

Regional Anesthesia Strategy Using Thoracic Paravertebral Block in a Patient with Tuberculosis-Related Pyopneumothorax: A Case Report

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ABSTRACT

Thoracic surgery in patients with severe pulmonary disease poses significant anesthetic challenges. General anesthesia with positive pressure ventilation may exacerbate ventilation-perfusion mismatch and worsen air leakage in the presence of a bronchopleural fistula. Regional anesthesia techniques that preserve spontaneous ventilation may offer a safer alternative in selected high-risk patients. We report a case of a 68-year-old male with tuberculosis-related right-sided pyopneumothorax complicated by bronchopleural fistula, severe chronic obstructive pulmonary disease with a restrictive component, atrial fibrillation with normal ventricular response, and hepatic insufficiency (ASA physical status III), who was scheduled for an open pleural window procedure. Given the high risk of general anesthesia and mechanical ventilation, ultrasound-guided unilateral thoracic paravertebral block (TPVB) was selected as the primary anesthetic technique, combined with dexmedetomidine sedation. The block was performed at T5-T7 using ropivacaine, achieving adequate dermatomal anesthesia. Sedation was titrated to preserve spontaneous ventilation and patient cooperation. The procedure was completed without conversion to general anesthesia. The patient remained hemodynamically stable, with preserved spontaneous breathing and adequate oxygenation throughout the surgery. No vasopressors, rescue opioids, or airway interventions were required. Postoperative pain was minimal, and no block-related or respiratory complications occurred. Thoracic paravertebral block combined with dexmedetomidine sedation provided effective anesthesia and favorable perioperative stability for open pleural window surgery in a high-risk pulmonary patient. This case highlights the potential role of regional anesthesia-based strategies as an alternative to general anesthesia in carefully selected thoracic surgical patients where preservation of spontaneous ventilation is desirable.

Thoracic Paravertebral Block, Regional Anesthesia, Open Pleural Window, Bronchopleural Fistula, Dexmedetomidine, High-Risk Pulmonary Patient

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INTRODUCTION

Thoracic surgical procedures in patients with advanced pulmonary disease pose significant anesthetic challenges. General anesthesia with endotracheal intubation and positive pressure ventilation may exacerbate ventilation-perfusion mismatch, increase the risk of barotrauma, and worsen air leakage in the presence of a bronchopleural fistula [1]. These risks are further amplified in patients with chronic lung disease, active pulmonary infection, and poor physiological reserves [2,3].

Open pleural window surgery is commonly performed to manage chronic empyema and pyopneumothorax. Although this procedure is often considered less invasive than formal thoracotomy, it still involves substantial nociceptive stimulation of the thoracic wall and pleura. Consequently, adequate anesthesia

and analgesia are essential, and the preservation of spontaneous ventilation remains desirable in selected high-risk patients [4]. The thoracic paravertebral block (TPVB) provides unilateral somatic and sympathetic blockade of the thoracic dermatomes and has been widely used for postoperative analgesia in thoracic surgery [5]. Compared with thoracic epidural anesthesia, TPVB is associated with a lower incidence of hypotension, urinary retention, and motor blockade, while offering comparable analgesic efficacy [6]. When combined with light-to moderate sedation, TPVB may serve as an alternative anesthetic strategy that avoids airway manipulation and mechanical ventilation. Despite growing evidence supporting the analgesic benefits of TPVB, its use as a primary anesthetic technique for thoracic procedures remains limited, particularly in patients with active pulmonary tuberculosis complicated by bronchopleural fistulas. Reports describing the feasibility and safety of TPVB with sedation for open pleural window surgery in high-risk pulmonary patients are scarce [7,8].

Here, we report a case of successful anesthetic management using an ultrasound-guided thoracic paravertebral block combined with dexmedetomidine sedation for open pleural window surgery in an elderly patient with tuberculosis-related pyopneumothorax and bronchopleural fistula. This case highlights the role of regional anesthesia-based strategies in minimizing respiratory compromise while providing adequate surgical anesthesia in patients with severe pulmonary comorbidities.

CASE DESCRIPTION

A 68-year-old male (weight 35 kg, height 160 cm) was scheduled for an open pleural window procedure due to right-sided tuberculosis-related pyopneumothorax complicated by bronchopleural fistula. The patient was classified as ASA physical status III. Relevant comorbidities included severe chronic obstructive pulmonary disease with a concurrent restrictive component (FEV1 0.73 L, 26% predicted; FVC 1.62 L, 49% predicted; FEV1/FVC 45%), consistent with GOLD stage IV obstruction in the setting of a 50-pack-year smoking history and tuberculosis-related parenchymal destruction.

