CASE REPORT

Immediate Total Spinal Anesthesia Following Thoracic Epidural Test Dose: Importance of Degenerative Spinal Disease and Recommendations for Prevention

Ratikorn Boonchai, MD[1], Sarayuth Boonchai, MD[2]

[1] Department of Anesthesia, Prince of Songkla University, Songkhla, Thailand; [2] Department of Surgery, Prince of Songkla University, Songkhla, Thailand

Background: Total spinal anesthesia (TSA) following epidural analgesia is rare but potentially life-threatening, particularly during major abdominal surgeries such as pancreaticoduodenectomy. Degenerative spinal disease may increase the risk of rapid cephalad spread of local anesthetic, thereby predisposing patients to immediate TSA even with technically correct catheter placement.

Case Report: A 60-year-old woman scheduled for elective pancreaticoduodenectomy developed immediate TSA following a thoracic epidural test dose of 3 mL 2% lidocaine with adrenaline (1:200,000). Despite a negative cerebrospinal fluid (CSF) aspiration test, she experienced rapid-onset neurological impairment and respiratory arrest. Emergency management included airway support, tracheal intubation, mechanical ventilation, invasive monitoring, and spinal imaging. Magnetic resonance imaging (MRI) revealed multilevel degenerative spinal changes that may have contributed to the intrathecal spread of local anesthetic. The surgery was postponed, and the patient fully recovered neurologically without residual deficits.

Conclusion: The present case highlights the need for thorough pre-procedural spinal evaluation in patients with suspected degenerative changes. A negative CSF aspiration does not rule out the risk of intrathecal migration. Clinicians should consider alternative regional techniques such as erector spinae or paravertebral blocks in high-risk patients. Multidisciplinary coordination and vigilant intraoperative monitoring are essential to improving patient safety and perioperative outcomes.

Keywords: Total spinal anesthesia; Thoracic epidural analgesia; Degenerative spinal disease; Regional anesthesia; Complication

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Pancreaticoduodenectomy, or the Whipple procedure, involves removal of the pancreatic head, duodenum, gallbladder, and distal bile duct. It is a major operation often followed by severe postoperative pain. Epidural analgesia is commonly employed for perioperative pain control in pancreaticoduodenectomy and has been associated with enhanced recovery, including fewer complications such as ileus, pneumonia, and deep vein thrombosis, along with improved bowel function, reduced nausea and vomiting, and shorter hospital stays[1]. Despite these benefits, epidural analgesia is not without risks. One of the most serious complications is total spinal anesthesia (TSA), a rare but potentially life-threatening event occurs when local anesthetic inadvertently spreads into the subarachnoid space, resulting in sudden paralysis, respiratory compromise, and hemodynamic instability. TSA is exceedingly rare, with reported incidence ranging from less than one in 100,000 to one in 27,000 procedures[2], and more recent obstetric surveillance estimating rates between one in 2,971 and one in 16,200 neuraxial procedures[3]. Recognized risk factors include unrecognized dural puncture, excessive or rapid injection of local anesthetic, immediate supine positioning, obesity, short stature, increased abdominal girth, prior epidural top-ups, and underlying spinal degenerative disease or deformity[2,3]. Although negative cerebrospinal fluid (CSF) aspiration during catheter placement is commonly used to rule out subarachnoid placement, it does not confirm true epidural location or entirely exclude the risk of intrathecal migration.

Degenerative spinal disease, often under-recognized during routine anesthetic evaluation,

Correspondence to:

Boonchai S.

Department of Surgery, Faculty of Medicine, Prince of Songkla University, 15 Kanchanavanich Road, Hat Yai, Songkhla 90110, Thailand.

Phone: +66-85-8235632

Email: sarayuth19899@gmail.com

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should be considered an anatomical challenge[4]. Structural deformities can obscure landmarks and complicate needle placement, while narrowed or irregular epidural spaces may lead to unpredictable spread of local anesthetic and incomplete block. In addition, altered anatomy increases the risk of nerve injury, particularly when multiple attempts are required. It may significantly predispose patients to rapid cephalad spread of local anesthetic following thoracic epidural injection. When present, such pathology may increase the likelihood of immediate TSA, even after technically sound epidural placement. In the present report, the authors presented a case of immediate TSA following test dose administration via a thoracic epidural catheter in a patient scheduled for elective pancreaticoduodenectomy. The authors described the clinical presentation, imaging findings, acute management, and eventual outcome. Furthermore, the authors discussed the importance of pre-procedural risk assessment, multidisciplinary response strategies, and alternative regional analgesic techniques that may offer safer analgesia in high-risk patients undergoing major abdominal surgery.

