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Original Article

Infection Is Not a Risk Factor for Perioperative and Postoperative Blood Loss and Transfusion in Revision Total Hip Arthroplasty

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ABSTRACT

Background: Septic hip revisions are associated with greater complications and higher costs than aseptic revisions. It is unclear whether blood loss and transfusion requirements are different in septic and aseptic revisions. We hypothesized that the blood loss and transfusion are dependent on the complexity of the revision surgery and patient's general health rather than the presence of infection.

Methods: We retrospectively reviewed 626 revision total hip arthroplasties in 547 patients between 2009 and 2013. All the procedures were classified as septic (n = 120) or aseptic (n = 506) based on the Musculoskeletal Infection Society criteria for periprosthetic joint infection. Independent risk factors for transfusion and blood loss were analyzed using a multiple regression analysis.

Results: The transfusion rate was higher in septic revisions (septic = 108/120 [90%], aseptic = 370/506 [73%]; $P < .001$), so was the average amount of blood loss (septic = 2533 ± 161 mL, aseptic = 1974 ± 68 mL; $P < .001$). After adjusting for potential confounders, infection was not an independent risk factor for transfusion ($P = .176$) or blood loss ($P = .437$). Increasing age ($P = .004$), higher American Society of Anesthesiologists score ($P = .047$), lower preoperative hemoglobin ($P < .001$), cell saver use ($P < .001$), and complex revision surgery ($P < .001$) were independently associated with greater risk of transfusion.

Conclusions: Although blood loss and transfusion rates were higher in septic revisions, the presence of infection alone did not increase the risk of transfusion or blood loss. Blood management strategies in revision total hip arthroplasties should be guided by the type of surgery planned and patient's preoperative health rather than the presence of infection.

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Revision total hip arthroplasty (THA) for periprosthetic joint infection is associated with higher complication rates and greater hospital costs than aseptic indications for revision [1]. Despite the advances in the surgical techniques, severe blood loss and transfusion remain to be an important complication after revision THA, with apparently higher rates reported in septic revisions [1-3]. The use of intraoperative blood salvage is relatively contraindicated in cases of septic revisions owing to the fear of bacterial contamination in the operative field, which translates to increased dependence on allogeneic transfusions to treat intraoperative blood loss [4]. Allogeneic transfusion is associated with higher costs and longer hospital stays in addition to the increased risk of postoperative infection, presumably through immunomodulation [5-9]. This could complicate the postoperative course, especially in septic revisions where stringent infection control is desired, increasing the risk of failure of the revision procedure [10]. Understanding the differences in blood product utilization based on indication of revision may also help hospital administrators in making decisions on medical reimbursements.

Although previous studies have reported higher rates of estimated blood loss and transfusion in septic revisions, it is unclear whether infection increases the risk of transfusion [1,3]. Septic revisions usually involve revision of multiple components and are performed in patients with poor overall health, which in itself are potential risk factors for transfusion [2]. Hence, contrary to the popular belief that septic revisions are more complex and use

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greater hospital resources, septic revisions might consume a similar amount of resources as aseptic revisions if adjusted for potential confounders. To the best our knowledge, none of the studies have evaluated the independent effects of the indication for revision hip arthroplasty on blood transfusion requirements. We hypothesized that although septic revisions may have higher rates of transfusion, it may in fact be the complexity of surgery performed and the patients' general health that increase the risk of transfusion rather than the infection.

Moreover, an easy and accurate preoperative tool to estimate the risk of transfusion will help preoperative planning and in identifying patients who may benefit from expensive blood conservation strategies. Therefore, our study aimed at (1) identifying whether the presence of infection poses an increased risk of blood transfusion and blood loss in revision THA and (2) establishing the preoperative risk factors for transfusion and build a predictive nomogram.

Materials and Methods

Study Design

This retrospective study was reviewed and approved by the institutional review board. All patients who underwent revision THA between October 2009 and June 2013 at a large single academic center using the operation room information system and Current Procedural Technology Codes were identified. The types of revision THA procedures considered were acetabular liner exchange, acetabular cup revision, femoral stem revision, revision of 2 components (including second stage of 2-stage revision), explant or implantation of antibiotic spacer (first stage of 2-stage revision), and an antibiotic spacer exchange. The information on patient demographics, comorbidities, diagnosis, revision procedure, preoperative hemoglobin, medications, blood loss, and transfusion requirements was obtained from electronic chart review.