Arterial blood gas analysis demonstrated chronic hypercapnia with metabolic compensation (pH 7.48, pCO₂ 47 mmHg, HCO₃ 35 mmol/L, BE +12). Additional comorbidities included atrial fibrillation with normal ventricular response, hepatic insufficiency (albumin 2.5 g/dL, AST 102 U/L, ALT 98 U/L), and severe malnutrition (body weighs 35 kg, BMI 13.7 kg/m²). Preoperative echocardiography revealed preserved left ventricular systolic function (ejection fraction 56%) with grade I diastolic dysfunction and mild tricuspid regurgitation suggestive of pulmonary hypertension. Coagulation parameters were within normal limits (PT 14.2 seconds, INR 0.98, aPTT 34.3 seconds, platelet count 298,000/μL), and the patient was not receiving anticoagulant therapy. Anticoagulation was not initiated given the patient's severe malnutrition, hepatic insufficiency, and the anticipated need for surgical intervention. No absolute contraindications for regional anesthesia were identified. Given the severity of pulmonary impairment, chronic hypercapnia, active bronchopleural fistula, and the risk of exacerbating air leakage with positive pressure ventilation, general anesthesia was considered high risk. To minimize respiratory compromise and avoid airway instrumentation, a regional anesthesia-based approach was planned. A unilateral ultrasound-guided thoracic paravertebral block (TPVB) was selected as the primary anesthetic technique, combined with procedural sedation.

The block was performed at the T5–T7 levels using a high-frequency linear ultrasound probe with an in-plane technique. After negative aspiration, 20 mL of 0.375% ropivacaine was administered incrementally, achieving adequate sensory blockade from T3 to T9 on the operative side. Block success was confirmed by the loss of cold sensation before the surgical incision. Sedation was achieved using a dexmedetomidine infusion initiated at 0.4 μg/kg/h without a loading dose, titrated to maintain a Ramsay Sedation Score of 2–3. Supplemental oxygen was delivered via a nasal cannula at 3–4 L/min. Spontaneous ventilation was preserved throughout the procedure. An open pleural window was created using the modified Eloesser flap technique. Segments of two consecutive ribs overlying the empyema cavity were resected to establish adequate drainage. Limited debridement of the pleural space was performed to evacuate purulent material and fibrinous debris. No extensive decortication was performed. Intraoperative vital signs demonstrated stable hemodynamics and adequate oxygenation throughout the procedure, with the heart rate, blood pressure, and peripheral oxygen

saturation remaining within acceptable limits. No episodes of respiratory depression, airway obstruction, or conversion to general anesthesia occurred. The surgical procedure lasted approximately 90 minutes and was completed uneventfully.

Postoperatively, the patient reported minimal pain with a numeric rating scale score of 2/10 at rest. No rescue opioid analgesia was required during the first 12 hours after surgery. No block-related complications, such as pneumothorax, systemic toxicity of local anesthetic, or neurological deficits, were observed.

DISCUSSION

Patients with severe pulmonary pathology undergoing thoracic surgery represent a high-risk population from an anesthetic standpoint. In this case, the presence of active pulmonary tuberculosis complicated by pyopneumothorax and bronchopleural fistula significantly increased the risks associated with general anesthesia, particularly with positive pressure ventilation. Preoperative spirometry revealed severe airflow limitation (FEV₁ 26% predicted) with a concurrent restrictive deficit (FVC 49% predicted), reflecting the combined effects of long-standing obstructive lung disease and tuberculosis-related parenchymal destruction. This mixed ventilatory impairment, coupled with the presence of a bronchopleural fistula, further reinforced the decision to avoid positive pressure ventilation and pursue a regional anesthesia-based strategy. Mechanical ventilation in such settings may exacerbate air leakage through the fistula, increase intrathoracic pressure, and worsen ventilation–perfusion mismatch, potentially leading to hypoxemia and postoperative respiratory failure [9].

Open pleural window surgery, although less extensive than formal thoracotomy, involves substantial nociceptive input from the chest wall and parietal pleura. Therefore, adequate anesthesia must balance effective analgesia with preservation of spontaneous ventilation. In patients with compromised pulmonary reserve, anesthetic strategies that avoid airway manipulation and ventilatory support are particularly advantageous [4]. The increasing adoption of regional anesthesia strategies in thoracic surgery further supports the rationale for minimizing systemic anesthetic exposure in high-risk patients. An observational prospective study evaluating different regional anesthesia techniques according to surgical approach demonstrated that regional anesthesia-based strategies, including erector spinae plane block, thoracic epidural analgesia, and intrathecal analgesia, provided effective postoperative analgesia after lung surgery, with low pain scores and comparable opioid consumption across techniques. These findings underscore the broader concept that appropriately selected regional techniques can achieve adequate analgesia and facilitate recovery after thoracic procedures [10].

