salvage	4	281	Risk Ratio (M-H, Random, 95% CI)	0.54 [0.35, 0.84]
5.2 Post-operative cell salvage	18	1629	Risk Ratio (M-H, Random, 95% CI)	0.65 [0.50, 0.85]
5.3 Intra & post-operative cell salvage	4	530	Risk Ratio (M-H, Random, 95% CI)	0.76 [0.59, 0.98]
6 Units of allogeneic blood transfused (Active vs Active)	8		Mean Difference (IV, Random, 95% CI)	Subtotals only
6.1 Cell Salvage (Active vs Active)	8	663	Mean Difference (IV, Random, 95% CI)	-0.66 [-1.02, -0.30]
7 Units of allogeneic blood transfused (Transfusion Protocol)	8		Mean Difference (IV, Random, 95% CI)	Subtotals only
7.1 Transfusion Protocol	7	561	Mean Difference (IV, Random, 95% CI)	-0.67 [-1.09, -0.25]

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
7.2 No Transfusion Protocol	1	102	Mean Difference (IV, Random, 95% CI)	-0.69 [-1.20, -0.18]
8 Units allogeneic blood transfused (Type of Surgery)	8		Mean Difference (IV, Random, 95% CI)	Subtotals only
8.1 Cardiac	6	501	Mean Difference (IV, Random, 95% CI)	-0.39 [-0.67, -0.12]
8.2 Orthopaedic	2	162	Mean Difference (IV, Random, 95% CI)	-1.10 [-1.91, -0.29]

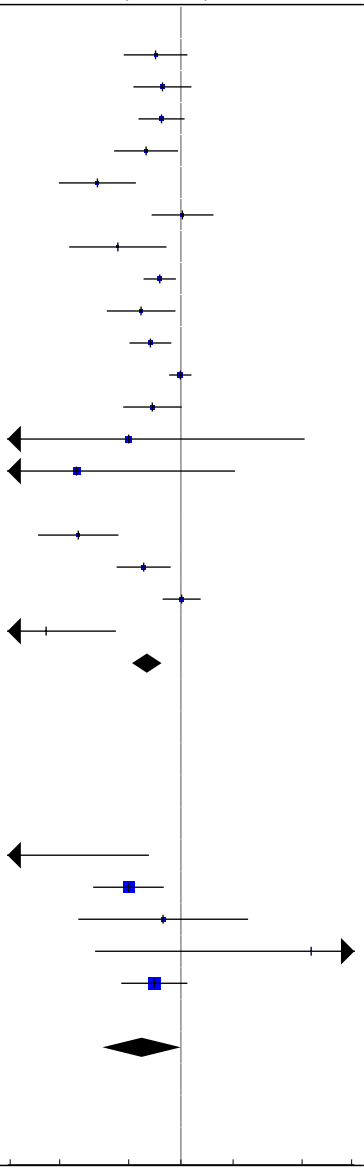
Analysis 4.1. Comparison 4 Cell salvage - blood transfused (active versus active), Outcome 1 No. exposed to allogeneic blood (Active vs Active).

Study or subgroup	Cell Salvage n/N	Control n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
4.1.1 Cell Salvage (Active vs Active)					
Axford 1994	10/16	14/16		5.26%	0.71[0.47,1.09]
Ayers 1995	1/67	15/89		0.74%	0.09[0.01,0.65]
Damgaard 2006	17/30	21/29		5.53%	0.78[0.53,1.15]
Dietrich 1989	17/25	22/25		6.09%	0.77[0.57,1.05]
Fragnito 1995	17/41	27/41		5.24%	0.63[0.41,0.96]
Gannon 1991	16/124	45/115		4.65%	0.33[0.2,0.55]
Healy 1994	20/75	23/43		4.95%	0.5[0.31,0.8]
Klein 2008	31/102	33/111		5.35%	1.02[0.68,1.54]
Mah 1995	9/44	26/55		3.81%	0.43[0.23,0.83]
Martin 2000	54/98	73/100		6.66%	0.75[0.61,0.94]
Mauerhan 1993	5/57	6/54		1.92%	0.79[0.26,2.44]
Menges 1992	8/14	12/12		5.03%	0.59[0.37,0.93]
Murphy 2004	41/98	64/102		6.28%	0.67[0.51,0.88]
Page 1989	42/48	45/51		7.01%	0.99[0.86,1.15]
Parrot 1991	13/22	19/22		5.53%	0.68[0.47,1.01]
Riou 1994	1/25	2/25		0.56%	0.5[0.05,5.17]
Rollo 1995	5/75	0/38		0.38%	5.64[0.32,99.48]
Schonberger 1993	1/20	4/20		0.68%	0.25[0.03,2.05]
Simpson 1994	0/12	0/12			Not estimable
Slagis 1991	19/51	27/51		5.14%	0.7[0.45,1.09]
Tempe 1996	11/50	43/50		4.5%	0.26[0.15,0.44]
Tempe 2001	12/20	20/20		5.71%	0.61[0.43,0.87]
Thurer 1979	37/54	40/59		6.44%	1.01[0.79,1.3]
Tripkovic 2008	4/30	24/30		2.52%	0.17[0.07,0.42]
Westerberg 2004	0/17	0/17			Not estimable
Subtotal (95% CI)	**1215**	**1187**		**100%**	**0.63[0.53,0.76]**
Total events: 391 (Cell Salvage), 605 (Control)					
Heterogeneity: Tau^2=0.12; Chi^2=90.85, df=22(P<0.0001); I^2=75.78%					
Test for overall effect: Z=4.97(P<0.0001)					



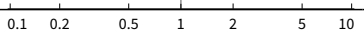
Analysis 4.2. Comparison 4 Cell salvage - blood transfused (active versus active), Outcome 2 No. exposed to allogeneic blood (Transfusion Protocol).

Study or subgroup	Cell Salvage n/N	Control n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
4.2.1 Transfusion Protocol					
Axford 1994	10/16	14/16		6.06%	0.71[0.47,1.09]
Damgaard 2006	17/30	21/29		6.36%	0.78[0.53,1.15]
Dietrich 1989	17/25	22/25		7.01%	0.77[0.57,1.05]
Fragnito 1995	17/41	27/41		6.03%	0.63[0.41,0.96]
Gannon 1991	16/124	45/115		5.35%	0.33[0.2,0.55]
Klein 2008	31/102	33/111		6.16%	1.02[0.68,1.54]
Mah 1995	9/44	26/55		4.38%	0.43[0.23,0.83]
Martin 2000	54/98	73/100		7.68%	0.75[0.61,0.94]
Menges 1992	8/14	12/12		5.79%	0.59[0.37,0.93]
Murphy 2004	41/98	64/102		7.23%	0.67[0.51,0.88]
Page 1989	42/48	45/51		8.08%	0.99[0.86,1.15]
Parrot 1991	13/22	19/22		6.36%	0.68[0.47,1.01]
Riou 1994	1/25	2/25		0.64%	0.5[0.05,5.17]
Schonberger 1993	1/20	4/20		0.78%	0.25[0.03,2.05]
Simpson 1994	0/12	0/12			Not estimable
Tempe 1996	11/50	43/50		5.18%	0.26[0.15,0.44]
Tempe 2001	12/20	20/20		6.58%	0.61[0.43,0.87]
Thurer 1979	37/54	40/59		7.42%	1.01[0.79,1.3]
Tripkovic 2008	4/30	24/30		2.89%	0.17[0.07,0.42]
Subtotal (95% CI)	**873**	**895**		**100%**	**0.64[0.52,0.77]**
Total events: 341 (Cell Salvage), 534 (Control)					
Heterogeneity: Tau^2=0.12; Chi^2=79.99, df=17(P<0.0001); I^2=78.75%					
Test for overall effect: Z=4.55(P<0.0001)					
4.2.2 No Transfusion Protocol					
Ayers 1995	1/67	15/89		6.01%	0.09[0.01,0.65]
Healy 1994	20/75	23/43		37.18%	0.5[0.31,0.8]
Mauerhan 1993	5/57	6/54		15.22%	0.79[0.26,2.44]
Rollo 1995	5/75	0/38		3.1%	5.64[0.32,99.48]
Slagis 1991	19/51	27/51		38.49%	0.7[0.45,1.09]
Westerberg 2004	0/17	0/17			Not estimable
Subtotal (95% CI)	**342**	**292**		**100%**	**0.59[0.35,1]**
Total events: 50 (Cell Salvage), 71 (Control)					
Heterogeneity: Tau^2=0.13; Chi^2=7.3, df=4(P=0.12); I^2=45.2%					
Test for overall effect: Z=1.97(P=0.05)					

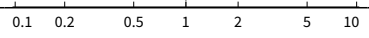


Analysis 4.3. Comparison 4 Cell salvage - blood transfused (active versus active), Outcome 3 No. exposed to allogeneic blood (Type of Surgery).

Study or subgroup	Cell Salvage n/N	Control n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
4.3.1 Cardiac					
Axford 1994	10/16	14/16		7.05%	0.71[0.47,1.09]
Damgaard 2006	17/30	21/29		7.59%	0.78[0.53,1.15]
Dietrich 1989	17/25	22/25		8.83%	0.77[0.57,1.05]



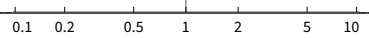
Study or subgroup	Cell Salvage n/N	Control n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
Fragnito 1995	17/41	27/41		7.01%	0.63[0.41,0.96]
Klein 2008	31/102	33/111		7.23%	1.02[0.68,1.54]
Martin 2000	54/98	73/100		10.27%	0.75[0.61,0.94]
Murphy 2004	41/98	64/102		9.28%	0.67[0.51,0.88]
Page 1989	42/48	45/51		11.22%	0.99[0.86,1.15]
Parrot 1991	13/22	19/22		7.59%	0.68[0.47,1.01]
Schonberger 1993	1/20	4/20		0.64%	0.25[0.03,2.05]
Tempe 1996	11/50	43/50		5.63%	0.26[0.15,0.44]
Tempe 2001	12/20	20/20		7.99%	0.61[0.43,0.87]
Thurer 1979	37/54	40/59		9.68%	1.01[0.79,1.3]
Westerberg 2004	0/17	0/17			Not estimable
Subtotal (95% CI)	**641**	**663**		**100%**	**0.73[0.61,0.87]**
Total events: 303 (Cell Salvage), 425 (Control)					
Heterogeneity: Tau^2=0.06; Chi^2=42.92, df=12(P<0.0001); I^2=72.04%					
Test for overall effect: Z=3.59(P=0)					
4.3.2 Orthopaedic					
Ayers 1995	1/67	15/89		2.57%	0.09[0.01,0.65]
Gannon 1991	16/124	45/115		15.6%	0.33[0.2,0.55]
Healy 1994	20/75	23/43		16.56%	0.5[0.31,0.8]
Mah 1995	9/44	26/55		12.87%	0.43[0.23,0.83]
Mauerhan 1993	5/57	6/54		6.58%	0.79[0.26,2.44]
Menges 1992	8/14	12/12		16.82%	0.59[0.37,0.93]
Riou 1994	1/25	2/25		1.94%	0.5[0.05,5.17]
Rollo 1995	5/75	0/38		1.32%	5.64[0.32,99.48]
Simpson 1994	0/12	0/12			Not estimable
Slagis 1991	19/51	27/51		17.17%	0.7[0.45,1.09]
Tripkovic 2008	4/30	24/30		8.58%	0.17[0.07,0.42]
Subtotal (95% CI)	**574**	**524**		**100%**	**0.46[0.33,0.65]**
Total events: 88 (Cell Salvage), 180 (Control)					
Heterogeneity: Tau^2=0.12; Chi^2=18.16, df=9(P=0.03); I^2=50.44%					
Test for overall effect: Z=4.44(P<0.0001)					



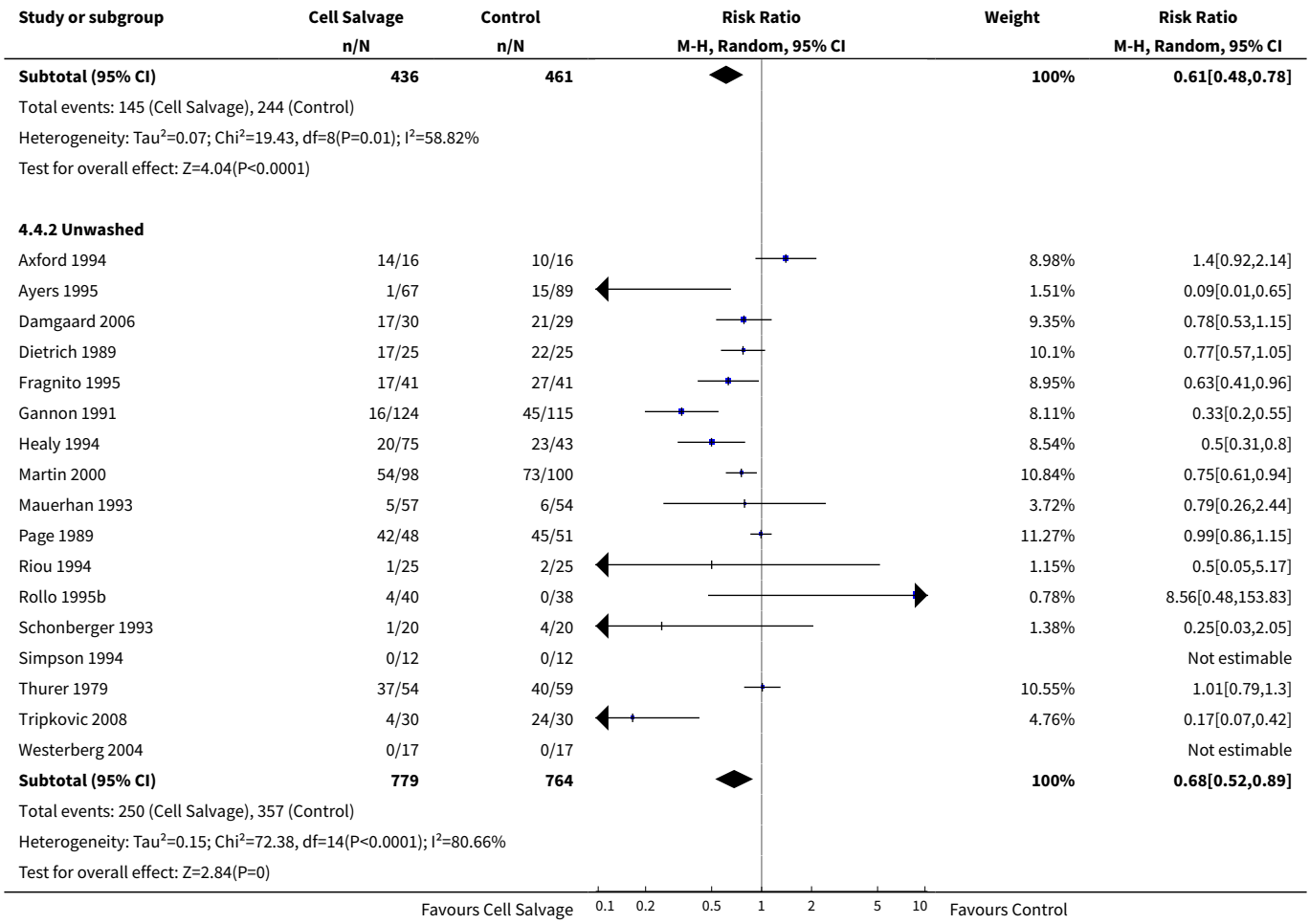
Favours Cell Salvage — Favours Control

Analysis 4.4. Comparison 4 Cell salvage - blood transfused (active versus active), Outcome 4 No. exposed to allogeneic blood (Washed vs Unwashed).