Case Report

A 60-year-old woman presented with a one-month history of epigastric pain, bloating, and weight loss. Computed tomography of the upper abdomen revealed an intraductal papillary mucinous neoplasm (IPMN) involving the main pancreatic duct, with associated ductal atrophy. She was scheduled for a pylorus-preserving pancreaticoduodenectomy. Her medical history included insulin-dependent type 2 diabetes, well-controlled hypertension, dyslipidemia, overweight, and mild anemia.

The authors inserted an epidural catheter at the eighth (T8) and ninth (T9) thoracic vertebrae using an 18G Tuohy needle via a paramedian approach under anatomical landmarks. Loss of resistance to air was confirmed at a depth of 6.5 cm. The catheter was advanced to 11 cm without encountering fluid or blood. A test dose of 2% lidocaine with adrenaline at 1:200,000, 3 mL was administered. Within two minutes, the patient reported numbness from the chest to the thighs, followed by respiratory distress and loss of consciousness. Oxygen saturation dropped to 62%. The authors immediately removed the epidural catheter and positioned the patient supine. Facemask ventilation was initiated, and oxygen saturation gradually improved to 100%. Her blood pressure remained stable at 125/70 mmHg, and electrocardiogram (ECG) showed sinus rhythm from 55 to 60 bpm. Her trachea was intubated by the attending anesthetist without the use of additional sedative agents. Neurological assessment revealed a Glasgow Coma Scale score of E1VtM1, pupils 5 mm with sluggish reaction to light bilaterally, and absent gag reflex. Arterial line monitoring showed mildly reduced blood pressure. After discussion with the surgical team and family, the authors decided to postpone the operation due to the risk of further hemodynamic instability during surgery.

Emergency spinal magnetic resonance imaging (MRI) showed no epidural hematoma or spinal cord compression. However, small air bubbles were visible in the posterior epidural space from T2 to T4, along with acute subarachnoid hemorrhage in the upper cauda equina region (Figure 1). Additionally, diffuse degenerative disc disease was noted, including ligamentum flavum thickening with moderate spinal stenosis at T2 and T3, mild spinal stenosis at T11 and T12, the second (L2) and third (L3) lumbar vertebrae, L5 to the first (S1) sacral vertebrae, severe spinal stenosis with right L5 transverse root compression at L4 and L5, multi-level neural foraminal narrowing, and grade 1 at L4 and L5 anterolisthesis. A concurrent emergent brain computed tomography showed no intracranial hemorrhage, recent infarct, or focal brain swelling.

Forty-five minutes after the test dose, she regained consciousness and was able to follow simple commands. Three hours later, she recovered motor function and tracheal reflexes. She was extubated and transferred to the surgical intensive care unit for continued neurological and hemodynamic monitoring. Analgesic level gradually regressed until there was no residual neurological defect on the following day, as shown in Figure 2.

During that visit, the patient reported feeling normal and provided written informed consent for publication of her case. A rescheduled pylorus-preserving pancreaticoduodenectomy was two weeks post-event. The operative time was eight hours and 42 minutes, conducted under general anesthesia with a total of 300 μg of fentanyl. Perioperative pain management included a bilateral thoracic paravertebral block (TPVB) at the T7 and T9 levels under ultrasound guidance, performed uneventfully using a single-shot technique with a total of 40 mL of 0.5% bupivacaine.

Discussion

Contemporary perioperative pain management in upper abdominal surgery employs multimodal

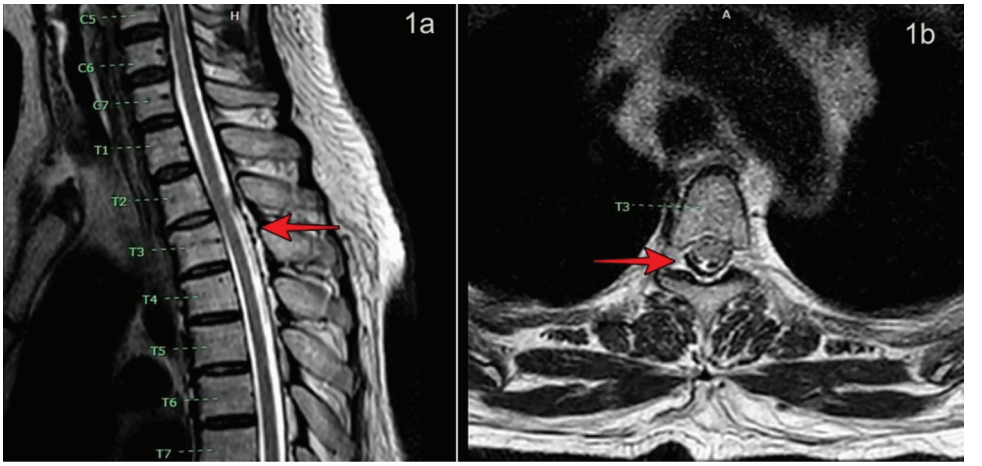

Figure 1. The thoracic portion of an emergent thoracolumbar spine magnetic resonance imaging (MRI) obtained after total spinal anesthesia (TSA) event revealed small air bubbles (arrows) along the posterior epidural region at T2-T4 levels in sagittal (1a) and coronal (1b) views, supporting correct needle placement via loss-of-resistance with air. Radiology review excluded compressive pathology and revealed significant multilevel degenerative spinal changes.