Study Subjects

A total of 687 revision THA procedures were performed during the study period and were considered eligible for the study. Each stage of a staged revision procedure was considered as a separate procedure. After excluding n = 58 procedures with incomplete data to assess the Musculoskeletal Infection Society (MSIS) criteria [11] and n = 3 procedures in which simultaneous hip and knee revisions were performed, n = 626 revision surgeries (547 patients) were included for analysis. All these revision surgeries were categorized into septic or aseptic based on the MSIS criteria at the time of procedure [11]. A procedure was considered to be septic when one of the following existed: 2 positive periprosthetic cultures with phenotypically identical organisms, a sinus tract communicating with the joint, or 3 of the following 5 minor criteria: elevated serum C-reactive protein (>1 mg/dL) and erythrocyte sedimentation rate (>30 mm/h), elevated synovial fluid white blood cell count (>3000/μL), elevated synovial fluid polymorphonuclear neutrophil percentage (>80%), positive histologic analysis of periprosthetic tissue (positive for acute inflammation), or a single positive culture in periprosthetic tissue or synovial fluid. Of the 626 revision surgeries in the final cohort, 120 (19%) were infected based on the MSIS criteria and were considered as septic revisions, whereas the remaining 506 (81%) were aseptic revisions. Aseptic revisions also included 21 (n = 21/506, 4%) metal on metal hip revisions, all of which were not infected based on the MSIS criteria. The demographics of the study population are described in Table 1. Preoperative antithrombotic drugs include any antiplatelet drugs such as aspirin, clopidogrel, and so forth or other anticoagulants such as heparin, warfarin, and so forth, which were being administered to the patient before the procedure (includes all patients with an active prescription of the drug within 30 days of the procedure even if it was stopped immediately before surgery). For the purpose of the study, coagulopathies included were platelet deficiencies or disorders, factor deficiencies, or any other chronic disorders of coagulation. All the revision surgeries were performed by one of the 17 surgeons trained in adult reconstruction, with general anesthesia being used in most procedures (n = 551/626, 88%). After the surgery, patients received pharmacologic prophylaxis for venous thromboembolism with either heparin or low-molecular weight heparin (n = 463), aspirin (n = 115), warfarin (n = 35), or other anticoagulants (n = 13). In addition, all patients received mechanical prophylaxis with sequential compression device. At this institution, patients undergoing revision THA do not donate blood preoperatively, and intraoperative cell savers are not used for revision surgeries performed for infection. However, the study classified revision surgeries as infected or not using the MSIS criteria retrospectively, which might have been different from the actual preoperative diagnosis. Therefore, some presumed aseptic revision surgeries could have used a cell saver even if they were infected based on the MSIS criteria. But, if the presence of infection was doubted by the surgeon based on intraoperative findings, blood obtained from cell saver was not transfused.

Table 1
Baseline Characteristics of the 626 Revision THAs (547 Patients).

Variable	Septic (n = 120)	Aseptic (n = 506)	*P* Value
Age, y (mean ± SD)	63.5 ± 14.8	64.2 ± 13.2	.604
Gender, n (%)			.036
Male	68 (57%)	233 (46%)	
Female	52 (43%)	273 (54%)	
Body mass index	31.9 ± 7.9	29.9 ± 6.8	.011
American Society of Anesthesiologists score (mean ± SD)	3.0 ± 0.6	2.8 ± 0.6	.010
Age-adjusted Charlson score (mean ± SD)	3.6 ± 2.0	3.0 ± 1.2	<.001
Presence of coagulopathies, n (%)	0 (0%)	15 (3%)	.088
Use of preoperative antithrombotics, n (%)	42 (35%)	153 (30%)	.311
Preoperative hemoglobin, g/dL (mean ± SD)	11.4 ± 1.9	12.7 ± 1.8	<.001
Use of cell saver, n (%)	20 (17%)	211 (42%)	<.001
Type of surgery, n (%)			<.001
Liner exchange (n = 66)	15 (13%)	51 (10%)	
Single component			
Acetabular revision (n = 170)	5 (4%)	165 (33%)	
Femoral revision (58)	2 (2%)	56 (11%)	
Dual component			
Revision acetabular and femoral (n = 232)	14 (12%)	218 (43%)	
Explant (first stage) (n = 83)	74 (62%)	9 (2%)	
Spacer exchange (n = 17)	10 (8%)	7 (1%)	

THAs, total hip arthroplasties; SD, standard deviation.

Outcomes

The primary outcome of interest was requirement of blood transfusion in the perioperative period. This included patients who received a transfusion either intraoperatively or within 3 days after the surgery (to account for any blood loss as a direct consequence of the surgery) [12]. Only transfusions with blood products such as whole blood and/or packed red blood cells collected from either autologous or allogeneic sources were considered for the study. Transfusions with platelets, fresh frozen plasma, or cryoprecipitate were not included as they may not necessarily reflect the blood loss.

The decision to transfuse blood products was determined by the surgeon or resident using the following standardized criteria:

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