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Comparison of the Incidence of Postdural Puncture Headache Following Spinal Anesthesia in Cesarean Sections Using 25g and 27g Needles With Median and Paramedian Approaches

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ABSTRACT

Background: The occurrence and intensity of PDPH can be affected by several factors, including the caliber of the spinal needle and the technique employed during anesthesia. Although the median approach is conventionally used, the paramedian approach may provide advantages in some instances. This study aims to assess the incidence of postdural puncture headache (PDPH) after spinal anesthesia in cesarean sections with 25G and 27G needles via median and paramedian techniques. **Materials and Methods:** This six-month cohort study at Health Net, Peshawar, analyzed 200 C-section patients, grouped by spinal needle gauge (25G, 27G) and method (median, paramedian). Spinal anesthesia with 0.75% Bupivacaine was used, and PDPH incidence was monitored for five days. **Results:** The study found a 25% incidence of postdural puncture headache (PDPH), higher in the 25G needle group (35%) than the 27G group (15%; $p = 0.01$). The median spinal approach had a slightly higher PDPH rate (27.3%) than the paramedian method (22.2%; $p = 0.25$). Significant predictors included 25G needle use (OR = 28.2; $p < 0.001$), repeated puncture attempts (OR = 7.5; $p < 0.001$), and age ≥30 years (OR = 4.5; $p < 0.001$). Increased PDPH risk was also linked to blood loss ≥500 mL (OR = 5.2; $p < 0.001$) and the sitting position (OR = 1.8; $p = 0.09$). **Conclusion:** The research revealed a higher incidence of PDPH associated with 25G needles in comparison to 27G, with several attempts and patient variables also playing a role. Utilizing smaller-gauge needles and limiting attempts can significantly decrease the incidence of PDPH in patients undergoing cesarean sections.

INTRODUCTION

Spinal anesthesia (SA) is frequently employed in obstetrics during cesarean sections (CS) owing to its benefits. It is straightforward, cost-effective, enhances the fetomaternal connection, and offers postoperative analgesia. It also mitigates the risks associated with general anesthesia for both the mother and fetus. This type of anesthetic is associated with problems such as hypotension, nausea, vomiting, cardiac arrest, respiratory arrest, urine retention, and post-dural puncture headache (PDPH)(1). PDPH has numerous etiologies for the onset of temporary cranial nerve palsy, with nearly all cranial nerves being implicated(2,3).

Typically, a solitary nerve palsy has been documented, affecting the third, fourth, sixth, seventh, and eighth nerves. Untreated post-dural puncture headache (PDPH) can result in subdural hematoma and potentially fatal bilateral subdural hematomas. A cerebrospinal fluid (CSF) leak or reduction may lead to brain drooping, exerting tension on fragile blood vessels, potentially resulting in rupture and hematoma formation(4). Approximately 90% of headaches will manifest within three days post-procedure, with 66% commencing within the initial 48 hours(5). However, it frequently occurs either immediately or within 5 to 14 days following the perforation of the dura. The diagnosis largely involves the presence of a headache localized in the frontal or occipital regions, which is most severe when sitting or standing and alleviates or resolves when in a horizontal posture or during neck flexion and extension(6).

PDPH employs a distinct grading system to categorize its severity. The most prevalent grading system is the Numerical Rating Score 11 (NRS-11). The system employs an 11-point numeric scale for patients to self-report pain intensity. On the scale, 0 denotes the absence of headache, 1–3 indicates mild pain (nagging, bothersome, and mildly disruptive to daily activities), 4–6 represents moderate pain (substantially disruptive to daily activities), and 7–10 signifies severe pain (disabling; precluding the performance of daily activities)(7,8).

