Journal of Arthritis
ISSN: 2167-7921

Moideen et al., J Arthritis 2017, 6:2
DOI: 10.4172/2167-7921.1000235

Research Article Open Access

Autologous Blood Transfusion Reduces Post-Operative Blood Transfusion Following Total Hip Replacement

Abdul Nazeer Moideen[1]*, Lara Elizabeth McMillan[1] and George Zafiropoulos[2]

[1]*Welshbone, South Wales Orthopaedics Research Network, Wales, UK*

[2]*Department of Trauma and Orthopaedics, Prince Charles Hospital, Merthyr Tydfil, UK*

***Corresponding author:** Abdul Nazeer Moideen, Welshbone, South Wales Orthopaedics Research Network, Wales, UK, Tel: 02920748044; E-mail: anmoideen@doctors.net.uk

Received date: February 11, 2017; **Accepted date:** March 20, 2017; **Published date:** March 26, 2017

Abstract

Background: Allogenic blood transfusions are expensive and associated with risks and complications such as transmission of infections and incompatibility reactions.

Aim: The objective of this study was to evaluate the efficacy of autologous blood transfusion in reducing the need for allogenic blood requirement after total hip replacement and also the cost benefit involved.

Method: A retrospective case notes analysis of 178 consecutive patients undergoing total hip replacements from 2006 to 2007 were carried out. 73 patients belonged to Bellovac® ABT (Astra Tech) drains for post-operative blood salvage group (ABT group) and 105 patients belonged to standard Bellovac® (Astra Tech) vacuum drains group (Non-ABT group). Pre and post-operative haemoglobin (Hb) were compared between ABT and Non-ABT group in relation to type of surgery and anaesthesia.

Results: 20 out of the 73 (27.3%) patients in ABT group and 45 out of 105 (42.8%) in Non-ABT group required blood transfusion (p=0.035). Forty six units (0.63 units per person) in ABT group and 106 units (1 unit per person) in Non-ABT were transfused in total (p=0.03). The average pre and post-operative Hb in ABT group were 13.1 and 9.6 while in Non-ABT group were 13.4 and 9.4 respectively.

Conclusion: Autologous blood transfusion caused a reduction in the number of patients requiring blood transfusion and also reduced the amount of units transfused.

Keywords: Total hip replacement; Retransfusion drains; Autologous blood transfusion

Introduction

There were around 61,450 total hip replacement (THR) done in England and Wales in 2006 [1]. Following total hip or knee replacement around 750 ml of blood loss is common [2]. After primary THR, there is 30% to 40% increased rate of homologous blood transfusion [3]. There are a number of risks associated with homologous blood transfusion. In 1980s healthcare workers became aware of risks of transfusion of blood borne infection following discovery of human immunodeficiency virus (HIV). Transfusion of blood borne diseases including HIV, parvovirus, cytomegalovirus, hepatitis has been well documented [4]. In recent times there has been concerns regarding transmission of a variant of Creutzfeldt Jacob disease following blood transfusion in the U.K. Transfusion of homologous blood is also associated with immunologic reactions such as transfusion related acute lung injury, acute haemolytic reaction, anaphylactic reaction and febrile reactions [5]. Clerical error is also a big risk occurring up to 1 in 20,000 blood transfusions [6].

Several techniques have been used to reduce homologous blood transfusion. They include pre-operative donation, intra and post-operative salvage, and the use of recombinant erythropoietin. Predonation of autologous blood sometimes can be unnecessary owing to non-requirement of blood in the post-operative period. This could lead to unnecessary wastage and high financial cost of autologous donation. It has been reported that the cost of discarded autologous blood to be around $36 million annually in the United States [7]. In intra and post-operative salvage, the shed blood can be returned after filtration (unwashed) or after treatment in a cell saver (washed). Transfusion of unwashed blood is relatively simple and inexpensive whereas transfusion of washed cells requires expensive cell saver machine.

In our institution autologous blood drainage has been used successfully for total knee replacements (TKR). But for primary THR usage of autologous blood drainage system has been controversial. Therefore in this study we have evaluated a post-operative blood salvage and retransfusion system following primary total hip replacement. The aim of the study was to determine the efficacy of the autologous blood transfusion in the reducing the need for homologous blood requirement and the cost benefit involved.

Patients and Methods

The medical records of 178 consecutive patients who underwent primary THR for osteoarthritis from January 2006 to June 2007 were reviewed respectively to assess the efficacy of post-operative cell

salvage system. Patients who were on anticoagulants prior to surgery, revision THR and THR for fracture neck of femur were excluded from the study. At pre-operative assessment, patients were advised to discontinue aspirin or clopidogrel seven days before surgery. Pre-operative Hb was recorded. Four senior consultants performed all the surgery using anterolateral approach. All patients had three drains – 2 deep to fascia lata and one superficial to it. One of the surgeons (GZ) used Bellovac® ABT (Astra Tech) drains for post-operative blood salvage (ABT group) (n=73). Other surgeons used standard Bellovac® (Astra Tech) vacuum drains (Non-ABT group) (n=105).

