Meningitis or epidural abscesses after neuraxial block for removal of infected hip or knee prostheses


Department of Anesthesiology, Hospital for Special Surgery, 535 East 70th Street, New York, NY 10021, USA
Weill Cornell Medical College, 1300 York Avenue, New York, NY 10065, USA

* Corresponding author. E-mail: juleselyseek@hss.edu

Background. Infection, whether localized or systemic, can be a relative contraindication to neuraxial anaesthesia. Data correlating neuraxial anaesthesia and the development of meningitis or epidural abscess in this setting are limited.

Methods. Retrospective chart review was performed on 710 medical records of patients admitted between 1998 and 2009 for removal of potentially infected total hip and total knee prostheses. Ultimately, 474 patients were identified as being infected. Factors that predisposed a patient to an immunocompromised state, and signs and symptoms of infection in the pre-, intra-, and postoperative stages were documented. Bacteraemic patients were reviewed for signs of neuraxial infection. The endpoint of follow-up was development of complications before hospital discharge.

Results. All 474 patients had removal of the infected prosthesis under neuraxial anaesthesia. Mean patient age was 65.5 yr (58% > 65 yr) and mean length of hospital stay was 21 days. Patient characteristics included concurrent disease (65%), steroid use (5.3%), preoperative antibiotic use (50.8%), signs of inflammatory process (84%), bacteraemia (4.2%), and documented positive intraoperative joint cultures (88%). Using clinical standards for diagnosis of central neuraxial infection, patients developed infectious complications (incidence of 0.6% on 95% confidence interval), although three patients had findings attributable to anaesthesia, including epidural haematoma, psoas abscess, and back pain.

Conclusions. Based on clinical criteria, our findings suggest that the incidence of central nervous system infection after neuraxial anaesthesia in patients with infected hip and knee prostheses is low after neuraxial block.

Keywords: epidural abscess; meningitis bacterial; neuraxial anaesthesia complications; postoperative complications; prosthesis-related infections

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A feared complication of joint arthroplasty is prosthesis infection with a yearly incidence of 0.5–1% for hip, 0.5–2% for knee, and <1% for shoulder arthroplasty. Removal of an infected prosthesis is often required, followed by a course of i.v. antibiotics. Anaesthesia for prosthesis removal can be performed using either general or regional technique. The presence of a joint infection (which might be systemic at the time of presentation for removal) is a relative contraindication to neuraxial anaesthesia based on the concern that subarachnoid or dural puncture could cause spread of the infection to the intrathecal or epidural space, leading to meningitis or epidural abscess formation.

A review of the literature on the incidence of meningitis or epidural abscess in patients with potentially localized or systemic infections concluded that serious central neuraxial infections such as arachnoiditis, meningitis, or abscess after spinal or epidural anaesthesia are rare. This conclusion was based on a number of large-scale studies evaluating the incidence of these complications in uninfected patients. The authors concluded that central neuraxial blocks should not be performed in patients with untreated systemic infections, and that patients with systemic infection can safely undergo spinal anaesthesia provided that prior antibiotic therapy is initiated. Only two studies, however, were included that assessed this population, but since their review, one other relevant study has been published. In all three reports, there were no cases of epidural abscess or meningitis, but the sample sizes in these studies were 319, 531, and 46 patients, respectively.

Moen and colleagues reported on neurological complications occurring after neuraxial block in a very large group of patients with spinal or epidural infections.
of patients from Sweden (1,260,000 spinals and 450,000 epidurals) and found 29 cases of meningitis and 13 cases of epidural abscess. None of these patients had documented infections before undergoing neuraxial block.

It is common practice at our institution to perform epidural or spinal anaesthesia for infected lower extremity prosthesis removal. We designed a retrospective study to test the hypothesis that the incidence of clinically evident neuraxial infection in this setting is increased. The primary outcome was occurrence of an epidural abscess or meningitis. Secondary outcomes included patient and clinical factors (i.e. co-morbidities, clinical signs and symptoms, antibiotic use) associated with these cases.

**Methods**

After IRB approval, medical records spanning a 12 yr period (1998–2009) were retrospectively reviewed for all patients admitted to the hospital for the removal of a unilateral hip and knee infected joint prosthesis. Patients were identified utilizing ICD-9 code for prosthesis infection. Final inclusion criteria identified patients who underwent removal of an infected total hip or knee prosthesis because of confirmed infection after receiving neuraxial anaesthesia. Infections were confirmed with positive intraoperative cultures. If patients presented with infectious symptoms (i.e. swollen joint, fever, erythema) had negative intraoperative cultures and documented recent antibiotic use, they were also counted as confirmed infectious cases.

