Epidemiology of postoperative spinal implant infections

Friederike Schömig[1], Jaspaul Gogia[2], John Caridi[3]

[1]Center for Musculoskeletal Surgery, Charité – University Medicine Berlin, Berlin, Germany; [2]Department of Orthopedics, Kaiser Permanente San Jose Medical Center, San Jose, CA, USA; [3]Departments of Neurosurgery and Orthopedics, Mount Sinai Hospital, New York, NY, USA

Correspondence to: Friederike Schömig. Center for Musculoskeletal Surgery, Charité – University Medicine Berlin, Charitéplatz 1, 10117 Berlin, Germany. Email: friederike.schoemig@charite.de.

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Introduction

Postoperative infections associated with implants are one of the main complications, not only in orthopedic surgery, but in all surgical fields. In orthopedics, the most progress concerning the diagnosis and therapy of postoperative implant-associated infections has been made in the field of arthroplasty, with periprosthetic joint infection (PJI) occurring in 1–2% of primary and 4% of revision arthroplasties (1). Here, a clear diagnostic algorithm to detect PJI has been established and a therapy algorithm exists (1).

In spinal surgery, however, there are no clear criteria to define postoperative infections, even though, over the last several years the number of spine surgeries performed has steadily increased worldwide and instrumentation has become crucial in managing several pathologies in the spine (2,3). Despite improvements in surgical technique and postoperative care, as well as the use of perioperative antibiotics, postoperative spinal implant infections (PSIIs) occur in 0.7–20% of adult instrumented spine surgeries. This high range of infection rate is correlated with different types of procedures, patient populations and preoperative diagnoses (4). Not only does PSII lead to higher patient mortality and morbidity, extended hospitalization and worse long-term outcomes, it also increases health care costs (5). Due to these detrimental effects, prevention of PSII is highly important and identification as well as understanding of its epidemiology and risk factors are necessary in order to optimize factors that determine the risk of infection, and to thereby, improve patient outcomes.

Epidemiology and risk factors for PSII

Multiple studies have identified risk factors associated with the development of infection following instrumented spine surgery. These risk factors can be divided into patient-specific and surgical factors.

Patient-specific factors that have been shown to contribute to the risk of PSII include age, obesity, malnutrition, immune status, smoking, alcohol abuse, malignancies, diabetes, perioperative incontinence, preoperative urinary tract infection, American Society of Anesthesiology (ASA) score, previous spine surgeries, and previous postoperative infection (4,6-12). However, some of these factors, such as smoking or preoperative urinary tract infection, did not reach significance in follow-up studies. In their recent meta-analysis, Meng *et al.* identified significant associations for ASA score, diabetes, obesity, previous spine surgery, smoking, urinary tract infection, hypertension, transfusion, cerebrospinal fluid leak, dural tear, and blood loss but were not able to confirm significance for male gender, age, alcohol or steroid use (11).

Preoperatively, prophylactic antibiotic therapy with a broad-spectrum antibiotic with coverage of *Staphylococcus aureus*, such as a first- or second-generation cephalosporin, should be initiated and its timing is also significantly correlated with an increased risk of postoperative infections. It was shown that preoperative prophylactic antibiotics should be administered within an hour of surgery and should be repeated every 3–4 hours (7,13). Also, preoperative cleaning and disinfection of the patient's skin with iodine and chlorhexidine combined with isopropyl alcohol compounds is essential (7).

In addition to the above-mentioned patient-specific factors, there are several surgical factors that correlate with postoperative infection rates. Surgical approach to the spine has been shown to be a significant risk factor, with a posterior approach having an increased risk of infection compared to an anterior approach (14). The procedure with the highest rate of infection was shown to be the combined lumbar anterior/posterior fusion (6). Concerning instrumentation, there has been differing data, with some studies showing a highly increased risk of surgical site infection after instrumentation due to the development of a biofilm, while others were not able to reproduce this data (10,15-17).

Additionally, the number of spinal surgeries performed in the patient, operation time, the number of operated levels, greater soft tissue dissection, perioperative blood loss and blood transfusions, use of allograft and the contamination of implants due to longer exposition time to air as well as the number of people in the operating theatre have been shown to increase the risk of development of PSII (6,9-20).

Conclusions

Overall, the strength of the evidence concerning risk factors for PSII is moderate. There still is a great need for further research to clearly define risk factors in order to improve prevention of infection. It is important to note that most studies were performed as case-control studies and thus only allow the determination of relative odds rather than showing the absolute risk for a patient.

In many cases, there is still conflicting or no convincing data, which is why only a few measures for prevention of infection can be recommended. Due to the limited spine literature available, combined with its heterogeneity, risk stratification cannot be calculated at this time. Even though some factors show a clear correlation with a higher risk of infection, there is no data available on how these risk factors interact when encountered in combination. Thus, further research is needed in order to provide surgeons with data to preoperatively ascertain a patient's risk of developing postoperative infection and then, accordingly, risk modify pre-operative and intraoperative decisions. Clinical guidelines and diagnostic tools, as well as treatment algorithms for (I) preoperative evaluation of infection risk; (II) rapid diagnosis of infection postoperatively; and (III) specific treatment of infection, similar to those already existing in PJI, are implicitly needed in spine surgery.

Despite this lack of guidelines, it is still important to recognize the data that is available and to be aware of patient-specific and surgical risk factors leading to postoperative implant infection. Some of these factors may be altered before surgery and thus may help in limiting complication rates. As many of these factors are invariable, however, basic principles of sterility and tissue handling continuously need to be practiced. Currently, the only evidence-based practice and thus gold standard for prevention of infection is perioperative antibiotics. For almost every recommendation besides this, convincing data is still needed.

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