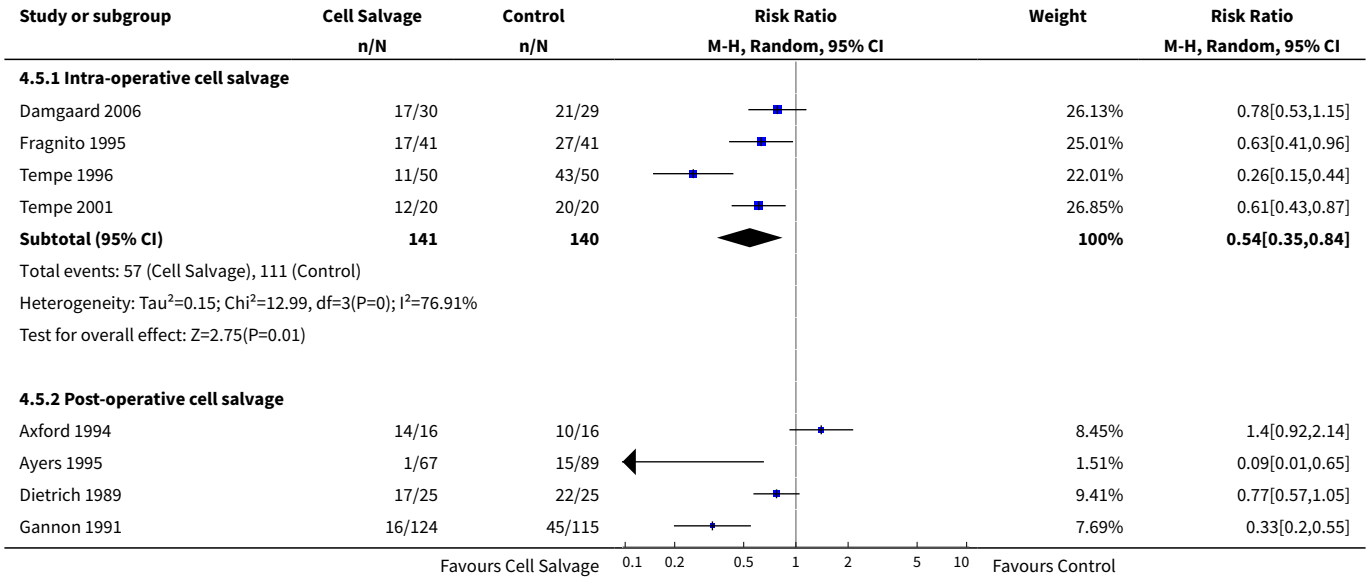
Study or subgroup	Cell Salvage n/N	Control n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
4.4.1 Washed					
Klein 2008	31/102	33/111		12.92%	1.02[0.68,1.54]
Mah 1995	9/44	26/55		8.26%	0.43[0.23,0.83]
Menges 1992	8/14	12/12		11.86%	0.59[0.37,0.93]
Murphy 2004	41/98	64/102		16.29%	0.67[0.51,0.88]
Parrot 1991	13/22	19/22		13.52%	0.68[0.47,1.01]
Rollo 1995a	1/35	0/38		0.55%	3.25[0.14,77.25]
Slagis 1991	19/51	27/51		12.21%	0.7[0.45,1.09]
Tempe 1996	11/50	43/50		10.22%	0.26[0.15,0.44]
Tempe 2001	12/20	20/20		14.18%	0.61[0.43,0.87]



Favours Cell Salvage — Favours Control



Analysis 4.5. Comparison 4 Cell salvage - blood transfused (active versus active), Outcome 5 No. exposed to allogeneic blood (Timing of cell salvage).



Study or subgroup	Cell Salvage n/N	Control n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
Healy 1994	20/75	23/43		8.06%	0.5[0.31,0.8]
Mah 1995	9/44	26/55		6.56%	0.43[0.23,0.83]
Martin 2000	54/98	73/100		10.04%	0.75[0.61,0.94]
Mauerhan 1993	5/57	6/54		3.66%	0.79[0.26,2.44]
Menges 1992	8/14	12/12		8.16%	0.59[0.37,0.93]
Page 1989	42/48	45/51		10.41%	0.99[0.86,1.15]
Riou 1994	1/25	2/25		1.15%	0.5[0.05,5.17]
Rollo 1995b	4/40	0/38		0.78%	8.56[0.48,153.83]
Schonberger 1993	1/20	4/20		1.39%	0.25[0.03,2.05]
Simpson 1994	0/12	0/12			Not estimable
Slagis 1991	19/51	27/51		8.29%	0.7[0.45,1.09]
Thurer 1979	37/54	40/59		9.8%	1.01[0.79,1.3]
Tripkovic 2008	4/30	24/30		4.63%	0.17[0.07,0.42]
Westerberg 2004	0/17	0/17			Not estimable
Subtotal (95% CI)	**817**	**812**		**100%**	**0.65[0.5,0.85]**
Total events: 252 (Cell Salvage), 374 (Control)					
Heterogeneity: Tau^2=0.17; Chi^2=79.47, df=15(P<0.0001); I^2=81.12%					
Test for overall effect: Z=3.19(P=0)					
4.5.3 Intra & post-operative cell salvage					
Klein 2008	31/102	33/111		26.76%	1.02[0.68,1.54]
Murphy 2004	41/98	64/102		43.44%	0.67[0.51,0.88]
Parrot 1991	13/22	19/22		29.17%	0.68[0.47,1.01]
Rollo 1995a	1/35	0/38		0.63%	3.25[0.14,77.25]
Subtotal (95% CI)	**257**	**273**		**100%**	**0.76[0.59,0.98]**
Total events: 86 (Cell Salvage), 116 (Control)					
Heterogeneity: Tau^2=0.02; Chi^2=4.12, df=3(P=0.25); I^2=27.15%					
Test for overall effect: Z=2.13(P=0.03)					

Analysis 4.6. Comparison 4 Cell salvage - blood transfused (active versus active), Outcome 6 Units of allogeneic blood transfused (Active vs Active).

Study or subgroup	Cell Salvage N	Cell Salvage Mean(SD)	Control N	Control Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
4.6.1 Cell Salvage (Active vs Active)							
Axford 1994	16	1.7 (2)	16	2.2 (2.3)		4.77%	-0.52[-1.98,0.94]
Dietrich 1989	25	1.4 (1.9)	25	2.8 (2)		7.46%	-1.42[-2.49,-0.35]
Fragnito 1995	41	2.4 (0.8)	41	2.5 (0.9)		17.8%	-0.04[-0.41,0.33]
Martin 2000	98	1.8 (0.7)	100	2.2 (0.5)		20.86%	-0.4[-0.57,-0.23]
Page 1989	48	3.2 (2.1)	51	3.8 (2.6)		9.07%	-0.68[-1.6,0.24]
Schonberger 1993	20	0.1 (1.3)	20	0.6 (1.3)		10.11%	-0.5[-1.33,0.33]
Slagis 1991	51	0.8 (1.2)	51	1.5 (1.4)		15.28%	-0.69[-1.2,-0.18]
Tripkovic 2008	30	0.2 (1)	30	1.7 (1.2)		14.65%	-1.52[-2.06,-0.98]
Subtotal ***	**329**		**334**			**100%**	**-0.66[-1.02,-0.3]**
Heterogeneity: Tau^2=0.15; Chi^2=24.33, df=7(P=0); I^2=71.23%							
Test for overall effect: Z=3.6(P=0)							

Analysis 4.7. Comparison 4 Cell salvage - blood transfused (active versus active), Outcome 7 Units of allogeneic blood transfused (Transfusion Protocol).

Study or subgroup	Cell Salvage N	Cell Salvage Mean(SD)	Control N	Control Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
4.7.1 Transfusion Protocol							
Axford 1994	16	1.7 (2)	16	2.2 (2.3)		6.2%	-0.52[-1.98,0.94]
Dietrich 1989	25	1.4 (1.9)	25	2.8 (2)		9.43%	-1.42[-2.49,-0.35]
Fragnito 1995	41	2.4 (0.8)	41	2.5 (0.9)		20.3%	-0.04[-0.41,0.33]
Martin 2000	98	1.8 (0.7)	100	2.2 (0.5)		23.13%	-0.4[-0.57,-0.23]
Page 1989	48	3.2 (2.1)	51	3.8 (2.6)		11.27%	-0.68[-1.6,0.24]
Schonberger 1993	20	0.1 (1.3)	20	0.6 (1.3)		12.44%	-0.5[-1.33,0.33]
Tripkovic 2008	30	0.2 (1)	30	1.7 (1.2)		17.23%	-1.52[-2.06,-0.98]
Subtotal ***	**278**		**283**			**100%**	**-0.67[-1.09,-0.25]**
Heterogeneity: Tau^2=0.19; Chi^2=23.55, df=6(P=0); I^2=74.52%							
Test for overall effect: Z=3.1(P=0)							
4.7.2 No Transfusion Protocol							
Slagis 1991	51	0.8 (1.2)	51	1.5 (1.4)		100%	-0.69[-1.2,-0.18]
Subtotal ***	**51**		**51**			**100%**	**-0.69[-1.2,-0.18]**
Heterogeneity: Not applicable							
Test for overall effect: Z=2.67(P=0.01)							

Analysis 4.8. Comparison 4 Cell salvage - blood transfused (active versus active), Outcome 8 Units allogeneic blood transfused (Type of Surgery).

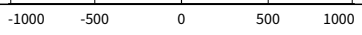
Study or subgroup	Cell Salvage N	Cell Salvage Mean(SD)	Control N	Control Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
4.8.1 Cardiac							
Axford 1994	16	1.7 (2)	16	2.2 (2.3)		3.3%	-0.52[-1.98,0.94]
Dietrich 1989	25	1.4 (1.9)	25	2.8 (2)		5.84%	-1.42[-2.49,-0.35]
Fragnito 1995	41	2.4 (0.8)	41	2.5 (0.9)		27.82%	-0.04[-0.41,0.33]
Martin 2000	98	1.8 (0.7)	100	2.2 (0.5)		46.27%	-0.4[-0.57,-0.23]
Page 1989	48	3.2 (2.1)	51	3.8 (2.6)		7.69%	-0.68[-1.6,0.24]
Schonberger 1993	20	0.1 (1.3)	20	0.6 (1.3)		9.08%	-0.5[-1.33,0.33]
Subtotal ***	**248**		**253**			**100%**	**-0.39[-0.67,-0.12]**
Heterogeneity: Tau^2=0.03; Chi^2=7.47, df=5(P=0.19); I^2=33.04%							
Test for overall effect: Z=2.83(P=0)							
4.8.2 Orthopaedic							
Slagis 1991	51	0.8 (1.2)	51	1.5 (1.4)		50.69%	-0.69[-1.2,-0.18]
Tripkovic 2008	30	0.2 (1)	30	1.7 (1.2)		49.31%	-1.52[-2.06,-0.98]
Subtotal ***	**81**		**81**			**100%**	**-1.1[-1.91,-0.29]**
Heterogeneity: Tau^2=0.27; Chi^2=4.83, df=1(P=0.03); I^2=79.29%							
Test for overall effect: Z=2.65(P=0.01)							

Comparison 5. Cell salvage - blood loss

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Total blood loss (All Studies)	32	2311	Mean Difference (IV, Random, 95% CI)	-39.02 [-85.10, 7.05]
2 Total blood loss (Active vs Control)	24	1570	Mean Difference (IV, Random, 95% CI)	-38.98 [-99.91, 21.95]
3 Total blood loss (Active vs Active)	8	741	Mean Difference (IV, Random, 95% CI)	-48.32 [-116.38, 19.74]

Analysis 5.1. Comparison 5 Cell salvage - blood loss, Outcome 1 Total blood loss (All Studies).

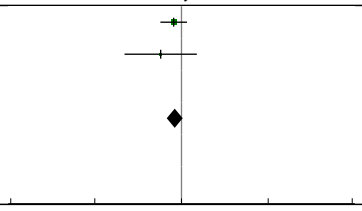
Study or subgroup	Cell Salvage N	Cell Salvage Mean(SD)	Control N	Control Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
Abuzakuk 2007	52	673 (355)	52	867 (434)		4.79%	-194[-346.4,-41.6]
Altinel 2007	16	725.6 (309.8)	16	888.5 (497.8)		2.05%	-162.9[-450.2,124.4]
Bouboulis 1994	42	1437 (897)	33	1322 (873)		1.16%	115[-287.88,517.88]
Clagett 1999	50	981 (983)	50	1000 (787)		1.49%	-19[-368.03,330.03]
Dalrymple-Hay 1999	56	652 (382)	56	686 (374)		5.21%	-34[-174.02,106.02]
Davies 1987	25	3224 (2392)	25	2999 (1579)		0.17%	225[-898.52,1348.52]
Dietrich 1989	25	722 (233)	25	890 (359)		4.31%	-168[-335.77,-0.23]
Elawad 1991	19	1464 (386)	20	2200 (608)		1.74%	-736[-1054,-418]
Fragnito 1995	41	719.5 (196)	41	843.9 (292.4)		6.49%	-124.4[-232.15,-16.65]
Goel 2007	24	355 (196)	25	316 (119.8)		7.2%	39[-52.4,130.4]
Heddle 1992	39	1006 (534)	40	1008 (484)		2.96%	-2[-226.91,222.91]
Kelley 1993	18	842.8 (1554.2)	18	651.7 (345.1)		0.38%	191.11[-544.37,926.59]
Koopman 1993a	17	4100 (1400)	20	3700 (1900)		0.18%	400[-665.96,1465.96]
Koopman 1993b	29	1200 (600)	30	1200 (600)		1.85%	0[-306.24,306.24]
Laub 1993	19	1115.8 (627.2)	19	1079.6 (491.7)		1.42%	36.2[-322.15,394.55]
Lorentz 1991	16	1753 (783)	15	1720 (794)		0.64%	33[-522.56,588.56]
Majowski 1991	20	1020 (540)	20	1140 (513)		1.66%	-120[-446.43,206.43]
Martin 2000	98	1684 (2257)	100	1233 (1710)		0.64%	451[-107.58,1009.58]
McGill 2002	84	821.6 (477.3)	84	795.8 (443.9)		5.24%	25.8[-113.59,165.19]
Menges 1992	14	2104 (567)	12	1872 (491)		1.14%	232[-174.68,638.68]
Murphy 2004	99	1359 (842)	97	1369 (907)		2.61%	-10[-255.13,235.13]
Newman 1997	35	896 (545)	35	891 (401)		2.97%	5[-219.16,229.16]
Niranjan 2006	40	855.5 (281)	40	963 (303.2)		5.66%	-107.5[-235.63,20.63]
Parrot 1991	21	860 (664)	22	951 (866.3)		0.91%	-91[-551.1,369.1]
Pleym 2005	23	487 (137)	24	552 (220)		6.64%	-65[-169.32,39.32]
Schaff 1978a	63	813 (960)	51	711 (664)		1.92%	102[-197.01,401.01]
Sirvinskas 2007	41	690.4 (206.4)	49	602.6 (259.7)		6.99%	87.88[-8.45,184.21]
Tempe 1996	50	578.6 (261.7)	50	623.6 (374.6)		5.71%	-45[-171.66,81.66]
Tripkovic 2008	30	1434 (374)	30	1372 (345)		3.91%	62[-120.08,244.08]
Ward 1993	18	1495 (679)	17	1114 (788)		0.82%	381[-107.58,869.58]



Favours Cell Salvage

Favours Control

Study or subgroup	Cell Salvage N	Cell Salvage Mean(SD)	Control N	Control Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
Westerberg 2004	12	315 (114.3)	17	360 (86.6)		7.87%	-45[-121.66,31.66]
Zhao 1996	22	550 (300)	20	670 (380)		3.29%	-120[-328.45,88.45]
Total ***	**1158**		**1153**			**100%**	**-39.02[-85.1,7.05]**
Heterogeneity: Tau^2=5494.94; Chi^2=52.26, df=31(P=0.01); I^2=40.68%							
Test for overall effect: Z=1.66(P=0.1)							



Analysis 5.2. Comparison 5 Cell salvage - blood loss, Outcome 2 Total blood loss (Active vs Control).