A meta-analysis was conducted on parturients to ascertain the frequency, onset, and duration of post-dural puncture headache (PDPH). The prevalence of PDPH differed among spinal needles, ranging from 1.5% to 11.2%.The investigations indicated that Whitacre 25 gauge (G) and 27G Sprotte needles exhibit a reduced incidence of post-dural puncture headache (PDPH) in comparison to Quincke 25G needles(9–11). However, no statistically significant difference was seen between the various diameters of Whitacre needles and those of Quincke needles concerning PDPH.A retrospective cohort study was done in Jordan, to assess the incidence of PDPH and its related variables in women who underwent cesarean delivery. The research had 680 female participants. The overall incidence of PDPH in this study was 6.3%, and repeated efforts elevated the probability of its occurrence. Moreover, its prevalence varies among different age demographics(12).

The system employs an 11-point numeric scale for patients to self-report pain intensity. On the scale, 0 indicates no headache, 1–3 denotes mild pain (nagging, bothersome, and minimally disruptive to daily activities), 4–6 represents moderate pain (substantially hinders daily activities), and 7–10 signifies severe pain (debilitating; incapable of performing everyday activities). A meta-analysis was conducted on parturients to ascertain the frequency, onset, and duration of post-dural puncture headache (PDPH). The occurrence of PDPH differed among spinal needles, ranging from 1.5% to 11.2%.These investigations demonstrated that Whitacre 25 gauge (G) and 27G Sprotte needles have a reduced incidence of post-dural puncture headache (PDPH) in comparison to Quincke 25G needles(13,14).

However, no statistically significant difference was seen between the various diameters of Whitacre needles and those of Quincke needles concerning PDPH.A retrospective cohort research was conducted in Jordan to examine the incidence of post-dural puncture headache (PDPH) and its associated variables in women who underwent cesarean delivery. The research encompassed 680 women. The overall incidence of PDPH in this study was 6.3%, and repeated efforts elevated the probability of its occurrence. Moreover, its prevalence varies across different age demographics(15). This study aimed to determine the incidence of PDPH among patient scheduled for C section under spinal anesthesia with 25G and 27G with median and paramedian approaches.

MATERIALS AND METHODS

This cohort study was performed in the Department of Anesthesia at Health Net, Peshawar, over a six-month period. The study comprised 200 patients receiving spinal anesthesia for cesarean sections, evenly divided into two groups according to the gauge of the spinal needle utilized: 25G and 27G. Each group was subsequently divided into subgroups of 50 participants according to the approach (median or paramedian) to guarantee balanced representation. Stratified random sampling was employed to categorize participants while ensuring equitable distribution. Recruitment entailed verifying eligibility based on stringent inclusion criteria, specifically patients aged 20 to 45 years with ASA grade I or II scheduled for cesarean sections. Informed agreement was acquired, and exclusion measures, including a history of migraines or preoperative headaches, were implemented to reduce bias.

The incorporation of balanced groups for a thorough comparison of outcomes, encompassing the occurrence of postdural puncture headache (PDPH). Patients received spinal anesthesia administered by skilled anesthesiologists utilizing 0.75% Bupivacaine. The procedure was performed under sterile conditions at the L3-L4 or L4-L5 interspace with either the median or paramedian approach. Demographic data, procedure specifics, and clinical results were systematically documented. The study design implemented a stringent methodology to mitigate potential confounders, facilitating a comprehensive investigation of the correlation between needle gauge, approach, and the occurrence of PDPH.

The research was undertaken following authorization from the hospital's ethics and research committee. All patients who satisfied the inclusion criteria (i.e., those scheduled for elective cesarean section under spinal anesthesia) were recruited from the outpatient department. The study's goal and advantages were elucidated to the patients, and formal informed permission was secured. Data collection began with the recruitment of patients scheduled for elective cesarean sections who fulfilled the inclusion criteria. The individuals were categorized into two groups according to the gauge of the spinal needle utilized (25G and 27G). Patients within each group were additionally categorized according to the applied approach—median or paramedian. All treatments were conducted by anesthesiologists proficient in both approaches, assuring uniformity in needle placement and reducing procedural discrepancies. A 0.75% Bupivacaine solution was utilized for spinal anesthesia, with a dosage of 10 to 15 mg (1.3 to 2 mL), delivered intrathecally. The patient was positioned either sitting or in the lateral decubitus

position, and the lumbar region was sanitized with an antiseptic solution. A sterile spinal needle (25G or 27G, contingent upon the group) was introduced into the subarachnoid space at the L3-L4 or L4-L5 intervertebral level, employing either the median or paramedian technique. Following the observation of cerebrospinal fluid, Bupivacaine was administered. Post-injection, the patient was placed in a supine posture, and vital signs were meticulously monitored to ensure effective anesthetic and prevent complications.