Patients who did not undergo prosthesis removal or were considered aseptic were excluded. Aseptic patients were defined as patients with no recent antibiotic use before admission and negative postoperative wound cultures. Additionally, patients who were transferred to another institution shortly after their surgery (at most, a day after surgery) were excluded because follow-up information regarding potential infectious complications was unavailable. Finally, patients were excluded if they did not receive neuraxial anaesthesia. If general anaesthesia was performed, the rationale for this anaesthetic decision was recorded when available.

Significant co-morbidities (diabetes mellitus, prior myocardial infarction, chronic renal insufficiency, rheumatoid arthritis, hypertension) were documented. In addition, infectious indicators including signs and symptoms of systemic infection such as fever (institutionally defined as a temperature >37.5°C), chills, hypotension (defined as a systolic arterial pressure <100 mm Hg), and an elevated leucocyte count...
(defined as >10.7 cells nl⁻¹) and also results of intraoperative and postoperative cultures were documented. The perioperative use of antibiotics up to 6 months before admission and characteristics of intraoperative infectious organisms were also documented. The primary outcome of a neuraxial infectious complication was defined as a clinical diagnosis of meningitis or epidural abscess in the inpatient postoperative period before discharge. Upon completion of chart review, descriptive analysis was conducted with Microsoft Excel and SPSS 14.0. All chart review and analysis was performed at the Hospital for Special Surgery in New York, NY, United States.

Results

Seven hundred and ten patients admitted to the hospital between 1998 and 2009 were identified for the removal of a unilaterally infected hip or knee joint prosthesis. Exclusion criteria are described in Figure 1. The reasons for the use of general anaesthesia included patient preference (3/80), coagulopathy (20/80), and anatomic contraindications such as prior posterior spinal fusions or severe spinal stenosis (9/80). In 48 cases, no clear reasons were provided by the anaesthesiologists as to why general anaesthesia was selected. Upon further review, these charts revealed that no patients developed neuraxial infectious complications. Comparison of these 80 patients with those who underwent neuraxial block showed no major differences in terms of perioperative and postoperative infectious indicators except for a higher incidence of fever in patient profiles, and preoperative and postoperative infection.

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Table 1 Patient profile upon admission

<table>
<thead>
<tr>
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<th>Neuraxial anaesthesia (n=474) (%)</th>
<th>General anaesthesia (n=80) (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASA class: I/II/III/IV</td>
<td>2/215/236/14</td>
<td>0/19/57/4</td>
</tr>
<tr>
<td>Average age (yr)</td>
<td>65.5 (range: 12-95)</td>
<td>65.2 (range: 32-88)</td>
</tr>
<tr>
<td>Number of patients over 65 yr old</td>
<td>273 (57.6)</td>
<td>42.0 (52.5)</td>
</tr>
<tr>
<td>Length of stay (days)</td>
<td>21 (range: 3-151)</td>
<td>22.6</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>74 (15.6)</td>
<td>18.0 (22.5)</td>
</tr>
<tr>
<td>Rheumatoid arthritis</td>
<td>49 (10.3)</td>
<td>10.0 (12.5)</td>
</tr>
<tr>
<td>Steroid use</td>
<td>25 (5.3)</td>
<td>5.0 (6.3)</td>
</tr>
<tr>
<td>Hypertension</td>
<td>253 (53.4)</td>
<td>36.0 (45)</td>
</tr>
<tr>
<td>Chronic renal insufficiency</td>
<td>10 (2.1)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Myocardial infarction</td>
<td>29 (6.1)</td>
<td>9 (11.3)</td>
</tr>
<tr>
<td>Average BMI</td>
<td>29.6</td>
<td>28.9</td>
</tr>
<tr>
<td>Obese (defined as BMI &gt;35)</td>
<td>91 (19.2)</td>
<td>13.0 (16.3)</td>
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Localized infection was confirmed in all 474 patients by one of the following determinants: positive intraoperative joint culture (87%, 414/474), positive Gram stain (56%, 264/474), and joint pus expressed within the surgical site (50%, 236/474). Patients with negative cultures were included if there was recent antibiotic use that could explain the negative joint culture results (9.3%, 44/474; 19/44 had positive Gram stains, 11 of whom had joints that expressed pus; in 8/44 cases, joint pus was the only additional confirmation of infection). In addition, 17% of the confirmed infected patients were infected with two or more organisms. The most common organisms that grew out of intraoperative joint cultures are listed in Table 2. The pre- and postoperative infectious indicators are presented in Tables 3 and 4. Pre-admission antibiotics were started in 241 (51%) of patients. Bacteraemia was noted in 4.2% (20/474) of patients. Eighteen of these patients received antibiotics in the operating theatre and one patient who did not receive an intraoperative antibiotic had taken antibiotics before operation. Patients received spinal, epidural, combined spinal/epidural, or general anaesthesia with neuraxial anaesthesia (Table 5). Of note, two patients were converted to general anaesthesia after unsuccessful attempts to insert a spinal catheter.

