

Effect of Autologous Blood Donation with Intraoperative Cell Salvage and Blood Transfusion on the Requirements of Revision Total Hip Arthroplasty

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Abstract

Background: Revision total hip arthroplasty (THA) is associated with increased blood loss.

Patients and methods: We reviewed 32 patients who underwent revision THA to identify modes of implant failure, use of autologous blood donation with/without intraoperative cell salvage, and allogeneic blood transfusion requirements.

Results: Five patients underwent revision THA for infection or fractures. None used autologous blood donation and four required allogeneic blood transfusion. Twenty-seven patients underwent revision THA for aseptic loosening. In this group, 17 used autologous blood donation with intraoperative cell salvage, and the other 10 used intraoperative cell salvage without autologous blood donation. Allogeneic transfusion was required in only two of 17 patients of the former group, and in seven of 10 patients of the latter group ($p=0.007$). Use of autologous blood donation with intraoperative cell salvage led to lower allogeneic blood transfusion requirements.

Conclusions: These data show that use of autologous blood donation with intraoperative cell salvage is clearly associated with decreased allogeneic blood transfusion requirements for revision THA. Identification and treatment of patients at a higher risk of allogeneic blood transfusion may guide probable allogeneic blood transfusion requirements, and is a safe, effective method of managing blood loss for revision THA.

Key words: Revision hip arthroplasty, Blood loss, Transfusion, Autologous blood donation, Intraoperative cell salvage

Introduction

Patients undergoing revision total hip arthroplasty (THA) are at considerable risk of massive perioperative blood loss that necessitates allogeneic blood transfusion¹. Allogeneic blood transfusion carries the risk of disease transmission and immunologic reactions². Identification of patients that might require transfusion is desirable to improve blood use and more accurately identify which patients should receive established perioperative blood conservation interventions. We examined the influence of variables such as age, sex, preoperative haemoglobin (Hb) concentration, modes of implant failure, use of autologous blood donation (ABD) and inoperative cell salvage (ICS),

and allogeneic blood transfusion requirements following revision THA.

Patients and Methods

A retrospective analysis was conducted on 32 patients who underwent elective revision THA in the Department of Orthopaedic Surgery, Faculty of Medicine, Fukuoka University (Fukuoka, Japan) over a two-year period.

Several weeks before THA, patients deposited 200–400 mL of blood weekly as long as their Hb level remained >11.0 g/dL. To prevent dizziness, nausea, and syncope caused by hypovolemia, patients were given lactated Ringer's solution after autologous blood was collected. Patients were given iron supplementation in accordance

with guidelines set by our hospital. Patients with Hb <13.5 g/dL were given iron supplementation *via* the intravenous route. Patients with Hb <12.5 g/dL were given iron supplementation *via* oral and intravenous routes. Intravenous iron supplementation 40mg was given immediately after autologous blood collection. Oral iron supplementation 210mg per day was given everyday from autologous blood collection until surgery. After the induction of general anaesthesia, procedures were carried out by two senior surgeons using various surgical methods. The analysis focused on the modes of implant failure, and included cases of revision THA for infection or fractures as well as early revisions for dislocations secondary to malpositioning of implants. Intraoperative cell salvage (ICS) was carried out using a continuous autotransfusion system (Electa®; Sorin, Milan, Italy). Blood was retrieved from the operative field using a single dedicated suction catheter. Collected blood was separated *via* centrifugation and red blood cells collected in sterile bags for autotransfusion. Blood from ICS was transfused intraoperatively, and autologous blood collected preoperatively was transfused immediately after surgery. In accordance with guidelines set by our hospital, patients with Hb <7-8 g/dL should be considered use of allogeneic transfusion. In this study, allogeneic transfusion was used in consideration of each Hb level, amount of bleeding, anamnesis, blood pressure, and the general state. Prophylactic anticoagulants such as edoxaban were administered postoperatively for 12 days to prevent deep-vein thrombosis. Drains were removed <24 h after surgery. Hb levels were measured just before preoperative donation

of autologous blood as well as 1 day and 7 days after surgery.

