The Journal of Arthroplasty xxx (2016) 1–6

Contents lists available at ScienceDirect

The Journal of Arthroplasty

journal homepage: www.arthroplastyjournal.org

Original Article

Allogeneic Blood Transfusion Is a Significant Risk Factor for Surgical-Site Infection following Total Hip and Knee Arthroplasty: A Meta-Analysis

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ARTICLE INFO

Article history:
Received 8 June 2016
Received in revised form
21 August 2016
Accepted 22 August 2016
Available online xxx

Keywords:
meta-analysis
allogeneic blood transfusion
total hip arthroplasty
total knee arthroplasty
surgical-site infection

ABSTRACT

Background: Blood loss occurs significantly more frequently during total hip and knee arthroplasty than among any other type of orthopedic operation, which can sometimes lead to requiring a blood transfusion. Although allogeneic blood transfusion has been identified as a risk factor for postoperative surgical-site infection following arthroplasty, results are inconclusive. The purpose of this study was to conduct a systematic meta-analysis to investigate whether having an allogeneic blood transfusion significantly increases the risk for surgical-site infection, particularly after total hip and knee arthroplasty.

Methods: We performed a systematic review and meta-analysis using random-effect models. Using an electronic database search, we selected 6 studies that included data on 21,770 patients and among these studies compared the postoperative infection rate between an allogeneic blood-transfusion exposure group and a nonexposure group. We calculated the pooled odds ratios and 95% confidence intervals for the groups.

Results: The prevalences of surgical-site infections in our pooled analyses were 2.88% and 1.74% for the transfusion and nontransfusion groups, respectively. The allogeneic blood transfusion group had a significantly higher frequency of surgical-site infections based on pooled analysis using a random-effect model (pooled odds ratio = 1.71, 95% confidence interval: 1.23-2.40, $P = .002$).

Conclusion: Allogeneic blood transfusion is a significant risk factor for increasing the surgical-site infection rate after total hip and knee arthroplasty.

Total hip and knee arthroplasties have been widely performed in patients with advanced degenerative or inflammatory arthritis to relive pain and improve function. Generally hip and knee arthroplasties yield satisfactory clinical outcomes [1]. However, several studies have reported complications associated with these surgeries, some of which can be fatal, including perioperative blood loss [2-4]. To avoid acute blood loss, which is one of the major complications from arthroplasty, surgical teams will often administer allogeneic blood transfusion. Previous studies have indicated that 2%-70% of patients received a blood transfusion after total hip or knee arthroplasty [5-8].

Several studies have investigated postoperative infection rates following blood transfusion across several surgery types [9-21]. However, results for total hip or knee arthroplasty yield conflicting results, with some studies concluding that allogeneic blood transfusion increases risk for postoperative infection [18,19,22-24] and others concluding that it does not [13,25]. Across these studies, comparison groups and the definition of infection for analyses (eg, surgical-site infection, urinary tract infection, pneumonia, septicemia) were different for each study. Therefore, we cannot, as of yet, conclude decisively whether allogeneic blood transfusion is significantly associated with postoperative surgical-site infection after total hip or knee arthroplasty.

The current study utilizes a meta-analysis design to evaluate whether allogeneic blood transfusion is significantly associated with postoperative surgical-site infections after total hip and total knee arthroplasty. It has been hypothesized that allogeneic blood

The authors received no financial support.

No author associated with this paper has disclosed any potential or pertinent conflicts which may be perceived to have impending conflict with this work. For full disclosure statements refer to http://dx.doi.org/10.1016/j.arth.2016.08.026.

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http://dx.doi.org/10.1016/j.arth.2016.08.026
0883-5403/

transfusion is a significant risk factor for increasing the postoperative surgical-site infection rate in total hip and total knee arthroplasty.

Materials and Methods

Data Sources and Search Strategy

We performed an electronic literature search of three online databases, PubMed, EMBASE, and the Cochrane Central Register of Controlled Trials. The last electronic search was carried out on December 30, 2015. No restrictions were imposed on the publication language, study period, or sample size. Key terms for searching the title and abstract included "transfusion," "infection," "arthroplasty," "prosthetic," and "prosthesis." After the initial electronic search, relevant articles and their bibliographies were searched manually. The entire search process was conducted in four phases, according to guidelines from PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-analyses; http://www.prisma-statement.org).

