

## Original Article

## Incidence of Post Dural Puncture Headache (PDPH) Following Subarachnoid Block in Lower Segment Caesarean Section: A Hospital-based Prospective Observational Study

\*Priyabrata Mohanty<sup>1</sup>, Koshy Varghese<sup>2</sup>, Umesh Kumar Singh<sup>3</sup>

<sup>1</sup>Department of Anaesthesiology and Critical Care, Vikash Hospital, Sambalpur, Odisha, India, <sup>2</sup>Department of Anaesthesiology, Tata Main Hospital, Jamshedpur, Jharkhand, India, <sup>3</sup>Department of Anaesthesiology, Manipal Tata Medical College, Jamshedpur, Jharkhand, India

## Abstract

**Background:** Post-dural puncture headache (PDPH) remains one of the most distressing complications of spinal anaesthesia, particularly relevant in obstetric anaesthesia where subarachnoid block is commonly employed for caesarean sections. This study aimed to determine the incidence of PDPH following subarachnoid block in patients undergoing lower segment caesarean section (LSCS) and identify associated risk factors in a tertiary care hospital in Eastern India.

**Methodology:** This prospective observational study was conducted over 18 months (January 2019 to June 2020) at Tata Main Hospital, Jamshedpur. A total of 1305 patients undergoing LSCS under subarachnoid block were enrolled. Patient demographics, obstetric history, and anaesthetic technique-related variables—including needle size, number of attempts, and operator experience—were recorded. Patients were followed postoperatively for five days for the onset of headache and assessed clinically for PDPH.

**Results:** The overall incidence of PDPH was 1.5% (19/1305 patients). Among patients reporting headache, 56% experienced onset within 24-48 hours, with predominantly mild intensity and postural characteristics. The headache duration averaged 27.2±11.6 hours. The number of dural puncture attempts was significantly associated with PDPH occurrence ( $p=0.030$ ), with incidence rising from 1.2% in a single attempt to 8.3% in  $\geq 2$  attempts. No significant associations were found with age, needle gauge, gravida status, operator experience, or bupivacaine dose.

**Conclusion:** This study demonstrated a low PDPH incidence following spinal anaesthesia for caesarean section. Technical precision in achieving successful first-attempt spinal anaesthesia emerged as the most critical factor in preventing PDPH, emphasizing the importance of operator skill over traditional risk factors.

**Keywords:** Spinal anaesthesia, Post-Dural Puncture Headache, Caesarean section, Subarachnoid space, Obstetric anaesthesia, Bupivacaine, Lumbar puncture

\*Correspondence: Priyabrata Mohanty, Email: mohanty.priyabrata0@gmail.com

**How to Cite:** Mohanty P, Varghese K, Singh UK. Incidence of Post Dural Puncture Headache (PDPH) Following Subarachnoid Block in Lower Segment Caesarean Section: A Hospital-based Prospective Observational Study. Niger Med J 2025; 66 (6): 2557-2568. <https://doi.org/10.71480/nmj.v67i1.980>

Quick Response Code:



## Introduction

Spinal anaesthesia has become the preferred technique for lower segment caesarean section (LSCS) due to its rapid onset, excellent muscle relaxation, and superior maternal safety profile [1]. However, post-dural puncture headache (PDPH) remains one of the most distressing complications, causing significant patient discomfort, increased treatment costs, prolonged hospital stays, and potentially requiring epidural blood patch intervention [2,3].

PDPH pathophysiology involves cerebrospinal fluid leakage through the dural puncture site, causing intracranial hypotension and compensatory cerebral vasodilation. This results in a characteristic bilateral fronto-occipital headache that worsens upright and improves supine, often accompanied by nausea, vomiting, and neck stiffness [2].

Multiple factors influence PDPH development, including patient demographics (younger age, female sex, pregnancy), technical factors (needle type, size, number of attempts), operator experience, and procedure type [5]. In obstetric populations, PDPH is particularly significant as it interferes with maternal well-being, infant care, and breastfeeding during the crucial postpartum period. Among parturients, PDPH incidence varies considerably from 1.5% to 11.2% depending on needle gauge and design [4].

