

## QUESTION 13: Is preoperative anemia a risk factor for surgical site infection/periprosthetic joint infection (SSI/PJI)?

**RECOMMENDATION:** Based on available evidence, preoperative anemia, as defined by a hemoglobin of less than 13.0 g/dl in men and 12.0 g/dl in women, is an independent risk factor for postoperative SSI/PJI following total joint arthroplasty (TJA).

**LEVEL OF EVIDENCE:** Moderate

**DELEGATE VOTE:** Agree: 89%, Disagree: 8%, Abstain: 3% (Super Majority, Strong Consensus)

### RATIONALE

Anemia is a common condition that is estimated to manifest in 21 to 35% of patients who present for primary TJA [1,2]. Anemia often presents as part of a spectrum of comorbidities and is difficult to study in isolation. However, recent literature demonstrates a link between postoperative complications and preoperative anemia in several published studies [3–13]. The majority of the orthopaedic literature focuses on TJA with one study investigating preoperative anemia in relation to total ankle arthroplasty (TAA) [14].

One of the most devastating complications following TJA is that of PJI or SSI and as the number of arthroplasties performed annually continues to increase, prevention will be paramount. Although rare, this devastating complication represents an increase in morbidity and mortality as well as an important economic burden [4,13,15]. Several documented patient-related risk factors exist for increased incidence of PJI including rheumatological disease, diabetes and obesity [4,16]. In some instances, preoperative optimization of these chronic diagnoses can lead to favorable risk modification preoperatively [16]. Preoperative anemia, most commonly defined by the World Health Organization (WHO) by a hemoglobin value of less than 13.0 g/dL in men and 12.0 g/dL in women, is one such risk factor that has been evaluated and found to be an independent predictor of postoperative complications including PJI [2,4,5,10,11,17,18].

A compelling study to this end is a retrospectively collected, case-controlled study that demonstrates patients who have preoperative hemoglobin values of less than 13.0 g/dl in men and 12.0 g/dl in women had a higher overall rate of complications (odds ratio (OR): 2.11) than their matched counterparts [11]. The cohort consisted of 2,576 (19%) patients who had anemia matched to 10,987 patients with lab values within normal limits. After controlling for other significant comorbidities, the rate of overall complications for the anemic cohort was 33.2% as compared to 15.4% in the non-anemic cohort. Pertinent to the present discussion, the rate of infection was 4.5% in the anemic patients compared to 1.12% in the non-anemic patients (OR: 2.83, 95% confidence interval (CI) 1.78 to 4.51;  $p < 0.0001$ ) [11].

A pair of level II studies by Bozic et al., based on administrative data within a Medicare population, revealed an Adjusted Hazard Ratio for anemia in TJA to be 1.36 and 1.26 respectively ( $p = 0.0347$  and  $p = 0.0014$ ) [17,18]. In a level III study specifically investigating the relationship between preoperative anemia and PJI, Greenky et al. reported that anemia was independently associated with an adjusted odds ratio of 1.95 (1.38 to 2.56) for the risk of PJI postoperatively [5].

Swenson et al. reviewed an institutional series of patients with confirmed PJI and demonstrated that preoperative anemia in this setting leads to decreased success of open debridement and polyethylene exchange [10]. They demonstrated an odds ratio of 6.7 (CI 2.2 to 22.4,  $p = 0.0013$ ) of failure in patients with preoperative anemia. Failure, they found, was exacerbated by a combination of infection with *Staphylococcus* species and preoperative anemia as patients that underwent irrigation and debridement absent these two factors had a 97.1% success rate as defined by maintenance of a well-fixed implant without the need for additional surgery or lifelong oral antibiotics [10].

The present data suggests with moderate certainty that patients with preoperative anemia are more likely to suffer from a periprosthetic joint infection postoperatively than those who undergo surgery and are not anemic. Although studies that draw this conclusion are few, they independently corroborate this conclusion in both large cohort administrative-based data and institutional registries. Although adjusted odds ratios from these studies vary (1.26 to 2.11), all demonstrate that a hemoglobin value below 13.0 g/dl in men and 12.0 g/dl in women is an independent risk factor for PJI [5,10,11,15,17,18].

It also remains unclear if the presence of preoperative anemia itself, regardless of management, is a risk factor or indeed if it is the treatment for anemia with allogeneic blood transfusion which conveys a risk. Preoperative anemia is also the greatest predictor of the need for blood transfusion even in the setting of routine tranexamic acid use [19–21] and allogeneic blood transfusion has been independently correlated to SSI/PJI [7,22,23]. Further research is needed into this area, preferably with robust, large scale, multi-centered trials.

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