Bellovac® ABT set is a closed circuit system consisting of suction, filters and 500 ml of autotransfusion bag. Blood passes through a 200 µm filter before collecting into the autotransfusion bag. During transfusion, blood again passes through two concentric filters in the transfusion set measuring 40 µm and 80 µm. No anticoagulants are used due to low fibrinogen content in the blood collected post-operatively. Bellovac® ABT system was not used if there was infection, malignancy or contamination of the operating site. In the post-operative period, the blood collection was started immediately upon wound closure if prosthesis used was uncemented or after 30 minutes for cemented prosthesis. Autologous blood was retransfused to the patient via the closed circuit when 500 ml blood was collected or within 6 hours (whichever was earliest). A recommended maximum of 1500 ml can be transfused via this system. Patients who drained less than 200 ml over 6 h were not retransfused. Retransfusion of collected blood is contraindicated if there is significant amount of air leakage into the collecting bag. Blood drained after 6h were discarded. All drains were removed 2 days post-surgery. The protocol was devised following manufacturer's recommendation.

Patients in both groups underwent identical post-operative protocol including three doses of post-operative antibiotics. All patients received 40 mg of enoxaparin for 5 days post-surgery and 2 mg (if <60 yrs) or 1mg (if >60 yrs) of warfarin for 6 weeks as per the anti-thrombotic prophylaxis protocol of the hospital. Patients received homologous transfusion if their haemoglobin (Hb) level dropped below 8 g/dl or if they develop symptomatic anaemia (exertional breathlessness, angina, fatigue or dizziness). All patients were monitored during autologous or homologous blood transfusion as per hospital protocol.

The following parameters were recorded for each patient: age, sex, type of prosthesis, type of drain, volume of autologous blood transfused, volume of blood in vacuum drain on removal, units of homologous blood transfused, length of stay in the hospital and complications. Statistical analysis was performed using Statistical Package for Social Sciences version 17 (SPSS Inc., Chicago, Illinois). The Mann-Whitney U test (non-parametric data) was used for the comparison of univariate means and chi-squared test for comparison of categorical variables.

Results

There were 73 patients in ABT group and 105 in Non-ABT group. Their demographics, types of anaesthesia and prosthesis are shown in Table 1. There was no statistical difference in the ages of two groups (p=0.912). The mean duration of operation for ABT and Non-ABT groups were 1.2 h and 1.4 h respectively. The mean length of stay for ABT group was 13 days (6-107) and mean for Non-ABT group was 12.5 days (5-65). There was no statistically significant difference between the groups for length of stay (p=0.749). The average pre-operative haemoglobin levels between the two groups did not differ significantly (13.1 and 13.4 respectively). Postoperative blood measurement showed a significant difference in Hb drop between ABT group (3.44 g/dl) and Non-ABT group (4.07 g/dl) (p=0.005) (Table 2).

	ABT group (n=73)	Non-ABT group (n=105)
Sex		
Male	27 (37%)	46 (44%)
Female	46 (63%)	59 (56%)
Age (years)	68 (31-92)	69 (45-93)
Type of anaesthesia		
General	5 (7%)	17 (16%)
Spinal	61 (83%)	66 (63%)
Epidural	7 (10%)	22 (21%)
Prosthesis		
Cemented	3 (4%)	42 (40%)
Uncemented	44 (60%)	14 (13%)
Hybrid	26 (36%)	49 (47%)

Table 1: Patient demographics, type of anaesthesia and prosthetic type

	ABT group (n=73)	Non-ABT group (n=105)	p-value
Mean pre-operative haemoglobin (g/dl)	13.1 (10-16.5)	13.4 (9.2-15.8)	0.173
Mean post-operative haemoglobin (g/dl)	9.6 (5.8-13.6)	9.4 (5.7-13.6)	0.429
Mean change in haemoglobin (g/dl)	3.4 (0.4-6.7)	4.1 (0.7-7.3)	0.005

Table 2: Pre- and post-operative haemoglobin levels and mean difference.

	ABT group (n=73)	Non-ABT group (n=105)	p-value
Volume in drains (ml)	302 (40-700)	438 (60-1550)	
Volume retransfused (ml)	359 (150-700)	n/a	
No. of patients retransfused	56 (77%)	n/a	
Units of homologous blood transfused	46	106	
No. of patients transfused	20 (27%)	45 (43%)	0.035
Units transfused per person	0.67	1	0.03

Table 3: Drainage volume and transfusion for both groups.

