

## 1.10. PREVENTION: OPERATING ROOM, ANESTHESIA

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**QUESTION 1: Does the type of anesthesia (general (GA) vs. neuraxial (NA)) influence the risk of subsequent surgical site infections/periprosthetic joint infections (SSIs/PJIs)?**

**RECOMMENDATION:** Compared to GA, NA appears to be associated with reduced risks of SSIs/PJIs after total hip arthroplasties (THAs) and total knee arthroplasties (TKAs).

**LEVEL OF EVIDENCE:** Limited

**DELEGATE VOTE:** Agree: 76%, Disagree: 12%, Abstain: 12% (Super Majority, Strong Consensus)

### RATIONALE

Anesthetic technique may be a modifiable risk factor for the development of infectious complications after THA or TKA [1]. There are 16 observational studies [1–16] and 2 systematic reviews [17–18] comparing anesthetic type with risks of SSIs after joint arthroplasty.

Nine studies associated NA with reduced risks of SSIs after THA [2–3], TKA [4–6] or combined THA/TKA cohorts [1,7–9]. The earliest retrospective study of 3,081 patients from a national database in Taiwan described a protective benefit of NA [1]. Three large-scale reviews of The American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) concluded that GA was associated with more wound infections and more overall complications than NA [3–5]. Four additional large-scale studies sampled institutional [6], health system [7–8] or surveillance [9] databases and associated NA with lower incidences of post-arthroplasty SSIs. A large 30-year prospective study of SSIs after THA by a single surgeon found no overall influences of primary anesthetic choices on SSIs [10]. However, NA was associated with reduced risks of blood transfusions and avoiding transfusion reduced the incidence of SSIs.

Seven observational studies concluded that there is no influence of anesthetic type on the risks of SSIs after THAs [10–11], bilateral TKAs [12] or in combined THA/TKA cohorts [13–16]. However, two studies did find that NA was associated with decreased incidences of overall systemic infections compared to GA (including SSIs, sepsis, urinary tract infections and pneumonia) [11–12]. One case-control study of primary and revision THAs/TKAs found no effects of anesthetic type on the development of SSI [14]. The remaining six population-based studies derived data from ACS-NSQIP [11], administrative [12,16], joint registries [15] or institutional databases [10,13] and found no associations between anesthesia type and SSIs.

There are two systematic reviews [17–18] (with one meta-analysis) [18] addressing this topic. Results were conflicting, with one systematic review/meta-analysis concluding that NA lowers the risk of post-arthroplasty SSIs [18] and the other failing to find any influences of anesthetic types on SSIs after total joint arthroplasties [17]. Notably, the latter systematic review included fewer than half the number of studies analyzed.

In summary, most of the available evidence investigating SSIs after joint arthroplasty is retrospective in nature or comprises prospectively collected data derived from large databases. Nevertheless, the overall study quality was moderate to high based on the individual study quality assessment. The evidence either (1) favors the use of NA, compared to GA or (2) shows no effect of anesthetic choice for reducing SSI risks after THAs/TKAs. Given that there is no evidence to support the use of GA to mitigate the risks of SSIs after joint arthroplasty and the preponderance of available data supports NA, we strongly recommend NA, when feasible, as the preferred anesthetic for THAs/TKAs.

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## QUESTION 2: Can regional anesthesia be administered to patients with orthopaedic infections?

**RECOMMENDATION:** Yes. Central nervous system (CNS) infectious complications, such as meningitis, epidural abscesses or vertebral osteomyelitis are exceedingly rare when regional anesthesia is administered to patients with infections after an orthopaedic procedure. However, the potential benefits of neuraxial anesthesia likely outweigh any possible risks.

**LEVEL OF EVIDENCE:** Moderate

**DELEGATE VOTE:** Agree: 91%, Disagree: 3%, Abstain: 6% (Super Majority, Strong Consensus)

### RATIONALE

There are several proposed benefits of neuraxial anesthesia compared to general anesthesia for joint surgery, including fewer pulmonary and cardiac complications, surgical site infections and venous thromboembolic events as well as a reduction in mortality [1]. However, some surgeons and anesthesiologists alike consider the presence of an active infection to be a contraindication to administering neuraxial anesthesia due to the risks of seeding the spinal canal. This fear stems from case reports of patients developing devastating bacterial meningitis, epidural abscesses or vertebral osteomyelitis following spinal or epidural anesthesia [2,3]. In one historic study on military personnel from 1919, five out of six patients with bacteremia during a routine lumbar puncture subsequently developed meningitis [4]. Of 1,089 bacteremic patients, 2.1% of patients who received lumbar puncture and 0.8% of patients who did not receive lumbar puncture developed meningitis [5]. In a third study, 27% of children with pneumococcal sepsis who underwent lumbar puncture developed meningitis compared to 22% of children with pneumococcal sepsis who did not undergo lumbar puncture [6]. However, bacterial septicemia, in itself, is a risk factor for meningitis and it is likely that patients indicated for a lumbar puncture were those already at the greatest risk for developing meningitis. In patients without an active infectious source, the incidence of CNS infection has been reported to be as low as 0.04% [7–9].