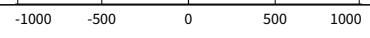
Study or subgroup	Cell Salvage N	Cell Salvage Mean(SD)	Control N	Control Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
Abuzakuk 2007	52	673 (355)	52	867 (434)		7.02%	-194[-346.4,-41.6]
Altinel 2007	16	725.6 (309.8)	16	888.5 (497.8)		3.31%	-162.9[-450.2,124.4]
Bouboulis 1994	42	1437 (897)	33	1322 (873)		1.93%	115[-287.88,517.88]
Clagett 1999	50	981 (983)	50	1000 (787)		2.45%	-19[-368.03,330.03]
Dalrymple-Hay 1999	56	652 (382)	56	686 (374)		7.54%	-34[-174.02,106.02]
Davies 1987	25	3224 (2392)	25	2999 (1579)		0.29%	225[-898.52,1348.52]
Elawad 1991	19	1464 (386)	20	2200 (608)		2.84%	-736[-1054,-418]
Goel 2007	24	355 (196)	25	316 (119.8)		9.77%	39[-52.4,130.4]
Heddle 1992	39	1006 (534)	40	1008 (484)		4.63%	-2[-226.91,222.91]
Kelley 1993	18	842.8 (1554.2)	18	651.7 (345.1)		0.65%	191.11[-544.37,926.59]
Koopman 1993a	17	4100 (1400)	20	3700 (1900)		0.32%	400[-665.96,1465.96]
Koopman 1993b	29	1200 (600)	30	1200 (600)		3.01%	0[-306.24,306.24]
Laub 1993	19	1115.8 (627.2)	19	1079.6 (491.7)		2.35%	36.2[-322.15,394.55]
Lorentz 1991	16	1753 (783)	15	1720 (794)		1.1%	33[-522.56,588.56]
Majowski 1991	20	1020 (540)	20	1140 (513)		2.73%	-120[-446.43,206.43]
McGill 2002	84	821.6 (477.3)	84	795.8 (443.9)		7.56%	25.8[-113.59,165.19]
Newman 1997	35	896 (545)	35	891 (401)		4.65%	5[-219.16,229.16]
Niranjan 2006	40	855.5 (281)	40	963 (303.2)		8.06%	-107.5[-235.63,20.63]
Parrot 1991	21	860 (664)	22	951 (866.3)		1.54%	-91[-551.1,369.1]
Pleym 2005	23	487 (137)	24	552 (220)		9.16%	-65[-169.32,39.32]
Schaff 1978a	63	813 (960)	51	711 (664)		3.12%	102[-197.01,401.01]
Sirvinskas 2007	41	690.4 (206.4)	49	602.6 (259.7)		9.54%	87.88[-8.45,184.21]
Ward 1993	18	1495 (679)	17	1114 (788)		1.38%	381[-107.58,869.58]
Zhao 1996	22	550 (300)	20	670 (380)		5.08%	-120[-328.45,88.45]
Total ***	**789**		**781**			**100%**	**-38.98[-99.91,21.95]**
Heterogeneity: Tau^2=7717.8; Chi^2=41.08, df=23(P=0.01); I^2=44.02%							
Test for overall effect: Z=1.25(P=0.21)							

Analysis 5.3. Comparison 5 Cell salvage - blood loss, Outcome 3 Total blood loss (Active vs Active).

Study or subgroup	Cell Salvage N	Cell Salvage Mean(SD)	Control N	Control Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
Dietrich 1989	25	722 (233)	25	890 (359)		11.99%	-168[-335.77,-0.23]
Fragnito 1995	41	719.5 (196)	41	843.9 (292.4)		20.97%	-124.4[-232.15,-16.65]
Martin 2000	98	1684 (2257)	100	1233 (1710)		1.44%	451[-107.58,1009.58]
Menges 1992	14	2104 (567)	12	1872 (491)		2.63%	232[-174.68,638.68]
Murphy 2004	99	1359 (842)	97	1369 (907)		6.56%	-10[-255.13,235.13]
Tempe 1996	50	578.6 (261.7)	50	623.6 (374.6)		17.47%	-45[-171.66,81.66]
Tripkovic 2008	30	1434 (374)	30	1372 (345)		10.62%	62[-120.08,244.08]
Westerberg 2004	12	315 (114.3)	17	360 (86.6)		28.32%	-45[-121.66,31.66]
Total ***	**369**		**372**			**100%**	**-48.32[-116.38,19.74]**

Heterogeneity: Tau²=2728.24; Chi²=10.21, df=7(P=0.18); I²=31.42%

Test for overall effect: Z=1.39(P=0.16)



Favours Cell Salvage — Favours Control

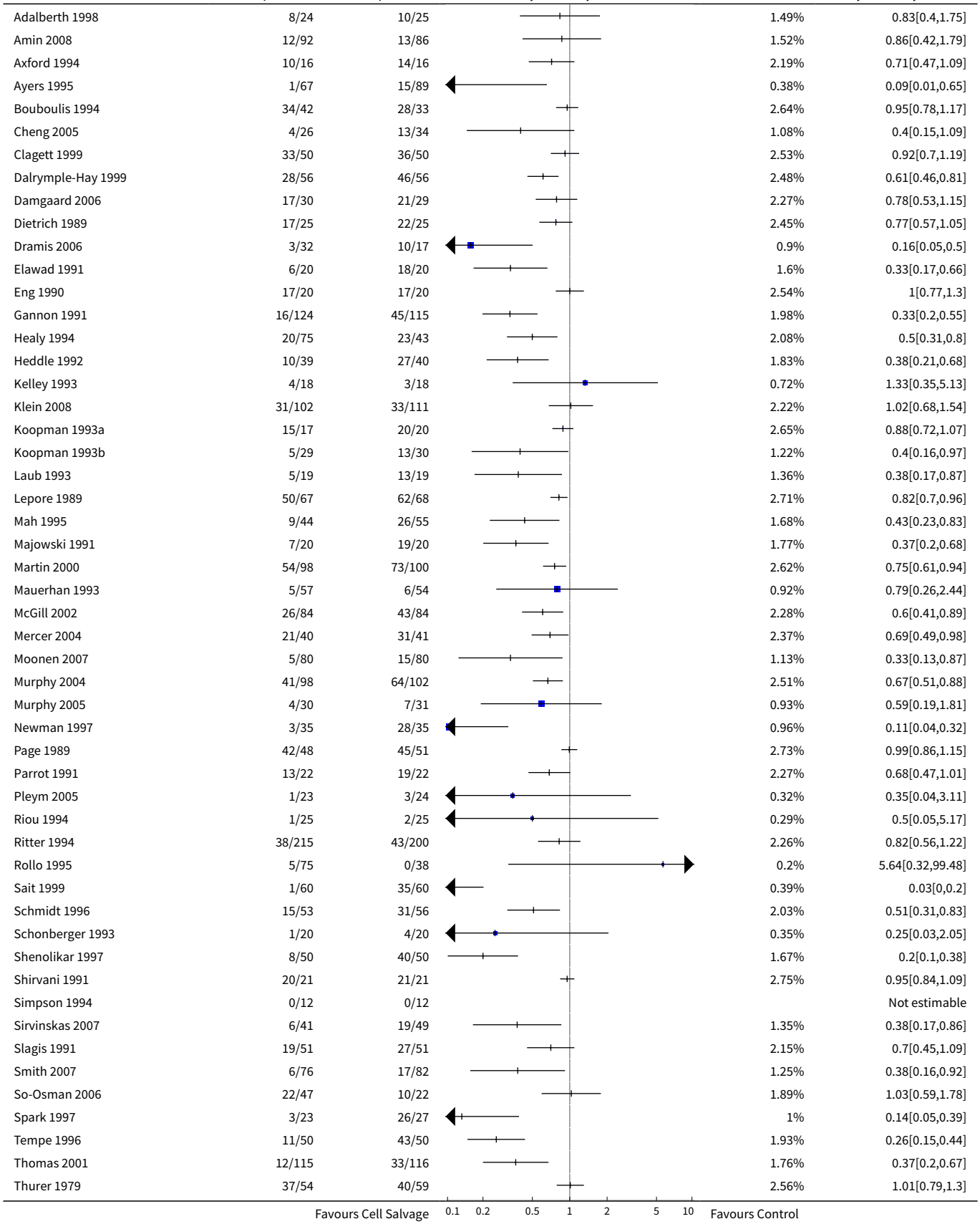
Comparison 6. Cell salvage - blood transfused (language and methodological quality)

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Language of Publication (All Studies)	66		Risk Ratio (M-H, Random, 95% CI)	Subtotals only
1.1 English	60	5711	Risk Ratio (M-H, Random, 95% CI)	0.61 [0.54, 0.70]
1.2 Non-English	6	274	Risk Ratio (M-H, Random, 95% CI)	0.63 [0.50, 0.79]
2 Methodological Quality - Allocation concealment (All Studies)	67		Risk Ratio (M-H, Random, 95% CI)	Subtotals only
2.1 Allocation concealment - Yes	1	47	Risk Ratio (M-H, Random, 95% CI)	0.35 [0.04, 3.11]
2.2 Allocation concealment - Unclear	42	3812	Risk Ratio (M-H, Random, 95% CI)	0.62 [0.53, 0.72]
2.3 Allocation concealment - No	24	2166	Risk Ratio (M-H, Random, 95% CI)	0.62 [0.51, 0.75]

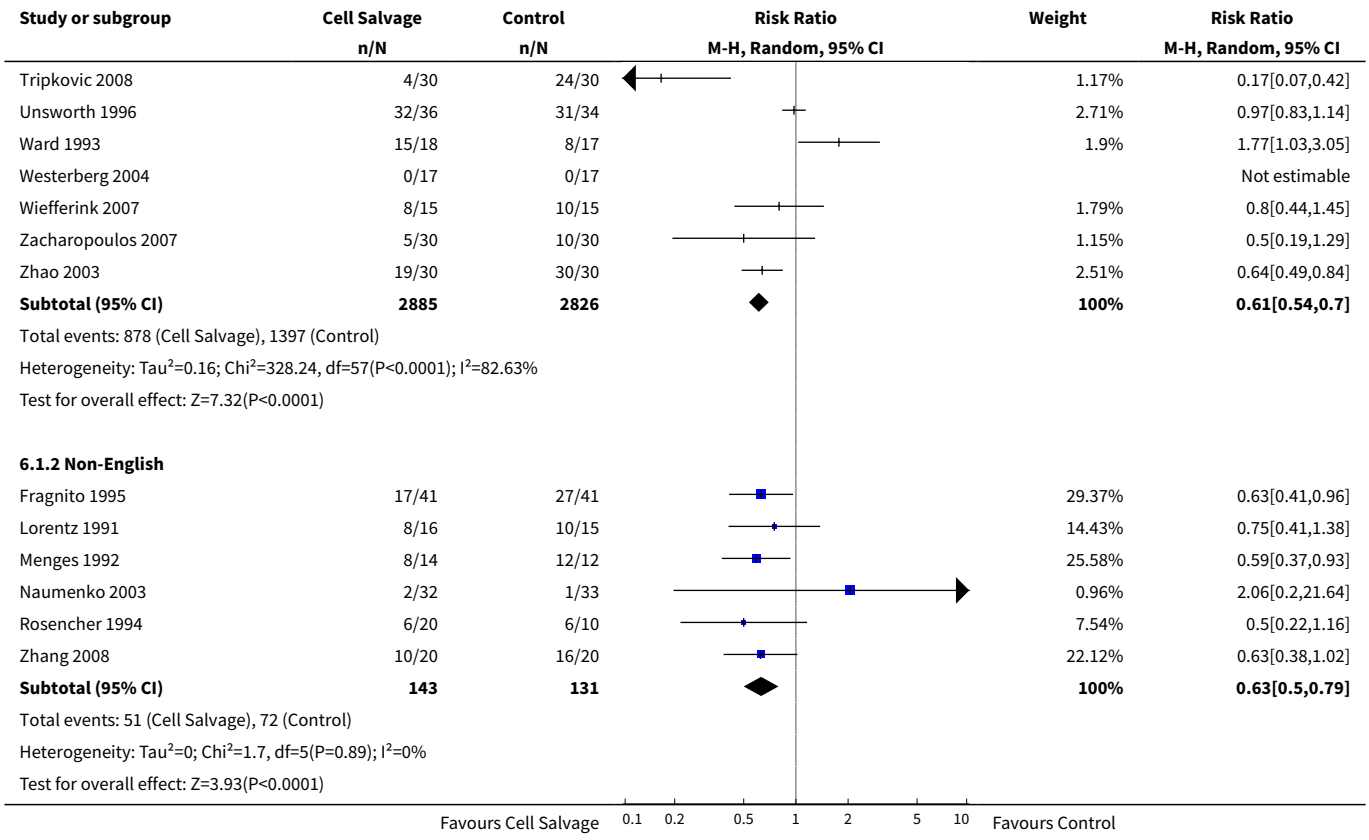
Analysis 6.1. Comparison 6 Cell salvage - blood transfused (language and methodological quality), Outcome 1 Language of Publication (All Studies).

Study or subgroup	Cell Salvage n/N	Control n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
6.1.1 English					
Abuzakuk 2007	13/52	12/52		1.6%	1.08[0.55,2.15]