In the ABT group, 56 patients (76.7%) were re-transfused a mean blood volume of 360 ml (200-700); blood was discarded in 17 cases (23.3%) of this group because of insufficient volume. This is

comparable with other studies which reported mean re-transfusion volumes of 264 ml and positive re-transfusion rates of 75.6% [8]. Among these, patients with uncemented prosthesis received an average of 400 ml (200-700 ml), hybrid 300 ml (200-500 ml) and cemented 300ml (250-300 ml) of salvaged blood. Twenty patients in ABT group (27.3%) and 45 patients in Non-ABT group (42.9%) received homologous transfusion (χ^2=4.44; p=0.035). In total 46 units (0.63 units per person) of homologous blood in ABT group and 106 units (1 unit per person) in Non-ABT were transfused (p=0.03) (Table 3).

There were no complications associated with homologous or autologous blood transfusion. One patient in ABT group was treated for atrial fibrillation and two patients in Non-ABT group were treated for chest infection.

Discussion

Increased awareness of morbidity and mortality associated with homologous blood transfusion has led to research into alternatives to blood transfusion. They include erythrocyte induction using recombinant human erythropoietin [8,9], tranexamic acid [10], pre-operative donation [11], haemodilution [12], intra-operative [13] and post-operative salvage [8]. However the best method to reduce the need for blood transfusion following THR remains controversial.

Bellovac® ABT system is safe, simple to setup and use. It contains three filters, a 200 µm filter which blocks large debris such as cell fragments, clotted blood, bone substance and bone cement, 80 and 40 µm filters which traps tinniest of debris and clots. Questions have been raised about the safety of the collected unwashed blood [14]. A study done by Sinardi et al. [15] has shown blood collected with Bellovac® ABT contained RBCs of normal morphology, with increased concentrations of 2,3-DPG and ATP and therefore able to deliver oxygen and energy to tissues. A study done by Hand et al. [16] has shown that there was no evidence of methyl methacrylate monomer in the systemic blood following transfusion of shed blood following cemented TKR. Comparison of coagulation parameters in patients has shown no significant difference in the measurement of antithrombin III, aPTT, thromboplastin time, thrombin time and plasminogen in the sera over time after transfusion of autologous shed blood [17]. Several studies have demonstrated an increase in concentration of complement split products and cytokines levels such as C3a, SC5b, TNF-α, IL-1α, IL-1β, IL-6 and IL-8 in shed blood, but only elevated IL-6 in plasma following transfusion [18,19]. One of the most common side effects of autologous blood transfusion is febrile reaction and it has been found to be related to higher concentration of IL-6 in shed blood [20]. We did not find any such side effects with our study.

Many studies have shown that the use of ABT following TKR is effective in reducing post-operative blood transfusion [21,22]. But there has been very few studies involving ABT in primary THR without the use of pre-operative donation or intra-operative salvage [23,24]. In our study autologous blood transfusion using Bellovac® ABT system has shown a significant reduction in post-operative allogenic blood transfusion following primary total hip replacement (42.9% to 27.3%; P=0.035) which are comparable to studies by Strumper et al. [21] (47% to 34%) and Wynn Jones et al. [22] (46% to 26%). Patients who received postoperative retransfusion also had a significantly smaller haemoglobin drop (difference 0.63 g/dl; P=0.005) in the peri-operative period. There was an increase in mean blood volume collected among uncemented implants compared to cemented implants which was similar to the findings of Hays and Mayfield [25].

During this study the cost of Bellovac® ABT system was £46.95 and a unit of blood cost £132. Cost analysis has shown that there was a reduction of 9% of the cost per person when Bellovac® ABT system was used compared to vacuum drain (Table 4).

	ABT group (n=73)	Non-ABT group (n=105)
Cost of drain (£)	46.95	16
Cost of unit of blood (£)	132	132
Units transfused per person	0.67	1
Cost of blood per person (£)	88.44	132
Total cost per person (£)	135.39	148

Table 4: Cost comparison between two groups.

Conclusion

This study confirms that the use of post-operative salvage significantly reduces the need for homologous blood transfusion following primary total hip replacement. Bellovac® ABT system is cost effective, easy and safe to use with no obvious complications. Therefore, in patients having primary total hip replacements with no evidence of infection or cancer, the use of autologous blood transfusion should be considered as it reduces the need for post-operative blood transfusion.

Compliance with Ethical Standards

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Acknowledgement

We would like to thank all the consultants for contributing patients and the audit department at the hospital for providing with case notes.