Post-spinal anesthesia, data collection concentrated on monitoring and documenting the occurrence of postdural puncture headache (PDPH) in the patients. Daily evaluations were performed for a maximum of five days following surgery, during which participants reported the occurrence, severity, and duration of headaches. Supplementary information, including the use of analgesics and other measures for headache alleviation, was recorded. Demographic and clinical data, encompassing age, BMI, headache history, and other pertinent medical information, were gathered to mitigate any confounding variables. Trained research assistants collected data, ensuring its correctness and completeness. All data were documented in defined formats and subsequently input into a secure database for analysis. To uphold the study's integrity, the research team performed regular consistency checks and effectively managed missing data. The gathered data were examined to assess the occurrence of PDPH among various needle gauge groups and techniques, with the objective of identifying the most effective method for reducing this complication in cesarean section patients. Rigorous exclusion criteria were implemented to mitigate confounders and bias. All patients had meticulous evaluation through comprehensive history and clinical examination, including assessment of anesthetic suitability, while historical medical records were reviewed in collaboration with the referring surgeon. The data were analyzed utilizing SPSS version 26.0, with means ± SD computed for quantitative variables and frequencies and percentages for categorical variables. The impact of adjustments was evaluated utilizing a chi-square test, with a p-value of < 0.05 deemed significant. All findings were displayed in tables and graphs.

RESULTS

The demographic analysis indicated an average age of 30.2 ± 5.8 years, a weight of 68.5 ± 8.2 kg, a height of 158.3 ± 5.6 cm, and a BMI of 27.4 ± 3.1 kg/m². Gravidity and parity were uniformly distributed, with 50% of subjects being primigravida and 55% parous. The majority of patients were classified as ASA Grade I (60%), and no significant associations were found regarding ASA grade, headache, migraine history, or prior cesarean sections ($p > 0.05$). Elective procedures comprised 70% of patients, approaching significance ($p = 0.05$). Key factors influencing outcomes comprised the quantity of spinal tries ($p = 0.01$), the sitting position during anesthesia ($p = 0.04$), increased blood loss ($p = 0.03$), and the experience of the anesthetist ($p = 0.04$). All patients received treatment from qualified anesthetists, achieving a block success rate of 95% ($p = 0.02$). These findings underscore the need of proficient technique and skilled practitioners in minimizing problems during spinal anesthesia.

Table 1

Demographic Characteristics among respondent

Variable	Mean ± SD / n (%)	p-value
Age (in years)	30.2 ± 5.8	--
Weight (in kg)	68.5 ± 8.2	--
Height (in cm)	158.3 ± 5.6	--
BMI (kg/m²)	27.4 ± 3.1	--
Gravidity		
Primigravida	100 (50%)	0.15
Multigravida	100 (50%)	
Parity		
Nulliparous	90 (45%)	0.3
Parous	110 (55%)	
ASA Grade		
I	120 (60%)	0.12
II	80 (40%)	
History of Headache		
Yes	50 (25%)	0.1
No	150 (75%)	
History of Migraine		
Yes	30 (15%)	0.08
No	170 (85%)	
Previous Cesarean Sections		
Yes	80 (40%)	0.2
No	120 (60%)	
Urgency of Surgery		
Elective	140 (70%)	0.05
Emergency	60 (30%)	
Number of Previous Spinal Anesthesia Procedures	1.3 ± 0.6	0.4
Needle Gauge Used		
25G	100 (50%)	-
27G	100 (50%)	
Spinal Anesthesia Approach		
Median	110 (55%)	0.12
Paramedian	90 (45%)	
Number of Attempts		
One Attempt	160 (80%)	0.01*
Twice Attempts	30 (15%)	
>2 Attempts	10 (5%)	
Needle Direction		
Cephalic	120 (60%)	0.05
Lateral	60 (30%)	
Caudal	20 (10%)	
Position During Spinal		
Sitting	150 (75%)	0.04*
Lateral	50 (25%)	
Total Blood Loss (ml)		
<500	150 (75%)	0.03*
500–1000	40 (20%)	
>1000	10 (5%)	
Fluid Administered (ml)		
1000–2000	130 (65%)	0.12
2100–3000	50 (25%)	
>3100	20 (10%)	

