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ORIGINAL PAPER

Reinfusion of unwashed salvaged blood after total knee arthroplasty in patients with rheumatoid arthritis

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Abstract Autotransfusion with unwashed salvaged blood (USB) is effective for avoiding allogeneic blood transfusion (ABT) in patients undergoing total knee arthroplasty (TKA). We performed a retrospective study to determine the percentage of patients receiving ABT and the volume of postoperative blood drainage after introduction of autotransfusion with USB for patients with rheumatoid arthritis (RA) undergoing TKA. In 100 patients without autotransfusion (group 1) and 100 patients receiving autotransfusion of USB (group 2), we compared the number of patients who required ABT, as well as the postoperative drainage volume, ABT volume, and autotransfusion volume. In group 1, 83% of the patients received ABT, while only 47% received ABT in group 2, and there was a significant decrease ($p<0.001$). However, the postoperative drainage volume was significantly increased in group 2 ($p<0.001$).

Résumé L'utilisation du sang récupéré en post-opératoire (USB) est une technique qui permet d'éviter la transfusion de sang autologue, chez les patients ayant bénéficié d'une prothèse totale du genou. Nous avons réalisé une étude rétrospective afin de déterminer le pourcentage de patients recevant le sang récupéré et le volume nécessaire. Nous avons réalisé cette étude pour déterminer le pourcentage de patients recevant une transfusion en rapportant ceci au volume de sang récupéré dans les drains après réalisation d'une auto-transfusion, ces patients étant porteurs d'une arthrite rhumatoïde. Chez 100 patients sans auto-transfusion (groupe 1) et 100 patients ayant bénéficié d'une auto-transfusion (groupe 2), nous avons comparé le nombre de patients ayant bénéficié d'une nouvelle transfusion ainsi que le volume du sang récupéré dans les redons, volume de sang réinjecté et l'importance de l'auto-transfusion. Dans le groupe 1, 83% des patients ont reçu une transfusion alors que seulement 47% en ont eu besoin dans le groupe 2. Il existe une différence significative entre ces deux groupes ($p<0.001$). Cependant la perte sanguine dans les redons était significativement plus important dans le groupe 2 ($p<0.001$).

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Introduction

Autotransfusion has been widely used in artificial joint surgery, and it plays an important role in avoiding the need for allogeneic blood transfusion (ABT). Preoperative banking of autologous blood is effective in patients without symptomatic anaemia, but when a patient is suffering from anaemia and considerable perioperative blood loss is expected, autotransfusion with salvaged blood is indicated. We perform cementless total knee arthroplasty (TKA), which can lead to greater postoperative blood loss than cemented TKA [10, 17], in patients with both rheumatoid arthritis (RA) and osteoarthritis (OA).

There have been many reports about the efficacy of preoperative autologous donation [5, 9, 12]. When TKA is

done for OA patients without anaemia, we can almost completely avoid ABT by using preoperatively banked autologous blood. However, management of RA patients with chronic anaemia remains difficult and it is often impossible to store much autologous blood. We have tried erythropoietin for these patients, but it was not sufficiently effective [15, 23].

If RA patients cannot donate their own blood preoperatively, ABT will often be required if other autologous transfusion methods are not used. Therefore, we have adopted the practice of autotransfusion with unwashed salvaged blood (USB) when TKA is performed on RA patients, and the number of patients requiring ABT has decreased markedly since the introduction of autotransfusion with USB.

Materials and methods

This study was conducted in 200 patients with RA who underwent TKA from June 1988 through August 1995 without preoperative banking of autologous blood. In September 1991, autotransfusion with USB was first introduced. Until that time, ABT was used to manage patients with postoperative anaemia.

One hundred patients who underwent surgery before the introduction of autotransfusion with USB were classified into group 1, while another 100 patients who received reinfusion of USB collected by an autologous blood salvage system formed group 2.