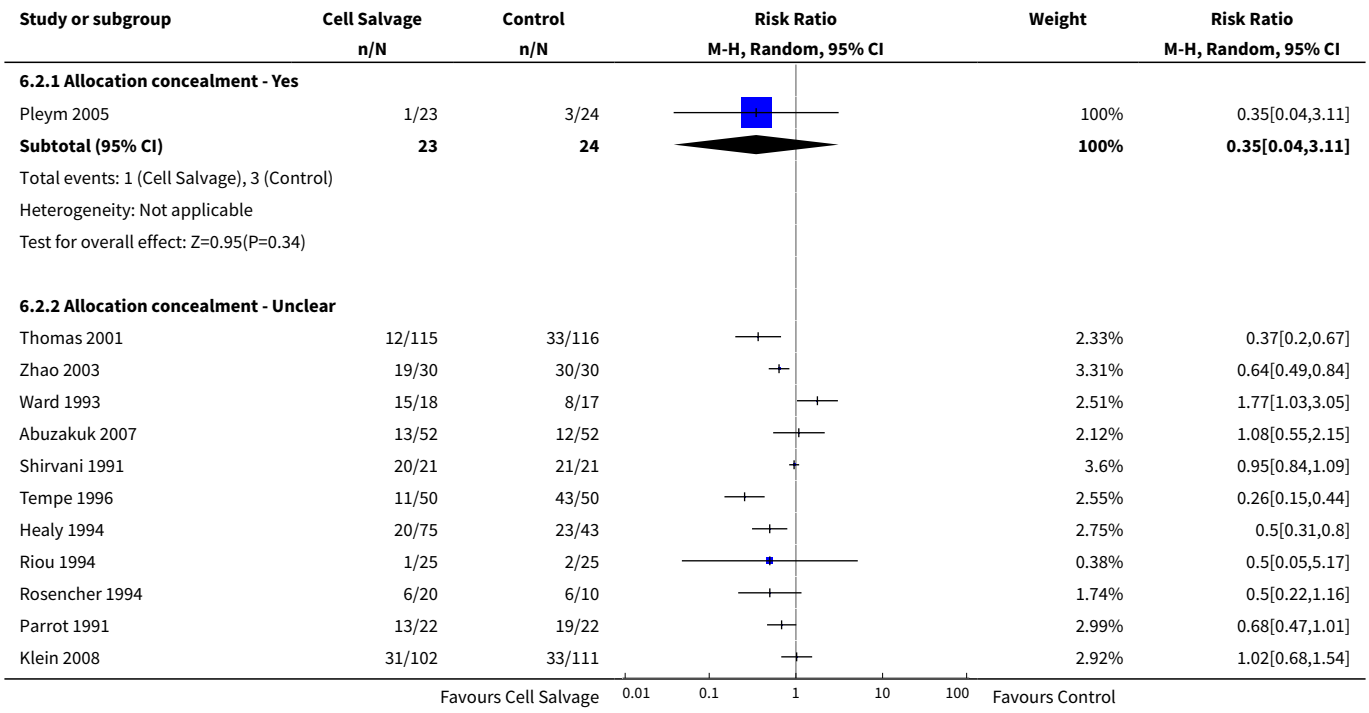
Favours Cell Salvage — Favours Control

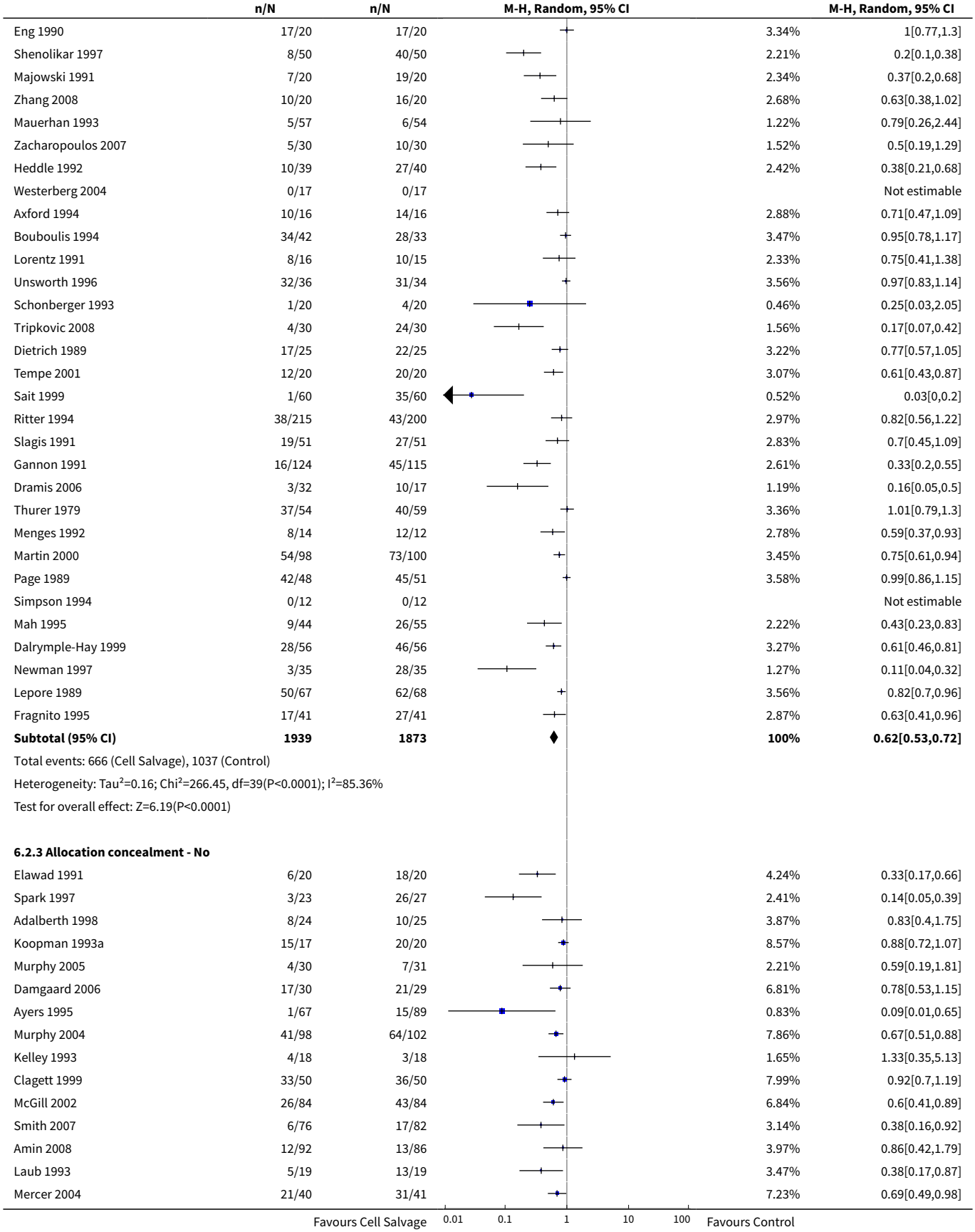


Study or subgroup	Cell Salvage n/N	Control n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
Adalberth 1998	8/24	10/25		1.49%	0.83[0.4,1.75]
Amin 2008	12/92	13/86		1.52%	0.86[0.42,1.79]
Axford 1994	10/16	14/16		2.19%	0.71[0.47,1.09]
Ayers 1995	1/67	15/89		0.38%	0.09[0.01,0.65]
Bouboulis 1994	34/42	28/33		2.64%	0.95[0.78,1.17]
Cheng 2005	4/26	13/34		1.08%	0.4[0.15,1.09]
Clagett 1999	33/50	36/50		2.53%	0.92[0.7,1.19]
Dalrymple-Hay 1999	28/56	46/56		2.48%	0.61[0.46,0.81]
Damgaard 2006	17/30	21/29		2.27%	0.78[0.53,1.15]
Dietrich 1989	17/25	22/25		2.45%	0.77[0.57,1.05]
Dramis 2006	3/32	10/17		0.9%	0.16[0.05,0.5]
Elawad 1991	6/20	18/20		1.6%	0.33[0.17,0.66]
Eng 1990	17/20	17/20		2.54%	1[0.77,1.3]
Gannon 1991	16/124	45/115		1.98%	0.33[0.2,0.55]
Healy 1994	20/75	23/43		2.08%	0.5[0.31,0.8]
Heddle 1992	10/39	27/40		1.83%	0.38[0.21,0.68]
Kelley 1993	4/18	3/18		0.72%	1.33[0.35,5.13]
Klein 2008	31/102	33/111		2.22%	1.02[0.68,1.54]
Koopman 1993a	15/17	20/20		2.65%	0.88[0.72,1.07]
Koopman 1993b	5/29	13/30		1.22%	0.4[0.16,0.97]
Laub 1993	5/19	13/19		1.36%	0.38[0.17,0.87]
Lepore 1989	50/67	62/68		2.71%	0.82[0.7,0.96]
Mah 1995	9/44	26/55		1.68%	0.43[0.23,0.83]
Majowski 1991	7/20	19/20		1.77%	0.37[0.2,0.68]
Martin 2000	54/98	73/100		2.62%	0.75[0.61,0.94]
Mauerhan 1993	5/57	6/54		0.92%	0.79[0.26,2.44]
McGill 2002	26/84	43/84		2.28%	0.6[0.41,0.89]
Mercer 2004	21/40	31/41		2.37%	0.69[0.49,0.98]
Moonen 2007	5/80	15/80		1.13%	0.33[0.13,0.87]
Murphy 2004	41/98	64/102		2.51%	0.67[0.51,0.88]
Murphy 2005	4/30	7/31		0.93%	0.59[0.19,1.81]
Newman 1997	3/35	28/35		0.96%	0.11[0.04,0.32]
Page 1989	42/48	45/51		2.73%	0.99[0.86,1.15]
Parrot 1991	13/22	19/22		2.27%	0.68[0.47,1.01]
Pleym 2005	1/23	3/24		0.32%	0.35[0.04,3.11]
Riou 1994	1/25	2/25		0.29%	0.5[0.05,5.17]
Ritter 1994	38/215	43/200		2.26%	0.82[0.56,1.22]
Rollo 1995	5/75	0/38		0.2%	5.64[0.32,99.48]
Sait 1999	1/60	35/60		0.39%	0.03[0,0.2]
Schmidt 1996	15/53	31/56		2.03%	0.51[0.31,0.83]
Schonberger 1993	1/20	4/20		0.35%	0.25[0.03,2.05]
Shenolikar 1997	8/50	40/50		1.67%	0.2[0.1,0.38]
Shirvani 1991	20/21	21/21		2.75%	0.95[0.84,1.09]
Simpson 1994	0/12	0/12			Not estimable
Sirvinskas 2007	6/41	19/49		1.35%	0.38[0.17,0.86]
Slagis 1991	19/51	27/51		2.15%	0.7[0.45,1.09]
Smith 2007	6/76	17/82		1.25%	0.38[0.16,0.92]
So-Osman 2006	22/47	10/22		1.89%	1.03[0.59,1.78]
Spark 1997	3/23	26/27		1%	0.14[0.05,0.39]
Tempe 1996	11/50	43/50		1.93%	0.26[0.15,0.44]
Thomas 2001	12/115	33/116		1.76%	0.37[0.2,0.67]
Thurer 1979	37/54	40/59		2.56%	1.01[0.79,1.3]

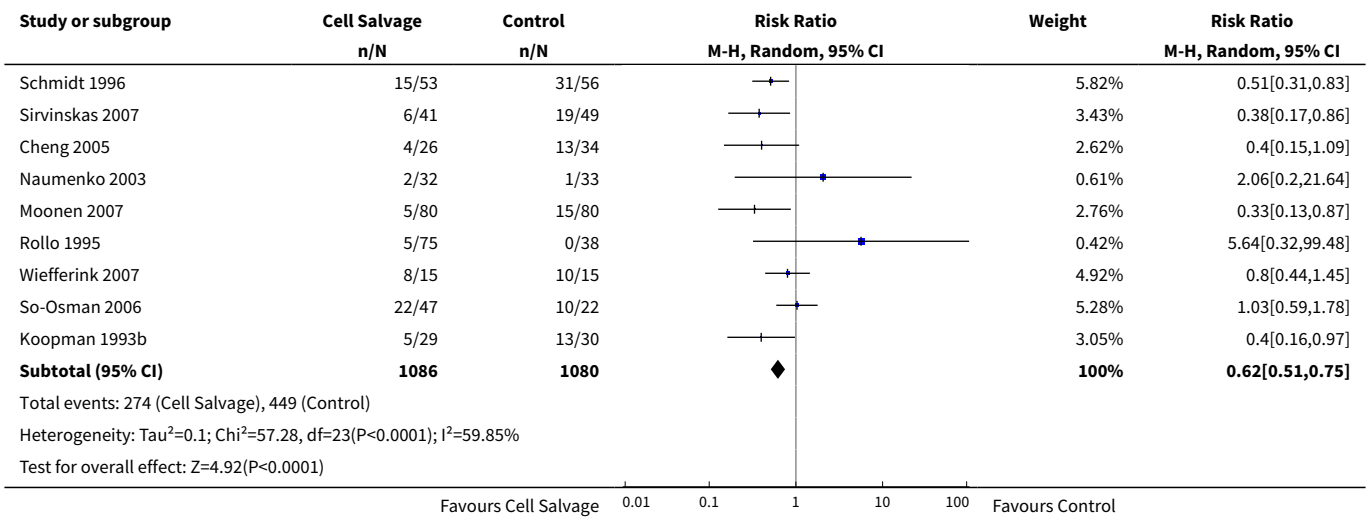


Analysis 6.2. Comparison 6 Cell salvage - blood transfused (language and methodological quality), Outcome 2 Methodological Quality - Allocation concealment (All Studies).





Study or subgroup	Cell Salvage n/N	Control n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
Eng 1990	17/20	17/20		3.34%	1[0.77,1.3]
Shenolikar 1997	8/50	40/50		2.21%	0.2[0.1,0.38]
Majowski 1991	7/20	19/20		2.34%	0.37[0.2,0.68]
Zhang 2008	10/20	16/20		2.68%	0.63[0.38,1.02]
Mauerhan 1993	5/57	6/54		1.22%	0.79[0.26,2.44]
Zacharopoulos 2007	5/30	10/30		1.52%	0.5[0.19,1.29]
Heddle 1992	10/39	27/40		2.42%	0.38[0.21,0.68]
Westerberg 2004	0/17	0/17			Not estimable
Axford 1994	10/16	14/16		2.88%	0.71[0.47,1.09]
Bouboulis 1994	34/42	28/33		3.47%	0.95[0.78,1.17]
Lorentz 1991	8/16	10/15		2.33%	0.75[0.41,1.38]
Unsworth 1996	32/36	31/34		3.56%	0.97[0.83,1.14]
Schonberger 1993	1/20	4/20		0.46%	0.25[0.03,2.05]
Tripkovic 2008	4/30	24/30		1.56%	0.17[0.07,0.42]
Dietrich 1989	17/25	22/25		3.22%	0.77[0.57,1.05]
Tempe 2001	12/20	20/20		3.07%	0.61[0.43,0.87]
Sait 1999	1/60	35/60		0.52%	0.03[0,0.2]
Ritter 1994	38/215	43/200		2.97%	0.82[0.56,1.22]
Slagis 1991	19/51	27/51		2.83%	0.7[0.45,1.09]
Gannon 1991	16/124	45/115		2.61%	0.33[0.2,0.55]
Dramis 2006	3/32	10/17		1.19%	0.16[0.05,0.5]
Thurer 1979	37/54	40/59		3.36%	1.01[0.79,1.3]
Menges 1992	8/14	12/12		2.78%	0.59[0.37,0.93]
Martin 2000	54/98	73/100		3.45%	0.75[0.61,0.94]
Page 1989	42/48	45/51		3.58%	0.99[0.86,1.15]
Simpson 1994	0/12	0/12			Not estimable
Mah 1995	9/44	26/55		2.22%	0.43[0.23,0.83]
Dalrymple-Hay 1999	28/56	46/56		3.27%	0.61[0.46,0.81]
Newman 1997	3/35	28/35		1.27%	0.11[0.04,0.32]
Lepore 1989	50/67	62/68		3.56%	0.82[0.7,0.96]
Fragnito 1995	17/41	27/41		2.87%	0.63[0.41,0.96]
Subtotal (95% CI)	**1939**	**1873**		**100%**	**0.62[0.53,0.72]**
Total events: 666 (Cell Salvage), 1037 (Control)					
Heterogeneity: Tau^2=0.16; Chi^2=266.45, df=39(P<0.0001); I^2=85.36%					
Test for overall effect: Z=6.19(P<0.0001)					
6.2.3 Allocation concealment - No					
Elawad 1991	6/20	18/20		4.24%	0.33[0.17,0.66]
Spark 1997	3/23	26/27		2.41%	0.14[0.05,0.39]
Adalberth 1998	8/24	10/25		3.87%	0.83[0.4,1.75]
Koopman 1993a	15/17	20/20		8.57%	0.88[0.72,1.07]
Murphy 2005	4/30	7/31		2.21%	0.59[0.19,1.81]
Damgaard 2006	17/30	21/29		6.81%	0.78[0.53,1.15]
Ayers 1995	1/67	15/89		0.83%	0.09[0.01,0.65]
Murphy 2004	41/98	64/102		7.86%	0.67[0.51,0.88]
Kelley 1993	4/18	3/18		1.65%	1.33[0.35,5.13]
Clagett 1999	33/50	36/50		7.99%	0.92[0.7,1.19]
McGill 2002	26/84	43/84		6.84%	0.6[0.41,0.89]
Smith 2007	6/76	17/82		3.14%	0.38[0.16,0.92]
Amin 2008	12/92	13/86		3.97%	0.86[0.42,1.79]
Laub 1993	5/19	13/19		3.47%	0.38[0.17,0.87]
Mercer 2004	21/40	31/41		7.23%	0.69[0.49,0.98]



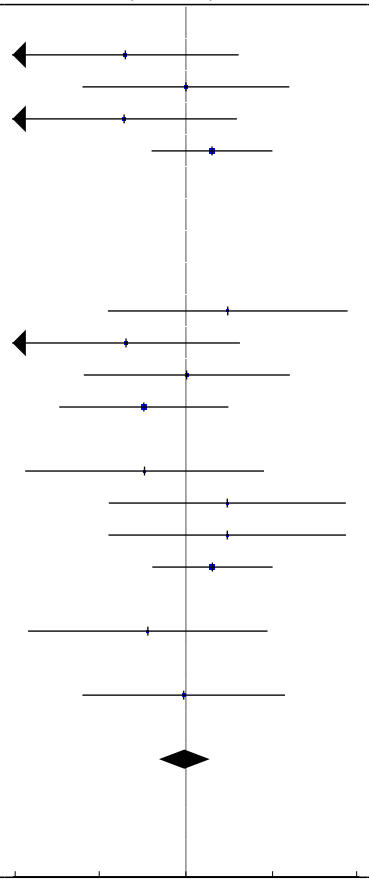
Comparison 7. Adverse events and other outcomes

