
Opioid-Free Anesthesia in Spine Surgery: A Case Report Utilizing Thoracolumbar Interfascial Plane (TLIP) Block and Dexmedetomidine

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ABSTRACT

Opioid-free anesthesia (OFA) is gaining traction as a promising approach to minimize opioid-related complications such as respiratory depression, postoperative nausea and vomiting (PONV), and delayed recovery, especially in high-risk surgical cases. This study aims to report the successful implementation of OFA in a 47-year-old male patient with a complete spinal cord injury at the Th12 level (Frankel A) and thoracolumbar fracture-dislocation undergoing spinal stabilization surgery. The OFA protocol utilized preoperative gabapentinoids and NSAIDs, an ultrasound-guided bilateral TLIP (*Thoracolumbar Interfascial Plane*) block, and a continuous dexmedetomidine infusion for intraoperative management, without administering any opioids throughout the perioperative period. Postoperative analgesia was maintained with dexmedetomidine, ketorolac, and acetaminophen. The patient remained hemodynamically stable, experienced no PONV, and required no rescue opioids. These findings suggest that OFA can be a feasible and effective alternative in major spine surgeries, providing adequate pain control while avoiding the side effects associated with opioids. The implication of this case highlights the potential for wider application of OFA protocols to improve postoperative outcomes and support enhanced recovery in complex surgical settings.

Keywords: *Opioid-free anesthesia, TLIP block, dexmedetomidine, spinal cord injury, spine surgery.*

INTRODUCTION

Opioid-free anesthesia (OFA) seeks to mitigate opioid-related side effects, including respiratory depression, ileus, and chronic reliance, while ensuring sufficient perioperative analgesia (Bohringer et al., 2020a). Its utilization in spinal surgery is especially beneficial for individuals with spinal cord injuries (SCI), where autonomic dysregulation and respiratory impairment present considerable hazards. (BARAKAT et al., 2024) Regional anesthesia methods, such as the thoracolumbar interfascial plane (TLIP) block, deliver focused analgesia for posterior spinal surgeries. (Yeole et al., 2022). Dexmedetomidine, an α_2 -adrenergic agonist, enhances OFA by providing drowsiness, analgesia, and hemodynamic stability while avoiding respiratory depression. (Olata et al., 2024)

The use of opioids as part of perioperative anesthesia management has long been a standard practice in modern medicine. However, the side effects associated with opioids—such as respiratory depression, postoperative nausea and vomiting (PONV), ileus, and the risk of chronic dependence—present serious concerns, particularly in patients with complex conditions such as spinal cord injuries (SCI). Individuals with complete SCI often suffer from autonomic dysregulation, hypotension, and impaired respiratory control, making them particularly vulnerable to the adverse effects of opioids during and after surgery.

In response to these challenges, *Opioid-Free Anesthesia* (OFA) has emerged as a promising strategy to provide adequate perioperative analgesia while avoiding opioid-related complications. One of the techniques increasingly used in OFA protocols is the *Thoracolumbar Interfascial Plane* (TLIP) block, which targets the dorsal rami of spinal nerves and is

particularly suitable for posterior spinal surgeries. When combined with non-opioid adjuvants such as dexmedetomidine—an $\alpha 2$ -adrenergic agonist that offers sedation, analgesia, and hemodynamic stability without respiratory depression—this regional anesthesia approach supports the goals of multimodal pain management and enhanced recovery.

Previous studies have explored the utility of opioid-free anesthesia (OFA) in enhancing postoperative recovery while minimizing the adverse effects of opioid use. Choudhary et al. (2021) demonstrated that OFA incorporating dexmedetomidine significantly reduced postoperative nausea and vomiting, opioid requirements, and hospital stay in patients undergoing major abdominal surgery. However, this study did not focus on patients with spinal cord injury (SCI), where autonomic dysregulation presents a unique anesthetic challenge. Meanwhile, Ueshima and Otake (2019) introduced the use of the thoracolumbar interfascial plane (TLIP) block as an effective technique for posterior spinal surgery analgesia, showing its potential for targeted regional pain control. Despite its promise, there is limited literature discussing the combined use of TLIP block and OFA in patients with complete SCI undergoing complex spine stabilization procedures.

