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Successful Spinal Anesthesia Using a 22-Gauge Quincke Needle after Injection Failure Via a 25-Gauge Needle Caused by Dural Tenting in a Patient with Previous Lumbar Fusion Surgery: A Case Report

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Abstract | **Case Report**

Spinal anesthesia in patients with a history of posterior lumbar interbody fusion (PLIF) can be technically challenging due to altered anatomy, epidural fibrosis, and dural thickening. We reports a case where spinal anesthesia initially failed using a 25-gauge (G) Quincke needle despite free cerebrospinal fluid (CSF) flow, but was subsequently achieved by switching to a 22G Quincke needle. An 85-year-old female with a history of L4–5 PLIF was scheduled for open reduction and internal fixation of a femur fracture under spinal anesthesia. A paramedian approach was performed at the L3–4 level using a 25G Quincke needle. Free flow of clear CSF was observed; however, local anesthetic could not be injected due to absolute resistance, even after 360-degree needle rotation. Suspecting dural tenting and partial dural penetration, the needle was removed, and a 22G Quincke needle was inserted along the same trajectory. Following CSF re-confirmation, the anesthetic was injected smoothly without resistance, resulting in a successful sensory and motor block without complications. In patients with prior lumbar surgery, dural thickening or fibrosis can lead to dural tenting with a fine 25G needle, causing partial penetration where CSF flows out but drug administration is obstructed. Switching to a larger gauge (22G) needle with greater flexural rigidity can effectively overcome dural resistance and ensure successful intrathecal drug delivery.

Keywords: Spinal Anesthesia, Dural Tenting, Posterior Lumbar Interbody Fusion, Spinal Needle Gauge, Case Report.

INTRODUCTION

Spinal anesthesia is widely recognized as the preferred technique for elderly patients undergoing lower limb orthopedic procedures, such as femur fracture repair. However, in patients with a history of lumbar spine surgery, such as posterior lumbar interbody fusion (PLIF), performing a successful lumbar puncture becomes technically demanding due to posterior hardware, altered anatomical landmarks, supraspinous ligament calcification, and epidural fibrosis [1].

While fine-gauge spinal needles (e.g., 25-gauge or smaller) are routinely recommended to minimize the risk of post-dural puncture headache (PDPH), their structural flexibility makes them susceptible to bending and dural tenting—a clinical phenomenon in which the needle pushes the dura mater forward without completely puncturing it [2]. This can lead to a deceptive situation where cerebrospinal fluid (CSF) flows out through a partial dural tear or the edge of the bevel, yet drug injection is completely obstructed by surrounding dural tissue [3, 4]. Here, we report a case of successful spinal anesthesia using a 22G Quincke needle in an 85-year-old female with a history of L4–5 PLIF, after an initial attempt with a 25G Quincke needle resulted in complete injection failure despite free CSF outflow.

CASE REPORT

An 85-year-old female (height: 152 cm, weight: 54 kg) presented with a left femur fracture and was scheduled for open reduction and internal fixation (ORIF). Written informed consent for publication of this case report was obtained from the patient, and approval was obtained from the Institutional Review Board (IRB) of our institution. Her medical history was notable for hypertension, angina, chronic bronchitis, and an L4–5 posterior lumbar interbody fusion (PLIF) performed 23 years prior (Figure 1). Preoperative laboratory values and electrocardiogram were within normal limits.

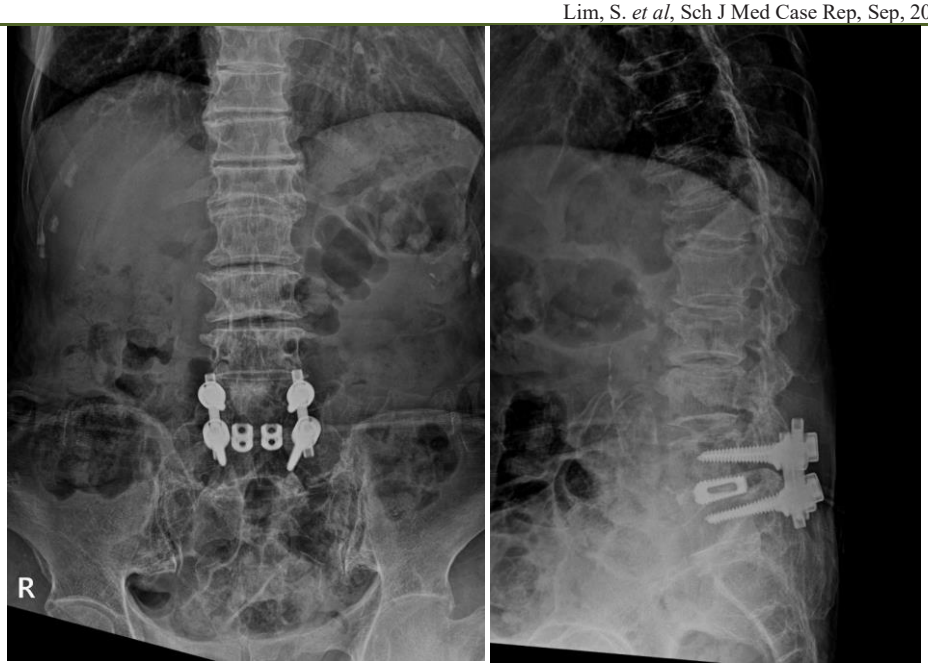

Fig. 1: Preoperative lumbar spine X-ray anteroposterior (left) and lateral (right) showing posterior lumbar interbody fusion (PLIF) at the L4–5 level with surgical hardware, severe interspace narrowing, and posterior degenerative changes

