

## QUESTION 5: Is postoperative hyperglycemia a risk factor for the development of infection following spinal surgery?

**RECOMMENDATION:** From the limited evidence, the association between postoperative hyperglycemia and surgical site infection (SSI) remains unclear and further study is needed.

**LEVEL OF EVIDENCE:** Limited

**DELEGATE VOTE:** Agree: 93%, Disagree: 7%, Abstain: 0% (Super Majority, Strong Consensus)

### RATIONALE

Postoperative hyperglycemia does not only occur in patients diagnosed with diabetes mellitus (DM). Only 41% of patients with serum glucose levels greater than 200 mg/dL were identified in the medical records with the diagnosis of diabetes [1]. Langlois et al. suggested that non-diabetic patients experienced a statistical increase in blood glucose levels in the first three days following spine surgery [2]. They also pointed out the possibility of blood glucose elevation in non-diabetic patients associated with postsurgical complications. After major surgery, perioperative blood glucose elevations may be associated with previously undiagnosed DM, or occur because of the activation of the hypothalamic-pituitary axis, a physical response to severe stress in individuals at risk [3].

DM is a disease of uncontrolled hyperglycemia, which impairs the immune system. The wound healing in patients with diabetes is impaired as a result of microangiopathic changes and ischemia, impaired granulocyte function and a lack of platelet-derived growth factor function in the wound [4]. Despite the lack of multiple randomized clinical trials, various retrospective studies have found that DM is strongly associated with SSI after spinal surgery [5–16]. Moreover, DM increases the risk of not only SSI but other postoperative complications such as urinary tract infection, unplanned readmission and prolonged length of stay [17–19].

From a retrospective case-control study of patients who underwent an orthopaedic spinal operation performed at a university-affiliated tertiary care hospital, the risk of SSI, the odds ratio for postoperative hyperglycemia (> 200 mg/dL), was 2.9 (95% confidence interval (CI): 1.2, 6.5) after univariate analyses. But, the risk did not remain significant after multivariate logistic regression analysis [11]. A retrospective case-control study evaluating 104 patients with SSI after spinal surgery matched with 104 randomly-selected control patients without SSI after spinal surgery, revealed that patients with postoperative glucose measurements greater than 126 mg/dL within 48 hours after surgery were significantly more likely to develop an SSI than patients without an elevated glucose measurement on univariate analysis (crude odds ratio: 3.2, 95% CI: 1.6, 6.3). But, it was not significant after adjusting for other variables [20]. A retrospective case-control study evaluating specific independent risk factors for SSI after laminectomy or spinal fusion at a tertiary care hospital affiliated with a university hospital, identified that high serum glucose (> 200 mg/dL) at any time during hospitalization was significantly associated with SSI in the univariate analysis (odds ratio: 3.0, 95% CI: 1.4, 6.3) [1].

On the other hand, a retrospective study evaluating perioperative variables to determine the risk factors for SSI in a total of 2,715 patients undergoing posterior lumbar spinal surgery revealed that high preoperative serum glucose (odds ratio: 1.169, 95% CI: 1.016, 1.345) and a history of DM (odds ratio: 2.227, 95% CI: 1.100, 4.506) were associated with SSI in multivariate logistic regression analysis, although postoperative serum glucose level showed no association [21]. In

another retrospective study using the Nationwide Inpatient Sample (NIS) database, uncontrolled DM revealed a higher risk of postoperative infection (odds ratio: 4.90, 95% CI = 2.84, 8.46) than controlled DM (odds ratio: 1.91, 95% CI: 1.54, 2.37) [7]. But, there was no ICD-9-CM coding standard or parameter in the clinical setting that provides standardization of “uncontrolled” or “controlled” diabetic patients. Furthermore, the NIS does not provide quantitative data on blood glucose levels or hemoglobin A1c (HbA1c) percentage, making it impossible to further stratify cohorts based on overall control of a patient’s diabetic condition.

Limited evidence supports the association between perioperative HbA1c and SSI [22,23]. The cut-off values for HbA1c differ among studies and the results were originated from small retrospective studies without multivariate analyses. Larger prospective studies are needed to confirm the association.

Though DM is strongly related to SSI in spinal surgery, no observational studies were able to reveal a significant association between postoperative hyperglycemia and SSI in multivariate analyses. From the limited evidence, the association between postoperative hyperglycemia and SSI remains unclear, and further study is needed on this issue.

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## QUESTION 6: Is there an association between urinary tract infection (UTI) and surgical site infection (SSI) following spinal surgery?

**RECOMMENDATION:** Evidence regarding an association between UTI and SSI following spine surgery is conflicting and no convincing relationship has been proven. In a like fashion, no convincing relationship has been established between asymptomatic bacteriuria and SSI following spine surgery.

**LEVEL OF EVIDENCE:** Limited

**DELEGATE VOTE:** Agree: 71%, Disagree: 21%, Abstain: 8% (Super Majority, Strong Consensus)

### RATIONALE

The treatment of organisms isolated from urine culture in the setting of orthopaedic surgery with hardware implantation is controversial and has been often driven by anecdote. The risk of seeding of hip and knee arthroplasties from asymptomatic bacteriuria has been studied and found to be small, with no cases in two studies [1,2]. A systematic review of the topic concluded that there was no evidence to support a direct causal relationship between perioperative asymptomatic bacteriuria and arthroplasty infection [3].

Data from the American College of Surgeons National Surgical Quality Improvement Program suggests that UTIs occur in nearly 1 of 50 patients undergoing posterior lumbar fusion procedures [4]. However, there are few studies that directly address a relationship between UTI and SSI in instrumented spine surgery. Nunez-Pereira et al. studied 466 patients, of whom 89 had UTIs and 54 had SSIs, with 22 patients having both [5]. Of these 22, the same organism was isolated from the surgical site and urine in nine patients. UTI conferred an odds ratio (OR) of 3.1 for SSI, though the statistical analysis recognized all UTIs and not just infections with the same organism. Tominaga et al. studied a cohort of 825 patients with 14 patients who developed SSIs and 20 patients who developed UTIs, and found no association between SSI and UTI [6].

It seems germane as well to address the relationship of asymptomatic bacteriuria and postoperative spine infection. Lee et al. studied 355 women > 65 years of age undergoing spine surgery [7]. Of these, 42 developed asymptomatic bacteriuria, with no association with SSI. A statistically significant association was found between asymptomatic bacteriuria with a Foley catheter in place and infec-

tion in patients who had undergone instrumentation of multiple levels. However, of 15 patients with postoperative infections, only 2 had the same organism (*Staphylococcus epidermidis* in both cases) isolated from cultures of surgical site and urine.

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