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Comparison of cutting and Pencil-Point spinal needle in spinal anesthesia regarding postdural puncture headache

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Abstract

Spinal anesthesia is widely used in cesarean section. Postdural puncture headache is a common complication after this procedure. The type of spinal needle plays an important role in its occurrence. This study aimed to compare the incidence of postdural puncture headache between cutting and pencil-point spinal needles. This prospective cohort study included 208 pregnant women undergoing cesarean section at Maternity Teaching Hospital in Erbil. Patients were divided into two groups. One group received spinal anesthesia using a cutting needle 25G (104 patients), and the other group received a pencil-point needle 25G (104 patients). All patients were followed for 7 days after the procedure. Data on headache, onset, severity, and management were collected and analyzed. Postdural puncture headache occurred in 9 patients (8.7%) in the cutting needle group and 3 patients (2.9%) in the "pencil-point group". Headache started on day 1 in 6 patients (66.7%) in the "cutting group" and in all patients (100%) in the "pencil-point group". The mean severity score was 7.9±0.8 in the "cutting group" and 7.7±0.6 in the "pencil-point group". Nausea was present in 6 patients (66.7%) and 3 patients (100%) respectively. All patients received conservative treatment. No patient required advanced intervention. Postdural puncture headache was more frequent with cutting needles compared to pencil-point needles. Both needle types showed similar severity and clinical features. Pencil-point needles may be associated with a lower risk of headache.

Keywords: Spinal anesthesia, Postdural puncture headache, Cutting needle, Pencil-Point needle

Introduction

Spinal anesthesia is a widely used neuraxial technique in modern clinical practice, particularly for procedures involving the lower abdomen, pelvis, and lower extremities. It involves the administration of local anesthetic agents into the subarachnoid space, resulting in rapid onset of sensory and motor blockade with high efficacy and safety. Due to its advantages, including reduced systemic drug exposure, lower cost, and improved postoperative recovery, spinal anesthesia is frequently preferred over general anesthesia in many surgical settings, especially in obstetrics and gynecology.[1] Despite its benefits, spinal anesthesia is not without complications. One of the most common and clinically significant adverse effects is postdural puncture headache (PDPH). PDPH is defined as a positional headache that typically occurs within five days following dural puncture and is often associated with symptoms such as nausea, neck stiffness, tinnitus, and visual disturbances.[2] The underlying mechanism involves leakage of Cerebrospinal Fluid (CSF) from the puncture site, leading to intracranial hypotension and traction on pain-sensitive intracranial structures.[3] Although PDPH is often self-limiting, resolving within one to two weeks, it can significantly impair patient comfort, delay mobilization, prolong hospital stay, and increase healthcare costs.[3,4] Several factors influence the incidence of PDPH, including patient characteristics (such as age, sex, and pregnancy status) and procedural factors. Among these, the type and size of the spinal needle play a critical role.[5] Cutting needles, such as the Quincke type, create a larger dural defect by slicing through dural fibers, which may increase the risk of persistent CSF leakage. In contrast, pencil-point (atraumatic) needles, such as Whitacre and Sprotte, separate rather than cut dural fibers, resulting in a smaller dural opening and reduced CSF loss.[3,4]

Recent studies have highlighted the importance of needle design in minimizing PDPH. A prospective randomized study demonstrated that pencil-point spinal needles were associated with a significantly lower incidence of PDPH compared to cutting or atraumatic cutting needles, regardless of needle gauge, with reported rates as low as 0% in some

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groups.[4] These findings suggest that optimizing needle selection may be an effective strategy to reduce PDPH incidence and improve patient outcomes. Given the clinical impact of PDPH and the modifiable nature of needle-related factors, it is essential to evaluate the comparative effectiveness of different spinal needle types. The study aimed to compare the incidence of postdural puncture headache (PDPH) between patients undergoing spinal anesthesia using cutting (Quincke) needles and those using pencil-point (atraumatic) needles.