Study Selection

We selected studies that fit the following predefined criteria: (1) the study was performed before December 2015; (2) the study offered a concise definition of surgical-site infection and did not include generalized infections, such as sepsis, pneumonia, or urinary tract infection (UTI); and (3) the study outcomes were based on comparisons between an allogeneic blood transfusion group and a nonexposure group (eg, only autologous blood transfusion or none). Data from the included studies were extracted independently by 2 authors.

Data Extraction and Quality Assessment

We analyzed the full text of all selected articles and then extracted study characteristics, design, number of patients, type of arthroplasty, type of transfusion, definition of infection, follow-up period, and publication years.

The methodological quality of eligible studies was assessed by using the Newcastle-Ottawa Scale (NOS) [26]. This scale assessed risk of bias in 3 domains: (1) selection of study groups; (2) group comparability; and (3) ascertainment of exposure and outcome. With regard to the selection (four numbered items) and exposure (3 numbered items) domains, each assessed study could be awarded a maximum of one star for each numbered item. Regarding the comparability (1 numbered item) domain, a maximum of 2 stars could be awarded. According to the NOS, the higher the score, the higher the study quality (Table 1). All study scores were determined by the 2 reviewers, first independently and then by consensus. Studies with scores $\geq$7 were considered to have a low bias risk, scores of 4-6 had a moderate bias risk, and scores <4 had a high bias risk. We determined that 3 months of follow-up were adequate for inclusion in the analyses.

Outcomes and Definitions

Our focal outcome was the presence of a postoperative surgical-site infection at the latest available follow-up time point. Our definition of a surgical-site infection excluded generalized infections, such as UTI, septicemia, pneumonia, phlebitis, and so forth and focused on infections around the surgical site, such as superficial subcutaneous infections or deep prosthetic infections.

Data Synthesis and Analyses

We performed comparisons of the surgical-site infection rate between an allogeneic blood transfusion group (patients who received an allogeneic blood transfusion only or both an allogeneic and autologous blood transfusion) and a nonexposure group (patients who received only an autologous blood transfusion or no transfusion). Second, a subgroup analysis was performed to determine whether the effects differed across subgroups.

We analyzed differences in outcomes using a random effects model to account for between-study heterogeneity. For all comparisons, odds ratios (ORs) and 95% confidence intervals (CIs) were calculated as summary statistics for binary outcomes. Statistical heterogeneity was quantified using I^2 statistics. We tested for publication bias by calculating funnel plot asymmetry and by using Egger's test. All P values were 2 sided, and $P < .05$ was considered statistically significant. Statistical analyses were performed using STATA/SE 12.0 (Stata Corp LP, College Station, TX).

Results

Search Results

We searched 254 citations from online databases. Of these citations, we reviewed the full text of 19 articles, and 6 studies met our inclusion criteria [23,24,27-29] (Fig. 1). These final 6 studies included data from 21,770 patients, including an allogeneic blood transfusion exposure group with 7012 patients (32.2%) and an autologous blood transfusion or a nontransfused group that included 14,758 patients (67.8%). A subgroup analysis, which compared an allogeneic blood transfusion group and a nontransfused group, included 5 studies with data from 9593 patients, made up of 3050 (31.8%) allogeneic blood transfusion patients (31.8%) and 6543 (68.2%) nonexposed patients.

Table 1
Newcastle-Ottawa Scale for Risk of Bias Assessment of Studies Included in the Meta-Analysis.

Study	Selection				Comparability	Outcome			Overall
	Representativeness of Exposed Cohort	Selection of Nonexposed	Ascertainment of Exposure	Outcome Not Present at Start		Assessment of Outcome	Adequate Follow-Up Length	Adequacy of Follow-Up	
Rosencher et al (2003) [23]	★	★	★	★	★★	★	☆	☆	7
Innerhofer et al (2005) [24]	★	★	★	★	★★	★	☆	☆	7
Dowsey et al (2008) [27]	★	★	★	★	★★	★	★	★	9
Basora et al (2010) [25]	★	★	★	★	★★	★	★	★	9
Friedman et al (2014) [28]	★	★	★	★	★★	★	☆	☆	7
Newman et al (2014) [29]	★	★	★	★	★★	★	★	★	9

★, score of 1; ★★, score of 2; ☆, score of 0.