The electronic database of our hospital was searched. Variables such as preoperative and postoperative Hb concentrations, patient demographics (e.g., age, sex), type of revision surgery, mode of implant failure, use of ABD and ICS, and allogeneic blood transfusion requirements were recorded for each case.

Statistical analyses

Fisher's contingency table analysis was used to test for differences in allogeneic blood transfusion requirements of patients who underwent revision THA for aseptic loosening between groups using ABD with ICS, and ICS without donation of autologous blood. $p < 0.05$ was considered significant.

Results

Three patients underwent revision THA due to infection (Table 1). Types of components that underwent revision were femoral component, acetabular component, and dual components each. Seventy-six-y female and 58y female had many amounts of intraoperative bleeding. Seventy-four-y female had the anamnesis hemorrhage in the precedence surgery: extraction of implant and debridement. Furthermore, in this operation, her preoperative blood pressure dropped. All three patients could not take advantage of ABD and ICS, so they required allogeneic blood transfusion. Two patients underwent revision THA for fractures. Types of components revised were acetabular

Table 1. Allogeneic blood transfusion requirements upon revision total hip arthroplasty due to infection or fracture

Age, sex	76 y, F	74 y, F	58 y, F	52 y, M	74 y, M
Mode of implant failure	Infection	Infection	Infection	Fracture	Fracture
Weight (kg)	60	52	65	53	61
BMI (kg/m ²)	28.5	23.7	26.9	17.1	26.2
Type of component revised	Femoral	Acetabular	Dual	Dual	Acetabular
Operative time (min)	77	195	356	208	150
perioperative blood loss (mL)	2260	495	1800	unkown	370
Preoperative haemoglobin concentration (g/dL)	9.6	9.9	11.2	11.6	13.6
haemoglobin concentration just before allogeneic transfusion (g/dL)	8.3	unkown	7.3	5.9	N/A
Postoperative haemoglobin concentration: POD1 (g/dL)	10.1	11.6	9.3	11.1	9.6
Postoperative haemoglobin concentration: POD7 (g/dL)	9.2	10.9	6.3	9.5	8.6
Transfusion	RBC 2 units	RBC 4 units	RBC 4 units	ICS 1103 mL*+ RBC 4 units	None

ICS – intraoperative cell salvage.

Table 2. Characteristics of cases of revision total hip arthroplasty due to aseptic loosening

	Group A	Group B
	Autologous blood donation with intraoperative cell salvage	Intraoperative cell salvage without autologous blood donation
Number of cases (n)	17	10
Age (years)	64.2 ± 18.8	67.3 ± 19.7
Male:female	2:15	2:08
Weight (kg)	53.2 ± 11.8	49.8 ± 18.8
BMI (kg/m ²)	22.3 ± 6.6	21.8 ± 7.1

component, and dual components. Both patients could not take advantage of ABD. One patient required allogeneic blood transfusion despite using ICS. Another patient did not require allogeneic blood transfusion despite not using ICS because her blood loss was low upon revision THA of an acetabular component.

Twenty-seven patients underwent revision THA for aseptic loosening (Table 2). Group A (17 patients) used ABD with ICS, and group B (10 patients) used ICS without ABD. Fibrin sealant made from autologous blood was sprayed at the component site in group A. The mean amount of autologous blood donated in group A was 494 mL (range: 200–800 mL). The mean amount of ICS in group A was 271 mL (120–734 mL), and was 302 mL (126–460 mL) in group B. The allogeneic blood transfusion requirement of group A was 11.8%, whereas that of group B was 70.0%. Allogeneic blood transfusion requirements of group A were significantly lower than those of group B ($p=0.007$) (Fig. 1).

Discussion

ABD can be carried out in several ways: preoperative ABD, intraoperative blood salvage, and postoperative blood

salvage^{3–10}. Preoperative ABD has been shown to reduce the absolute risk of allogeneic blood transfusion by 43.8%¹¹.