Patients and Methods

This prospective cohort study was conducted at the Maternity Teaching Hospital in Erbil over a period of six months, from August 2025 to February 2026. A total sample size of 208 patients was calculated using the Fleiss formula for comparison of two independent proportions, assuming a significance level (α) of 0.05 and a study power of 80%. Based on expected PDPH rates of 7.2% in the cutting needle group and 0% in the "pencil-point group", 104 patients were included in each group. According to the type of spinal needle used during the procedure patients were allocated into two groups. The study included pregnant women aged 20–45 years undergoing elective or emergency cesarean section under spinal anesthesia. Obstetric patients, particularly those undergoing cesarean sections, were specifically targeted due to their higher risk of PDPH.[6] Only classified as American Society of Anesthesiologists (ASA) physical status I were included. Patients were excluded if they had contraindications to spinal anesthesia such as coagulopathy, infection at the puncture site, or severe hypovolemia. Additionally, patients with a history of chronic headache, migraine, or previous PDPH were excluded. Cases of failed spinal anesthesia requiring conversion to general anesthesia were also excluded from the analysis. Spinal anesthesia was performed by trained anesthesiology staff using standard aseptic techniques. The choice of needle type (cutting Needle 25G versus pencil-point Needle 25G) was determined according to routine clinical practice. Procedural data collected included number of attempts, first-pass success rate, and total procedure time. All patients were followed for 7 days' post-procedure to assess the development of PDPH. The primary outcome was the incidence of PDPH within 7 days after spinal anesthesia. Secondary outcomes included time to onset of headache, duration of symptoms, severity measured using a 0–10 Numeric Rating Scale (NRS), and the need for therapeutic interventions such as analgesics, caffeine administration, or epidural blood patch. Data were collected using structured forms and patient follow-up was conducted either during hospital stay or via phone after discharge. All collected data were coded to maintain patient confidentiality.

Statistical analysis was performed using appropriate tests. The incidence of PDPH between the two groups was compared using Fisher's exact test, and results were expressed as risk ratios and risk differences with 95% confidence intervals. Continuous variables were analyzed using Student's t-test or Mann–Whitney U test as appropriate, while time-to-event outcomes were assessed using Kaplan–Meier analysis. A p-value of less than 0.05 was considered statistically significant. Ethical approval for the study was obtained from the Kurdistan Higher Council of Medical Specialties (KHCMS). Written informed consent was obtained from all participants prior to enrollment, and confidentiality of patient data was strictly maintained throughout the study.

Results

Table (1) shows the baseline characteristics of the participants in both groups. The mean age in the cutting needle group was 30.5±5.6 years, while in the "pencil-point group" it was 29.6±6.4 years. The mean BMI was the same in both groups at 27.7 kg/m^2 (±3.6 vs ±2.2). Regarding the type of surgery, 29 patients (27.9%) in the "cutting group" had elective surgery and 75 (72.1%) had emergency surgery. In the "pencil-point group", 33 patients (31.7%) had elective surgery and 71 (68.3%) had emergency surgery.

Table (1): Baseline characteristics of study participants

Variable	Cutting Needle (n=104)	Pencil-Point Needle (n=104)	P-value
Age (years), mean ± SD	30.5±5.6	29.6±6.4	0.259

BMI (kg/m^2), mean ± SD	27.7±3.6	27.7±2.2	0.861
Type of surgery, n (%)			
– Elective	29 (27.9%)	33 (31.7%)	0.649
– Emergency	75 (72.1%)	71 (68.3%)	

Table (2) presents medical history and risk factors. There were no cases of hypertension, diabetes mellitus, pre-eclampsia/eclampsia, chronic daily headache, migraine, or neurological disease in either group (0%). Previous PDPH was reported in 3 patients (2.9%) in the "cutting group" and 9 patients (8.7%) in the "pencil-point group". For smoking status, most patients were never smokers: 102 (98.1%) in the "cutting group" and 98 (94.2%) in the "pencil-point group". Current smokers were 2 (1.9%) and 6 (5.8%) respectively. For caffeine intake, in the "cutting group" 6 (5.8%) had no intake, 55 (52.9%) had 1–2 cups/day, and 43 (41.3%) had 3–4 cups/day. In the "pencil-point group", 1 (1%) had no intake, 37 (35.6%) had 1–2 cups/day, and 66 (63.5%) had 3–4 cups/day. Previous neuraxial block was present in 27 (26%) in the "cutting group" and 30 (28.8%) in the "pencil-point group".