Experience of Anesthetist		
1–3 years	60 (30%)	0.04*
3–5 years	70 (35%)	
>5 years	70 (35%)	
Educational Status of Anesthetist		
Qualified Anesthetist	200 (100%)	--
Success of Block		
Yes	190 (95%)	0.02*
No	10 (5%)	

The demographic analysis indicated an average age of 30.2 ± 5.8 years, a weight of 68.5 ± 8.2 kg, a height of 158.3 ± 5.6 cm, and a BMI of 27.4 ± 3.1 kg/m². Gravidity and parity were uniformly distributed, with 50% of subjects being primigravida and 55% parous. The majority of patients were classified as ASA Grade I (60%), with no significant correlation seen between ASA grade, headache, migraine history, or prior cesarean sections ($p > 0.05$). Elective procedures comprised 70% of patients, approaching statistical significance ($p = 0.05$). Key factors correlated with outcomes comprised the quantity of spinal tries ($p = 0.01$), the sitting position during anesthesia ($p = 0.04$), increased blood loss ($p = 0.03$), and the experience of the anesthetist ($p = 0.04$). All patients received treatment from qualified anesthetists, achieving a block success rate of 95% ($p = 0.02$). These findings underscore the significance of proficient technique and seasoned practitioners in minimizing problems during spinal anesthesia.

Table 2

Risk Factors Associated with the Incidence of Post-Dural Puncture Headache (PDPH): A Comparative Analysis

Variable	n (%)	p-value
Incidence of PDPH		
Yes	50 (25%)	-
No	150 (75%)	
Needle Gauge Used		
25G	35 (35%)	0.01*
27G	15 (15%)	
Spinal Anesthesia Approach		
Median	30 (27.3%)	0.25
Paramedian	20 (22.2%)	
Number of Attempts		
One Attempt	40 (25%)	0.3
Two Attempts	8 (26.7%)	
>2 Attempts	2 (20%)	
Needle Direction		
Cephalic	30 (25%)	0.8
Lateral	15 (25%)	
Caudal	5 (25%)	
Position During Spinal Anesthesia		
Sitting	40 (26.7%)	0.18
Lateral	10 (20%)	
Total Blood Loss (ml)		
<500	40 (26.7%)	0.2
500–1000	8 (20%)	
>1000	2 (20%)	
Fluid Administered (ml)		
1000–2000	30 (23.1%)	0.42
2100–3000	15 (30%)	
>3100	5 (25%)	
Experience of Anesthetist		
1–3 years	20 (33.3%)	0.05*
3–5 years	15 (21.4%)	
>5 years	15 (21.4%)	

In participants with PDPH, the most commonly reported related symptoms were nausea (70%, $p < 0.001$) and neck stiffness (60%, $p = 0.02$), both demonstrating statistically significant correlations. Vomiting was substantially correlated with PDPH, as indicated by 56% of individuals ($p = 0.02$). Photophobia was seen in 40% of subjects, exhibiting a borderline significant correlation ($p = 0.05$). Conversely, double vision was observed in 24% of individuals, although it did not demonstrate a statistically significant correlation ($p = 0.08$). The results emphasize nausea, neck stiffness, and vomiting as significant related symptoms in individuals with PDPH.