Outcome or subgroup title	No. of studies	No. of partici-pants	Statistical method	Effect size
1 Mortality - All Studies	22	1788	Risk Ratio (M-H, Random, 95% CI)	0.96 [0.49, 1.88]
2 Mortality - Active vs Control	16		Risk Ratio (M-H, Random, 95% CI)	Subtotals only
2.1 Active vs Control	16	1132	Risk Ratio (M-H, Random, 95% CI)	1.41 [0.66, 3.05]
3 Mortality - Active vs Active	6	656	Risk Ratio (M-H, Random, 95% CI)	0.27 [0.07, 1.08]
4 Re-operation for bleeding - All Studies	19	1683	Risk Ratio (M-H, Random, 95% CI)	0.90 [0.53, 1.53]
5 Re-operation for bleeding - Active vs Control	10		Risk Ratio (M-H, Random, 95% CI)	Subtotals only
5.1 Active vs Control	10	688	Risk Ratio (M-H, Random, 95% CI)	1.00 [0.45, 2.24]
6 Re-operation for bleeding - Active vs Active	9	995	Risk Ratio (M-H, Random, 95% CI)	0.83 [0.41, 1.68]
7 Any infection - All Studies	23	2892	Risk Ratio (M-H, Random, 95% CI)	0.68 [0.46, 0.99]
8 Any infection - Active vs Control	16		Risk Ratio (M-H, Random, 95% CI)	Subtotals only
8.1 Active vs Control	16	1860	Risk Ratio (M-H, Random, 95% CI)	0.63 [0.41, 0.96]
9 Any Infection - Active vs Active	7	1032	Risk Ratio (M-H, Random, 95% CI)	0.88 [0.37, 2.07]
10 Wound complication - All Studies	16	1962	Risk Ratio (M-H, Random, 95% CI)	0.94 [0.57, 1.55]

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
11 Wound complication - Active vs Control	12		Risk Ratio (M-H, Random, 95% CI)	Subtotals only
11.1 Active vs Control	12	1464	Risk Ratio (M-H, Random, 95% CI)	0.88 [0.49, 1.57]
12 Wound complication - Active vs Active	4	498	Risk Ratio (M-H, Random, 95% CI)	1.13 [0.43, 2.99]
13 Any thrombosis - All Studies	11	925	Risk Ratio (M-H, Random, 95% CI)	1.13 [0.48, 2.66]
14 Any thrombosis - Active vs Control	10		Risk Ratio (M-H, Random, 95% CI)	Subtotals only
14.1 Active vs Control	10	807	Risk Ratio (M-H, Random, 95% CI)	1.13 [0.48, 2.66]
15 Stroke - All Studies	7	696	Risk Ratio (M-H, Random, 95% CI)	0.64 [0.21, 1.98]
16 Stroke - Active vs Control	5		Risk Ratio (M-H, Random, 95% CI)	Subtotals only
16.1 Active vs Control	5	439	Risk Ratio (M-H, Random, 95% CI)	0.79 [0.20, 3.21]
17 Stroke - Active vs Active	2	257	Risk Ratio (M-H, Random, 95% CI)	0.43 [0.06, 2.90]
18 Non-fatal myocardial infarction - All Studies	11	951	Risk Ratio (M-H, Random, 95% CI)	0.80 [0.43, 1.46]
19 Non-fatal myocardial infarction - Active vs Control	6		Risk Ratio (M-H, Random, 95% CI)	Subtotals only
19.1 Active vs Control	6	509	Risk Ratio (M-H, Random, 95% CI)	0.65 [0.32, 1.31]
20 Non-fatal myocardial infarction - Active vs Active	5	442	Risk Ratio (M-H, Random, 95% CI)	1.46 [0.43, 4.88]
21 Deep vein thrombosis (DVT)	7		Risk Ratio (M-H, Random, 95% CI)	Subtotals only
21.1 Active vs Control	7	645	Risk Ratio (M-H, Random, 95% CI)	0.83 [0.31, 2.23]
22 Hospital length of stay (LOS) - Active vs Control	10		Mean Difference (IV, Random, 95% CI)	Subtotals only
22.1 Active vs Control	10	772	Mean Difference (IV, Random, 95% CI)	-1.38 [-2.79, 0.03]
23 Hospital length of stay (LOS) - Active vs Active	1	196	Mean Difference (IV, Random, 95% CI)	2.8 [-2.11, 7.71]
23.1 Active vs Active	1	196	Mean Difference (IV, Random, 95% CI)	2.8 [-2.11, 7.71]

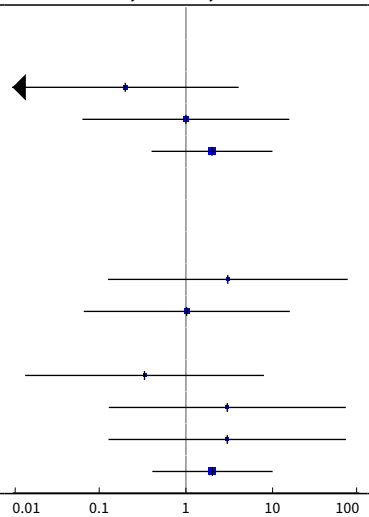
Analysis 7.1. Comparison 7 Adverse events and other outcomes, Outcome 1 Mortality - All Studies.

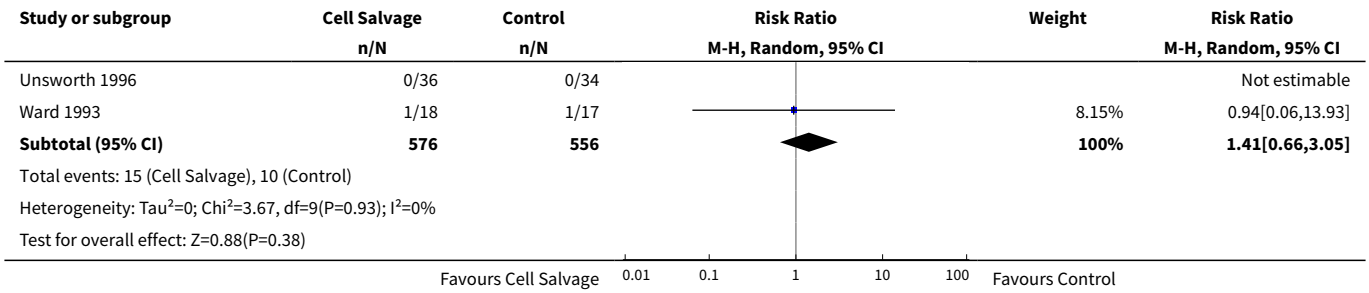
Study or subgroup	Cell Salvage n/N	Control n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
Bouboulis 1994	0/42	0/33			Not estimable
Clagett 1999	0/50	2/50		4.98%	0.2[0.01,4.06]
Dalrymple-Hay 1999	1/56	1/56		5.99%	1[0.06,15.59]
Damgaard 2006	0/30	2/29		5.04%	0.19[0.01,3.87]
Davies 1987	4/25	2/25		17.56%	2[0.4,9.95]
Dietrich 1989	0/25	0/25			Not estimable
Eng 1990	0/20	0/20			Not estimable
Goel 2007	0/24	0/25			Not estimable
Kelley 1993	0/18	0/18			Not estimable
Lepore 1989	1/67	0/68		4.46%	3.04[0.13,73.42]
Martin 2000	0/98	2/100		4.94%	0.2[0.01,4.2]
Mercer 2004	1/40	1/41		6.03%	1.02[0.07,15.83]
Murphy 2004	1/99	3/97		8.96%	0.33[0.03,3.09]
Murphy 2005	0/30	0/31			Not estimable
Niranjan 2006	0/40	1/40		4.49%	0.33[0.01,7.95]
Parrot 1991	1/22	0/22		4.56%	3[0.13,69.87]
Pleym 2005	1/25	0/25		4.54%	3[0.13,70.3]
Schaff 1978a	5/63	2/51		17.71%	2.02[0.41,10]
Schonberger 1993	0/20	0/20			Not estimable
Thurer 1979	0/54	1/59		4.47%	0.36[0.02,8.74]
Unsworth 1996	0/36	0/34			Not estimable
Ward 1993	1/18	1/17		6.24%	0.94[0.06,13.93]
Total (95% CI)	**902**	**886**		**100%**	**0.96[0.49,1.88]**
Total events: 16 (Cell Salvage), 18 (Control)					
Heterogeneity: Tau^2=0; Chi^2=8.04, df=13(P=0.84); I^2=0%					
Test for overall effect: Z=0.12(P=0.9)					



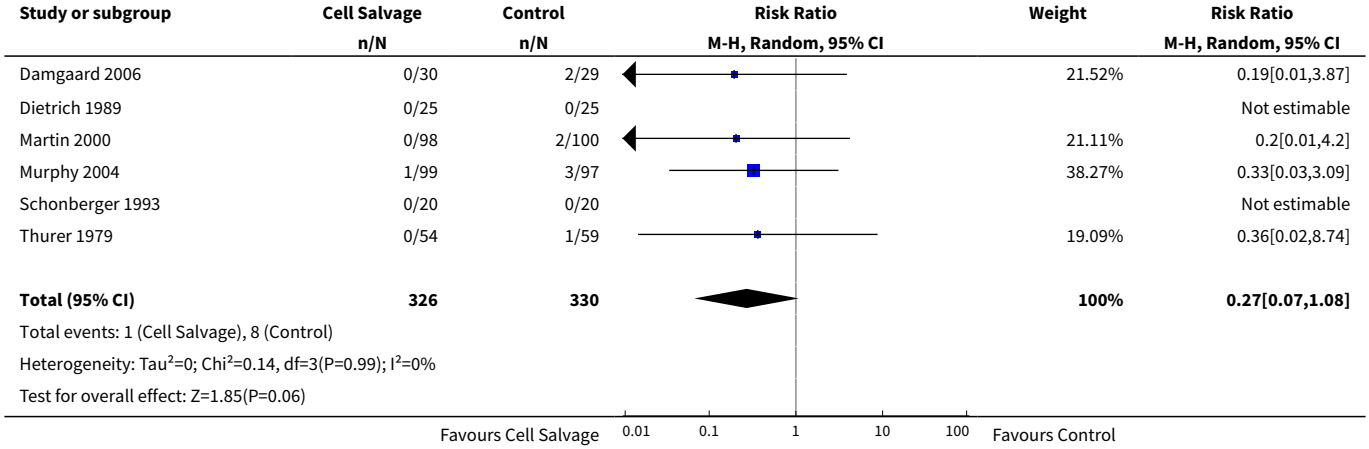
Analysis 7.2. Comparison 7 Adverse events and other outcomes, Outcome 2 Mortality - Active vs Control.

Study or subgroup	Cell Salvage n/N	Control n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
7.2.1 Active vs Control					
Bouboulis 1994	0/42	0/33			Not estimable
Clagett 1999	0/50	2/50		6.51%	0.2[0.01,4.06]
Dalrymple-Hay 1999	1/56	1/56		7.82%	1[0.06,15.59]
Davies 1987	4/25	2/25		22.93%	2[0.4,9.95]
Eng 1990	0/20	0/20			Not estimable
Goel 2007	0/24	0/25			Not estimable
Kelley 1993	0/18	0/18			Not estimable
Lepore 1989	1/67	0/68		5.83%	3.04[0.13,73.42]
Mercer 2004	1/40	1/41		7.88%	1.02[0.07,15.83]
Murphy 2005	0/30	0/31			Not estimable
Niranjan 2006	0/40	1/40		5.87%	0.33[0.01,7.95]
Parrot 1991	1/22	0/22		5.96%	3[0.13,69.87]
Pleym 2005	1/25	0/25		5.93%	3[0.13,70.3]
Schaff 1978a	5/63	2/51		23.12%	2.02[0.41,10]

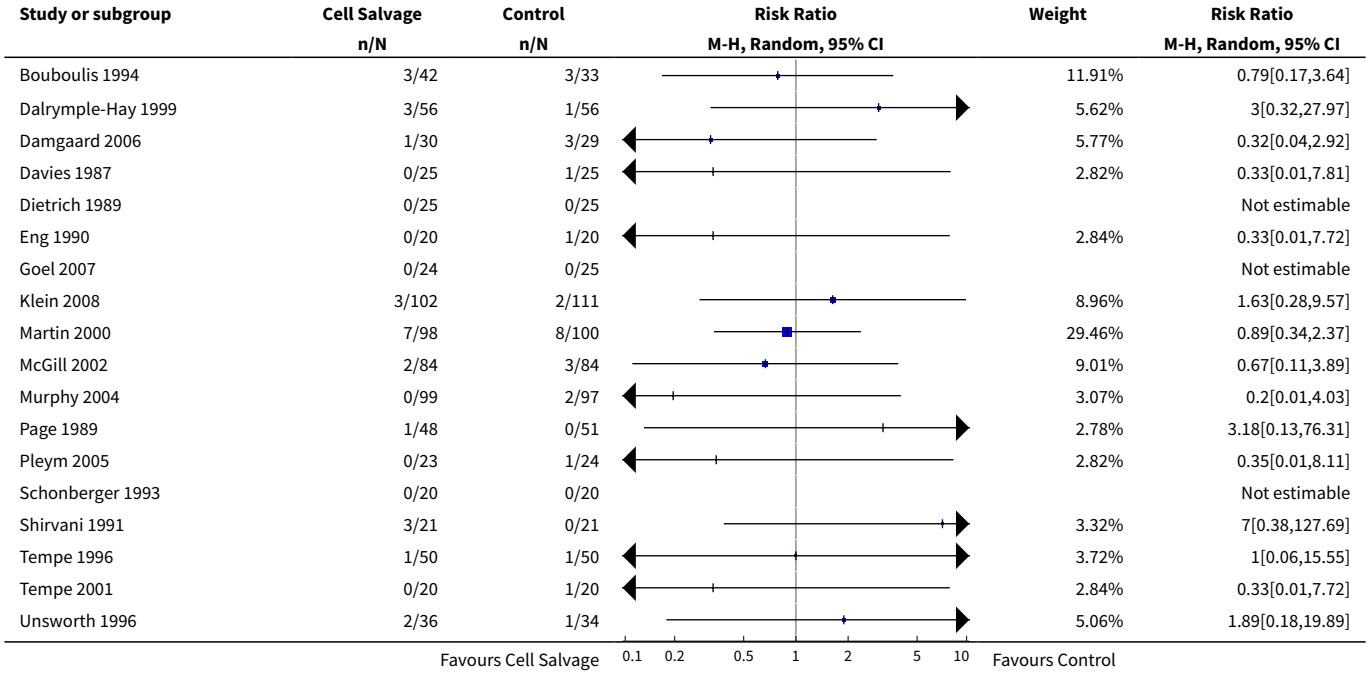


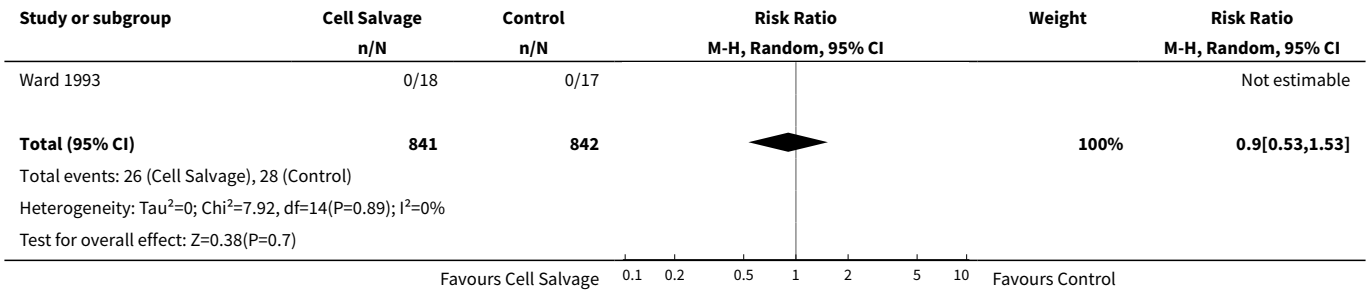


Analysis 7.3. Comparison 7 Adverse events and other outcomes, Outcome 3 Mortality - Active vs Active.