Table (2): Medical history & risk factors

Variable	**Cutting Needle (n=104)**	**Pencil-Point Needle (n=104)**	**P-value**
Past medical history			
Hypertension, n (%)	0 (0%)	0 (0%)	NA
Diabetes mellitus, n (%)	0 (0%)	0 (0%)	NA
Pre-eclampsia/eclampsia*, n (%)	0 (0%)	0 (0%)	NA
Chronic daily headache, n (%)	0 (0%)	0 (0%)	NA
Migraine, n (%)	0 (0%)	0 (0%)	NA
Previous PDPH, n (%)	3 (2.9%)	9 (8.7%)	0.074
Neurological disease, n (%)	0 (0%)	0 (0%)	NA
Smoking status n (%)			
– Never	102 (98.1%)	98 (94.2%)	0.279*
– Former	0 (0%)	0 (0%)	
– Current	2 (1.9%)	6 (5.8%)	
Caffeine intake, n (%)			
– None	6 (5.8%)	1 (1%)	0.002*
– 1–2 cups/day	55 (52.9%)	37 (35.6%)	
– 3–4 cups/day	43 (41.3%)	66 (63.5%)	
– >4 cups/day	0 (0%)	0 (0%)	
Previous neuraxial block, n (%)	27 (26%)	30 (28.8%)	

Table (3) shows procedure characteristics. Most patients were in the sitting position: 88 (84.6%) in the "cutting group" and 85 (81.7%) in the "pencil-point group". The rest were in lateral decubitus position (16 vs 19 patients). For intervertebral level, L2–L3 was used in 97 (93.3%) in the "cutting group" and 104 (100%) in the "pencil-point group". L3–L4 was used in 7 (6.7%) only in the "cutting group". Midline approach was used in 98 (94.2%) in the "cutting group" and 102 (98.1%) in the "pencil-point group". Paramedian approach was used in 6 (5.8%) and 2 (1.9%) respectively. All patients used 25G needles (100%). Single puncture was seen in 97 (93.3%) in the "cutting group" and 104 (100%) in the "pencil-point group". Two punctures occurred in 7 (6.7%) only in the "cutting group". No redirection occurred in 59 (56.7%) and 64 (61.5%), while 1–2 redirections occurred in 45 (43.3%) and 40 (38.5%). Free CSF flow was present in all patients (100%). Traumatic tap occurred in 1 patient (1%) in the "cutting group" and none in the "pencil-point group". No paraesthesia was reported in either group.

Table (3): Spinal anesthesia procedure characteristics

Variable	Cutting Needle (n=104)	Pencil-Point Needle (n=104)	P-value
Patient position, n (%)			
– Sitting	88 (84.6%)	85 (81.7%)	0.578
– Lateral decubitus	16 (15.4%)	19 (18.3%)	
Intervertebral level, n (%)			
– L2–L3	97 (93.3%)	104 (100%)	0.014*
– L3–L4	7 (6.7%)	0 (0%)	
Approach, n (%)			
– Midline	98 (94.2%)	102 (98.1%)	0.279*
– Paramedian	6 (5.8%)	2 (1.9%)	
Number of punctures, n (%)			
– 1	97 (93.3%)	104 (100%)	0.014*
– 2	7 (6.7%)	0 (0%)	
Number of redirections, n (%)			
– 0	59 (56.7%)	64 (61.5%)	0.481
– 1-2	45 (43.3%)	40 (38.5%)	
Free CSF flow, n (%)	104 (100%)	104 (100%)	NA
Traumatic tap (blood in CSF), n (%)	1 (1%)	0 (0%)	1.000
Paresthesia, n (%)	0 (0%)	0 (0%)	NA

