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Results of open heart surgery in Jehovah's Witness patients. Single centre experience

Andrzej Juraszek[1], Piotr Kołsut[1], Jarosław Szymański[1], Jarosław Kuriata[1], Krzysztof Kuśmierski[1], Ewa Sitkowska-Rysiak[2], Małgorzata Jasińska[2], Mariusz Kuśmierczyk[1]

[1]Department of Cardiac Surgery and Transplantation, Institute of Cardiology, Warsaw, Poland
[2]Department of Anesthesiology, Institute of Cardiology, Warsaw, Poland

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Abstract

Aim: Evaluation the results in patients from the religious community of Jehovah's Witness (JW) undergoing open heart surgery at our institution.

Material and methods: Between September 2011 and March 2015, 21 patients with a religious background of the JW church underwent open heart surgery at our institution performed by the same surgical team. Mean age was 68.43 ±8.93 years. There were 13 (61.9%) female patients. Recombinant human erythropoietin was administered to every patient with a hemoglobin value < 12.0 g/dl. Nine patients undergoing isolated coronary artery revascularization were operated on without cardiopulmonary bypass. Seven patients underwent combined surgery and 5 patients underwent aortic valve replacement via ministernotomy. The mean follow-up time was 16.45 ±11.09 months (range: 1.67–44.3 months).

Results: Mean baseline hematocrit serum level was 40.15 ±3.34% (range: 34.5–46.1%). Perioperatively the hematocrit serum levels decreased to the mean level of 29.89 ±4.31% (range: 21.4–36.3%). The mean hematocrit value at discharge was 30.85 ±3.59% (range: 23.5–38.4%). One death was observed in the perioperative period. Five (24%) patients suffered from sternum wound infection requiring vacuum-assisted therapy. During the follow-up period 1 patient died due to a non-cardiac related cause.

Conclusions: After careful preoperative preparation the results of open heart surgery in JW were very good, including combined procedures. The decrease of hematocrit serum levels significantly characterizing the postoperative period was highly acceptable in this series. Nevertheless, the number of sternum wound infections was a limiting factor for prompt postoperative recovery.

Key words: cardiac surgery, Jehovah's Witness.

Streszczenie

Cel: Zbadanie wyników operacji serca u chorych ze wspólnoty religijnej świadków Jehowy (JW) w instytucji autorów.

Materiał i metody: Od września 2011 do marca 2015 r. w placówce autorów ten sam zespół chirurgiczny wykonał operacje serca u 21 pacjentów należących do wspólnoty JW. Średni wiek chorych wynosił 68,43 ±8,93 roku. W grupie było 13 (61,9%) kobiet. Zrekombinowaną ludzką erytropoetynę podawano każdemu pacjentowi z wartością hemoglobiny < 12,0 g/dl. Dziewięciu pacjentów poddanych izolowanemu zabiegowi pomostowania aortalno-wieńcowego (CABG) było operowanych bez krążenia pozaustrojowego (CBP). U 7 chorych wykonano zabiegi złożone, a u 5 pacjentów przeprowadzono wymianę zastawki aortalnej przez ministernotomię. Średni czas obserwacji wynosił 16,45 ±11,09 miesiąca (zakres: 1,67–44,3 miesiąca).

Wyniki: Średni wyjściowy poziom hematokrytu w surowicy wynosił 40,15 ±3,34% (zakres: 34,5–46,1%). W okresie okołooperacyjnym średni poziom hematokrytu zmniejszył się do 29,89 ±4,31% (zakres: 21,4–36,3%). Przy wypisie ze szpitala jego średnia wartość wyniosła 30,85 ±3,59% (zakres: 23,5–38,4%). W okresie okołooperacyjnym stwierdzono 1 zgon. U 5 (24%) pacjentów wystąpiło zakażenie rany mostka wymagające terapii próżniowej. Podczas obserwacji 1 pacjent zmarł z przyczyny niezwiązanej z sercem.

Wnioski: Po starannym przygotowaniu przedoperacyjnym wyniki operacji serca w grupie JW były bardzo dobre, również w przypadku zabiegów złożonych. Spadek poziomu hematokrytu w surowicy charakterystyczny dla okresu pooperacyjnego był akceptowalny. Niemniej zwiększona liczba infekcji rany mostka była czynnikiem ograniczającym szybki powrót pacjentów do normalnego funkcjonowania po zabiegu.