Despite widespread use of spinal anaesthesia for caesarean sections, limited contemporary data exist on PDPH incidence in regional populations. Understanding local epidemiology is essential for developing prevention strategies and improving patient counselling. This study aimed to determine PDPH incidence following subarachnoid block in patients undergoing LSCS at a tertiary care hospital in Eastern India. The study also attempted to identify risk factors associated with PDPH development in the study population.

## Methods

This prospective observational descriptive study was conducted in the Department of Anaesthesiology at a tertiary care hospital in Eastern India. The study received approval from the Institutional Ethics Committee (IEC) of the concerned institution (*vide reference no. TMH/FRM/QMS/ALL/19 dated 11.12.2018*), prior to commencement and was conducted over an 18-month period from January 2019 to June 2020.

The study included patients scheduled for lower-segment caesarean section under subarachnoid block with ASA physical status I or II, encompassing both elective and emergency procedures. Patients were excluded if they refused to provide informed consent for study participation or subarachnoid block, had pregnancy-induced hypertension, valvular heart disease or cardiac arrhythmias, local infection at the injection site, or coagulation disorders.

Sample size calculation was based on hospital audit data for PDPH incidence over a three-month period. Using the formula for single proportion  $n = Z^2P(1-P)/d^2$ , where  $n$  represents the required sample size,  $Z$  equals 2.58 for 99% confidence level,  $P$  equals 0.02 representing 2% PDPH incidence from the institutional audit, and  $d$  equals 0.01 with precision set at half of  $P$  (since  $P$  was less than 10%). The calculated minimum sample size was 1305 patients.

**Conduct of the study.** Following institutional pre-anaesthetic evaluation protocols, written informed consent was obtained for both the anaesthetic procedure and study participation. All demographic data, pre-anaesthetic consultation details, intraoperative parameters, and postoperative information were recorded using standardized anaesthesia charts and study-specific proformas.

Standard monitoring with electrocardiography, non-invasive blood pressure, and pulse oximetry was established in the operating room with baseline parameters recorded. Intravenous access was secured with an 18G cannula, followed by preloading with 500ml Ringer's lactate solution. Subarachnoid block was performed under strict aseptic conditions at L3-L4 or L4-L5 interspaces with patients positioned in sitting or lateral positions. Following local anaesthesia with 2ml of 2% lidocaine, either a 25G or 27G Quincke spinal needle was inserted with bevel orientation laterally, and hyperbaric bupivacaine 0.5% in doses of

10-15mg was administered intrathecally. All procedures were performed by consultant anaesthesiologists or supervised trainees. Intraoperative monitoring included sensory block level assessment and hemodynamic parameters recorded at 3-minute intervals initially, then 5-minute intervals. Hypotension, defined as greater than 20% decrease in baseline systolic blood pressure, was managed with incremental intravenous mephentermine 6mg doses.

Patients were monitored postoperatively in the recovery unit and subsequently in wards for three days, with follow-up continuing telephonically until the fifth postoperative day, as most patients were discharged on day three, while headache onset remains possible until day five. Specific questioning regarding headache symptoms was conducted for all patients, with those reporting headaches undergoing detailed evaluation and follow-up until symptom resolution. The diagnosis of PDPH was made based on clinical history and symptomatology, primarily a characteristic positional headache. Patients readmitted with suspected PDPH were included in follow-up protocols to ensure comprehensive data collection.

Treatment followed institutional protocols, including bed rest, diclofenac 50-75mg administered intramuscularly or intravenously when not contraindicated, 1.5L intravenous fluids, caffeine-containing beverages, paracetamol 1gm administered twice or thrice daily, or opioids as required based on clinical assessment. Epidural blood patch was considered for moderate to severe cases that were unresponsive to conservative management approaches.