Table (4) shows intraoperative findings. Hypotension occurred in 66 (63.5%) in the "cutting group" and 67 (64.4%) in the "pencil-point group". The mean minimum SBP was 75.6±6.6 mmHg in the "cutting group" and 73.3±10.4 mmHg in the "pencil-point group". All patients received vasopressors (100%). Nausea/vomiting occurred in 54 (54%) in the "cutting group" and 55 (54.4%) in the "pencil-point group". The mean crystalloid volume was 1946±329.4 mL in the "cutting group" and 1817±262.2 mL in the "pencil-point group". The mean duration of surgery was 57.7±6.8 minutes in the "cutting group" and 56.8±4.9 minutes in the "pencil-point group".

Table (4): Intraoperative characteristics

Variable	Cutting Needle (n=104)	Pencil-Point Needle (n=104)	P-value
Hypotension, n (%)	66 (63.5%)	67 (64.4%)	0.885
Minimum SBP (mmHg), mean ± SD	75.6±6.6	73.3±10.4	0.125
Vasopressor use, n (%)	104 (100%)	104 (100%)	NA
Nausea/vomiting, n (%)	54 (54%)	55 (54.4%)	0.931
Crystalloid volume (mL), mean ± SD	1946±329.4	1817±262.2	0.002
Duration of surgery (min), mean ± SD	57.7±6.8	56.8±4.9	0.275

Table (5) includes only patients with headache. PDPH occurred in 9 patients (8.7%) in the "cutting group" and 3 (2.9%) in the "pencil-point group" as shown in Figure (1). For onset, on day 1 it occurred in 6 (66.7%) in the "cutting group" and 3 (100%) in the "pencil-point group". On day 2 it occurred in 3 (33.3%) only in the "cutting group". Mean severity (VAS) was 7.9±0.8 in the "cutting group" and 7.7±0.6 in the "pencil-point group". All patients reported postural headache (100%). For location, forehead pain was seen in 7 (77.8%) vs 2 (66.7%), occipital in 7 (77.8%) vs 2 (66.7%), whole head in 2 (22.2%) vs 1 (33.3%). No unilateral or head and neck pain was reported. For character, dull pain occurred in 2 (22.2%) vs 0, pulsatile in 4 (44.4%) vs 2 (66.7%), and pressure-like in 3 (33.3%) vs 1 (33.3%). Associated symptoms included nausea in 6 (66.7%) vs 3 (100%), vomiting in 4 (44.4%) vs 2 (66.7%), dizziness in 1 (11.1%) vs 0, visual disturbance in 0 vs 1 (33.3%), tinnitus in 1 (11.1%) vs 0, and photophobia in 5

(55.6%) vs 1 (33.3%). No neck pain was reported all are illustrated in Figure (2). For physical limitations, difficulty sitting was mild in 7 (77.8%) vs 3 (100%), severe in 1 (11.1%) vs 0. Difficulty in self-care was mild in 6 (66.7%) vs 3 (100%). Difficulty in breastfeeding was mild in 5 (55.6%) vs 3 (100%).