Performance of ABT was decided on the basis of the haemoglobin (<7 mg/dl) and/or clinical signs (blood pressure, pulse, etc.).

We compared the number of patients receiving ABT in each group, as well as the volume of postoperative drainage, the ABT volume, and the volume of autotransfusion with USB.

For autotransfusion, a ConstaVac Blood Conservation (CBC) system (Stryker Instruments, Kalamazoo, Michigan, USA) was used to salvage shed blood and to reinfuse USB. Autotransfusion was not employed in patients who had a bleeding diathesis or abnormalities of coagulation/fibrinolysis at the time of preoperative assessment. Patients on anticoagulant therapy were also excluded from this study.

Patients underwent TKA under a combination of epidural and spinal anaesthesia. A tourniquet was employed during surgery and was released after wound closure. Collection of blood from the drain tube using the CBC system was started immediately after the completion of surgery. After approximately 400 ml of blood had accumulated, it was reinfused after being passed through a microaggregate filter (model SQ40s; Pall, Glen Cove, New York, USA). Salvaged blood was reinfused for the first six hours after surgery, and no anticoagulants were administered during salvage or reinfusion. The volume of postoperative blood loss was calculated from the end of the operation to the time of removing the drain on the second postoperative day, and this was defined as the postoperative drainage volume.

Results are reported as the mean ± standard deviation. Fisher's exact test was used to compare the ABT rate, while other parameters were analysed with the t test. A p value of less than 0.05 was considered to indicate statistical significance.

Results

In group 1, the 100 patients (109 TKAs) included 13 men and 87 women with an average age of 58.5 years. Group 1 was the control group, and 83 out of 100 patients (83%) received ABT. The mean postoperative drainage volume was 1,011±650 ml (range 75–3,125 ml, n=100), and the mean ABT volume was 740±576 ml (range 0–2,800 ml, n=100). Among the 91 patients undergoing unilateral TKA, 75 patients (82%) required ABT. Their mean postoperative drainage volume was 964±616 ml (range 75–2,915 ml, n=91), and the mean ABT volume was 712±553 ml (range 0–2,800 ml, n=91).

In group 2, the 100 patients (121 TKAs) included 11 men and 89 women with an average age of 59.2 years. Patients in group 2 all received autotransfusion, and 47 out of 100 patients (47%) also required ABT. The mean postoperative drainage volume was 1,437±799 ml (range 220–4520 ml, n=100); the mean autotransfusion volume was 935±627 ml (range 100–3,800 ml, n=100), and the mean ABT volume was 248±314 ml (range 0–1,600 ml, n=100). Among the 79 patients who underwent unilateral TKA, 30 patients (38%) required ABT. Their mean postoperative drainage volume was 1,167±542 ml (range 220–2,970 ml, n=79); the mean autotransfusion volume was 750±420 ml (range 100–2,020 ml, n=79), and the mean ABT volume was 185±286 ml (range 0–1,600 ml, n=79).

There were no significant differences in the surgical procedures, gender, age, body weight, preoperative haemoglobin (Hb), and preoperative prothrombin time (PT) between the two groups (Table 1).

Compared with group 1, there was a significantly lower (p<0.001) percentage of patients receiving ABT in group 2, but the postoperative drainage volume was significantly larger (p<0.001) (Table 2). Among patients having unilateral TKA, the ABT volume was smaller (p<0.001), and the percentage of patients requiring ABT was lower in group 2 compared with group 1, but the postoperative drainage volume was significantly larger (p<0.05) (Table 2).