Although that study primarily focused on postoperative pain management rather than intraoperative anesthesia, it reinforces the principle that regional anesthesia plays a central role in modern thoracic surgery. In the present case, this concept was extended beyond analgesia to serve as the primary anesthetic strategy. The thoracic paravertebral block combined with sedation allowed surgical completion while preserving spontaneous ventilation and avoiding airway manipulation, which was particularly advantageous in a patient with active pulmonary disease and bronchopleural fistula [8]. The thoracic paravertebral block provides unilateral segmental anesthesia by blocking the spinal nerves as they emerge from the intervertebral foramina, producing somatic and sympathetic blockade over the targeted dermatomes. Compared with thoracic epidural anesthesia, TPVB is associated with a lower incidence of hypotension due to reduced sympathetic blockade, as well as decreased risk of urinary retention and motor weakness [11]. These characteristics make TPVB especially suitable for frail patients and those with limited cardiovascular and pulmonary reserves. In the present case, TPVB was selected as the primary anesthetic technique to minimize respiratory compromise while providing sufficient anesthesia for surgery. The block achieved adequate dermatomal coverage for the open pleural window procedure, allowing the surgery to proceed without conversion to general anesthesia.

Preservation of spontaneous ventilation was maintained throughout the procedure, and no episodes of hypoxemia, hypercapnia, or airway obstruction were observed. This is relevant in patients with bronchopleural fistula, where avoidance of positive pressure ventilation may reduce the risk of enlargement of the fistulous tract and worsening air leaks. Sedation was provided using dexmedetomidine, which offers several advantages in this context. Dexmedetomidine produces cooperative sedation with minimal respiratory depression and

allows patients to maintain protective airway reflexes [12]. Its sympatholytic properties may contribute to hemodynamic stability and attenuation of stress responses during surgery. In this case, dexmedetomidine provided an adequate level of sedation without the need for opioid supplementation or rescue analgesia, consistent with its opioid-sparing effects [13]. Mild reductions in heart rate and blood pressure were observed but remained within acceptable limits and did not require pharmacologic intervention [8]. Alternative regional anesthesia techniques, such as thoracic epidural anesthesia, can also provide effective analgesia for thoracic procedures. However, epidural anesthesia carries a higher risk of bilateral sympathetic blockade, which may result in hypotension and necessitate vasopressor support, particularly in elderly or malnourished patients. Additionally, epidural placement may be contraindicated or relatively unfavorable in patients with coagulopathy or infection-related concerns [6]. In contrast, TPVB offers a more localized and unilateral block, reducing the likelihood of systemic hemodynamic effects.

Other non-regional approaches, including general anesthesia with lung-protective ventilation or bronchial blockers, may be appropriate for selected patients. However, in cases with an active bronchopleural fistula and severe lung disease, such approaches remain challenging and may increase perioperative morbidity. [9]. Endobronchial interventions under general anesthesia have been reported; however, they require advanced airway management and may not be feasible in all settings [3]. The successful use of TPVB with sedation in this case underscores the importance of individualized anesthetic planning based on pathophysiology rather than conventionally. TPVB remains underreported as a primary anesthetic for thoracic surgery, and this case supports regional anesthesia-based strategies in high-risk pulmonary patients. This study had some limitations. As this was a single-case report, the findings cannot be generalized to patients undergoing pleural window surgery. TPVB success is operator-dependent and requires expertise in ultrasound-guided regional anesthesia. Patient selection is essential, as not all patients may tolerate surgery with regional anesthesia and sedation. In this case, chest wall resection was limited to two consecutive ribs without extensive pleural decortication. TPVB as the sole anesthetic technique may be more challenging for procedures requiring extensive rib resection or pleural debridement.

CONCLUSION

Ultrasound-guided thoracic paravertebral block combined with dexmedetomidine sedation provided effective anesthesia and stable perioperative conditions for open pleural window surgery in a high-risk patient with tuberculosis-related pyopneumothorax and bronchopleural fistula. This approach may represent a valuable alternative to general anesthesia in carefully selected patients, particularly when preservation of spontaneous ventilation is desired.

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