Słowa kluczowe: kardiochirurgia, świadkowie Jehowy.

Introduction

Members of the Jehovah's Witness (JW) community do not accept transfusion homologous, or autologous, whole blood, packed red blood cells, white blood cells or platelets [1, 2]. They base their rejection of blood products on the interpretation of certain biblical passages, especially from Genesis 9:2-4, Acts 15:28.29. There are about 123 000 JW currently living in Poland, which makes 0.32% of the

Address for correspondence: Andrzej Juraszek MD, PhD, Department of Cardiac Surgery and Transplantation, Institute of Cardiology, 42 Alpejska St, 04-628 Warsaw, Poland, phone: +48 692 738 648, e-mail: ajuraszek@ikard.pl

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population [3]. The reported experience in cardiac surgery in these patients concludes that the results have improved significantly with advances in surgical techniques and blood conservation protocols [4]. Conflicting evidence exists with regard to outcome in these patients. Furthermore, reported experience in the literature regarding this special cohort of patients is limited.

Aim

The aim of the study was to evaluate the results of our JW cardiac surgery program that started in 2011. We have focused on the evaluation of patients' comorbidities, complexity of the surgery as well as on pre- and postoperative values of hematocrit and hemoglobin serum levels, considering them to be significant indicators for the success rate in open heart operations performed on patients from the JW community.

Material and methods

Between September 2011 and March 2015, 21 JW patients (61.9% female) at the mean age of 68.4 ±8.9 years underwent elective open heart surgery at our institution. All of the patients refused any form of blood transfusion by signing a special consent form during the preoperative interview with the surgeon and anesthesiologist on the first day of hospitalization. The hospital team agreed to respect patients' wishes. The operations were performed by one experienced surgeon. Meticulous hemostasis was provided via standard surgical means as well as by topical hemostatic agents. Basic preoperative patient data are summarized in Table I.

Anesthesiological management

Before induction of anesthesia, basic monitoring including electrocardiogram, pulse oximetry and invasive blood pressure monitoring was routinely performed. Administration of intravenous solution was minimized to 3 ml/kg bw before general anesthesia under central venous pressure control. To obtain the optimal fluid balance preoperative fasting was reduced for JW patients. They were allowed to drink water or unsugared fluids until 4 h before cardiac surgery.

General anesthesia was induced using midazolam 0.1 mg/kg, etomidate 0.2 mg/kg, fentanyl 0.008 mg/kg, and cis-atracurium 0.15 mg/kg *i.v.* or pancuronium 0.09 mg/kg *i.v.* depending on the preoperative renal function and maintained using sevoflurane and fentanyl 0.15 mg/h. Mechanical ventilation was performed with FIO_2 of 0.4, tidal volume (V_T) of 7 ml/kg bw, respiratory frequency (RF) of 10–12 l/min, keeping $PaCO_2$ in the normal range (±3 mm Hg from the preoperative value), and a positive end-expiratory pressure (PEEP) of 3–5 cm H_2O throughout the entire procedure.

All JW patients with a preoperative hemoglobin value (Hb) of < 12.0 g/dl were treated with recombinant human erythropoietin (NeoRecormon, Roche Registration Ltd.) two-times a week starting at least 2 weeks before cardiac surgery. Iron, vitamin B_{12} and folic acid were supplied 2 weeks before(?) and 1 month after the surgery. Isovolemic hemodilution was induced before cardiopulmonary bypass (CPB) in patients with a hematocrit value of > 45%. Blood autotransfusion was accepted by the JW patients. This worked by immediate preoperative storage of blood in a reservoir constantly connected to the patient to be returned by infusion after the surgery.

Conductance of cardiopulmonary bypass

The extra-corporeal circuit consisted of a membrane oxygenator with an integrated arterial filter (Trillium Fusion, Medtronic) and an open venous reservoir system (Affinity CVR, Medtronic). To minimize the priming of the cardiopulmonary circuit we used short tubing connections from the venous reservoir outlet to the arterial pump head, to the oxygenator/heat-exchanger inlet and additionally from the suction pumps to the cardiotomy reservoir inlet. We also changed the venous tube from 1/2 inch to 3/8 inch. Further, we implemented a vacuum-assisted venous drainage with a maximal suction of 50 mm Hg in order to achieve a venous return of 3 l/m^2, resulting in a total priming volume of 1100 ml. Mixtures of 500 ml 6% hydroxyethyl-starch solution (Voluven, Fresenius-Kabi) and 500 ml of Ringer's lactate solution, 100 ml mannitol 20% and heparin sodium 10 000 IU were used to prime the circuit. Finally, we supplemented with tranexamic acid (Cyclokapron, MEDA Pharmaceutics) in a dosage of 6–10 mg/kg bw to CPB-priming, depending on preoperative renal function.