Table (5): Characteristics of headache (Among Patients with Headache Only)

Variable		Cutting Needle (n=104)	Pencil-Point Needle (n=104)	P-value
PDPH within 7 days, n (%)		9 (8.7%)	3 (2.9%)	0.074
		n= 9	n=3	
Day of onset, n (%)	Day 1	6 (66.7%)	3 (100%)	0.509*
	Day 2	3 (33.3%)	0 (0%)	
Severity (VAS), mean ± SD		7.9±0.8	7.7±0.6	
Postural nature, n (%)	Worse when sitting/standing	9 (100%)	3 (100%)	NA
Headache location, n (%)	Forehead	7 (77.8%)	2 (66.7%)	1.000*
	Occipital	7 (77.8%)	2 (66.7%)	1.000*
	Unilateral	0 (0%)	0 (0%)	NA
	Whole head	2 (22.2%)	1 (33.3%)	1.000*
	Head and neck	0 (0%)	0 (0%)	NA
Headache character, n (%)	Dull	2 (22.2%)	0 (0%)	1.000*
	Pulsatile	4 (44.4%)	2 (66.7%)	1.000*
	Sharp	0 (0%)	0 (0%)	NA
	Pressure-like	3 (33.3%)	1 (33.3%)	1.000*
Associated symptoms				
Nausea		6 (66.7%)	3 (100%)	0.509*
Vomiting		4 (44.4%)	2 (66.7%)	1.000*
Neck pain		0 (0%)	0 (0%)	NA
Dizziness		1 (11.1%)	0 (0%)	1.000
Visual disturbance		0 (0%)	1 (33.3%)	0.250*
Tinnitus		1 (11.1%)	0 (0%)	1.000*
Photophobia		5 (55.6%)	1 (33.3%)	1.000*
Physical Limitations				
Difficulty sitting	Not at all	1 (11.1%)	0 (0%)	1.000*
	Mildly	7 (77.8%)	3 (100%)	
	Severely	1 (11.1%)	0 (0%)	
Difficulty self-care	Not at all	3 (33.3%)	0 (0%)	0.509*
	Mildly	6 (66.7%)	3 (100%)	
Difficulty breastfeeding	Not at all	4 (44.4%)	0 (0%)	0.491*
	Mildly	5 (55.6%)	3 (100%)	

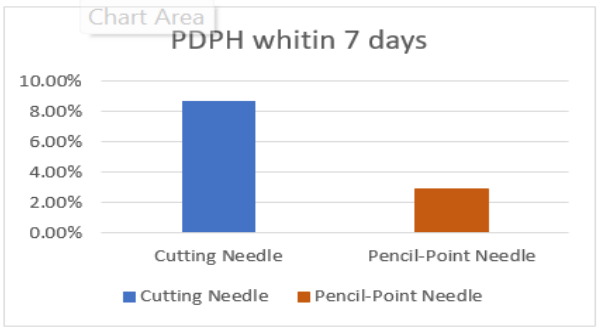

Figure (1): Prevalence of PDHP within 7 days in both study groups

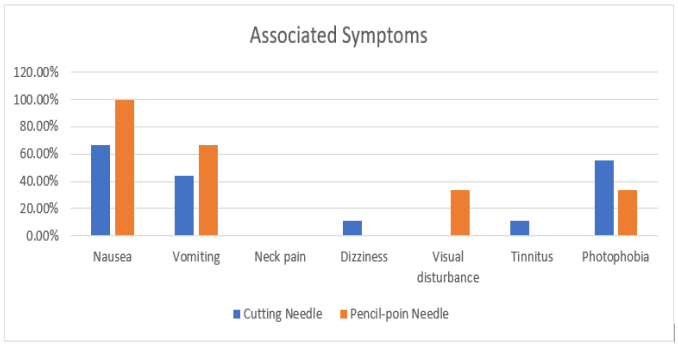

Figure (2): Associated Symptoms in both study groups

Table (6) shows outcomes and management. The mean time to onset was 37.44±11.1 hours in the "cutting group" and 26±3.5 hours in the "pencil-point group". The mean duration of headache was 4.44±1.4 days in the "cutting group" and 5.0±2.0 days in the "pencil-point group". Complete resolution occurred in 4 (44.4%) vs 1 (33.3%). Persistent headache occurred in 5 (55.6%) vs 2 (66.7%). All patients received bed rest, oral fluids, simple analgesics, and caffeine (100%). Opioids were used in 6 (66.7%) vs 2 (66.7%). No epidural blood patch was used (0%).