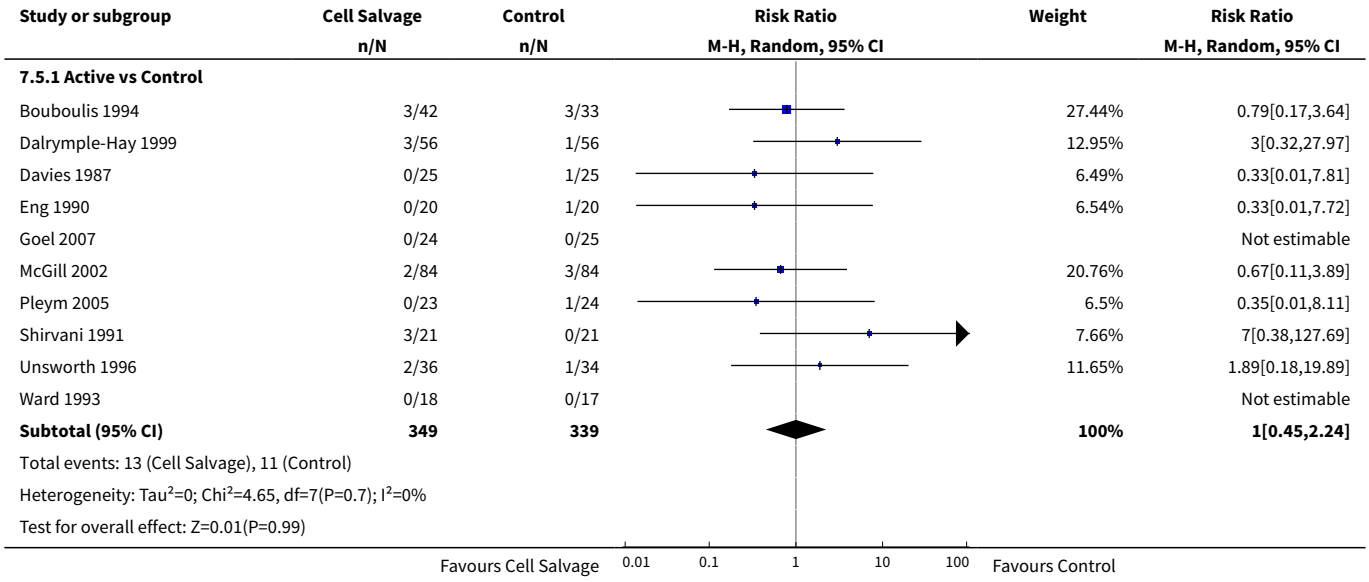


Analysis 7.4. Comparison 7 Adverse events and other outcomes, Outcome 4 Re-operation for bleeding - All Studies.

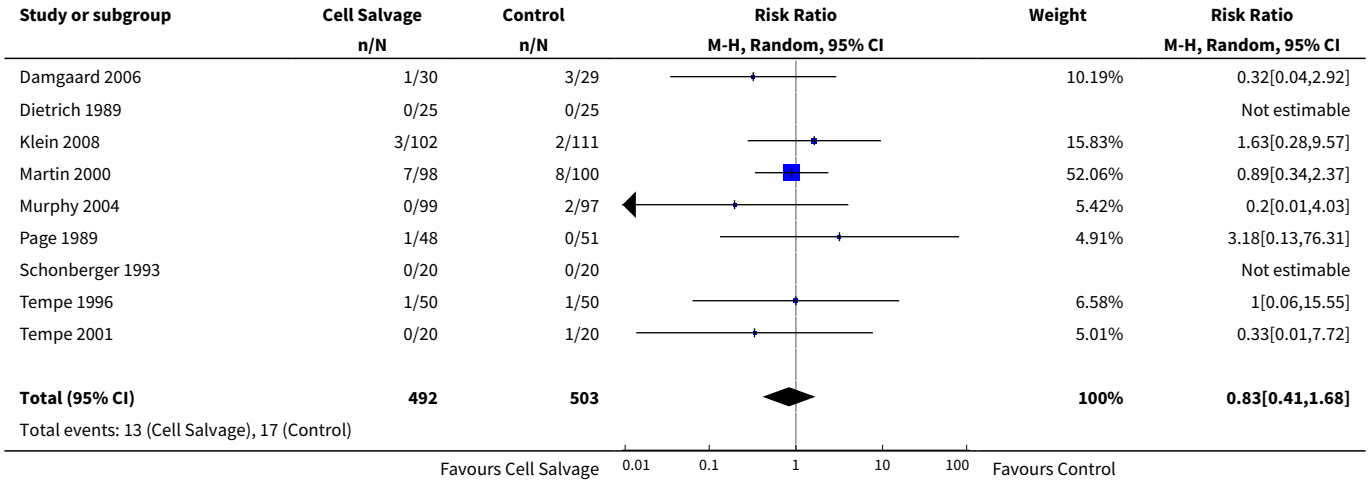




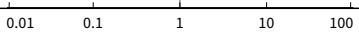
Analysis 7.5. Comparison 7 Adverse events and other outcomes, Outcome 5 Re-operation for bleeding - Active vs Control.



Analysis 7.6. Comparison 7 Adverse events and other outcomes, Outcome 6 Re-operation for bleeding - Active vs Active.

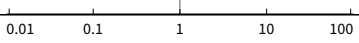


Study or subgroup	Cell Salvage n/N	Control n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
Heterogeneity: Tau²=0; Chi²=3.21, df=6(P=0.78); I²=0%					
Test for overall effect: Z=0.51(P=0.61)					



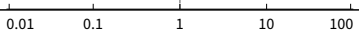
Analysis 7.7. Comparison 7 Adverse events and other outcomes, Outcome 7 Any infection - All Studies.

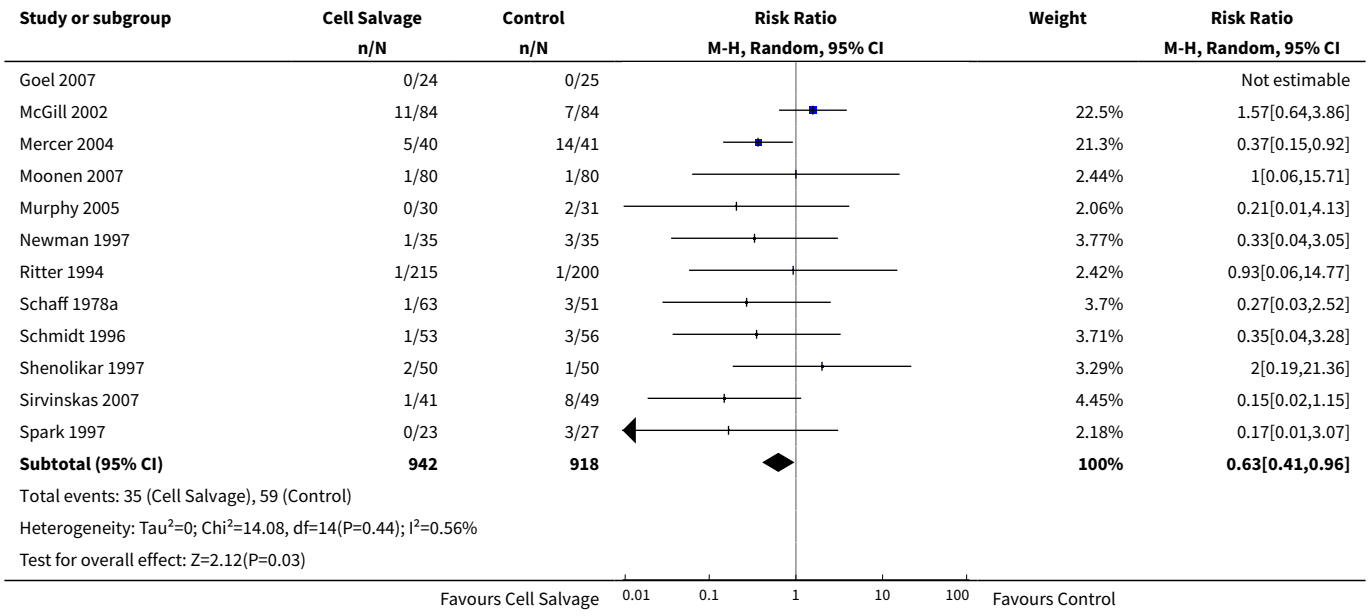
Study or subgroup	Cell Salvage n/N	Control n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
Amin 2008	3/92	2/86		4.54%	1.4[0.24,8.19]
Bouboulis 1994	3/42	0/33		1.65%	5.53[0.3,103.54]
Clagett 1999	5/50	10/50		14.17%	0.5[0.18,1.36]
Damgaard 2006	2/30	3/29		4.81%	0.64[0.12,3.58]
Eng 1990	0/20	1/20		1.43%	0.33[0.01,7.72]
Gannon 1991	0/124	0/115			Not estimable
Goel 2007	0/24	0/25			Not estimable
Klein 2008	6/102	5/111		10.59%	1.31[0.41,4.15]
McGill 2002	11/84	7/84		17.55%	1.57[0.64,3.86]
Mercer 2004	5/40	14/41		16.59%	0.37[0.15,0.92]
Moonen 2007	1/80	1/80		1.87%	1[0.06,15.71]
Murphy 2004	2/99	2/97		3.76%	0.98[0.14,6.82]
Murphy 2005	0/30	2/31		1.58%	0.21[0.01,4.13]
Newman 1997	1/35	3/35		2.89%	0.33[0.04,3.05]
Page 1989	0/48	0/51			Not estimable
Ritter 1994	1/215	1/200		1.85%	0.93[0.06,14.77]
Rollo 1995	1/75	1/38		1.88%	0.51[0.03,7.88]
Schaff 1978a	1/63	3/51		2.84%	0.27[0.03,2.52]
Schmidt 1996	1/53	3/56		2.84%	0.35[0.04,3.28]
Shenolikar 1997	2/50	1/50		2.52%	2[0.19,21.36]
Sirvinskas 2007	1/41	8/49		3.41%	0.15[0.02,1.15]
Spark 1997	0/23	3/27		1.67%	0.17[0.01,3.07]
Thurer 1979	0/54	2/59		1.56%	0.22[0.01,4.45]
Total (95% CI)	**1474**	**1418**		**100%**	**0.68[0.46,0.99]**
Total events: 46 (Cell Salvage), 72 (Control)					
Heterogeneity: Tau²=0; Chi²=16.19, df=19(P=0.64); I²=0%					
Test for overall effect: Z=2.03(P=0.04)					



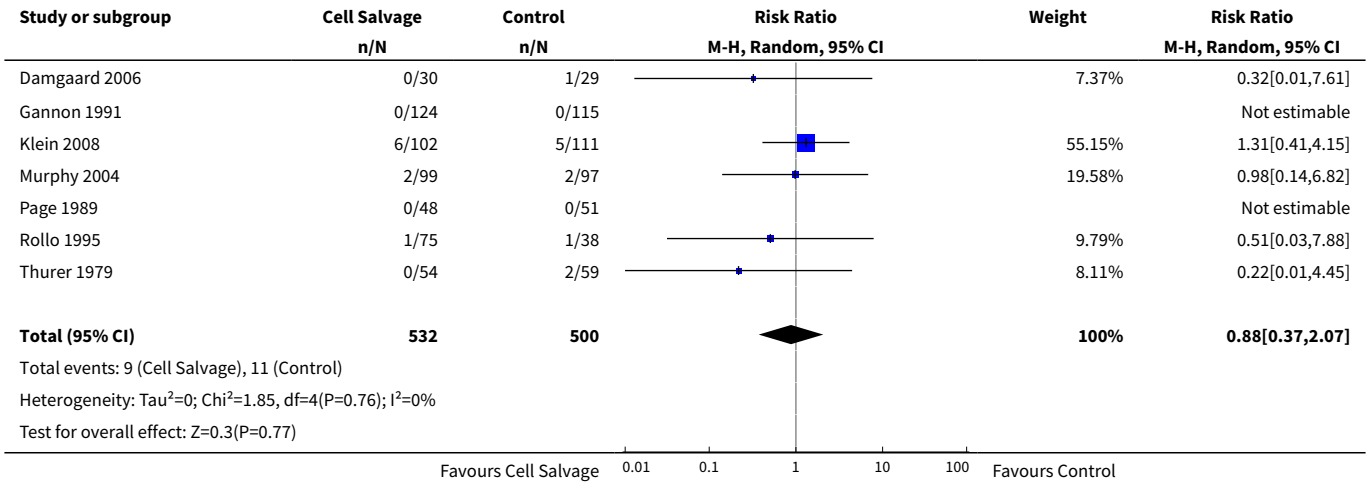
Analysis 7.8. Comparison 7 Adverse events and other outcomes, Outcome 8 Any infection - Active vs Control.

Study or subgroup	Cell Salvage n/N	Control n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
7.8.1 Active vs Control					
Amin 2008	3/92	2/86		5.92%	1.4[0.24,8.19]
Bouboulis 1994	3/42	0/33		2.16%	5.53[0.3,103.54]
Clagett 1999	5/50	10/50		18.24%	0.5[0.18,1.36]
Eng 1990	0/20	1/20		1.87%	0.33[0.01,7.72]

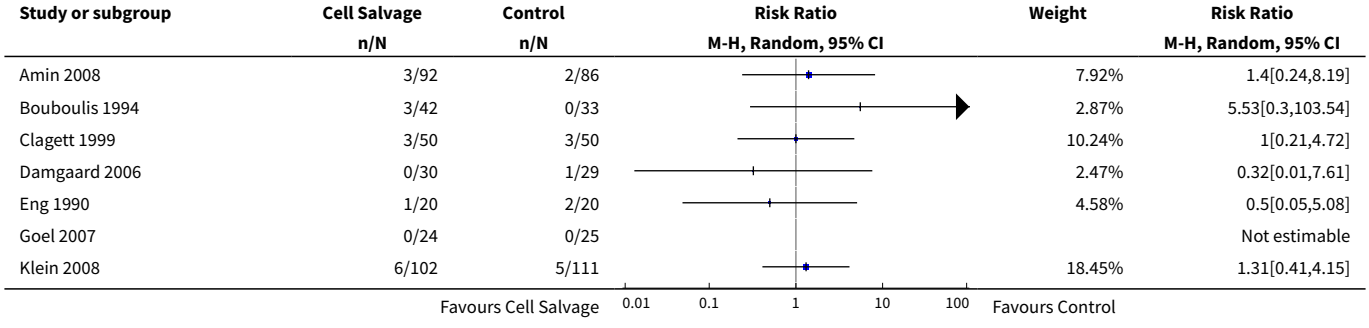


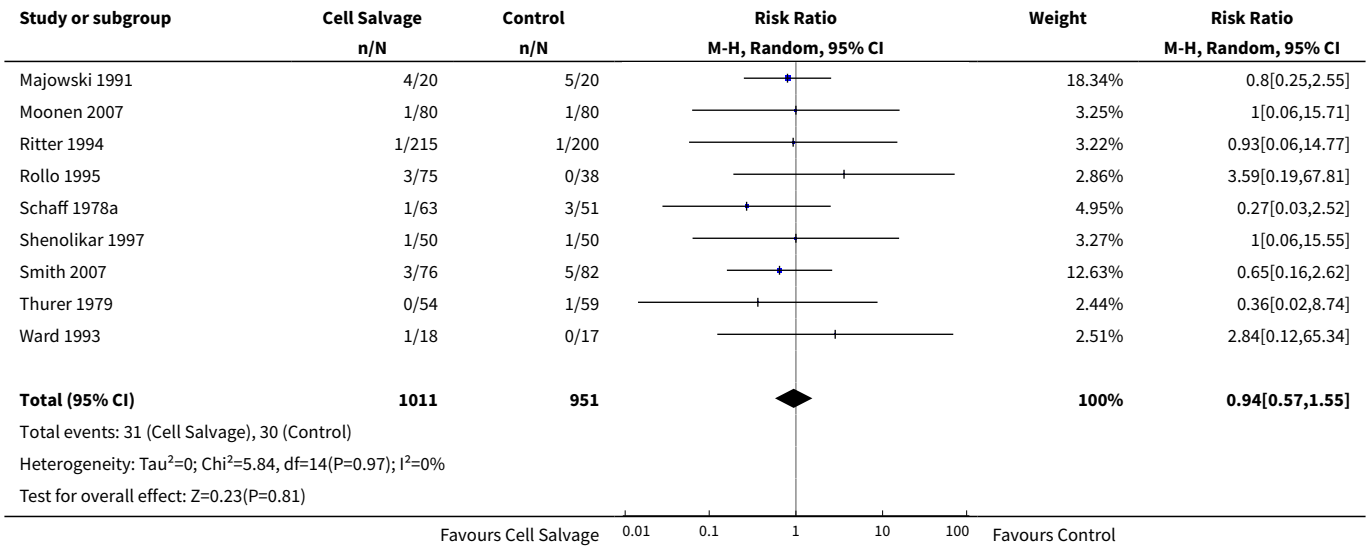


Analysis 7.9. Comparison 7 Adverse events and other outcomes, Outcome 9 Any Infection - Active vs Active.