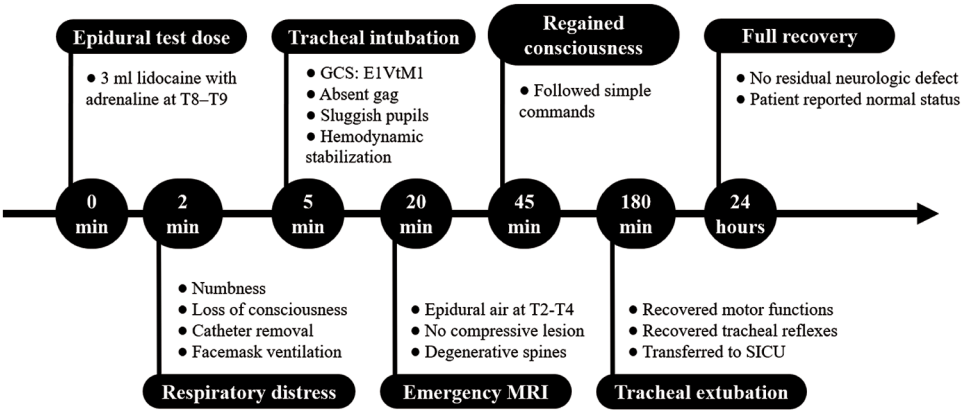

Figure 2. Timeline after thoracic epidural test dose: at 2 minutes the patient developed respiratory distress and loss of consciousness, progressing to total spinal anesthesia (TSA), with emergency magnetic resonance imaging (MRI) at 20 minutes showing epidural air at T2-T4; neurologic recovery occurred by 3 hours and full resolution at 24 hours.

strategies to minimize opioid use and enhance recovery. Pre-emptive analgesics such as paracetamol, gabapentin, non-steroidal anti-inflammatory drugs (NSAIDs), and cyclooxygenase-2 (COX-2) inhibitors are routinely used. Epidural analgesia, often incorporated intraoperatively and continued postoperatively, provides superior pain control and improved recovery profiles[5]. However, studies have suggested that epidural analgesia may not be the preferred option in selected patients undergoing pancreaticoduodenectomy[6].

Among the rare but critical complications is TSA, which may occur abruptly even after technically correct epidural placement[7]. Contributing factors include inadvertent subarachnoid spread of local anesthetic, anatomical variations, and pre-existing degenerative spinal disease[4]. While CSF aspiration is a common safety check during catheter placement, it does not entirely exclude intrathecal positioning or sudden catheter migration. This underscores the need for heightened vigilance following test dose administration.

A prior report by Sambhukumar et al. described gradual neurological symptoms without TSA following delayed catheter migration at the L3 and L4 level[8]. Unlike such reports that typically involve delayed onset or lower spinal injections, the patient uniquely developed TSA immediately after a thoracic-level test dose at the T8 and T9 level, despite negative CSF aspiration, emphasizing the

Table 1. Regional analgesia techniques for upper laparotomy: comparative features and considerations in degenerative spine

Categories	Technique	Injection site	Volume (mL)	Analgesic distribution	Catheter	Complications	TSA risk	Degenerative spine suitability
Neuraxial block	EB	Thoracic epidural space, T7-T9 level	3 to 10	Bilateral, somatic & visceral, T4-T12[9,15,16]	Single, 3 to 5 cm (epidural space)	Hypotension, intrathecal migration, hematoma, pruritus, urinary retention	High	Use with caution
	TPVB	Paravertebral space, T7-T9 level (bilateral required)	15 to 20 per side	4 dermatome levels[10], somatic & visceral	Bilateral	Hypotension, pleural puncture, vascular injury, LAST	Low	Recommended
Fascial plane block	ESB	Between erector spinae muscle and transverse process at T9 level (bilateral required)	20 per side	T5-L2[11], somatic & visceral	Bilateral	Pneumothorax, vascular injury, LAST	Low	Recommended
	QLB	Lateral/posterior/anterior to QL muscle (QL 2, 3), bilateral required	15 to 20 per side	T7-L2[12], somatic & visceral	Bilateral, 10 to 12 cm in plane	Hypotension, injury to pleura/kidney/nerves, hematoma, LAST	Low	Recommended
	Subcostal TAP	Between RAM and TAM at subcostal level (bilateral required)	15 to 30 per side	T9-T11[13], mainly somatic	Bilateral, 15 to 20 cm in plane	Peritoneal placement, LAST	Minimal	Recommended
	Posterior RSB	Between RAM and posterior rectus sheath (bilateral required)	10 per side	T6-T12[17,18], mainly somatic	Bilateral, 6 to 20 cm in plane	Peritoneal/liver/bowel/vascular injury	Minimal	Recommended
Wound infiltration	Wound infiltration/catheter	Preperitoneal, suprafascial, or subcutaneous space	10 per side	Somatic only[14]	Single or bilateral, 15 to 20 cm	Catheter dislodgement or leakage	None	Recommended