All patients operated on with CPB received a single bolus of heparin sodium 300 IU/kg before starting the cardiopulmonary circuit, whereas patients operated on without CPB received 150 IU/kg of heparin sodium. The target activated clotting time was above 450 s. The heparin effect was reversed with protamine (1 mg for each 100 IU used) at the end of surgery in all patients. Hemochrom 400 (International Technidyne Corp., Edison, NJ, USA) was used to manage heparin and protamine application during and after CPB.

Tab. I. Basic preoperative patients data

Parameter	Result
n	21
Mean age [years]	68.4 ±8.9 (range: 51–80)
Female gender	13 (61.9%)
Cardiac diagnoses:	
Coronary artery disease	14 (66.7%)
Valve pathology	12 (57.1%)
Ascending aortic aneurysm	3 (14.3%)
Comorbidities:	
Diabetes mellitus	10 (47.6%)
Obesity	10 (47.6%)
Renal impairment	6 (28.6%)
Mean preoperative LVEF [%]	55.9 ±8.97 (range: 40–70)

LVEF – left ventricular ejection fraction

Operation types

Nine (42.86%) patients underwent coronary artery revascularization (CABG) without CPB. Seven (33.33%) combined procedures and 4 (19%) single aortic valve replacements (via upper ministernotomy, aortic valve replacement via ministernotomy – mAVR) were performed. One patient underwent tricuspid valve repair as a reoperation after aortic valve replacement (AVR) and mitral valve replacement (MVR). EuroSCORE II operative risk was 1.14 ±0.78%, ranging from 0.5% to 3.5%.

The mean follow-up time was 16.45 ±11.09 months (range: 1.67–44.3 months).

Statistical analysis

Continuous variables are presented as mean ± standard deviation. Discrete data are reported as percentages. Comparison of changes in hematocrit and hemoglobin levels were investigated by repeated measure analysis of variance. The study cohort was divided into two subgroups. The first group included patients who underwent mAVR and CABG without CPB. The second one included combined procedures. Normality of parameter distribution was determined using the Shapiro-Wilk test. Relations between preoperative risk factors and wound infections were assessed using Fisher's exact test. The impact of hematocrit level on wound infections was investigated using univariate logistic regression and presented as the odds ratio with 95% confidence interval. Analysis was performed using R 3.1.0 statistical software (R Core Team (2014). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL http://www.R-project.org/).

Results

General results

No intraoperative death was observed. None of the patients required reoperation due to bleeding. Mean intensive care unit stay time was 4.52 ±3.86 days. Mean postoperative hospital stay was 12.81 ±6.58 days. One patient died after off-pump coronary artery bypass grafting in the postoperative period due to anemia. There was one non-cardiac-related death in the follow-up period.

Trends of hematocrit and hemoglobin serum levels

Mean preoperative hematocrit was 40.15 ±3.34% and mean preoperative hemoglobin level was 13.62 ±1.21 g/dl. At hospital discharge, mean hematocrit was 30.85 ±3.59% and mean hemoglobin level was 10.32 ±1.28 g/dl. The perioperative values of hematocrit and hemoglobin serum in all patients are precisely shown in Tables II and III and Figures 1 and 2. Figures 3 and 4 compare hematocrit and hemoglobin serum levels for patients undergoing CABG without CPB and mAVR with patients who underwent combined procedures.

Differences between less invasive and combined procedures

As mentioned above, the study cohort was divided into two subgroups. The first group included patients who underwent mAVR and CABG without CPB. The second one included combined procedures.

Significant differences in hematocrit levels between the groups were found at the time of follow-up ($p = 0.012$). Changes of hematocrit over time in both groups were statistically significant ($p < 0.001$). There were no significant changes in the interaction 'operation type*time' during follow-up ($p = 0.465$). Detailed comparisons at each time point showed a significant difference between the groups preoperatively and on the 1st postoperative day (Tab. IV).