**Method of data collection:** A predesigned, pretested proforma was utilized with Part A completed for all study participants and Part B for patients reporting headaches. PDPH was defined according to the International Classification of Headache Disorders criteria [6]. Headache severity was classified using the Lybecker grading system (Table 1) [7]. The contributory factors analyzed in this study included patient age, gravidity status, spinal needle type, number of dural puncture attempts, operator experience level, and dose of bupivacaine administered.

**Table 1: Lybecker classification of PDPH severity**

Grade	Restriction of daily activity	Bedridden status	Associated symptoms	Analgesic requirements
Mild	Slight restriction	Not bedridden	None	Responds well to non-opioid analgesics (e.g., NSAIDs, paracetamol, caffeine)
Moderate	Significant restriction	Bedridden part of the day	May or may not be present	Requires injectable analgesia or opiate derivatives
Severe	Complete restriction	Bedridden all day	Present (e.g., photophobia, tinnitus, vomiting)	Not responsive to conservative management or simple analgesics

**Statistical Analysis** Data tabulation and organization were performed using Microsoft Excel 2016, while comprehensive statistical analysis was conducted using the Statistical Package for Social Sciences (SPSS) version 16.0 (IBM Corp., Chicago, Illinois). The analyzed data were appropriately presented through tables, graphs, and diagrams to facilitate interpretation. Continuous variables, including patient age, headache onset time and bupivacaine dosage, were reported as mean ± standard deviation, whereas categorical variables such as age groups, gravidity, needle gauge, number of puncture attempts, and operator experience were presented as frequencies and percentages.

Statistical significance testing employed chi-square tests to evaluate associations between PDPH and categorical variables, including age groups (<30 years vs  $\geq$  30 years), gravidity status (primigravida vs multigravida), needle size (25G vs 27G), and operator experience (trainees vs consultants with different experience levels). Fisher's exact test was specifically applied when expected cell values were less than five, particularly for examining the relationship between PDPH occurrence and the number of dural puncture attempts (1 vs 2 vs >2 attempts). For continuous variables, the Mann-Whitney U test was utilized to compare bupivacaine dosage between patients who developed PDPH and those who did not. For all comparisons, a value of  $p < 0.05$  was considered statistically significant.

## Results

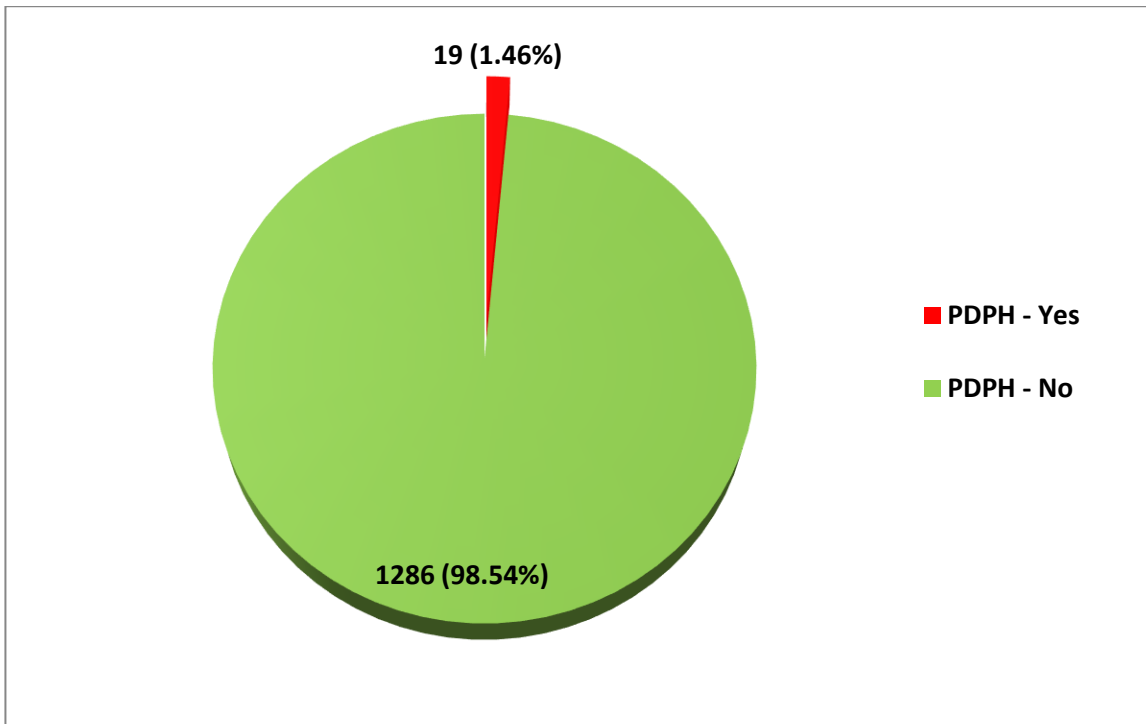
The mean age of the study population was 27.7 ( $\pm$ 4.9) years, with the majority between 20–30 years of age. Approximately 47.1% were primigravidae, and the use of 25G and 27G spinal needles was nearly equally distributed. The subarachnoid block was most commonly performed by trainee anaesthetists, and in the majority of cases (92.7%) it was accomplished in a single attempt (Table 2).

