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

Abdul Nazeer Moideen1*, Lara Elizabeth McMillan1 and George Zafiropoulos2

1Welshbone, South Wales Orthopaedics Research Network, Wales, UK
2Department 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

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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=0.03). Forty six units (0.63 units per person) in ABT group and 106 units (1 unit per person) in Non-ABT group were transfused in total (p=0.03). The average pre and post-operative Hb in ABT group were 13.1 and 9.6 respectively 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 nonrequirement 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 of them were 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 salvage (ABT group) (n=73). Other surgeons used standard Bellovac® (Astra Tech) vacuum drains (Non-ABT group) (n=105).

Results

There were 73 patients in ABT group and 105 in Non-ABT group. Their demographics, types of anaesthesia and prosthesis type 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).

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

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

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

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

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.
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 (χ²=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).

<table>
<thead>
<tr>
<th></th>
<th>ABT group (n=73)</th>
<th>Non-ABT group (n=105)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost of drain (£)</td>
<td>46.95</td>
<td>16</td>
</tr>
<tr>
<td>Cost of unit of blood (£)</td>
<td>132</td>
<td>132</td>
</tr>
<tr>
<td>Units transfused per person</td>
<td>0.67</td>
<td>1</td>
</tr>
<tr>
<td>Cost of blood per person (£)</td>
<td>88.44</td>
<td>132</td>
</tr>
<tr>
<td>Total cost per person (£)</td>
<td>135.39</td>
<td>148</td>
</tr>
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</table>

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

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References


