



RESEARCH ARTICLE

THE USE OF CELL SAVERS IN ORTHOPEDIC SURGERY

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ABSTRACT

Presently, cell salvage or autologous transfusion has been incorporated in various surgeries including orthopedics. Especially in spine, hip revision and pelvic surgeries as the anticipated blood loss is always high. In this paper, we review the literature in regard to cell salvage in orthopedics surgery. In terms of indications, contraindications, cost effectiveness and complications. We performed a literature search on PubMed and included the relevant articles. We found that majority of the published literature did not prefer the routine usage of autologous transfusion mainly because it is expensive and may lead to complications. Cell salvage is preferred if the blood loss is expected to be more than 20%, the patient has a rare blood type or if the patient's beliefs go against allogenic blood.

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INTRODUCTION

Intraoperative blood salvage which in another term can be referred to as autologous blood transfusion is a medical process that involves recuperating blood that was lost in the process of surgery and putting it back into the patient's system (Ashworth *et al.*, 2010). It is regarded to as a key method of auto transfusion. In most cases cell salvage (CS) helps to do away with the allogenic blood transfusion process thus reducing the complications it poses (Carless *et al.*, 2006). This method was initially practiced by James Blundell who tried the cell salvage process. He attempted a cell salvage transfusion by using saline to wash the bloody swabs of patients with postpartum hemorrhage (Blundell, 1918). Despite the fact that most of the patients did not survive, it led to the invention of autologous transfusion. As a result, technology associated with the cell salvage process has seen a lot of growth. Presently, cell salvage has been incorporated in various surgeries including urology, neurosurgery, cardiac, vascular and orthopedics. In this paper, we review the literature in regard to cell salvage process in the orthopedics surgery.

Indications and Contraindications of cell salvage in Orthopedics Surgery

In the past, the American Association of Blood Banks preferred that cell salvage be used when the anticipated blood

loss is more than 20%, if the blood group of the patient is uncommon or has multiple antibodies or if the patients' beliefs do not accept allogenic blood for instance Jehovah Witnesses (Natanson *et al.*, 2008). The use of cell salvage has become very common in orthopedics surgery mostly in the spine, hip revision and pelvic surgeries because in these surgeries it is very likely that a lot of blood will be lost (Rosenblatt, 2002; Firoozabadi *et al.*, 2015). Contraindications can be grouped into two categories: absolute and relative. The absolute contraindications are those which put the patient's life at risk and would lead to the lysis of the red blood cells (RBCs). The damaging of the red blood cells takes place when the blood comes into contact with fluids like hydrogen peroxide, hypnotic solution, sterile water and alcohol. Lysed red blood cells increase the chances of organ damage if transfused (From the Centers for Disease Control and Prevention, 1999; Pierce *et al.*, 1998). Some of the relative contraindications of the cell salvage process include infection of a contaminated or non-contaminated material, for instance bone chips, pharmacological matter and malignant cells. Moreover, an argument exists concerning collagen hemostatic agents and carbon monoxide resulting to electrocautery. Sick cell and thalassemia are some of the cells ailments that are associated with this too (Stephen *et al.*, 2011).

Cost effectiveness

In the process of reviewing the literature, we discovered that previous researches supported the use of cell salvage in orthopedic surgeries. One such demonstrative study was

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carried out in 1986 by Bovil DF and his colleagues (Bovill *et al.*, 1986). They carried out a retrospective service evaluation study to determine the effectiveness of autologous transfusion in key orthopedic surgeries. The study revealed that the use of the Cell Salvage intraoperatively was associated with significantly smaller volumes of transfused banked blood and significantly smaller hematocrit drops in the groups of patients who underwent total hip replacement or spine fusion, but not in the group of patients who underwent total knee replacement. After this, a random research was carried out by Elawad *et al.* (1991) in Sweden in 1991, weighing autologous blood transfusion against homologous blood transfusion in primary hip arthroplasty. The results showed that intraoperative auto-transfusion is secure and efficient and it should be preferred in the hip arthroplasty in order to minimize the risk which may be brought about by the homologous blood transfusion. Furthermore, a systematic review by Elgafy *et al.* (2010) concluded that there is little support for routine use of cell salvage during elective spinal surgery with regards to safety and efficacy.

However, recent research offers no proof of any major impact brought about by cell salvage in orthopedic surgeries. A study that was carried out by Veronique Voorn *et al.* in Netherlands (Voorn *et al.*, 2013), where all the heads of orthopedics departments in Dutch medical facilities were consulted, showed that CS was used in 31% and none of them lead to reduced red blood cells use or even reduction of the fraction of transfused patients. Bilgili *et al.* (2014) carried out a study where they assessed the cost effectiveness of CS in the complete knee arthroplasty. They discovered that CS does not minimize the risk posed by allogenic transfusion and it is even more expensive. They discovered that allogenic blood transfusion is associated with low body mass index (BMI) together with minimized preoperative hemoglobin levels and thus cell savers might be the better option in this case. During the same period, Akgul *et al.* (2014) researched the use of cell savers in surgical treatment of adolescent idiopathic scoliosis, and the conclusion was that allogenic blood transfusion while using cell saver in adolescent idiopathic scoliosis does not reduce at all.

Miao *et al.* (2014) also came to the conclusion that CS costs more when used in instrumented posterior correction and fusion surgery for scoliosis in school-aged children and adolescents. Even though this process minimizes intraoperative allogenic RBC transfusion, CS does not minimize the complete perioperative allogenic RBC transfusion. A single center demonstration cohort research was carried out by Firoozabadi *et al.* (2015) in regard to the use of CS in acetabular surgeries. The result was that CS is not preferred for common use especially in open reduction and internal correction of the Acetabular. It is, however, recommended in cases where loss of blood is expected to be major.

Complications

In regard to the challenges that may occur, few specific researches assessed the pollution of the processed blood. Slucky (1996) conducted a study in Florida which proved that the salvaged blood contains raised levels of carboxyhemoglobin when electrocautery is used. However, there no patient at all who showed any medical effects as a result of high levels of carbon monoxide. The second research was by John M Morton *et al.* (2014), in which they carried out

a trial transfusion where micro aggregate blood filters were used, and the resulting filtrate was assessed. They concluded that there was some titanium residue that could not be eliminated during filtration. However, the effects of these small masses of titanium to the patient are yet to be established. We also noted that some different studies showed other complications of autologous transfusion. A study by Keverline *et al.* (1998) in Pennsylvania showed low hematuria when minimal cell saver is practiced during pediatric orthopedic operation. Other complications include venous air embolism, hypercoagulability as a result of minimized levels of Anti-thrombin III and pollution (Engelhardt and Blumenberg, 1991). On the other hand, a research conducted by Elwad in Sweden (Elawad *et al.*, 1991) likened autologous and homologous processes in primary hip arthroplasty. The result showed that there was no postoperative variation in reference to the hematologic parameters researched and the fact that there is no proof of intravascular hemolysis in regard to autologous blood transfusion group. After the surgery, in the two cases, Anti-thrombin III, plasminogen and protein C reduced but other coagulation parameters remained steady in the two groups.

Conclusion

Majority of the literature that has been published did not prefer the routine usage of autologous transfusion mainly because it is expensive and may lead to complications. Cell salvage is highly preferred if the blood loss is expected to be more than 20%, the patient has a rare blood type or if the patient's beliefs go against allogenic blood for instance the Jehovah witnesses.

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