There was also a significant difference in hemoglobin levels between the two subgroups ($p = 0.016$). Changes over time in both groups were statistically significant ($p < 0.001$). There were no significant changes in the interaction 'operation type*time' during follow-up ($p = 0.236$). Detailed comparisons at each time point showed a significant difference between the groups intraoperatively (Tab. V).

Tab. II. Perioperative hematocrit course

Variable	Ht preoperatively [%]	Ht intraoperatively [%]	Ht 1st day [%]	Ht 2nd day [%]	Ht discharge [%]
All patients	40.15 ±3.34	31.49 ±5.39	32.99 ±4.32	29.89 ±4.31	30.85 ±3.59
mAVR, CABG off-pump	41.12 ±2.73	33.5 ±4.44	34.52 ±3.20	31.51 ±3.24	31.90 ±3.30
Combined procedures	38.7 ±3.83	28.22 ±5.44	30.50 ±4.94	27.25 ±4.72	29.16 ±3.59

Ht – hematocrit

Tab. III. Perioperative hemoglobin course

Variable	Hb preoperatively [g/dl]	Hb intraoperatively [g/dl]	Hb 1st day [g/dl]	Hb 2nd day [g/dl]	Hb discharge [g/dl]
All patients	13.62 ±1.21	10.83 ±1.77	11.11 ±1.40	9.99 ±1.47	10.32 ±1.28
mAVR, CABG off-pump	13.93 ±1.15	11.62 ±1.39	11.6 ±1.04	10.48 ±1.26	10.66 ±1.27
Combined procedures	13.14 ±1.22	9.65 ±1.68	10.30 ±1.59	9.22 ±1.52	9.76 ±1.15

Hb – hemoglobin

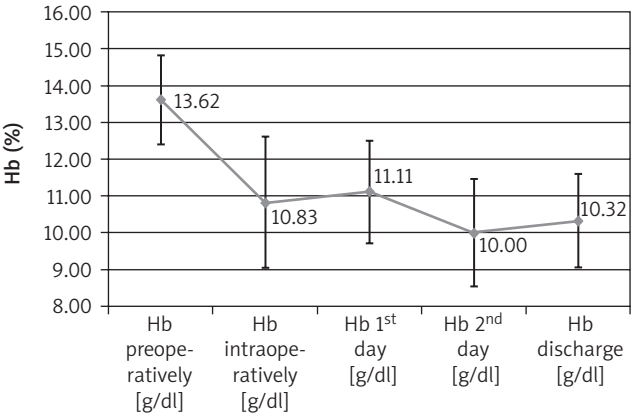

Fig. 1. Hemoglobin course in 21 operated patients

Hb – hemoglobin

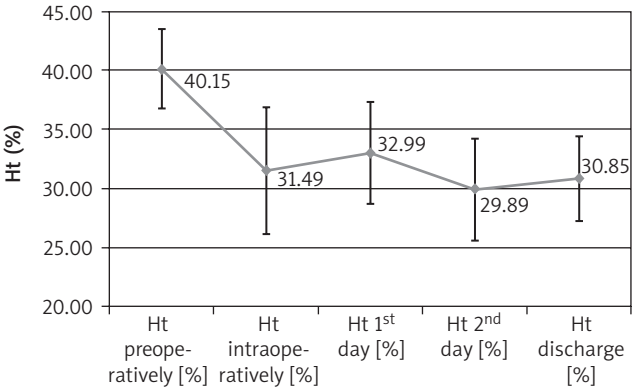

Fig. 2. Hematocrit course in 21 operated patients

Ht – hematocrit

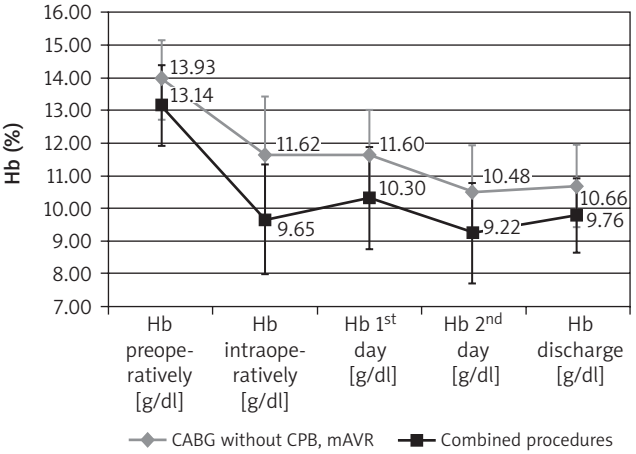

Fig. 3. Comparison of hemoglobin values between patients who underwent CABG off-pump or minimally invasive AVR operations and patients who underwent combined procedures