This article outlines the perioperative management of a patient with full spinal cord injury undergoing spinal stabilization via open fixation and arthrodesis, highlighting the complementary effects of the thoracolumbar interfascial plane block and dexmedetomidine. The objective of this research is to highlight the safety and efficacy of integrating regional anesthesia with opioid-free pharmacologic strategies in complex spine surgeries involving neurologically vulnerable patients. This study benefits anesthesiologists by providing a viable, replicable protocol to optimize pain control while avoiding opioid-related complications in SCI cases.

METHOD

A 47-year-old male farmer, (weight: 65 kg, height: 170 cm, BMI: 22.5 kg/m²), presented to the emergency department on August 12, 2024, after falling approximately 1.5–2 meters from a tree. The patient landed in a seated position, sustaining direct trauma to his lower back, which resulted in immediate severe pain and loss of bladder and bowel function. He was referred from a regional hospital for suspected thoracolumbar spinal injury.

On admission, the patient reported no preceding dizziness, syncope, or respiratory symptoms. Physical examination revealed complete motor paralysis (0/5 strength) and hypoesthesia in both lower extremities, consistent with a complete spinal cord injury (SCI) at the Th12 level (Frankel A classification). Upper extremity motor function remained intact (5/5 strength). Vital signs included a heart rate of 99 bpm, blood pressure of 130/70 mmHg, respiratory rate of 18 breaths/min, and peripheral oxygen saturation of 97% on room air. Chest auscultation demonstrated normal vesicular breath sounds without wheezing or crackles.

Imaging studies confirmed a burst fracture at Th12 with bilateral facet joint dislocation (Th11–Th12) and associated soft tissue swelling. A CT scan further revealed spinal canal compromise at the Th12 level. Electrocardiogram (EKG) showed sinus rhythm (87 bpm) without ischemic changes. Laboratory findings indicated mild leukocytosis (WBC 15.26 x 10³/μL) and normocytic anemia (Hgb 12.6 g/dL), while renal and coagulation profiles were

within normal limits. Elevated SGOT (57 U/L) suggested mild hepatic stress, though liver function was otherwise preserved.

Preoperative Considerations

Meticulous preoperative planning is essential for a patient with a Th12-level complete spinal cord injury (SCI) undergoing spinal stabilization surgery to ensure safety and efficacy. The absence of motor or sensory function below Th12 signifies a substantial deficit necessitating an anesthetic strategy to prevent exacerbation of the injury. Respiratory function must be assessed, as Th12, despite being below the primary innervation for respiratory muscles, may still exhibit subtle impairments that could compromise the patient's breathing, necessitating ventilatory support during or post-surgery.

Cardiovascular health is crucial as spinal cord injury patients frequently experience autonomic dysregulation, such as hypotension or bradycardia, which may complicate anesthesia. Assessing heart rate, blood pressure, and oxygen saturation establishes a baseline for the procedure. Clinicians must exercise caution during preoperative evaluations, as autonomic dysreflexia, a perilous increase in blood pressure, is more probable with injuries above T6, although it can also occur with Th12 injuries, particularly in patients with a prior history of the condition.

To prevent respiratory depression, which poses significant risks for spinal cord injury patients, opioid-free anesthesia (OFA) should be employed. Employing the thoracolumbar interfascial plane (TLIP) block for targeted analgesia, alongside dexmedetomidine for sedation and hemodynamic stability, mitigates complications and supports the patient's respiratory and autonomic functions. In addition to the technical elements, informed consent guarantees that the patient comprehends the methodology and its appropriateness for their situation.

Preoperatively hydrating and balancing the patient's electrolytes facilitates a smooth procedure and recovery. Spinal cord injury may alter the metabolism and clearance of anesthetic agents, necessitating accurate dosing to prevent adverse effects. These factors formulate a detailed preoperative strategy customized for this patient's condition and surgical procedure.