EB=epidural block; ESB=erector spinae block; IOM=internal oblique muscle; LAST=local anesthetic systemic toxicity; QL=quadratus lumborum; QLB=quadratus lumborum block; RAM=rectus abdominis muscle; RSB=rectus sheath block; TAM=transversus abdominis muscle; TAP=transversus abdominis plane; TPVB=thoracic paravertebral block; TSA=total spinal anesthesia

risk of rapid cephalad local anesthetic spread in high thoracic epidurals. Importantly, MRI revealed multilevel degenerative changes, including spinal stenosis and ligamentum flavum thickening, which may have facilitated cephalad spread by altering epidural space dynamics and reducing CSF volume, thereby enhancing intrathecal drug distribution[4,7,9]. These findings suggest that spinal degeneration should not be overlooked and may warrant pre-procedural imaging or detailed assessment in at-risk patients, with such imaging reserved for those with strong clinical suspicion rather than used routinely.

Timely, multidisciplinary intervention, including airway support, mechanical ventilation, hemodynamic monitoring, and postponement of surgery, was critical to the patient's full neurological recovery. Such coordination is especially vital in patients with comorbidities, like anemia or hypertension, where the hemodynamic shifts of pancreaticoduodenectomy further increase the risk of TSA-related complications such as cerebral hypoperfusion, myocardial ischemia, or renal injury[8].

To mitigate TSA risk, clinicians should employ incremental dosing with frequent aspiration, avoid rapid large boluses, maintain slight head-up positioning, and limit epidural catheter advancement to 3 to 5 cm. The use of saline rather than air for loss-of-resistance, pre-procedural ultrasound in difficult anatomy, and vigilance with test dosing may further enhance safety[4]. In addition to these measures, alternative regional techniques, including TPVB, erector spinae block (ESB), quadratus lumborum block (QLB), and continuous wound infiltration, remain valuable options that provide effective analgesia with reduced neurological and hemodynamic risks in patients with suspected spinal pathology[10-14].

Although fascial plane blocks may require larger volumes of local anesthetic, their overall safety profile makes them attractive alternatives for high-risk surgical candidates. Table 1 summarizes these techniques by injection site, dosage, efficacy, catheter use, and risks. However, uncertainties remain regarding optimal catheter placement and drug delivery methods by infusion versus intermittent bolus[9-18].

Furthermore, surgical factors, incision type such as right subcostal versus mirror L incision, anticipated duration, and surgeon preference,

must be integrated into block selection. Catheter-based wound infiltration or subcostal transversus abdominis plane (TAP) block may offer practical benefits in centers lacking experience in neuraxial techniques. Ultimately, proactive collaboration between anesthetists and surgeons allows tailoring of analgesic strategies aligned with Enhanced Recovery After Surgery (ERAS) protocols.

The present case illustrates that TSA, though rare, can occur suddenly and unpredictably in high thoracic epidurals, even after a negative test dose. It highlights the underestimated role of spinal degeneration in facilitating cephalad spread of local anesthetic. The authors advocate for thorough spinal assessment in high-risk patients and consideration of alternative regional techniques to enhance perioperative safety, while acknowledging limited causal inference and lack of long-term neurological follow-up.

What is already known about this topic?

TSA is a rare but potentially life-threatening complication of epidural analgesia. While TSA is often associated with lumbar-level catheter migration and delayed onset, high thoracic epidural placement is considered safe when CSF aspiration is negative.

What does this study add?

This case highlights that immediate TSA can still occur after a negative test dose in thoracic epidural analgesia, particularly in patients with unrecognized degenerative spinal disease. It underscores the limitations of CSF aspiration testing and supports the need for pre-procedural spinal assessment and consideration of alternative regional techniques in high-risk individuals.

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Ethical approval

Ethical approval for this case report was obtained from the Human Research Ethics Committee, Faculty of Medicine, Prince of Songkla University, under an exemption determination (REC.67-181-8-1).

Conflicts of interest

The authors declare no conflict of interest.

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