Of 474 patients evaluated, none had a clinically evident epidural abscess or meningitis (incidence of 0.6% on 95% confidence interval). Documented postoperative infectious complications included one patient each with epidural haematoma, psoas abscess, and back pain. The epidural haematoma occurred in a 43-yr-old woman with no significant medical history or pre-admission antibiotic and steroid use. Upon admission, she was afebrile and had a normal leucocyte count and normal coagulation. After receiving a combined spinal/
epidural anaesthesia, the patient underwent removal of an infected total hip. Her joint did not express pus and no antibiotics were used intraoperatively. Operative wound cultures grew Clostridium septicum. Several days later, after complaining of severe back pain, postoperative MRI revealed an epidural collection, with compression of the thecal sac. The INR at the time of diagnosis was 1.8 (secondary to warfarin therapy). The patient was taken to the operating theatre for neurosurgical decompression of the lumbar spine and the haematoma was evacuated; intraoperative cultures were negative. Five days after the procedure, repeat MRI showed no significant reaccumulation of the haematoma.

The patient who experienced a psoas abscess was an 84-yr-old female with a history of rheumatoid arthritis and myocardial infarction. She was transferred from another hospital with fever and an elevated leucocyte count (12.1 cells nl\(^{-1}\)). Five days before transfer to our institution, she had developed a retroperitoneal bleed while on warfarin therapy (INR 2.0). She did not report chills or joint swelling, and had not used steroids or antibiotics. She underwent spinal anaesthesia for removal of her total knee replacement, as her INR had normalized by the day of surgery. Intraoperative cultures, including blood, were positive for methicillin-sensitive Staphylococcus aureus. Concern for a potential abscess precipitated by back pain initiated a work up, including brain and spinal CT and MRI. These tests revealed only a psoas abscess, which was surgically drained and resolved.

The patient who reported back pain was a 48-yr-old female with hypertension and a long history of chronic lower back pain secondary to lumbar spinal stenosis. Upon hip prosthesis removal using combined spinal/epidural anaesthesia, pus was noted and joint cultures grew methicillin-resistant S. aureus. Evaluation of her spine with MRI was negative.

**Discussion**

The findings suggested by this retrospective analysis cautiously indicate that the incidence of in-hospital central nervous system infection after administration of neuraxial anaesthesia in patients with an infected hip or knee prosthesis is exceedingly low. This finding is consistent with the few series published in patients with distant systemic infections undergoing neuraxial blockade. Bader and colleagues\(^9\) evaluated 319 parturients with chorioamnionitis, eight of whom had documented bacteraemia, and none developed a spinal infection. Goodman and colleagues\(^10\) looked at 517 patients with the same pathology (13 of whom had bacteraemia), and again, none of the patients developed a spinal or epidural abscess. More recently, Kotzé and colleagues\(^11\) studied the incidence of infectious complications after thoracic epidural anaesthesia in 50 paediatric patients with empyema, and none developed a central nervous system infection. The number of patients enrolled in our study is relatively small, but similar to these prior reports. It was important to study this patient population since they are generally older, sicker, and represent a group of patients which may become more prevalent in the future.
future as the incidence of joint replacement surgery is significantly increasing.

We had two major complications: a psoas abscess and epidural haematoma. There was one infectious complication in the setting of retroperitoneal haematoma and bacteremia, leading to psoas abscess. This occurred after the patient had a spinal anaesthetic placed via the midline approach. Psoas abscess has been described after epidural anaesthesia. Lee and colleagues\(^1\) reported a case occurring 6–7 months after epidural anaesthesia, accompanied by vertebral osteomyelitis and discitis. In the light of the time lag between the procedure and the event and the fact that cultures grew *Tuberculosis mycobacterium*, they were thought to be unrelated. There was also a case report of iliopsoas abscess after removal of an indwelling epidural catheter that had been implanted for 13 days.\(^1\) Alpantaki and colleagues\(^5\) also reported a case of an epidural and psoas abscess occurring 1 month after epidural anaesthesia. Vertebral osteomyelitis and epidural and psoas haematomas were diagnosed simultaneously, which might have been a continuation of the same process.\(^6\)