**Table 2: Demographic, obstetric and technique-related characteristics of the study participants (N=1305)**

Characteristics	Categories	Frequency	Percentage (%)
<b>Age*</b>	< 20 years	84	6.5
	20-25 years	400	30.6
	25-30 years	460	35.2
	30-35 years	269	20.7
	> 35 years	92	7.0
<b>Gravida</b>	Primigravida	615	47.1
	Multigravida	690	52.9
<b>Size of spinal needle</b>	25G	662	50.7
	27G	643	49.3
<b>No. of attempts</b>	1	1210	92.7
	2	83	6.4
	>2	12	0.9
<b>Operators</b>	1 <sup>st</sup> year trainee	273	21.0
	2 <sup>nd</sup> year trainee	268	20.5
	3 <sup>rd</sup> year trainee	131	10.0
	Consultant with experience <5 years	202	15.5
	Consultant with experience $\geq$ 5 years	431	33.0

\* Mean ( $\pm$  SD) - 27.7 ( $\pm$ 4.9); Minimum – 17; Maximum – 42

Out of the 1305 women who underwent lower segment caesarean section (LSCS) under subarachnoid block, 25 participants (1.9%) developed post-operative headache, of which 19 cases (1.5%) were diagnosed as post-dural puncture headache (PDPH) (Figure 1).



**Figure 1: Pie diagram showing distribution of study participants according to diagnosis of post-dural puncture headache (PDPH) (N=1305)**

Among the 25 participants who reported post-LSCS headache, 56.0% experienced onset between 24–48 hours of surgery, and 28.0% within the first 24 hours. The headache was predominantly mild in intensity and had a postural nature in most cases: 76.0% reported worsening on sitting or standing and relief on lying down. The most common location was both frontal and occipital (64.0%), and 80.0% reported nausea as an associated symptom (Table 3). None of the patients reported other classical features such as photophobia, tinnitus, hypoacusia, or neck stiffness. Additionally, no participants had a prior history of migraine, chronic headache, neurological deficit, or backache. The duration of headache among the 19 confirmed PDPH cases was 27.2 ( $\pm 11.6$ ) hours on average. All cases were managed conservatively, and none required an epidural blood patch.

