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Intraoperative cell salvage in revision hip surgery

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ABSTRACT

Allogenic blood is a finite resource, with associated risks. Previous studies show intraoperative cell salvage (ICS) can reduce allogenic transfusion rates in orthopaedic surgery. However, there are concerns regarding efficacy and cost-effectiveness of ICS. This study was carried out to review ICS use in revision hip arthroplasty.

All patients who underwent ICS and re-infusion between 2008 and 2010 in the Southern General Hospital (SGH) were audited. The fall in haemoglobin (Hb), volume of blood re-infused and postoperative allogenic transfusion rates were recorded. This group was compared to a similar SGH cohort who underwent surgery by the same surgeons between 2006 and 2008, and a pre-2005 control group where no ICS was used.

The proportion of patients receiving a postoperative allogenic transfusion fell by 55% in the 2008–2010 ICS cohort compared with the control, and by 40% compared with the previous ICS group. In both instances, there was a statistically significant ($p < 0.001$) reduction in mean units transfused per patient; in the 2008–2010 ICS cohort, a mean of 0.8 units was used per patient, while 1.4 were used in the 2006–2008 cohort. 3.5 units were used in the control group. There was no statistically significant difference in age or preoperative Hb between the groups, or in length of hospital stay.

In this study, ICS has been shown to be effective in reducing rates and volume of postoperative allogenic transfusion in patients undergoing revision hip surgery at the SGH. However, further work is needed to establish the effect of changing anaesthetic technique on postoperative allogenic transfusion rates.

1. Introduction

Orthopaedic surgery is often associated with a high volume of blood loss, and hence high rates of postoperative transfusion. Although allogenic (donor) blood is routinely used, it is a finite and increasingly costly resource [1]. The risk of viral infection from allogenic blood is extremely low [2,3]. However, several large studies have shown that allogenic transfusion is associated with increased risk of postoperative bacterial infection [4–6].

Other risks associated with allogenic transfusion include acute transfusion reactions, haemolytic reactions and transfusion-associated acute lung injury. Clinical errors are the most common cause of transfusion related complications, as reported by the Serious Hazards of Transfusion (SHOT) working group [7].

The increasing cost and associated risks of allogenic blood have therefore led to a number of blood saving interventions becoming widely used in orthopaedic surgery. One such intervention has been intraoperative cell-salvage (ICS), a technique whereby blood lost intraoperatively is collected from the operative field, anti-coagulated, washed and filtered before being re-infused into the patient either during the procedure, or immediately post-operatively. As half of all units transfused in the UK are used for surgical patients [8], a blood conservation technique like ICS seems well placed to help reduce the national use of allogenic blood. Although ICS can also be successfully carried out in knee arthroplasty, it has been shown to be less effective than ICS in hip arthroplasty [9].

Other measures to reduce allogenic transfusion include the use of tranexamic acid [10], erythropoietin and iron supplementation [11,12]. A recent review by Munoz et al. [13] has shown that both oral and IV pre and perioperative iron reduce the volume of allogenic blood transfusion in orthopaedic and trauma patients. Pre-operative autologous donation for patients expected to require >2 units of allogenic blood has also been shown to reduce allogenic

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blood use [13,14]. It has been suggested that these interventions work best when partnered with cell salvage [15], and indeed cell salvage itself has been shown to offer a safe and cost-effective method of reducing allogeneic blood use [16–18].

Since its introduction in the 1970's, ICS has become routine in a range of surgical specialities. It has been shown to be effective at reducing allogenic transfusions in obstetric [1], vascular [19], cardiac [20], orthopaedic [21] and urological [16] procedures. Indications for ICS include; an anticipated blood loss of >1000 ml; a mean allogenic post-op transfusion of 1 unit or greater; the refusal of transfusion for religious reasons; a low pre-op haemoglobin; risk factors for bleeding or if more than 10% of patients undergoing the operation require a transfusion [16,23].

Absolute contraindications are: situations where red cell lysis occurs, such as blood being mixed with sterile water, hydrogen peroxide or alcohol; red cell abnormality, such as sickle cell disease [24]; or procedures with faecal or urine contamination [16,23]. Other more relative, though generally accepted, contraindications include: malignancy; the presence of contaminants too small to be filtered out, for example metal particles from metal on metal hip revisions; and infection. Contamination from fat particles is also cited as a contraindication [16], however fat particles can now be easily eliminated by using a leucocyte depletion filter [22].

