Prevention of Infection in Orthopedic Prosthetic Surgery

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KEYWORDS

• Orthopedic • Infection • Prosthetic joint • Prophylaxis

KEY POINTS

- Prosthetic joint surgery is the last resort in the treatment of osteoarthritis and other degenerative joint diseases and is sometimes complicated by infection.
- Prevention of infection in total joint arthroplasty is a multidisciplinary approach and involves patient-related and procedure-related factors along with postoperative care.
- Some prevention strategies are still controversial, and more research is needed; research of innovative materials and approaches to prevent infection is underway.

INTRODUCTION

Orthopedic prosthetic surgery has become a fairly frequent and safe orthopedic procedure. Data from the National Center for Health Statistics show only in 2010 more than a million total hip replacements and knee replacements were performed. It is estimated that approximately 4 million patients will benefit from a total joint replacement by 2030.[1] Postoperative prosthetic joint infections (PJI) are a rare (<2%)[2,3] but significant complication, with high functional, psychosocial, financial, and economic impact on the patients and the health care system. In the current environment, it is projected that the cost of caring for the infected orthopedic implants will exceed 1.62 billion dollars by 2020.[4]

Recently, a standardized definition of PJI was established, and several classifications are available, with respect to the timing of the clinical manifestations (early, delayed, late, and silent) and pathogenesis (exogenous or hematogenous).[5,6] The most common causative organisms are *Staphylococcus aureus* (SA), coagulase-negative staphylococci, and streptococci, which constitute skin flora, and underscore the exogenous route as the most frequent mechanism of infection.[7] The hematogenous

Disclosure Statement: The authors have nothing to disclose.
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Infect Dis Clin N Am ■ (2017) ■–■
http://dx.doi.org/10.1016/j.idc.2017.01.011 id.theclinics.com
0891-5520/17/Published by Elsevier Inc.

seeding of prosthesis from distant sites is mostly a late complication and represents a significant risk for organisms such as SA.[8] In addition, the fine balance between the individual patient factors, local prosthetic factors, organism virulence, and inoculum size dictates the development of a PJI. Hence, the prevention of PJI is a matter of perioperative optimization of the patient, careful preoperative, intraoperative, and postoperative measures to prevent infection.

Risk Factors

Several factors are involved in the development of a PJI, and they pertain to individual, patient-related factors as well as procedural and postprocedural factors, some clearly demonstrated in studies, others with a somewhat looser association (**Table 1**). Attempts were made to create composite risk scores to assist in the preoperative evaluation. The National Nosocomial Infections Surveillance score, for example, includes the length of procedure, the American Society of Anesthesiologists (ASA) score, and the surgical wound classification.[9]

PREOPERATIVE FACTORS

The preoperative risk factors mostly pertain to patient optimization and require a multidisciplinary approach, ideally with the involvement of the primary care physician, endocrinologist, and rheumatologist if necessary.

Obesity and Malnutrition

Obesity, malnutrition, and obesity with malnutrition were found to be associated with an increased risk of PJI in multiple studies.[10–13] Malnutrition is associated with impaired wound healing and immunity, hence an increased risk of infection. Although the association of poor nutritional status with increased risk for PJI is well established, there is

Table 1
Risk factors associated with development of prosthetic joint infection

Preoperative (Patient) Factors	Perioperative and Intraoperative Factors	Postoperative Factors
Obesity (body mass index >35)[12,13,22,70]	Prolonged duration of procedure[9,22]	Hematoma[9,22]
Malnutrition[10]	Antimicrobial prophylaxis[42,43]	Superficial surgical site infection[9]
Smoking[20,71]	Revision vs primary arthroplasty[72]	Wound drainage/dehiscence[9,22]
Anemia[23]	Metal-to-metal vs metal-to-plastic prosthesis[72,73]	Allogeneic blood transfusion[22]
DM[12]	Simultaneous bilateral procedure[22]	Acute coronary event or atrial fibrillation[22]
Inflammatory arthropathies[9,24]	Cement without antibiotic[72,74]	Perioperative infections at a distant site[22]
Malignancy[75]	Operating room (OR) traffic[60–62]	Invasive procedures with high bacteremic risk[64–66]
Immunosuppressive medication[25,26]	Laminar airflow in the OR[58,59]	
ASA >2[22]	Equipment contamination[76]	
SA colonization status[33,34,77]	Hypothermia[78,79]	
Antecedent septic arthritis[9]	Hair clipping[80]	
Genetic susceptibility[81]	Skin preparation and draping[82,83]	