Table 1 Profile of the two groups

Characteristic	Group 1 (n=100)	Group 2 (n=100)
Op. (unilateral/bilateral)	91/9	79/21
Gender (male/female)	13/87	11/89
Age (years)*	58.5±9.1 (39–80)	59.2±8.4 (42–78)
Body weight (kg)*	47.1±6.4 (38–74)	48.3±5.7 (40–71)
Preoperative Hb (g/dl)*	10.8±1.2 (8.3–14.4)	10.2±1.6 (7.9–14.7)
Preoperative PT (s)*	11.7±0.8 (10.5–12.8)	11.6±0.8 (10.4–13.2)

* Values given as mean ± standard deviation (range)

Discussion

Autotransfusion with USB is often used in patients having orthopaedic procedures such as artificial joint surgery, and many reports on this subject have been published [1, 8, 11, 14, 16, 18, 19, 21, 22, 24]. Zacharopoulos et al. [25] stated that use of the USB reinfusion system postoperatively is highly effective in reducing the demand of ABT, the number of patients who require ABT, and the cost of blood management after TKA. On the other hand, Martin et al. [13] reported that use of the USB reinfusion system did not decrease ABT requirements.

The chief advantage of autotransfusion with USB is that this method is available to patients who are unable to bank autologous blood preoperatively, whereas its main disadvantage is the risk of contamination during the process of blood collection [6, 14]. We have adopted this method for patients with RA who were unable to bank autologous blood preoperatively and have increased the percentage of patients completing TKA without ABT, but we predicted that the total volume of postoperative drainage would increase after autotransfusion of USB.

This study showed that autotransfusion with USB was useful for avoiding ABT, but also confirmed that the total postoperative drainage volume was significantly greater (even after unilateral TKA) compared with that in patients receiving ABT before the introduction of autotransfusion.

Our findings indicate that most postoperative blood loss occurred within the first six hours after surgery in group 2, because the autotransfusion volume accounted for approximately two thirds of the total postoperative drainage volume (935 ml out of 1,437 ml on average). The postoperative drainage volume was proportional to the autotransfusion volume, suggesting that autotransfusion with USB influences coagulation and fibrinolysis in some way.

Other authors have indicated that there is no major effect of USB on coagulation and fibrinolysis [14, 24]. In contrast, our previous experience of autotransfusion with USB after TKA is that blood loss is relatively high [10, 17].

Massive transfusion of USB consumes clotting factors and may lead to impairment of coagulation, but dilution of clotting factors also occurs with ABT or transfusion of banked autologous blood, so the increased volume of shed blood cannot be solely attributed to this effect. Blevins et al. [4] reported a significant decrease of factor V and factor VIII activity in unwashed filtered shed blood, while they found no decrease of these factors immediately after autotransfusion.

In our study, all of the patients had RA, and coagulation abnormalities associated with this disease have been described in many reports [2, 3, 7, 20]. Accordingly, the increase of postoperative drainage may have been associated with RA itself.

Table 2 Perioperative results for groups 1 and 2

Total	Group 1 (n=100)	Group 2 (n=100)	P value
ABT rate (%)	83/100 (83%)	47/100 (47%)	P<0.001
ABT* (ml)	740±576	248±314	P<0.001
Postoperative drainage* (ml)	1, 011±650	1,437±799	P<0.001
Autotransfusion with USB* (ml)	–	935±627	–
Unilateral	Group 1 (n=91)	Group 2 (n=79)	P value
ABT rate (%)	75/91 (82%)	30/79 (38%)	P<0.001
ABT* (ml)	712±553	185±286	P<0.001
Postoperative drainage* (ml)	964±616	1,167±542	P=0.025
Autotransfusion with USB* (ml)	–	750±420	–

* Values given as mean ± standard deviation

We usually bank autologous blood before performing cementless TKA in OA patients without anaemia, and we sometimes use erythropoietin to stimulate blood production. In RA patients, however, we have found that erythropoietin does not have the same effect on hematopoiesis [15, 23], and preoperative blood donation is sometimes impossible.

Since the introduction of autotransfusion with USB, the need to perform ABT has decreased considerably and this has advantages for both patients and surgeons. However, our study showed that relatively massive autotransfusion with USB results in an increase of postoperative drainage. Consequently, we need to pay attention to this point when performing autotransfusion with USB.

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