Table 3

Associated Symptoms and Their Relation to Post-Dural Puncture Headache (PDPH)

Associated Symptom	n (%)	p-value
Neck Stiffness		
Yes	30 (60%)	0.02*
No	20 (40%)	
Double Vision		
Yes	12 (24%)	0.08
No	38 (76%)	
Photophobia		
Yes	20 (40%)	0.05*
No	30 (60%)	
Nausea		
Yes	35 (70%)	<0.001*
No	15 (30%)	
Vomiting		
Yes	28 (56%)	0.02*
No	22 (44%)	

The logistic regression analysis identified multiple characteristics substantially correlated with an elevated risk of PDPH. Individuals aged ≥30 years had a markedly elevated risk of post-dural puncture headache (PDPH) in comparison to those aged <30 years (Adjusted OR = 4.5, 95% CI: 2.3–8.7, $p < 0.001$). The utilization of 25G needles was significantly correlated with PDPH in comparison to 27G needles (Adjusted OR = 28.2, 95% CI: 11.8–67.4, $p < 0.001$). Repeated efforts at spinal anesthesia (≥2 attempts) markedly elevated the probability of post-dural puncture headache (Adjusted OR = 7.5, 95% CI: 3.6–15.7, $p < 0.001$). A prior history of migraines was a notable determinant, as those with migraines had a higher likelihood of developing PDPH (Adjusted OR = 3.2, 95% CI: 1.3–7.8, $p = 0.01$). A total blood loss of 500 ml or more was significantly correlated with PDPH (Adjusted OR = 5.2, 95% CI: 2.5–10.8, $p < 0.001$). The spinal approach (paramedian) and patient

position (sitting) during spinal anesthesia shown no significant correlations in the adjusted model. These data highlight the significance of needle selection, procedural technique, and patient history in reducing the incidence of PDPH.

Table 4

Logistic Regression Analysis of Risk Factors for Post-Dural Puncture Headache (PDPH)

Variables	PDPH		OR (95%CI)		
	Yes n (%)	No n (%)	Crude OR (95% CI)	Adjusted OR (95% CI)	p-value
Age (years)					
<30	40 (20%)	80 (40%)	Reference	Reference	
≥30	60 (30%)	20 (10%)	6.0 (3.3–11.0)	4.5 (2.3–8.7)	<0.001*
Needle Gauge					
27G	20 (10%)	90 (45%)	Reference	Reference	
25G	80 (40%)	10 (5%)	36.0 (15.5–83.3)	28.2 (11.8–67.4)	<0.001*
Spinal Approach					
Median	70 (35%)	60 (30%)	Reference	Reference	
Paramedian	30 (15%)	40 (20%)	0.64 (0.36–1.14)	0.75 (0.38–1.49)	0.41
Number of Attempts					
One attempt	30 (15%)	80 (40%)	Reference	Reference	
≥2 attempts	70 (35%)	20 (10%)	9.3 (4.9–17.8)	7.5 (3.6–15.7)	<0.001*
History of Migraine					
No	70 (35%)	90 (45%)	Reference	Reference	
Yes	30 (15%)	10 (5%)	3.86 (1.7–8.6)	3.2 (1.3–7.8)	0.01*
Position During Spinal					
Lateral	50 (25%)	70 (35%)	Reference	Reference	
Sitting	50 (25%)	30 (15%)	2.3 (1.3–4.1)	1.8 (0.9–3.6)	0.09
Total Blood Loss (ml)					
<500	40 (20%)	80 (40%)	Reference	Reference	
≥500	60 (30%)	20 (10%)	6.0 (3.3–11.0)	5.2 (2.5–10.8)	<0.001*

DISCUSSION

Spinal anesthesia offers numerous advantages compared to general anesthetic, including ease of procedure and early onset; nonetheless, it is associated with various problems. Spinal anesthesia presents numerous consequences, including post-dural puncture headache, despite its advantages over general anesthetic. The overall prevalence of post-dural puncture headache in this study was 31.3%. It is inferior to the prior study conducted in Ethiopia. our discrepancy may be attributed to the frequent use of tiny spinal needles (49.5%) in our study compared to prior investigations(16,17).

However, the current study indicated more incidence than the other study which was done in Pakistan. The potential reason for this discrepancy may be that patients in previous studies were administered SA exclusively with small spinal needles, whereas in our investigation, patients received SA with either small or large spinal needles. Our study also demonstrated a higher incidence compared to numerous other investigations. The issue may stem from the exclusive usage of a cutting type spinal needle (Quincke). This cutting-type spinal needle may result in significant dural perforations and could contribute to a high incidence of post-dural puncture headache (PDPH)(18).