Preoperative ABD offers theoretical advantages, and should be targeted to males with a Hb level 11.0–14.0 g/dL and to females with a level of 13.0–14.0 g/dL whose anticipated perioperative blood loss is ≈ 1 L⁸. The results of a recent Cochrane review on perioperative cell salvage showed that re-transfusion of autologous blood reduced allogeneic blood transfusion requirements by 54% as compared with conventional drains in orthopaedic procedures¹². If high levels of blood loss are anticipated, preoperative blood donation may be considered, possibly combined with ICS⁸. The results of a review by Mahadevan et al. showed greater blood loss in males, older patients, during revision surgery of cemented implants, and dual-component revision THAs¹³. In the present study, use of ABD with ICS was clearly associated with decreased allogeneic blood transfusion requirements for revision THA. However, ABD cannot be employed for patients with anaemia, who are prone to infection, or immediately before surgery. Additionally, preoperative ABD can present logistical problems, be time-consuming, and waste donated blood¹⁴. In the present study, iron supplementation was used for patients with preoperative anaemia. There was no

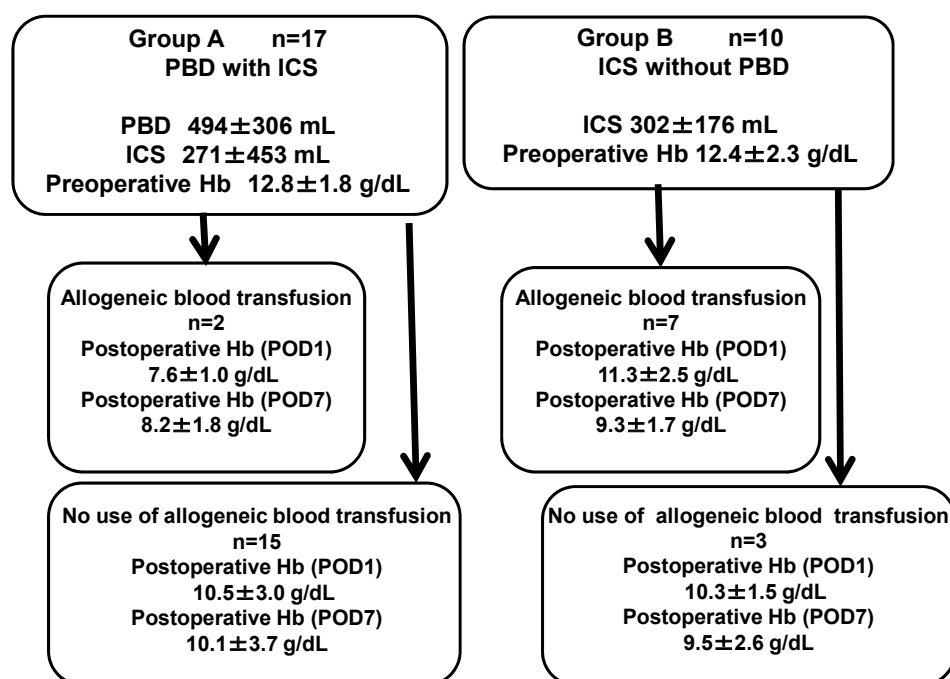


Fig. 1 Haemoglobin concentration and allogeneic blood transfusion requirements upon revision total hip arthroplasty due to aseptic loosening Hb – haemoglobin; ICS – intraoperative cell salvage; PBD – preoperative blood donation; POD – postoperative day. Allogeneic blood transfusion requirements of groups that used autologous blood donation with intraoperative cell salvage were significantly lower than those of groups that did not use autologous blood donation ($p=0.007$).

wastage of donated blood. Identification and perioperative treatment of patients at a higher risk of allogeneic blood transfusion may guide probable reduction of allogeneic blood transfusion requirements, and be a safe, effective method of managing blood loss for revision THA.

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