Approach to Decrease Infection Following Total Joint Arthroplasty

Daniel Hatz, MD[a], Afshin A. Anoushiravani, MD[a], Monique C. Chambers, MD, MSL[a], Mouhanad M. El-Othmani, MD[a], Khaled J. Saleh, MD, MSc, FRCS (C), MHCM, CPE[b,*]

KEYWORDS

• Surgical site infection • Prevention • Total joint arthroplasty • Prosthetic joint infection • Total knee infection • Total hip infection

KEY POINTS

- Surgical site infections are a debilitating and costly adverse outcome following total joint replacement that is minimized with proper preoperative, intraoperative, and postoperative screening.
- The most effective means of preventing surgical site infections is through the preoperative optimization of all total joint surgical candidates.
- New pharmacologic and intraoperative technologies are allowing orthopedic surgeons to better prevent and if needed combat surgical site infections.

INTRODUCTION

Degenerative joint osteoarthritis is a debilitating disease, profoundly altering a patient's functional capacity and quality of life. Advancements in total joint arthroplasty (TJA) have allowed for excellent pain relief and restoration of biomechanical function. By the year 2030, demand for TJA in the United States is expected to exceed 4 million TJA procedures a year.[1] One of the most concerning and serious complications of any TJA is deep infection. However, periprosthetic joint infections (PJI) have a reasonably low reported incidence at 0.5% to 3%.[1,2] As such, PJIs remain one of the most challenging orthopedic complications in terms of prevention and treatment. Unsuccessful treatment can result in devastating morbidity including several reoperations; overall loss of function; and significant cost to patient, caregivers, and the health care system. Estimated cost of a single PJI has been reported at approximately $50,000, increasing to greater than $100,000 for resistant organisms.[1] Reported cost of revisions because of infection in 2009 was $566 million and projected to reach up to $4 billion by 2030.[1] A better understanding of successful approaches to prevent periprosthetic infections will allow orthopedic surgeons to better optimize their patients preoperatively, intraoperatively, and postoperatively, improving patient outcomes.

Although eradicating periprosthetic infection may seem daunting, a methodical approach minimizes operative risks while improving outcomes. The development of PJI can result from several perioperative factors. Preoperative patient selection and optimization, intraoperative emphasis on sterility, and postoperative

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[a] Division of Orthopaedics and Rehabilitation, Southern Illinois University School of Medicine, 701 North First Street, Springfield, IL 62781, USA; [b] Department of Orthopaedic and Sports Medicine, Detroit Medical Center, 311 Mack Avenue, 5th Floor, Detroit, MI 48201, USA
* Corresponding author.
E-mail address: kjsaleh@gmail.com

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antibiotics and wound care play a pivotal role in avoiding the dreaded complications of infection. This article discusses current measures and concepts to decrease risks for deep infections in TJA.

PREOPERATIVE MEASURES

Optimizing the Patient

Assessment of the general medical health of each patient with a thorough history and physical examination is an important precursor for infection prevention. Several medical comorbidities have been shown to generate a significant propensity for infection, most notably diabetes, rheumatoid arthritis, obesity, and immunosuppression (including chronic steroid use).[3,4] The combination of these comorbidities is demonstrated to significantly increase the overall risk for infection.[5] Special care should be taken in selecting patients with manageable medical comorbidities and optimizing all current medical issues before proceeding with TJA.

Diabetes

Several studies have reported diabetes as an integral contributor to the development of infections. Diabetes combined with any other comorbidity has been shown to significantly increase infection rates.[2,6] Hemoglobin A_{1C} is a frequently ordered outpatient blood test representative of glucose control over the past 3 months. Marchant and colleagues[7] reported that patients with moderately elevated hemoglobin A_{1C} are two to four times as likely to develop PJI. However, other studies have suggested that the risk for PJI is more closely associated with the patient's current glycemic status rather than the patient's long-term glycemic control.[7] Mraovic and colleagues[8] reported patients with blood glucose levels greater than 200 mg/dL on postoperative Day 1 are twice as likely to have a PJI, compared with patients with well-controlled glucose levels. Surgical procedures, such as TJA, can result in stress-induced hyperglycemia postoperatively.[9] Patients with diabetes have increased variability in perioperative glycemic levels, increasing the propensity for PJI. Thus, orthopedic surgeons must be cognizant of the long-term and perioperative effects of poor glycemic control in all TJA candidates, but particularly those with diabetes mellitus.[2,4]

Obesity

Although an area of controversy, recent literature supports the correlation between obesity and morbid obesity with PJI.[3,10–14] Dowsey and Choong[11] prospectively examined 1214 consecutive primary total knee arthroplasties (TKA) comparing deep infection rates of morbidly obese and obese patients with nonobese control subjects. The results indicated morbidly obese patients (body mass index >40) were nearly at nine times higher risk of developing deep infection.[11] No infections were recorded in nonobese patients. Furthermore, obese patients (body mass index <40) did not demonstrate an increased risk for periprosthetic knee infections when compared with the nonobese control subjects.[3,4,10,15] A similar study in total hip arthroplasty (THA) patients evaluating obese and morbidly obese patients indicated increased risk for PJI in both cohorts.[16] Namba and colleagues[14] evaluated deep infections in obese patients with THA and TKA, concluding that obese patients had a 6.7- and 4.2-fold increased risk of developing deep infection following TKA and THA, respectively. In addition, the combination of obesity with diabetes revealed a nearly seven-fold increase in periprosthetic knee infections when compared with obese patients without diabetes.[3,4,10,15]

Other comorbidities

Comorbidities, such as cardiovascular disease, chronic anemia, rheumatoid arthritis, and chronic immunosuppression, have demonstrated increased rates of PJI.[3,4,10,15] In a study evaluating greater than 56,000 TKAs, patients with an American Society of Anesthesiologists score greater than three demonstrated a statistically significant increased infection rate of 53.3% compared with 38.2%.[17] Males are twice as likely to have PJI, than their female counterparts.[18] Patients with the human immunodeficiency virus, hemophilia, and those with CD4 counts of less than or equal to 200/mm^3 are at increased risk for PJI because of their immunocompromised status.[18,19] Hence, patients with high-risk comorbidities should be counseled extensively and medically optimized before elective surgical intervention.

Nutritional status

Nutritional status is predictive of infection and postoperative wound healing.[4,20–22] Malnutrition is most commonly delineated with a series of serologic tests including serum transferrin less than 200 mg/dL, serum albumin less than 3.5 g/dL, and a total lymphocyte count less than 1500/mm^3.[23] Poor nutritional status is most frequently cited in the elderly, bariatric patients, and the morbidly obese. Jaberi and colleagues[24] prospectively examined 10,325