**Table 3: Details of headache post-LSCS (N=25)**

Characteristics	Categories	Frequency	Percentage (%)
<b>Onset of headache post-LSCS*</b>	24 hours	7	28.0
	24-48 hours	14	56.0
	48-72 hours	3	12.0
	72-96 hours	1	4.0
<b>Location of headache</b>	Frontal only	3	12.0
	Occipital only	2	8.0

	Generalised	4	16.0
	Both frontal and occipital	16	64.0
<b>Worsening of headache with sitting/standing</b>	Yes	19	76.0
	No	6	24.0
<b>Relief of headache when supine</b>	Yes	19	76.0
	No	6	24.0
<b>Periodicity of headache</b>	Episodic	19	76.0
	Non-episodic	6	24.0
<b>Duration of headache*</b>	<24 hours	10	40.0
	24–48 hours	15	60.0
<b>Severity of headache</b>	Mild	25	100.0
	Moderate	0	0
	Severe	0	0
<b>Treatment of headache</b>	Conservative	25	100
	Epidural blood patch	0	0

\* Mean ( $\pm$  SD) duration - 46.1 ( $\pm$ 17.9)

In the bivariate analysis of factors associated with PDPH (Table 4), no statistically significant association was observed with age ( $p = 0.520$ ), size of spinal needle used ( $p = 0.389$ ), gravida status ( $p = 0.800$ ), operator experience ( $p = 0.615$ ), or dose of bupivacaine administered ( $p = 0.689$ ). However, the number of attempts during the block was significantly associated with the occurrence of PDPH ( $p = 0.030$ ); with the incidence of PDPH being higher when two or more attempts were required (8.3%) as compared to an incidence of 3.6% in the event of two attempts and 1.2% when the block was successful in one attempt.

**Table 4: Factors associated with incidence of PDPH among the study participants (N=1305)**

Parameters	Categories	Total	PDPH (n=19)	No PDPH (n=1286)	p-value <sup>#</sup>
<b>Age</b>	< 30 years	944 (72.3)	12 (1.3)	932 (98.7)	0.520
	$\geq$ 30 years	361 (27.7)	7 (1.9)	354 (98.1)	
<b>Gravida</b>	Primigravida	615 (47.1)	10 (1.6)	605 (98.4)	0.800
	Multigravida	690 (52.9)	9 (1.3)	681 (98.7)	
<b>Size of spinal needle</b>	25 G	662 (50.7)	12 (1.8)	650 (98.2)	0.389
	27 G	643 (49.3)	7 (1.1)	636 (98.9)	

<b>No. of attempts</b>	1	1210 (92.7)	15 (1.2)	1195 (98.8)	0.030*
	2	83 (6.4)	3 (3.6)	80 (96.4)	
	>2	12 (0.9)	1 (8.3)	11 (91.7)	
<b>Operators</b>	Trainees (1st, 2nd, 3rd year)	672 (51.5)	11 (1.6)	661 (98.4)	0.615
	Consultant <5 years exp.	202 (15.5)	2 (1.0)	200 (99.0)	
	Consultant ≥5 years exp.	431 (33.0)	6 (1.4)	425 (98.6)	
<b>Dose of bupivacaine (ml)</b>	--	--	2.56 (± 0.36)	2.61 (± 0.25)	0.689

Values are presented as n (%) or mean (±SD)

# Based on Chi-square test or Fisher Exact test (as applicable) for categorical variables and Mann Whitney U test for continuous variables

\*  $p$ -value < 0.05 was considered statistically significant

## Discussion

The present study revealed an overall incidence of PDPH of 1.5% among 1305 parturients undergoing lower segment caesarean section under subarachnoid block, which is remarkably lower than the rates reported in several contemporary studies. This finding contrasts with a recent meta-analysis that reported a pooled prevalence of PDPH of 23.47% [8], and other studies, including an Ethiopian investigation where the overall incidence was 31.3% [9] and another study reporting rates of 25.7% [10]. The substantially lower incidence observed in our study may be attributed to several methodological and technical factors, including the mixed use of different needle gauges, operator experience distribution, and strict diagnostic criteria employed for PDPH classification.