Given her age and surgical procedure, spinal anesthesia was planned. Due to surgical hardware and severe degenerative changes at the L4–5 level, the L3–4 interspace was selected. The patient was placed in the right lateral decubitus position. Under sterile conditions, a paramedian approach was chosen to bypass midline supraspinous and interspinous ligament calcification and scarring. A 25G Quincke spinal needle was positioned at the L3–4 interspace and advanced. A subtle loss of resistance was felt, and upon removal of the stylet, clear, free-flowing CSF was observed at the needle hub. However, when attempting to inject the anesthetic mixture (0.5% heavy bupivacaine 10 mg + fentanyl 15 mcg), absolute resistance was encountered on the syringe plunger. The needle rotated to 90, 180, and 360 degrees, but drug injections remained impossible in all directions, despite persistent CSF return between attempts. Additionally, the needle was incrementally advanced and retracted to re-attempt drug injection at points with active CSF flow, but marked injection resistance persisted.

Suspecting that the fine needle had caused dural tenting—resulting in partial penetration where only the tip of the bevel entered the subarachnoid space while the main aperture remained covered by dural tissue, the 25G needle was withdrawn. Subsequently, a 22G Quincke needle was inserted using the exact same entry point and trajectory. After feeling a distinct "pop" as the rigid needle pierced the dura, free flow of clear CSF was again verified. This time, the drug solution was injected smoothly without any resistance. The patient was placed in a supine position. A bilateral sensory block up to the T10 level was achieved within 10 minutes. The surgery lasted 120 minutes and proceeded uneventfully. No post-dural puncture headache or neurological deficits were observed postoperatively.

DISCUSSION

Failure of drug injection despite clear CSF flow is an uncommon but frustrating clinical scenario during spinal anesthesia [4]. This case highlights two key pathophysiological mechanisms in a patient with previous lumbar spine surgery: dural tenting/partial penetration and needle flexural rigidity.

In young, healthy tissue, the dura mater is elastic and easily pierced. However, in elderly patients—particularly those with prior spine surgery such as PLIF—the dura and surrounding epidural space often exhibit thickening, calcification, and dense epidural fibrosis [1]. When a fine 25G Quincke needle encounters a thickened or fibrotic dura, it can push the dural membrane inward without crisp penetration, a phenomenon known as dural tenting [3]. Under these conditions, two simultaneous events occur:

1. CSF Outflow: The sharp tip of the cutting bevel creates a micro-puncture or partially enters the subarachnoid space, allowing pressurized intrathecal CSF to flow out through the needle lumen [5].
2. Injection Block (Valve Effect): When forward pressure is applied to inject the drug, the tented dural tissue collapses back against the bevel opening or covers the main portion of the cutting edge, acting as a one-way check valve [4]. Because the 25G bevel aperture remains trapped within the dural or subdural layer, 360-

degree needle rotation fails to relieve the obstruction.

The flexural rigidity ($E \cdot I$) of a cylindrical tube is proportional to the fourth power of its outer radius (r^4), as modeled by its area moment of inertia:

$$I = \frac{\pi}{64}(D_{\text{outer}}^4 - D_{\text{inner}}^4)$$

The structural stiffness of a 22G needle (outer diameter ~ 0.72 mm) is substantially higher than that of a 25G needle (outer diameter ~ 0.51 mm). In our case, the 25G needle lacked sufficient column strength to pierce the resistant, post-surgical dural tissue cleanly, leading to tenting. Conversely, the 22G needle possessed enough rigidity to penetrate both the dura mater and arachnoid membrane decisively in a single stroke, ensuring the entire bevel aperture rested fully within the subarachnoid space. Furthermore, according to the Hagen-Poiseuille equation for viscous fluid dynamics through a cylindrical tube:

$$\Delta P = \frac{8 \cdot \mu \cdot L \cdot Q}{\pi \cdot r^4}$$

the internal hydraulic resistance (ΔP) in a 22G needle is significantly lower than in a 25G needle for a given flow rate (Q), further facilitating effortless injection once the dura is pierced.

From a clinical standpoint, when encountering high injection resistance despite CSF flow, clinicians should avoid forcing injections under high resistance, as this risks subdural or epidural delivery, resulting in a failed block or unexpected high spinal blockade [5]. If needle rotation fails to resolve the blockage with a 25G needle, persistent dural tenting should be suspected. Switching to a larger gauge (e.g., 22G) needle should be considered a practical solution to overcome dural resistance when fine needles deform or fail to fully penetrate.

CONCLUSION

In elderly patients with a history of lumbar fusion surgery, dural thickening and scarring can cause significant dural tenting when using flexible 25G spinal needles. This can create a false impression of successful subarachnoid entry due to initial CSF flow while preventing actual drug administration. When needle rotation fails to relieve injection resistance, replacing the 25G needle with a more rigid 22G needle offers a safe, practical, and effective approach to achieve complete dural penetration and ensure successful spinal anesthesia.

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