Hb – hemoglobin, mAVR – aortic valve replacement via ministernotomy, CABG – coronary artery bypass grafting, CPB – cardiopulmonary bypass

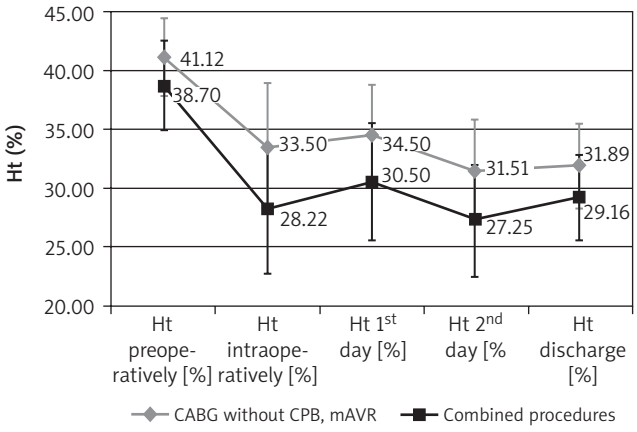

Fig. 4. Hematocrit values comparison between patients who underwent CABG without CPB or minimally invasive AVR operations and patients who underwent combined procedures

Ht – hematocrit, mAVR – aortic valve replacement via ministernotomy, CABG – coronary artery bypass grafting, CPB – cardiopulmonary bypass

Tab. IV. Relation of operation type, time and hematocrit course

A

Hematocrit [%]	Combined procedures	mAVR and CABG without CPB	*P*-value
Preoperatively	38.7 ±3.8	41.1 ±2.6	0.143
Intraoperatively	28.2 ±5.4	33.5 ±4.4	0.038
1st day	30.5 ±4.9	34.5 ±3.2	0.066
2nd day	27.3 ±4.7	31.5 ±3.2	0.046
Discharge	29.2 ±3.6	31.9 ±3.3	0.103

B – Analysis of variance

Variable	*df*	*F*	*P*-value
Type of operation	1	7.72	0.012
Time	4	47.73	< 0.001
Operation type*time	4	0.91	0.465

Tab. V. Relation of operation type, time and hemoglobin course

A

Hemoglobin [g/dl]	Combined procedures	mAVR and CABG without CPB	*P*-value
Preoperatively	13.1 ±1.2	13.9 ±1.1	0.154
Intraoperatively	9.6 ±1.7	11.6 ±1.3	0.015
1st day	10.3 ±1.6	11.6 ±1.0	0.065
2nd day	9.2 ±1.5	10.5 ±1.3	0.071
Discharge	9.8 ±1.1	10.7 ±1.3	0.113

B – Analysis of variance

Variable	*df*	*F*	*P*-value
Type of operation	1	6.99	0.016
Time	4	58.64	< 0.001
Operation type*time	4	1.42	0.236

Tab. VI. Relation between preoperative risk factors and the occurrence of sternum wound infections

Variable		No		Yes		*P*-value
		N	%	*N*	%	
Diabetes mellitus	No	9	81.8	2	18.2	0.90
	Yes	7	70.0	3	30.0	
Obesity	No	9	81.8	2	18.2	0.90
	Yes	7	70.0	3	30.0	
Renal insufficiency	No	12	80.0	3	20.0	0.89
	Yes	4	66.7	2	33.3	

Tab. VII. Relation between the intraoperative hematocrit course and the occurrence of sternum wound infections

Hematocrit value	OR	95% CI		*P*-value
Preoperatively	0.938	0.685	1.285	0.691
Intraoperatively	1.018	0.841	1.231	0.856
1st day	0.894	0.704	1.135	0.357
2nd day	1.097	0.849	1.417	0.480
Discharge	0.855	0.622	1.175	0.334

Sternum wound infections

Five (23.81%) patients developed sternum wound infections which were successfully treated with vacuum-assisted therapy (VAC). No relation was found between the occurrence of wound infection and risk factors (obesity, diabetes mellitus, renal impairment) or the perioperative hemoglobin course (Tabs. VI and VII).