The demographic profile of our study population, with a mean age of 27.7 years and predominant representation of women aged 20-30 years (65.8%), aligns well with typical obstetric populations undergoing caesarean delivery. Interestingly, our analysis revealed no statistically significant association between age and PDPH occurrence ( $p=0.520$ ), which contradicts some previous studies suggesting younger maternal age as a risk factor for PDPH [11,12]. This age-related susceptibility in pregnant women is attributed to the decreased elasticity of the dura with advancing age, making it less prone to gaping following puncture; as well as elevated estrogen levels, which influence cerebral vascular tone and thereby enhance vascular distension in response to cerebrospinal fluid hypotension [13]. The discordance between our findings and established age-related risk patterns may be explained by the relatively narrow age range in our obstetric population and the overall low incidence of PDPH, which may have limited the statistical power to detect age-related differences.

The absence of a significant association between gravida status and PDPH incidence ( $p = 0.800$ ) in our study is consistent with similar findings in the literature [12,14]. The study by Kassa et al. reported that multiparous women experienced a higher rate of PDPH compared to primiparous women (12.7% vs. 9.7%,  $p = 0.302$ ), without achieving statistical significance [14]. Our findings support the notion that parity alone may not be a determining factor for PDPH development when other technical variables are controlled.

One of the most striking findings of our study was the lack of significant association between spinal needle gauge and PDPH incidence ( $p=0.389$ ), despite the theoretical expectation that smaller gauge needles should result in lower PDPH rates. The incidence was 1.8% with 25G needles compared to 1.1% with 27G needles, a difference that did not reach statistical significance. These finding challenges conventional wisdom and contrast with established literature demonstrating clear benefits of smaller gauge needles. Previous studies have consistently shown higher PDPH rates with larger gauge needles, with some reporting incidence rates of 8.3% with 25G Quincke needles compared to 3.8% with 27G needles [15]. The lack of a significant difference in our study may be attributed to the overall low baseline incidence and the expertise of operators. Our observation aligned with the study by Syed et al. [16], which reported no definite advantage of the 27G Quincke needle over the 25G Quincke needle as far as the incidence of PDPH was concerned.

It is important to acknowledge that the lack of statistical significance between needle gauges in our study may reflect a type II error due to insufficient statistical power. With an overall PDPH incidence of only 1.5% (19 cases), the study may have been underpowered to detect clinically meaningful differences between the 25G and 27G needles. Previous large-scale studies with higher baseline PDPH rates have demonstrated clear advantages of smaller gauge needles, and our findings should not be interpreted as evidence against established practice guidelines recommending finer needles for reducing PDPH risk.

The distribution of cases across different levels of operator experience in our study provides valuable insights into the relationship between technical proficiency and PDPH occurrence. Despite 51.5% of procedures being performed by trainees, no significant association was observed between operator experience and PDPH incidence ( $p = 0.615$ ). This finding suggests that with appropriate supervision and training protocols, the experience level of the primary operator may not be the sole determinant of PDPH risk. However, this result should be interpreted cautiously, as the overall low incidence may have masked subtle differences between experience levels.

The most clinically significant finding in our study was the strong association between the number of lumbar puncture attempts and PDPH occurrence ( $p = 0.030$ ). The incidence dramatically increased from 1.2% with single attempts to 3.6% with two attempts and 8.3% when more than two attempts were required. This finding is consistent with established pathophysiology, as multiple attempts increase the likelihood of larger or multiple dural tears, leading to greater CSF leakage and subsequent PDPH development [12,17]. Our results align with previous studies demonstrating similar patterns. Chekol et al. concluded that multiple attempts were associated with a higher risk of PDPH [8], while Khraise et al. reported that repeated attempts at spinal anesthesia increased the PDPH rate from 4.7% to 10% [18]. This association underscores the importance of technical proficiency and suggests that factors contributing to difficult spinal access, such as anatomical variations, patient positioning, or operator skill, may be more relevant than the absolute level of experience.

The clinical characteristics of PDPH observed in our study align well with classical descriptions in the literature. The predominant onset between 24-48 hours post-procedure (56.0% of cases), with an additional 28.0% presenting within the first 24 hours, is consistent with the typical temporal pattern of PDPH development [2,3]. The postural nature of the headache, with 76.0% of patients reporting worsening on sitting or standing and improvement when supine, represents the pathognomonic feature of PDPH and supports the accuracy of our diagnostic criteria. The location pattern, with 64.0% of patients experiencing both frontal and occipital pain, reflects the typical distribution associated with intracranial hypotension secondary to CSF loss.