References

1. National Joint Registry for England and Wales (2007) 4th Annual Report. National Joint Registry for England and Wales, Hemel Hempstead.
2. Rosencher N, Kerkkamp HEM, Macheras G, Munuera LM, Menichella G, et al. (2003) Orthopaedic Surgery Transfusion Haemoglobin European Overview (OSTHEO) study: blood management in elective knee and hip arthroplasty in Europe. Transfusion 43: 459-469.
3. Sehat K, Evans R, Newman J (2004) Hidden blood loss following hip and knee arthroplasty. Correct management of blood loss should take hidden loss into account. J Bone Joint Surg Br 86: 561-565.
4. Sandler S, Yu H, Rassai N (2003) Risks of blood transfusion and their prevention. Clin Adv Hematol Oncol 1: 307-313.
5. Goodnough L (2005) Risks of blood transfusion. Anesthesiol Clin North America 23: 241-252.
6. Linden J, Wagner K, Voytovich A, Sheehan J (2000) Transfusion errors in New York State: an analysis of 10 years' experience. Transfusion 40: 1207-1213.
7. Eckhoff D, Rajagopalan C, Morrisey D, Winter W (1995) Efficacious/cost-effective use of blood products in TKA. Orthopaedic Transactions 19: 804.

8. Grosvenor D, Goyal V, Goodman S (2000) Efficacy of postoperative blood salvage following total hip arthroplasty in patients with and without deposited autologous units. J Bone Joint Surg Am 82: 951-954.
9. Karkouti K, McCluskey SA, Evans L, Mahomed N, Ghannam M, et al. (2005) Erythropoietin is an effective clinical modality for reducing RBC transfusion in joint surgery. Can J Anaesth 52: 362-368.
10. Alvarez JC, Santiveri FX, Ramos I, Vela E, Puig L, et al. (2008) Tranexamic acid reduces blood transfusion in total knee arthroplasty even when a blood conservation program is applied. Transfusion 48: 519-525.
11. Billote DB, Glisson SN, Green D, Wixson RL (2002) A prospective, randomized study of preoperative autologous donation for hip replacement surgery. J Bone Joint Surg Am 84: 1299-1304.
12. Bennett J, Haynes S, Torella F, Grainger H, McCollum C (2006) Acute normovolemic hemodilution in moderate blood loss surgery: a randomized controlled trial. Transfusion 46: 1097-1103.
13. Bridgens JP, Evans CR, Dobson PM, Hamer AJ (2007) Intraoperative red blood-cell salvage in revision hip surgery. A case-matched study. J Bone Joint Surg Am 89: 270-275.
14. Southern EP, Huo MH, Mehta JR, Keggi KJ (1995) Unwashed wound drainage blood. What are we giving our patients? Clin Orthop Relat Res 320: 235-246.
15. Sinardi D, Marino A, Chillemi S, Irrera M, Labruto G, et al. (2005) Composition of the blood sampled from surgical drainage after joint arthroplasty: quality of return. Transfusion 45: 202-207.
16. Hand GC, Henderson M, Mace P, Sherif N, Newman JH, et al. (1998) Methyl methacrylate levels in unwashed salvage blood following unilateral total knee arthroplasty. J Arthroplasty 13: 576-579.
17. Helwig U, Schaub S, Berghold A, Ziervogel H (2006) Coagulation parameters after retransfusion of unwashed blood. J Arthroplasty 21: 385-391.
18. Arnestad JP, Bengtsson A, Bengtson JP, Tylman M, Redl H, et al. (1994) Formation of cytokines by retransfusion of shed whole blood. Br J Anaesth 72: 422-425.
19. Bengtsson A, Avall A, Hyllner M, Bengtson JP (1998) Formation of complement split products and proinflammatory cytokines by reinfusion of shed autologous blood. Toxicol Lett 100: 129-133.
20. Handel M, Winkler J, Hörnlein RF, Northoff H, Heeg P, et al. (2001) Increased interleukin-6 in collected drainage blood after total knee arthroplasty: an association with febrile reactions during retransfusion. Acta Orthop Scand 72: 270-272.
21. Strümper D, Weber EW, Gielen-Wijffels S, Van Drumpt R, Bulstra S, et al. (2004) Clinical efficacy of postoperative autologous transfusion of filtered shed blood in hip and knee arthroplasty. Transfusion 44: 1567-1571.
22. Jones WH, Savage L, White C, Goddard R, Lumley H, et al. (2004) Postoperative autologous blood salvage drains – are they useful in primary uncemented hip and knee arthroplasty? A prospective study of 186 cases. Acta Orthop Belg 70: 466-473.
23. Smith LK, Williams DH, Langkamer VG (2007) Post-operative blood salvage with autologous retransfusion in primary total hip replacement. J Bone Joint Surg Br 89: 1092-1097.
24. Mirza S, Campion J, Dixon J, Panesar S (2007) Efficacy and economics of postoperative blood salvage in patients undergoing elective total hip replacement. Ann R Coll Surg Engl 89: 777-784.
25. Hays MB, Mayfield JF (1988) Total blood loss in major joint arthroplasty. A comparison of cemented and noncemented hip and knee operations. J Arthroplasty 3: S47-S49.