Discussion

Strict preoperative patient preparation and a meticulous surgical technique warranted very good clinical outcomes in this series. The decrease of hematocrit and hemoglobin serum levels that significantly characterizes the postoperative period of open heart surgery in JW was highly acceptable. In patients undergoing CABG without CPB and in patients undergoing isolated mAVR the decrease of hematocrit and hemoglobin serum levels was smaller. Therefore off-pump technique and minimized access surgery should be considered as the method of choice in an experienced team.

Nevertheless, 1 patient died on the 4th postoperative day after CABG without CPB due to a substantial decrease of hematocrit serum levels. This resulted in cardiocirculatory and global metabolic failure. The patient was operated on at the very beginning of the program, when the perioperative care was probably not optimized. This observation suggests that gaining experience in operating on JW patients leads to excellent results. In the follow-up period only one patient died due to a non-cardiac-related reason. The results of Vaislic *et al.* [4], who performed 500 operations on JW, also significantly improved from the beginning of the program in the 1990s. This was well reflected in the postoperative hemoglobin levels. The values started at 8.2 g/dl at the beginning of the program and finally reached the highly acceptable value of 11.2 g/dl in the 2000s. Therefore the home discharge hemoglobin value of 10.32 g/dl in our study was highly acceptable (hematocrit: 30.85 ±3.59%). In contrast, the relatively large hematocrit decrease to the level of approximately 26% after surgery resulted in a limited clinical outcome in the previous Viennese study on 35 JW patients [5].

The preoperative hemoglobin and hematocrit values in patients who underwent combined procedures were significantly lower. This was probably caused by the worse clinical state of this patient cohort. This trend was also observed in the postoperative period.

While performing cardiac surgery avoiding any form of blood transfusion it is feasible to keep hematocrit serum levels high by reducing the fluid volume, but it may result in hypotension, an accelerated heart rate and higher levels of serum lactate. The priming volume of the heart-lung machine can be minimized. However, conflicting evidence exists with regard to the impact on patients' outcome [6, 7]. Application of recombinant erythropoietin before the operation could help to keep hematocrit values at a higher level [6–9]. Furthermore, iron and vitamin B_{12} substitution serves as a valuable adjunct. In Poland, recombinant erythropoietin is not provided by the publicly funded health care system for this indication.

In this series elective patients with diverse and complex cardiac pathologies were included. When necessary, combined procedures were performed. Many of the patients suffered from renal and metabolic comorbidities. On the other hand, the preoperative left ventricular ejection fraction ranged from 40% to 70%, meaning that the cohort did not include patients with more than moderate impairment of left ventricular function. Even if there are promising reports on successful performance of complex cardiothoracic procedures such as re-heart transplantation [10], lung transplantation [11] and allograft root re-replacement for prosthetic valve endocarditis [12], it should be emphasized that we are all still far away from offering safe bloodless cardiac surgery in every situation.

Another interesting finding was the relatively high rate of sternum wound infections (24%). This may be directly associated with the postoperative anemia, but no relation was found between the perioperative hematocrit and the occurrence of wound infection in Fisher's exact test. No wound infection was found after mAVR. Jassar *et al.* [13], reporting their experience in 91 JW patients, noted a wound infection rate of 1.1%, while the majority of the patients in this study (88%) underwent only a single cardiac procedure.

We achieved highly acceptable clinical results compared to other patients operated on at the same time at our centre. The overall hospital mortality at our centre in the study period was 2.67%. Mean preoperative hematocrit was 38.07 ±5.27%, whereas hospital discharge mean hematocrit was 33.01 ±5.42%. The incidence of sternal wound infection was significantly lower (7.32%).

This study includes all the drawbacks associated with a retrospective clinical analysis. Due to the number of patients, the power of the statistical analysis was limited.

Conclusions

The decrease of hematocrit serum levels significantly characterizes the postoperative period of open heart surgery in JW. In patients undergoing CABG without CPB and in patients undergoing isolated valve replacement the decrease of hematocrit serum levels was the smallest. Therefore these techniques should be considered as the first choice when appropriate. Furthermore, highly normal preoperative hematocrit serum levels and a meticulous surgical technique remain the mainstay of therapy in these patients. Additionally, the number of sternum wound infections was a limiting factor for prompt postoperative recovery.

Disclosure

Authors report no conflict of interest.

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