Notably, all cases in our study were classified as mild in severity, and none required epidural blood patch therapy. This contrasts significantly with other studies reporting moderate to severe PDPH requiring interventional management [8-10]. The uniformly mild severity in our study may reflect early recognition and conservative management, different pain assessment scales, or genuinely less severe presentations, possibly related to technical factors or patient characteristics.

## Limitations and strengths

This study has some important limitations that warrant consideration. First, the telephonic follow-up methodology employed for patients discharged on day three may have introduced information bias. Patients with mild symptoms may have underreported or failed to recognize PDPH, potentially leading to underestimation of the true incidence. Second, the remarkably low event rate substantially limited the statistical power to detect associations with traditional risk factors such as needle gauge, age, and operator experience. Third, the single-centre design limits the generalizability of findings to other healthcare settings. Moreover, the observational nature of the study precludes causal inferences, and unmeasured confounding factors such as specific operator techniques, patient hydration status, or post-operative positioning may have influenced outcomes.

However, the strength of the study lies in the fact that it is one of the few prospective observational studies focusing on the incidence and profile of PDPH in post-caesarean patients under spinal anaesthesia, providing valuable data from a large sample size, thereby enhancing the validity of the results. Additionally, the detailed recording of technical variables—including needle size, number of attempts, and operator experience—allowed for meaningful analysis of risk factors, contributing to a better understanding of potentially modifiable contributors to PDPH.

## Practical recommendations

Based on our findings, we propose the following evidence-based recommendations to improve first-attempt success rates: (1) implementing simulation-based training programs that emphasize proper patient positioning, anatomical landmark identification, and standardized needle insertion techniques; (2) establishing competency-based assessment protocols before allowing independent practice; (3) ensuring graded supervision with immediate senior support available when initial attempts are unsuccessful; and (4) conducting regular institutional audits of first-attempt success rates to identify areas for targeted improvement. These training protocols should be integrated into residency curricula and continuing medical education programs, as our data suggest that technical proficiency in achieving successful spinal anaesthesia on the first attempt may be more crucial than other traditionally recognized risk factors in preventing this common complication in obstetric anaesthesia practice.

## Conclusion

This large prospective observational study demonstrated a remarkably low incidence of post-dural puncture headache following subarachnoid block for caesarean section. The headache was predominantly mild, postural, and self-limiting, with all cases responding well to conservative management. While traditional risk factors such as age, gravida status, needle gauge, and operator experience showed no significant association with PDPH occurrence in our study, the number of lumbar puncture attempts emerged as the most critical determinant. These findings highlight the importance of technical precision during spinal anaesthesia to minimise the risk of PDPH and improve maternal outcomes in the post-operative period. The study provides valuable real-world evidence that technical proficiency in achieving successful spinal anaesthesia on the first attempt may be more crucial than other traditionally recognized risk factors in preventing this common complication in obstetric anaesthesia practice.

## Data availability statement

The datasets used and analysed during the current study are available from the corresponding author on reasonable request.