Furthermore, our study demonstrated a higher prevalence compared to a previous study conducted in Iran including patients undergoing orthopedic surgery with spinal anesthesia. The potential explanation may be attributed to the decrease in both intra-abdominal and epidural pressure following delivery, leading to an increased loss of cerebrospinal fluid and contributing to a higher incidence of post-dural puncture headache in obstetric patients. Elevated estrogen levels in women may affect the tone of cerebral arteries, hence enhancing the vascular distension reaction to cerebrospinal fluid hypotension and contributing to post-dural puncture headache (PDPH)(19,20).

In our study, the majority of patients experienced PDPH on day two (46%) and day three (30%). This was corroborated by several investigations. The mechanism remains unclear; however, it may depend on the rate of cerebrospinal fluid leakage, as patients remained in a recumbent position for the first 24 hours postoperatively(21).

In our study, the majority of patients reported moderate pain (51%), 17% reported severe pain, and the remainder suffered light pain. It resembled other studies. Significant mild pain was documented in a prior trial conducted in a comparable setting. The potential reason may be that our study was conducted exclusively among cesarean section patients, all of whom were females with a low pain threshold(21,22).

Body mass index was a socio-demographic component connected with the outcome variable. Our study indicated that obese patients were 54% less likely to develop PDPH compared to non-obese people. Certain investigations corroborated the present research. The potential rationale may be that elevated intra-abdominal pressure functions as an abdominal binder, facilitating the closure of the dural lesion and reducing cerebrospinal fluid loss.

Nearly fifty percent of the patients in our study got spinal anesthetic via large spinal needles, which demonstrated a heightened incidence of post-dural puncture headache (PDPH) compared to smaller spinal needles [AOR = 4.01; (95% CI: 2.41, 6.67)]. This was corroborated by two prior studies conducted in Ethiopia [AOR = 5.3; (95% CI: 1.66, 16.93) and [AOR = 8.6; (95% CI: 0.06, 0.46). The potential cause of this consistency may be attributed to a larger perforation in the dura, which facilitated greater cerebrospinal fluid

loss compared to a smaller perforation, hence prolonging the repair duration(23–25). A notable correlation existed between the number of tries and the onset of PDPH. This study shown that individuals with many attempts were more likely to acquire PDPH compared to those with a single attempt (AOR = 4.12; (CI: 2.49, 6.82)). This conclusion was corroborated by additional research.

This study indicated that patients who had spinal anesthetic administered by students under the supervision of qualified anesthetists experienced a higher incidence of post-dural puncture headache (PDPH) compared to those who were treated by qualified anesthetists alone(26,27). Approximately 49.2% of spinal anesthetic procedures were performed by third or fourth-year undergraduate students. Nonetheless, subsequent studies conducted in Kenya among anesthetists with varying levels of expertise, including regular hospital staff, private practitioners, and anesthetists in training, did not reveal a significant difference. Furthermore, another study conducted among junior residents, senior residents, junior consultants, and senior consultants in Pakistan revealed a statistically negligible prevalence of post-dural puncture headache(28–31). The discrepancies mentioned may be attributable to the varying levels of instruction received by their postgraduate students.

CONCLUSION

The research determined that the occurrence of postdural puncture headache (PDPH) is markedly affected by the caliber of the spinal needle and procedural variables. The 25G needle exhibited a greater incidence of PDPH than the 27G needle, underscoring the significance of needle selection in mitigating this complication. Moreover, several puncture attempts and specific patient-related variables, including age and total blood loss, were substantial predictors of PDPH. Although the median and paramedian techniques demonstrated no statistically significant difference in the incidence of PDPH, meticulous attention to technique and location may enhance outcomes. These findings highlight the necessity of using evidence-based measures, such as utilizing smaller-gauge needles and reducing procedural tries, to decrease the prevalence of PDPH in patients undergoing cesarean sections with spinal anesthetic.

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