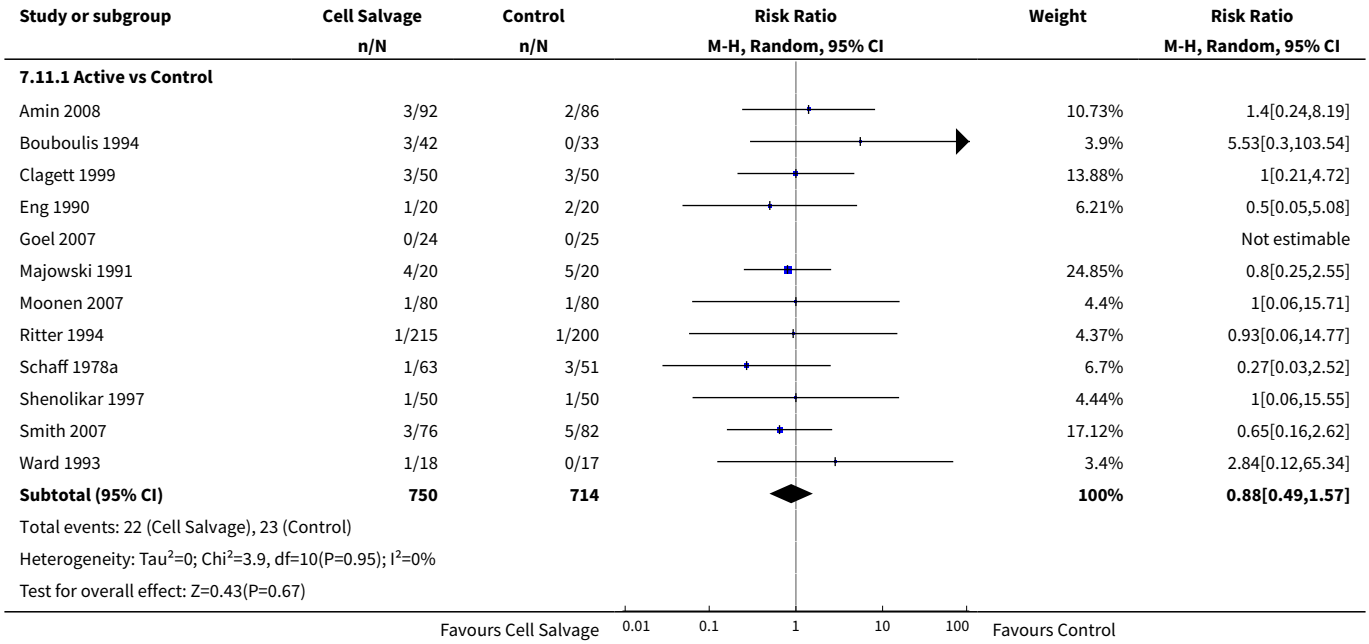


Analysis 7.10. Comparison 7 Adverse events and other outcomes, Outcome 10 Wound complication - All Studies.

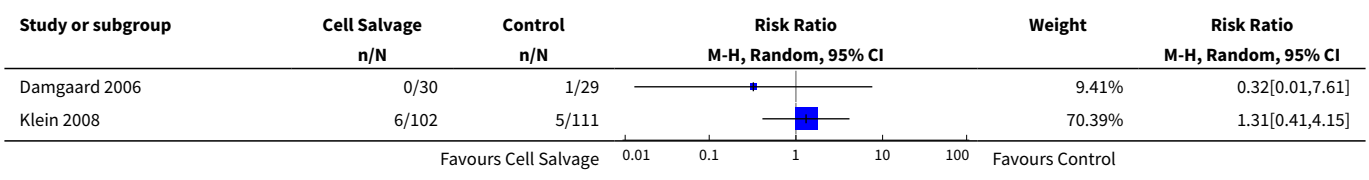


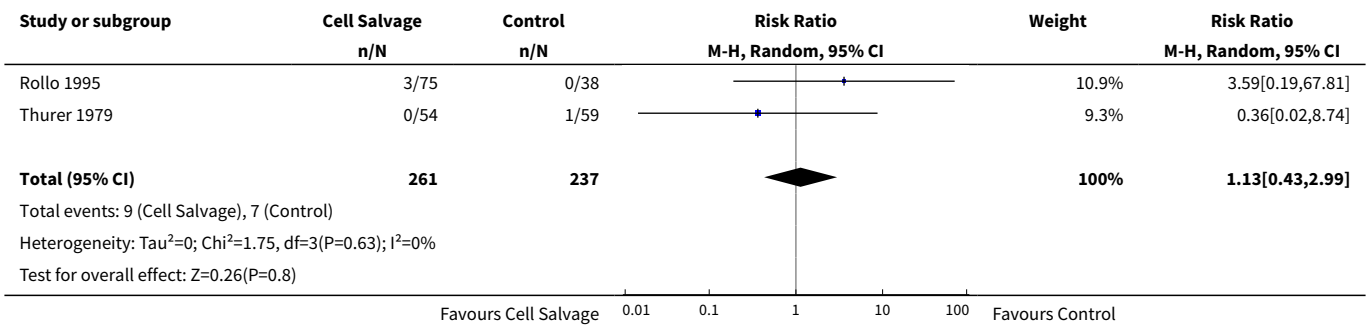


Analysis 7.11. Comparison 7 Adverse events and other outcomes, Outcome 11 Wound complication - Active vs Control.

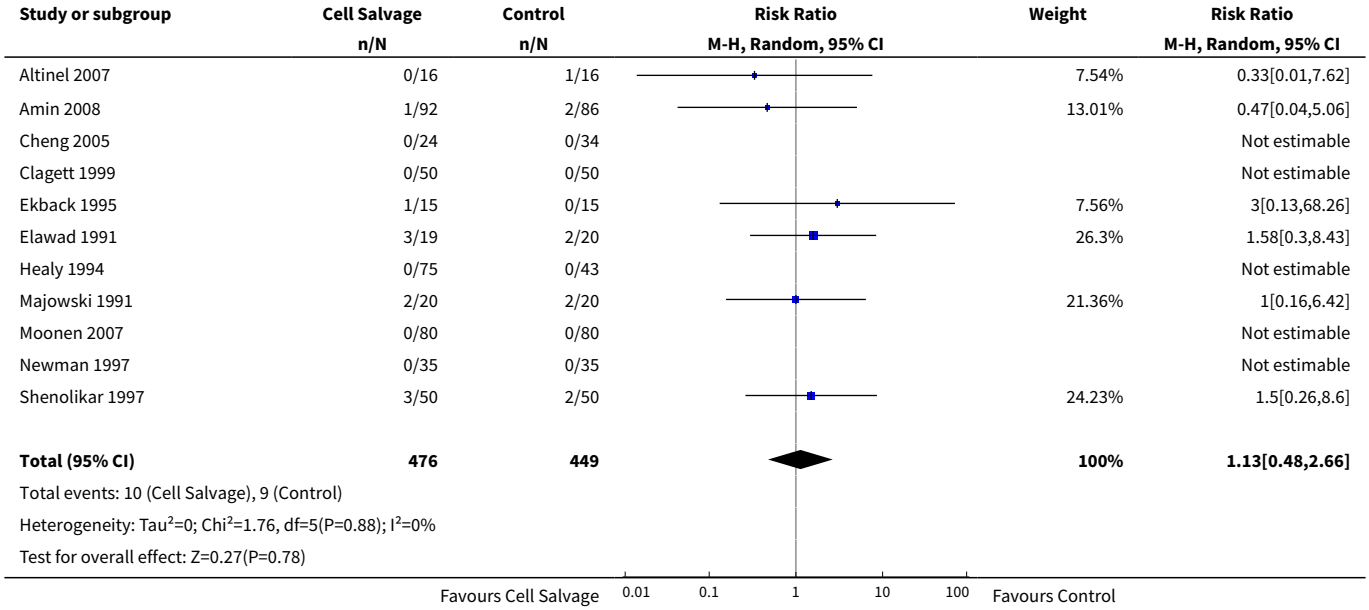


Analysis 7.12. Comparison 7 Adverse events and other outcomes, Outcome 12 Wound complication - Active vs Active.

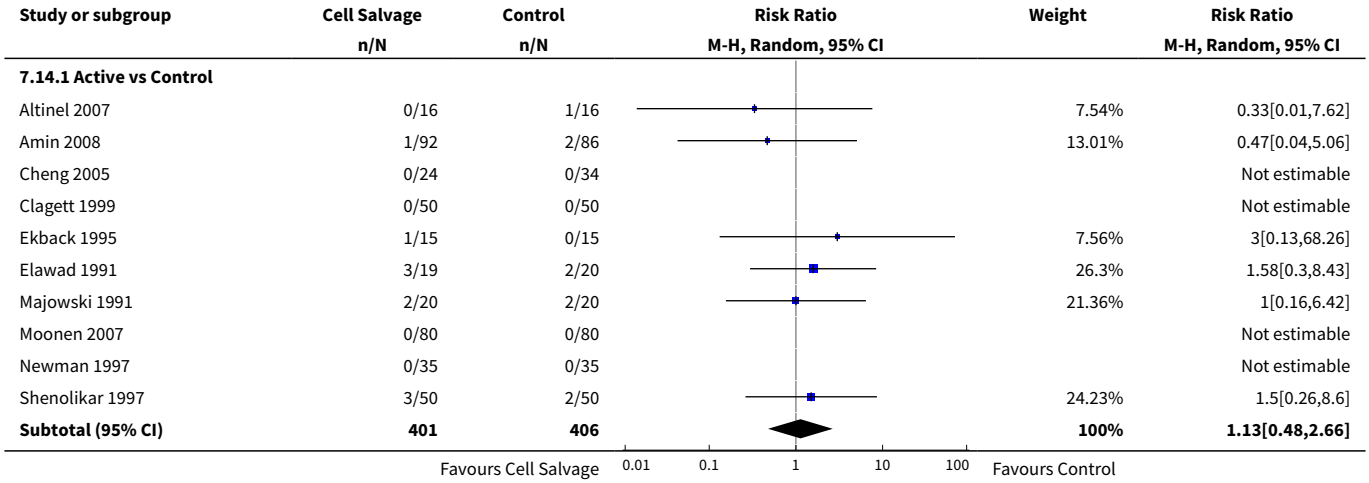




Analysis 7.13. Comparison 7 Adverse events and other outcomes, Outcome 13 Any thrombosis - All Studies.



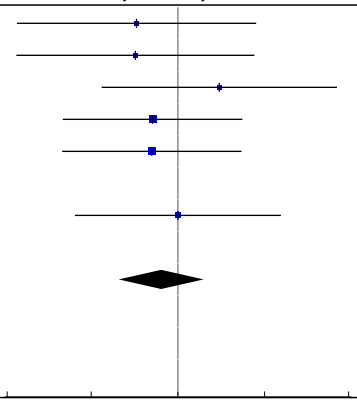
Analysis 7.14. Comparison 7 Adverse events and other outcomes, Outcome 14 Any thrombosis - Active vs Control.



Study or subgroup	Cell Salvage n/N	Control n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
Total events: 10 (Cell Salvage), 9 (Control)					
Heterogeneity: Tau²=0; Chi²=1.76, df=5(P=0.88); I²=0%					
Test for overall effect: Z=0.27(P=0.78)					

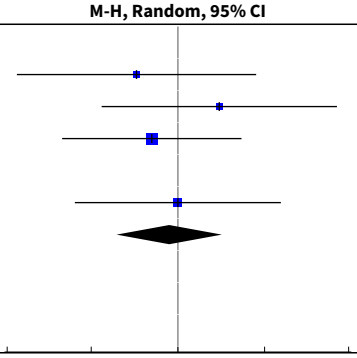
Analysis 7.15. Comparison 7 Adverse events and other outcomes, Outcome 15 Stroke - All Studies.

Study or subgroup	Cell Salvage n/N	Control n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
Clagett 1999	0/50	1/50		12.58%	0.33[0.01,7.99]
Damgaard 2006	0/30	1/29		12.71%	0.32[0.01,7.61]
Ekback 1995	1/15	0/15		13.01%	3[0.13,68.26]
Martin 2000	1/98	2/100		22.34%	0.51[0.05,5.54]
McGill 2002	1/84	2/84		22.4%	0.5[0.05,5.41]
Murphy 2005	0/30	0/31			Not estimable
Niranjan 2006	1/40	1/40		16.96%	1[0.06,15.44]
Total (95% CI)	**347**	**349**		**100%**	**0.64[0.21,1.98]**
Total events: 4 (Cell Salvage), 7 (Control)					
Heterogeneity: Tau²=0; Chi²=1.46, df=5(P=0.92); I²=0%					
Test for overall effect: Z=0.77(P=0.44)					



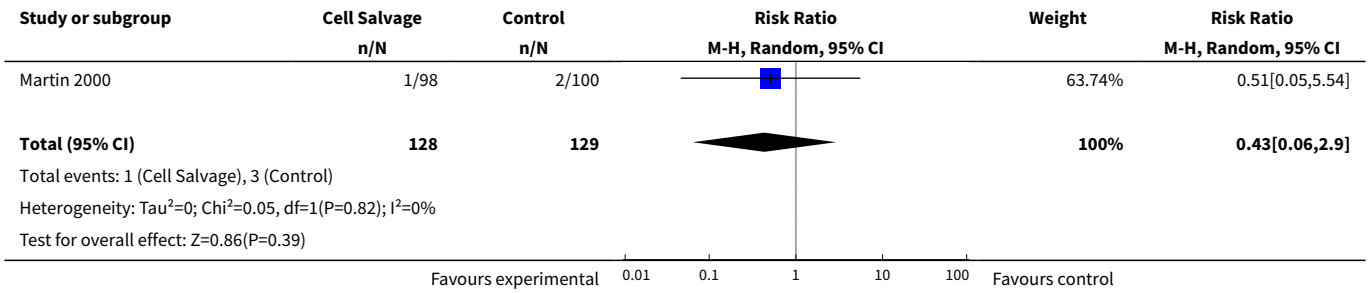
Analysis 7.16. Comparison 7 Adverse events and other outcomes, Outcome 16 Stroke - Active vs Control.