As demonstrated by these case reports, psoas abscess can occur in the setting of neuraxial anaesthesia. Given that our patient had a retroperitoneal haematoma with concomitant bacteremia, this is the most likely cause. A spinal source, however, cannot be ruled out. Psoas abscess has also been reported to occur from a local or contiguous source or from haematogenous dissemination.\(^6\) The epidural haematoma occurred 5 days after epidural anaesthesia with normal coagulation parameters. When the haematoma was diagnosed, INR was elevated due to warfarin treatment. Moen and colleagues\(^6\) found a higher incidence of spinal haematoma in elderly patients compared with younger obstetric patients. Of note, 11 of the 33 patients with haematoma had a coagulopathy and documented thrombophrophylaxis therapy.

Preoperative inclusion criteria were based on identification of patients with documented active infection requiring prosthetic joint removal. Criteria associated with bacterial seeding and spread of infection include comorbid diseases, immunocompromised states related to steroid use, HIV, age >65, concurrent infection, and markers of acute inflammation based on perioperative localized signs and symptoms, physical exam, and cultures.\(^6\) Approximately 50% of patients in this study had pus on removal of the joint, and 88% had positive intraoperative Gram stains that provided evidence of potential bacterial seeding; several patients also had microbiological evidence of infection based on preadmission joint aspirations. Subsets of patients had documented bacteremia (4.2%) or steroid use (5.3%). Given no documented neuraxial complications, no specific conclusion can be drawn regarding association between comorbidities or immunocompromised states and the incidence of infectious complications.

Antibiotic use was analysed in the pre-, intra-, and postoperative periods. Approximately 50% of patients had antibiotic use before admission. Interestingly, patients who received antibiotics before operation still grew organisms in their intraoperative cultures (29%) and/or had positive Gram stain results (27%), which could indicate improper antibiotic coverage, insufficient length of treatment, resistant species, non-compliance, or multiple infectious entities. Thus, the potential for infectious spread, and thus infectious complications, potentially grew more likely. This raises the question whether pre-, intra-, or postoperative antibiotic use might be a factor in preventing infection or specifically, to prevent meningitis or epidural abscess formation. The American Society of Regional Anesthesia recommendations are that patients with evidence of systemic infection can safely undergo spinal anaesthesia, provided antibiotic therapy has been initiated with a positive response to therapy. Approximately 16% (75/474) of our patients presented with fever, and 63% (47/75) of these patients used antibiotics preadmission, potentially indicating inadequate response to therapy. These data, although limited, add to the literature of this controversial issue.

The development of meningitis or an epidural abscess can take from several hours to several days, respectively.\(^1\) In this study, the average length of hospital stay was 21 days, with a range of 3–151 days. Although the observation period was likely adequate to capture all relevant endpoints, it remains a limitation that some patients could have developed a central neuraxial infection after discharge.

At our institution, patients undergoing removal of infected joints usually undergo spinal (short procedure) or combined spinal/epidural anaesthesia (anticipated long surgery), unless the INR is above 1.2. A total of 80 patients from the study underwent general anaesthesia. In approximately 50% of these cases, the exact reason for choosing general anaesthesia could not be determined from the chart. Hence, the unavailability of the decision process by which the anaesthesiologist chose general over regional anaesthesia could represent a possible selection bias. This subgroup of patients arguably could represent more severe cases of systemic infection. However, these patients were similar to those who underwent neuraxial anaesthesia in terms of patient profile, pre- and postoperative infectious indicators, except for a higher incidence of fever in the neuraxial anaesthesia group.

A final limitation is that the primary endpoint (epidural abscess or meningitis) was not formally evaluated in all patients. Specifically, radiographic studies and cerebrospinal fluid samples were not obtained for all subjects. Therefore, it is possible that a subclinical abscess or meningitis might have been present but not detected. Given the pathophysiology of these morbidities, subclinical presentation is possible, but unlikely.

In conclusion, the results of this limited case series lend support to the use of neuraxial anaesthesia in patients presenting for removal of infected hip or knee prosthesis. Based on a sample of only 474 patients, issues of safety cannot be assured. However, as the number of joint replacement procedures are increasing, these data should be useful in assisting with the anaesthetic management of this population.
Declaration of interest
None declared.

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References