Intraoperative Management

OFA Strategy

The opioid-free anesthesia (OFA) approach was adopted to mitigate risks linked to opioids, including respiratory depression, postoperative nausea/vomiting (PONV), and ileus, which are especially significant for this patient with neurogenic bowel/bladder dysfunction. Premedication consisted of pregabalin 75 mg orally and etoricoxib 90 mg orally, given 2 hours prior to surgery to address neuropathic pain and inflammation at the surgical site, respectively. Intraoperative analgesia was attained via a bilateral ultrasound-guided thoracolumbar interfascial plane (TLIP) block utilizing 20 mL of 0.25% bupivacaine combined with 5 mg dexamethasone per side, targeting the Th10–L2 dermatomes. Adjuvant agents comprised a dexmedetomidine infusion for sedation, analgesia, and hemodynamic stability, in addition to 400 mg of intravenous ibuprofen to further mitigate inflammation.

Monitoring

Standard ASA monitors—continuous electrocardiography (ECG), noninvasive blood pressure (NIBP), pulse oximetry (SpO₂), capnography (EtCO₂), and temperature—were employed. An invasive arterial line supplied real-time hemodynamic information, while train-of-four (TOF) monitoring directed neuromuscular blockade administration. The Bispectral Index (BIS) was sustained between 40 and 60 to regulate propofol dosage, while urine output was evaluated through a urinary catheter to monitor renal perfusion.

Induction of Anesthesia

Induction commenced with preoxygenation utilizing 100% oxygen for a duration of 3 minutes. Propofol target-controlled infusion (TCI) was administered to achieve an effect-site concentration of 6 µg/mL, titrated to induce loss of consciousness, followed by intravenous atracurium 30 mg to enable neuromuscular blockade. Intratracheal lidocaine 80 mg was administered to suppress airway reflexes during intubation. A reinforced endotracheal tube (7.5 mm ID) was inserted to avert kinking in the prone position, confirmed by bilateral breath sounds and EtCO₂ waveform.

Anesthesia Maintenance

Anesthesia was sustained using propofol TCI (2–4 µg/mL) aimed at a BIS of 40–60, augmented by a dexmedetomidine infusion (1 µg/kg loading dose over 10 minutes, followed by 0.3–0.5 µg/kg/hr). The TLIP block provided analgesia at the surgical site, while ibuprofen 400 mg IV and tranexamic acid 1 g IV managed inflammation and hemorrhage. Ventilation was administered using pressure-controlled mode (tidal volume 6–8 mL/kg, PEEP 5 cm H₂O), while intermittent atracurium (0.1 mg/kg every 45–60 minutes) sustained neuromuscular blockade.

Hemodynamic Regulation

Dexmedetomidine maintained systemic vascular resistance (SVR) and mitigated surgical stress. Hypotension (MAP <65 mmHg) was treated with phenylephrine boluses (10–20 µg IV), while conservative crystalloid infusion (5 mL/kg/hr) averted volume overload. Mild bradycardia induced by dexmedetomidine (heart rate 50–60 bpm) was tolerated, with atropine 0.5 mg IV on standby if necessary. Prone positioning was refined to reduce intra-abdominal pressure and facilitate venous return.

Emergence

Neuromuscular blockade was antagonized with neostigmine 2.5 mg and glycopyrrolate 0.5 mg administered intravenously at a TOF ratio exceeding 0.9. Extubation was conducted in the supine position once the patient was alert, hemodynamically stable, and satisfied extubation criteria (spontaneous ventilation, EtCO₂ <45 mmHg). Postoperative care comprised a dexmedetomidine infusion (200 µg/50 mL NS at 1 mL/hr) for 24 hours, augmented by ketorolac 30 mg PO every 8 hours and acetaminophen 500 mg PO every 6 hours. The patient was observed in an intermediate care unit with hourly neurological evaluations, antiemetics (ondansetron 4 mg IV as needed), and early mobilization.