Table (6): PDPH outcomes and management

Variable	Cutting Needle (n=104)	Pencil-Point Needle (n=104)	P-value
Time to onset (hours), mean ± SD	37.44±11.1	26±3.5	0.117
Duration (days), mean ± SD	4.44±1.4	5.0±2.0	0.604
Complete resolution at follow-up, n (%)	4 (44.4%)	1 (33.3%)	0.636
Persistent headache at follow-up, n (%)	5 (55.6%)	2 (66.7%)	
Management of PDPH			
Bed rest	9 (100%)	3 (100%)	NA
Oral fluids	9 (100%)	3 (100%)	
Simple analgesics	9 (100%)	3 (100%)	
Caffeine	9 (100%)	3 (100%)	
Opioids	6 (66.7%)	2 (66.7%)	1.000
Epidural blood patch	0 (0%)	0 (0%)	NA

Discussion

This study compared pencil-point and cutting design spinal needles in relation topuncture PDPH. The baseline characteristics such as age and BMI were similar between both groups. This is similar to Devanand et al.,[7] where no significant difference was found between groups at baseline. In our study, PDPH occurred in 9 patients (8.7%) in the cutting needle group and 3 patients (2.9%) in the "pencil-point group". Devanand et al.[7] reported similar findings, where PDPH occurred in 7 patients (10.8%) in the "cutting group" and 2 patients (3.3%) in the "pencil-point group". Mehraj et al.[8] also reported higher PDPH with cutting needles. They found PDPH in 27 patients (31.8%) in the Quincke group and 6 patients (7.1%) in the Whitacre group. Meshram et al.[9] reported a lower overall incidence of PDPH. In their study, only 6 out of 500 patients (1.2%) developed PDPH, and there was no significant difference between needle sizes. This incidence is lower than what we observed. A meta-analysis by Xu et al.[10] showed that pencil-point needles significantly reduce PDPH. They reported a higher risk of PDPH with cutting needles (RR 2.50, 95% CI 1.96–3.19). In our study, most procedures were done in the sitting position and midline approach. Batova et al.[11] reported that patient position and approach can affect PDPH. They found PDPH rates of 7.2% with Quincke midline approach and 2.7% with paramedian approach. In our results, most patients had a single puncture, especially in the "pencil-point group". Previous studies showed that multiple attempts increase PDPH risk. Batova et al.[11] also mentioned that repeated punctures are associated with higher PDPH. In our study, PDPH started mainly on day 1. Meshram et al.[9] reported that PDPH usually occurs within the first 1–2 days after spinal anesthesia. The severity of headache in our study was high, with mean VAS 7.9±0.8 in the "cutting group" and 7.7±0.6 in the "pencil-point group". Devanand et al.[7] reported mostly mild headache in the "pencil-point group", while the "cutting group" had mild, moderate, and severe cases. Associated symptoms such as nausea, vomiting, and photophobia were seen in our patients. Mehraj et al.[8] also reported symptoms like nausea, dizziness, and visual disturbance in patients with PDPH. In our study, all patients were treated with bed rest, fluids, caffeine, and simple analgesics. Meshram et al.[9] reported similar management, where all patients improved with conservative treatment. Overall, our findings are similar to most studies. Cutting needles showed higher PDPH rates, while pencil-point needles showed lower rates.

Conclusion

This study showed that postdural puncture headache occurred more often with cutting spinal needles than with pencil-point needles. The incidence was 8.7% in the "cutting group" and 2.9% in the "pencil-point group". The severity and clinical features of headache were similar in both groups. Most cases started early and were postural in nature. All patients improved with simple treatment, and no advanced intervention was needed. Based on these findings, pencil-point needles may be a better choice as they are associated with a lower rate of headache. Choosing the appropriate needle type can help reduce patient discomfort after spinal anesthesia.

Conflict of interest: The authors declare no conflict of interest

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