Although cell salvage has been shown to be useful in a number of procedures, there is still some debate as to its safety. For example, one of the most commonly cited objections is the theoretical risk of amniotic fluid embolus from blood salvaged during obstetric procedures [25], although evidence for this is weak [26]. There are also debates about its effectiveness and economic viability in some areas of cardiac surgery [27].

The safety and efficacy of ICS in orthopaedic surgery have, however, been well documented. Most studies described the use of ICS in hip and knee arthroplasty patients. Several studies have shown ICS to be effective in primary hip arthroplasty [9,28] A small, case-matched study showed that ICS significantly reduced allogenic transfusion in revision hip arthroplasty [29]. Two large randomised controlled trials (RCTs) and a large retrospective database review have shown similar outcomes in Knee surgery [30–32].

The aim of this study is to assess the impact of ICS on blood transfusion rates in patients undergoing revision hip arthroplasty.

2. Methods

This comparative cohort study was carried out in the Southern General Hospital in Glasgow. The following data was collected from a standardised cell salvage data sheet compiled by theatre staff on the day of operation date of operation; operation details, patient details, cell salvage complications where present, the volume of blood salvaged and re-infused, the total volume of blood lost during the operation and the volume of surgical irrigation and anticoagulant used.

Patient data, such as pre and postoperative haemoglobin (Hb) levels, was obtained from electronic patient records, transfusion data was obtained from both electronic and hard copy databases. Postoperative allogenic transfusions carried out up to and including 10 days postoperatively were recorded, with the day of operation as day zero. Any transfusions after this period were discounted. Length of postoperative stay was recorded, with the day of the operation as day zero. The pre and postoperative Hb levels recorded closest to the operation date were used. Ethical approval was not required.

The Cell Saver 5 salvage machine was used throughout the study period in all patient groups, and salvage was carried out as per manufacturer's (CellSaver) protocols. The same three surgeons carried out all operations throughout all three study periods.

2.1. Transfusion protocol and tranexamic acid

All patients in all cohorts were transfused allogenic packed red cells if their Hb was <80 g/L or if <100 g/L but symptomatic with a background of cardiac disease. All patients in all groups received 1 g tranexamic acid IV at the induction of anaesthesia.

2.2. Inclusion/exclusion criteria

All patients in the Southern General Hospital who underwent a revision hip operation with cell salvage and autologus blood re-infusion were initially included in the study. A small number of patients were excluded due to missing data on the ICS data sheets.

2.3. Statistical analysis

Results were analysed using the statistical software package Prism 4.0 (GraphPad). Graphs were generated by Microsoft Excel (Microsoft 2003). Analysis of variance (ANOVA) non-parametric tests were used to obtain p-values to test significance. The Kruskal–Wallis test was used to determine the significance in variance between all 3 study groups, and Dunn's multiple comparison test was used to compare significance of differences between specific groups. Standard descriptive statistics per group were also calculated, the mean number of units required per patient was calculated from the total post-op units transfused divided by the total number of patients in that revision hip cohort. A p-value of <0.05 was used as the threshold for significance.

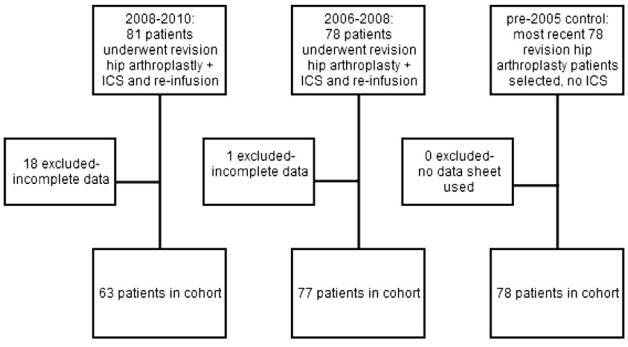
3. Results

3.1. Patient recruitment

Cell salvage was used in a total of 81 patients who underwent revision hip surgery between 2008 and 2010. Of these, 18 patients were excluded from the study due to unrecorded data such as preoperative Hb.

78 patients underwent revision hip surgery between 2006 and 2008, one of whom was excluded due to missing data. A control group of 78 revision hip patients who had no cell salvage was obtained from records dating from pre-2005, where cell salvage was not used.

Patient recruitment is summarised in the flow diagram below:



3.2. Comparison of cohorts

Patients who underwent revision hip arthroplasty in the new (2008–2010) and previous (2006–2008) cell-salvage group characteristics were compared with the pre-2005 control group. All 3 groups were found to be comparable in terms of age and