RESULTS AND DISCUSSION

The successful application of opioid-free anesthesia (OFA) in this complex spine surgery case underscores its viability as a strategy to mitigate opioid-related complications while ensuring effective analgesia and hemodynamic stability. The patient's complete spinal cord injury (SCI) at Th12 (Frankel A) and neurogenic bowel/bladder dysfunction posed unique challenges, including heightened risks of respiratory depression, postoperative ileus, and hemodynamic instability. These factors necessitated a tailored approach that prioritized non-opioid multimodal analgesia, regional anesthesia, and meticulous perioperative monitoring.

Opioid-free regimens are particularly advantageous in patients with SCI due to their susceptibility to respiratory compromise and autonomic dysregulation. In this case, the avoidance of opioids eliminated risks of respiratory depression, postoperative nausea/vomiting (PONV), and delayed gastrointestinal recovery, which are critical in a patient with preexisting neurogenic bowel dysfunction.(Chang et al., 2022; Jin et al., 2020) The preoperative administration of pregabalin 75 mg and etoricoxib 90 mg targeted neuropathic and inflammatory pain pathways, reducing central sensitization and surgical stress.(Verma et al., 2014; Yeole et al., 2022) This preemptive analgesia aligns with enhanced recovery after surgery (ERAS) principles, minimizing postoperative opioid demand.(Batchelor et al., 2019; Simpson et al., 2019)

The bilateral thoracolumbar interfascial plane (TLIP) block played a pivotal role in providing segmental analgesia to the surgical site (Th10–L2). By depositing local anesthetic (0.25% bupivacaine) and dexamethasone between the iliocostalis and longissimus muscles, the block effectively covered dorsal rami of thoracic and lumbar nerves, reducing nociceptive input during spinal instrumentation. The addition of dexamethasone extended the block duration and suppressed inflammation, further diminishing systemic analgesic requirements.(Pehora et al., 2017) Compared to epidural analgesia, the TLIP block offers a safer alternative in patients with spinal instability, avoiding dural puncture risks and hypotension.

Dexmedetomidine, a selective α_2 -adrenergic agonist, was integral to the OFA strategy. Its sympatholytic properties attenuated surgical stress responses, while its analgesic and sedative effects reduced propofol requirements. Unlike opioids, dexmedetomidine preserves respiratory drive, making it ideal for prone-positioned surgeries. The intraoperative use of ibuprofen 400 mg IV complemented the TLIP block by inhibiting cyclooxygenase-mediated inflammation, while tranexamic acid 1 g IV minimized blood loss, critical in spinal fusion procedures.

The patient's prone positioning and SCI necessitated vigilant hemodynamic management. Dexmedetomidine's ability to maintain systemic vascular resistance (SVR) countered the vasodilatory effects of propofol, while phenylephrine boluses addressed transient hypotension (Chang et al., 2022). Conservative fluid therapy (5 mL/kg/hr crystalloids) prevented volume overload and right ventricular strain (Malbrain et al., 2020). The reinforced endotracheal tube and pressure-controlled ventilation ensured airway security and optimal gas exchange, with EtCO₂ maintained at 35–40 mmHg to avoid hypercapnia-induced increases in intracranial pressure (Deng et al., 2020).

While this case demonstrates the feasibility of OFA in spine surgery, several limitations warrant consideration. First, the TLIP block's efficacy depends on precise ultrasound-guided

technique, which may vary among practitioners (Yi et al., 2025). Second, dexmedetomidine's bradycardic effects required close monitoring, though no intervention was needed in this case. Third, the single-case design limits generalizability, emphasizing the need for larger studies to validate OFA protocols in diverse populations.

CONCLUSION

This case highlights the synergistic potential of OFA, regional anesthesia, and multimodal analgesia in complex spine surgery. The combination of TLIP block, dexmedetomidine, and NSAIDs provided robust perioperative analgesia without compromising respiratory or hemodynamic stability. Future research should focus on standardizing OFA protocols, optimizing regional techniques, and evaluating long-term outcomes in patients with spinal cord injuries. By prioritizing opioid-sparing strategies, anesthesiologists can enhance recovery and reduce morbidity in high-risk surgical populations.

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