Large studies on patients undergoing orthopaedic procedures for infections, who received spinal anesthesia, provide moderate to strong evidence of its safety. Of 474 patients undergoing removal of an infected prosthesis with neuraxial anesthesia, no patients developed epidural abscess or meningitis [10]. There was a single case of an epidural abscess and no cases of meningitis out of 764 operations performed for perioperative joint infections (PJIs) with neuraxial anesthesia [11].

There is additional evidence to consider outside of orthopaedics. In two retrospective reviews of 531 and 319 women with chorioamnionitis who received epidural or spinal anesthesia, there were no reports of epidural abscesses or meningitis [12,13]. Similarly, there were no infectious CNS complications in 46 children receiving epidurals for postoperative analgesia after thoracotomy for empyema [14].

While there are no randomized trials comparing the safety of neuraxial and general anesthesia for patients with joint infections, the preponderance of evidence suggests that infections related to orthopaedic procedures should not serve as a contraindication to the use of neuraxial anesthesia.

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### QUESTION 3: Is it safe to use a neuraxial anesthesia (NA) in patients with active musculoskeletal infection?

RECOMMENDATION: Yes. The use of NA is safe in patients with periprosthetic joint infections (PJIs) without septicemia. There is limited evidence regarding the use of NA in patients with septicemia or other active musculoskeletal infections.

LEVEL OF EVIDENCE: Moderate

DELEGATE VOTE: Agree: 93%, Disagree: 3%, Abstain: 4% (Super Majority, Strong Consensus)

#### RATIONALE

Orthopaedic surgery can be performed under general or neuraxial anesthesia (GA/NA). Besides the reduced requirements for sedatives and opioid analgesics, NA is associated with lower postoperative complication rates and shorter lengths-of-stay compared to GA after major lower limb surgery [1–4]. NA also decreases the incidences of postoperative surgical site infections (SSIs) following total joint arthroplasty (TJA), by decreasing operative time, improving tissue oxygenation and offering a better ability to maintain normothermia [5].

In spite of its numerous benefits, NA can have severe infectious, vascular and neurological complications, though the rates of such complications are extremely low. Infectious complications may result in devastating morbidity and mortality, such as abscess, meningitis, paralysis or death [6]. Incidences of infectious complications after NA have been reported to be between 0.05 and 0.001% [6]. Pumberger et al. analyzed more than 100,000 consecutive TJA cases utilizing NA and found epidural hematoma in only eight patients, reflecting an incidence of 0.007 % [7].

One of the risk factors for meningitis and epidural abscess, following epidural or spinal block, could be pre-existing sepsis or bacteremia [8–10]. In a recent retrospective study of 101 spinal epidural abscesses, bacteremia was the most commonly identified cause (26%) [11]. A 2017 Practice Advisory by the American Society of Anesthesiologists Task Force reported that NA is only relatively contraindicated in the presence of bacteremia and that the evolving medical status of the patient should also be taken into account. The decision to perform a neuraxial technique should be determined individually and prophylactic antibiotic therapies should be considered prior to the procedure [8].

The safety of spinal and epidural anesthesia in patients presenting with localized infections has been demonstrated in the literature [12–16]. Goodman et al. studied the safety of NA in 531 patients with chorioamnionitis. None of the patients developed an infectious complication [12]. Regarding spinal infections and NA, patient-controlled epidural analgesia may be administered in patients with surgically treated spondylodiscitis as evidenced by the study performed by Gessler et al. [16].

To our knowledge, there are only two original papers directly related to the question of whether NA is safe in patients with active musculoskeletal infections [13,15]. Gritsenko et al. retrospectively evaluated 474 patients who underwent removal of an infected TJA after receiving NA [13]. In this cohort, 4.2 % had bacteremia and 88% had positive intraoperative joint cultures. None of the patients developed meningitis or epidural abscesses but one patient developed a psoas abscess. The authors recommended that no epidural catheters remain in place after the surgical procedure. Rasouli et al. studied 539 patients who underwent revision TJA due to PJIs [15]. A total of 134 patients received NA, 143 received GA and 260 received combined GA and NA. There were no cases of meningitis but one patient developed an epidural abscess after NA. It is important to note that this patient had 6 revision surgeries during a 42-day period, 2 under NA and 4 under GA. Additionally, the diagnosis of an epidural abscess was made 36 days after the last procedure. The abscess was drained and the patient was discharged in good condition. The authors concluded that the incidence of central nervous system infection after NA for PJIs is extremely rare and NA can be considered safe during surgery for PJIs [15].

According to the studies by Gritsenko et al. and Rasouli et al., NA can be considered a safe option during PJI revision surgeries [13,15]. Extrapolating the results from PJI [13,15], spine [16] and obstetric [12] literature, NA may be safe in other cases of active musculoskeletal infection, but there is insufficient evidence for this particular question. The decision of which anesthetic technique to use with active musculoskeletal infections should be determined individually given the current status and co-morbidities of the patient. Additionally, caution should be utilized particularly in patients with septicemia. The numerous benefits of NA must also be considered in this decision-making process.

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