Study or subgroup	Cell Salvage n/N	Control n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
7.16.1 Active vs Control					
Clagett 1999	0/50	1/50		19.38%	0.33[0.01,7.99]
Ekback 1995	1/15	0/15		20.03%	3[0.13,68.26]
McGill 2002	1/84	2/84		34.49%	0.5[0.05,5.41]
Murphy 2005	0/30	0/31			Not estimable
Niranjan 2006	1/40	1/40		26.11%	1[0.06,15.44]
Subtotal (95% CI)	**219**	**220**		**100%**	**0.79[0.2,3.21]**
Total events: 3 (Cell Salvage), 4 (Control)					
Heterogeneity: Tau²=0; Chi²=1.15, df=3(P=0.76); I²=0%					
Test for overall effect: Z=0.32(P=0.75)					

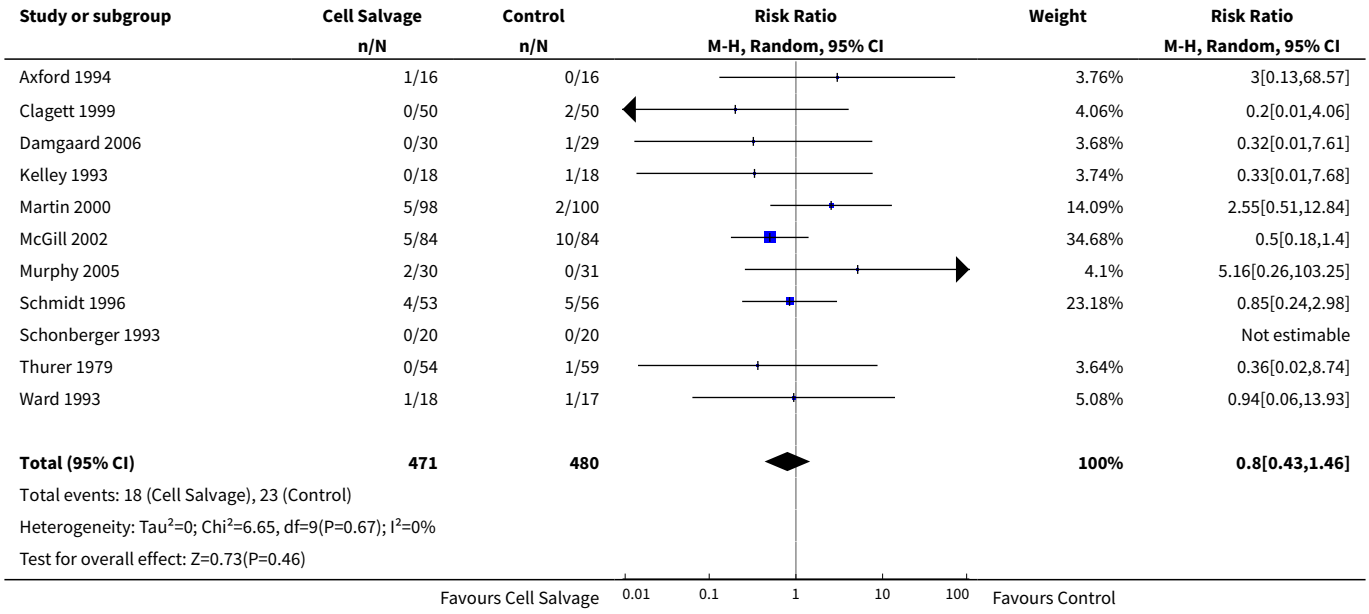


Analysis 7.17. Comparison 7 Adverse events and other outcomes, Outcome 17 Stroke - Active vs Active.

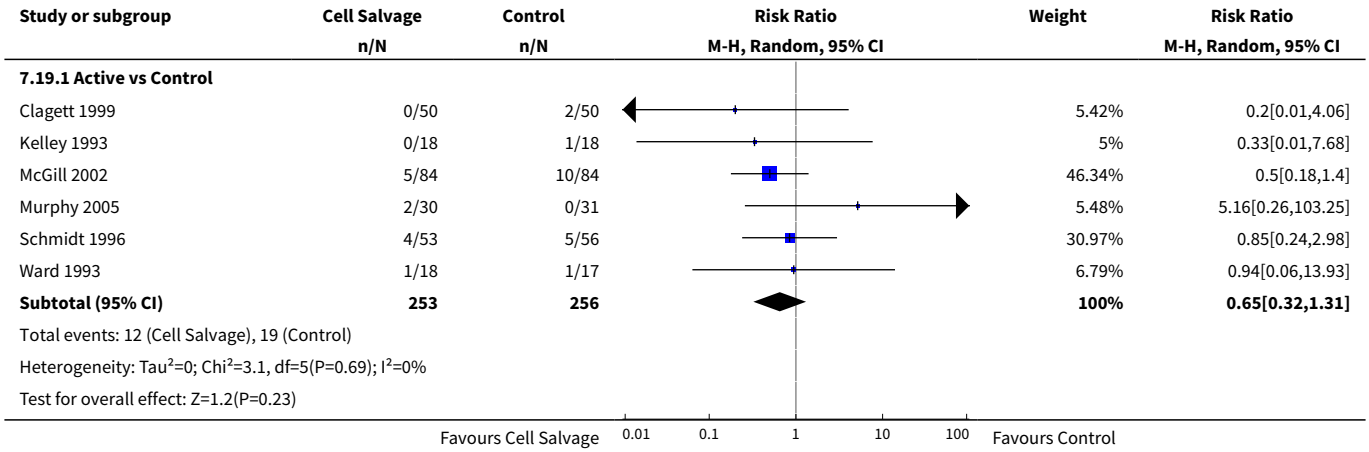
Study or subgroup	Cell Salvage n/N	Control n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
Damgaard 2006	0/30	1/29		36.26%	0.32[0.01,7.61]



Analysis 7.18. Comparison 7 Adverse events and other outcomes, Outcome 18 Non-fatal myocardial infarction - All Studies.



Analysis 7.19. Comparison 7 Adverse events and other outcomes, Outcome 19 Non-fatal myocardial infarction - Active vs Control.



Analysis 7.20. Comparison 7 Adverse events and other outcomes, Outcome 20 Non-fatal myocardial infarction - Active vs Active.

Study or subgroup	Cell Salvage n/N	Control n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
Axford 1994	1/16	0/16		14.93%	3[0.13,68.57]
Damgaard 2006	0/30	1/29		14.63%	0.32[0.01,7.61]
Martin 2000	5/98	2/100		55.98%	2.55[0.51,12.84]
Schonberger 1993	0/20	0/20			Not estimable
Thurer 1979	0/54	1/59		14.46%	0.36[0.02,8.74]
Total (95% CI)	**218**	**224**		**100%**	**1.46[0.43,4.88]**
Total events: 6 (Cell Salvage), 4 (Control)					
Heterogeneity: Tau^2=0; Chi^2=2.28, df=3(P=0.52); I^2=0%					
Test for overall effect: Z=0.61(P=0.54)					

Favours Cell Salvage — Favours Control

Analysis 7.21. Comparison 7 Adverse events and other outcomes, Outcome 21 Deep vein thrombosis (DVT).

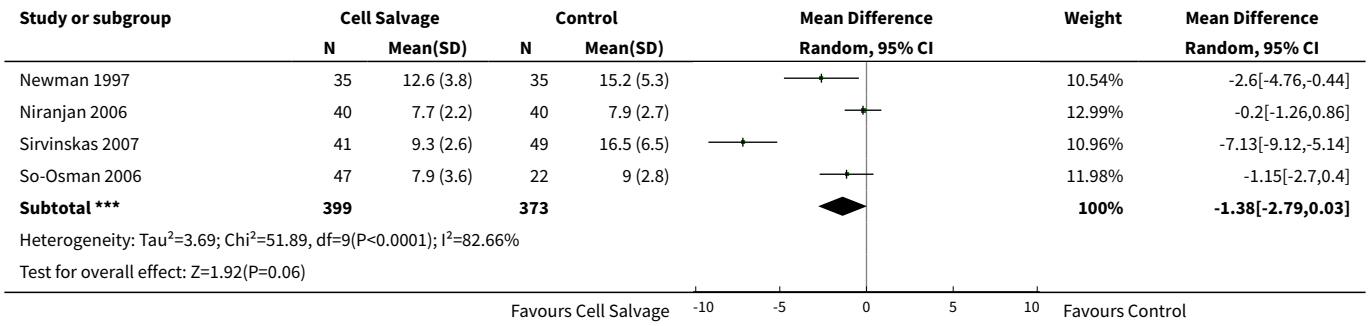
Study or subgroup	Cell Salvage n/N	Control n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
7.21.1 Active vs Control					
Amin 2008	1/92	2/86		17.22%	0.47[0.04,5.06]
Cheng 2005	0/24	0/34			Not estimable
Elawad 1991	3/19	2/20		34.83%	1.58[0.3,8.43]
Majowski 1991	2/20	2/20		28.27%	1[0.16,6.42]
Moonen 2007	0/80	0/80			Not estimable
Newman 1997	0/35	0/35			Not estimable
Shenolikar 1997	1/50	3/50		19.68%	0.33[0.04,3.1]
Subtotal (95% CI)	**320**	**325**		**100%**	**0.83[0.31,2.23]**
Total events: 7 (Cell Salvage), 9 (Control)					
Heterogeneity: Tau^2=0; Chi^2=1.48, df=3(P=0.69); I^2=0%					
Test for overall effect: Z=0.37(P=0.71)					

Favours Cell Salvage — Favours Control

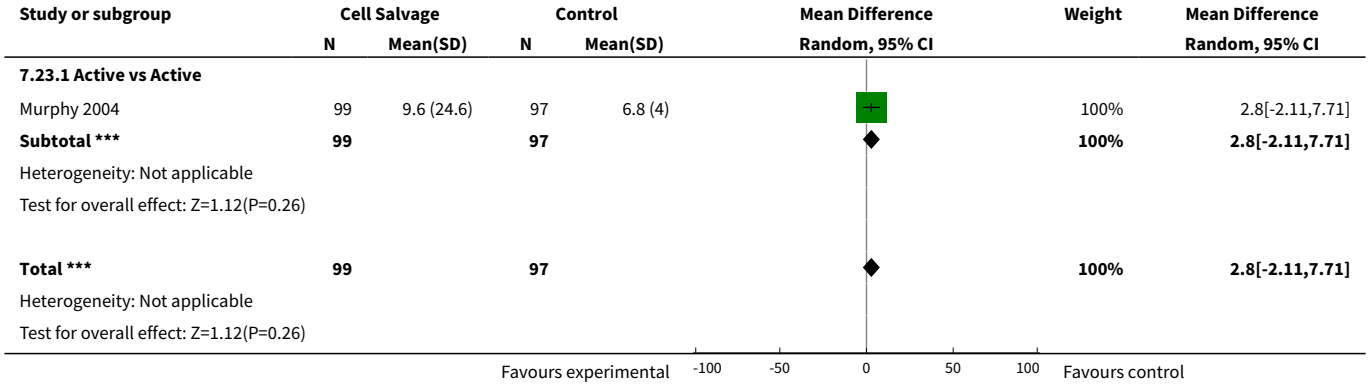
Analysis 7.22. Comparison 7 Adverse events and other outcomes, Outcome 22 Hospital length of stay (LOS) - Active vs Control.

Study or subgroup	Cell Salvage N	Cell Salvage Mean(SD)	Control N	Control Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
7.22.1 Active vs Control							
Abuzakuk 2007	52	8.1 (2.4)	52	8.3 (2.8)		13.09%	-0.2[-1.2,0.8]
Altinel 2007	16	21.2 (11.3)	16	16.5 (6.9)		3.53%	4.7[-1.79,11.19]
Bouboulis 1994	42	9.6 (6.4)	33	8.7 (4.2)		9.95%	0.9[-1.51,3.31]
Clagett 1999	50	12.2 (4.7)	50	12.7 (5.3)		11.02%	-0.5[-2.46,1.46]
Dalrymple-Hay 1999	56	7.3 (2.9)	56	9.7 (5.2)		11.96%	-2.4[-3.96,-0.84]
Eng 1990	20	10.8 (6.9)	20	12 (11.7)		3.99%	-1.15[-7.11,4.81]

Favours Cell Salvage — Favours Control



Analysis 7.23. Comparison 7 Adverse events and other outcomes, Outcome 23 Hospital length of stay (LOS) - Active vs Active.



APPENDICES

Appendix 1. Search strategy

MEDLINE search strategy

1. cell$ sav$.mp.
2. cell$ salvage.mp.
3. blood transfusion, autologous/
4. autotransfusion$.mp.
5. auto-transfusion$.mp.
6. blood salvage.mp.
7. autovac.mp.
8. solcotrans system.mp.
9. constavac.mp.
10. solcotrans.mp.
11. hemovac.mp.
12. BRAT.mp.
13. fresenius.mp.
14. consta vac.mp.
15. cell saver.mp.
16. dideco.mp.
17. electromedic.mp.
18. electromedics.mp.
19. gish biomedical.mp.
20. haemonetics.mp.

21. orth-evac.mp.
22. pleur-evac.mp.
23. sorenson.mp.
24. reinfusion system.mp.
25. sorin biomedical.mp.
26. or/1-25
27. exp blood transfusion/
28. exp hemorrhage/
29. exp anesthesia/
30. transfusion$.mp.
31. bleed$.mp.
32. blood loss$.mp.
33. hemorrhag$.mp.
34. haemorrhag$.mp.
35. or/27-34
36. 26 and 35
37. randomized controlled trial.pt.
38. controlled clinical trial.pt.
39. randomized controlled trials.sh.
40. random allocation.sh.
41. double blind method.sh.
42. single blind method.sh.
43. or/37-42
44. clinical trial.pt.
45. exp Clinical trials/
46. (clin$ adj25 trial$).ti,ab.
47. ((singl$ or doubl$ or trebl$ or tripl$) adj25 (blind$ or mask$)).ti,ab.
48. placebos.sh.
49. placebo$.ti,ab.
50. random$.ti,ab.
51. research design.sh.
52. or/44-51
53. comparative study.sh.
54. exp Evaluation studies/
55. follow up studies.sh.
56. prospective studies.sh.
57. (control$ or prospectiv$ or volunteer$).ti,ab.
58. or/53-57
59. 43 or 52 or 58
60. 36 and 59
61. animal/ not human/
62. 60 not 61

WHAT'S NEW

Date	Event	Description
19 December 2011	Amended	The Plain Language Summary Title has been shortened to comply with new guidelines.

HISTORY

Protocol first published: Issue 1, 2000
Review first published: Issue 4, 2003

Date	Event	Description
10 February 2010	New citation required and conclusions have changed	The review has been updated with the results of 24 additional trials.
1 June 2006	New search has been performed	May 2006 The searches were updated in January 2004 as part of a Health Technology Assessment (HTA) project. Two new studies have been included (Naumenko 2003; Zhao 2003), with the results of the review amended accordingly.

CONTRIBUTIONS OF AUTHORS

Contributors (names are listed alphabetically):

Paul Carless (University of Newcastle) obtained relevant papers, applied inclusion and exclusion criteria to retrieved papers, quality assessed trials, extracted data from the trials, entered data into MetaView 4.1, entered all study details into Review Manager 4.1 and co-wrote review; David Henry (University of Newcastle) obtained funding for the study, was involved in study design, screened abstracts and titles for relevant articles, and co-wrote review; Annette Moxey (University of Newcastle) obtained relevant papers, applied inclusion and exclusion criteria to retrieved papers, quality assessed trials, extracted data from the trials and entered data into MetaView 4.1; Dianne O'Connell (University of Newcastle) provided statistical consultancy for the review, checked data for consistency, and provided methodological content.

DECLARATIONS OF INTEREST

None known.

SOURCES OF SUPPORT

Internal sources

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External sources

- Australian Health Ministers' Advisory Committee. National Health and Medical Research Council of Australia, Australia.

INDEX TERMS

Medical Subject Headings (MeSH)

*Blood Transfusion, Autologous; *Erythrocyte Transfusion; Blood Specimen Collection [methods]; Elective Surgical Procedures; Randomized Controlled Trials as Topic

MeSH check words

Adult; Humans