## References

1. Erol DD, Aytac I. Current anesthesia for Cesarean Section. *Clin J Obstet Gynecol.* 2018; 1: 061-066. doi: 10.29328/journal.cjog.1001011
2. Turnbull DK, Shepherd DB. Post-dural puncture headache: pathogenesis, prevention and treatment. *Br J Anaesth.* 2003;91(5):718-29. doi: 10.1093/bja/aeg231
3. Alatni RI, Alsamani R, Alqefari A. Treatment and Prevention of Post-dural Puncture Headaches: A Systematic Review. *Cureus.* 2024;16(1):e52330. doi: 10.7759/cureus.52330
4. Choi PT, Galinski SE, Takeuchi L, Lucas S, Tamayo C, Jadad AR. PDPH is a common complication of neuraxial blockade in parturients: a meta-analysis of obstetrical studies. *Can J Anaesth.* 2003;50(5):460-9. doi: 10.1007/BF03021057
5. Kwak KH. Postdural puncture headache. *Korean J Anesthesiol.* 2017;70(2):136-143. doi: 10.4097/kjae.2017.70.2.136
6. Headache Classification Committee of the International Headache Society (IHS). The International Classification of Headache Disorders, 3rd edition (beta version). *Cephalalgia.* 2013 Jul;33(9):629-808. doi: 10.1177/0333102413485658
7. Lybecker H, Djernes M, Schmidt JF. Postdural puncture headache (PDPH): Onset, duration, severity, and associated symptoms. An analysis of 75 consecutive patients with PDPH. *Acta Anaesthesiol Scand* 1995;39:605–612. doi: 10.1111/j.1399-6576.1995.tb04135.x
8. Chekol B, Yetneberk T, Teshome D. Prevalence and associated factors of post-dural puncture headache among parturients who underwent cesarean section with spinal anesthesia: A systematic review and meta-analysis, 2021. *Ann Med Surg (Lond).* 2021;66:102456. doi: 10.1016/j.amsu.2021.102456
9. Ferede YA, Nigatu YA, Agegnehu AF, Mustofa SY. Incidence and associated factors of post-dural puncture headache after cesarean section delivery under spinal anesthesia in University of Gondar Comprehensive Specialized Hospital, 2019, cross-sectional study. *International Journal of Surgery Open.* 2021;33:100348. doi: 10.1016/j.ijso.2021.100348
10. Girma T, Mergia G, Tadesse M, Assen S. Incidence and associated factors of post-dural puncture headache in cesarean section done under spinal anesthesia 2021 institutional-based prospective single-armed cohort study. *Ann Med Surg (Lond).* 2022;78:103729. doi: 10.1016/j.amsu.2022.103729
11. Al-Hashel J, Rady A, Massoud F, Ismail II. Post-dural puncture headache: a prospective study on incidence, risk factors, and clinical characterization of 285 consecutive procedures. *BMC Neurol.* 2022;22(1):261. doi: 10.1186/s12883-022-02785-0
12. Weji BG, Obsa MS, Melese KG, Azeze GA. Incidence and risk factors of postdural puncture headache: prospective cohort study design. *Perioper Med (Lond).* 2020;9(1):32. doi: 10.1186/s13741-020-00164-2
13. Amorim JA, Gomes de, Valença MM. Post-dural (post-lumbar) puncture headache: risk factors and clinical features. *Cephalalgia.* 2012;32:916–923. doi: 10.1177/0333102412453951
14. Kassa MW, Bedada AG. The Incidence of Post-Dural Puncture Headache and Associated Factors Among Mothers Undergoing Cesarean Section at the Largest Tertiary Teaching Hospital in Botswana. *European Journal of Medical and Health Sciences.* 2025;7(3):25-31. doi: 10.24018/ejmed.2025.7.3.2301
15. Shaikh JM, Memon A, Memon MA, Khan M. Post dural puncture headache after spinal anaesthesia for caesarean section: a comparison of 25 g Quincke, 27 g Quincke and 27 g Whitacre spinal needles. *J Ayub Med Coll Abbottabad.* 2008;20(3):10-3. PMID: 19610505.
16. Syed S, Qayoom N, Naaz S, Mushtaq K, Mir AH, Bijli AH, Ali Z. Comparison of post-dural puncture headache-incidence and severity in obstetric patients after spinal anesthesia for caesarean section with 25G and 27G quincke needle. *Int J Res Med Sci.* 2017;5(2):596-600. doi: 10.18203/2320-6012.ijrms20170158
17. Uppal V, Russell R, Sondokoppam RV, Ansari J, Baber Z, Chen Y, et al. Evidence-based clinical practice guidelines on postdural puncture headache: a consensus report from a multisociety international working group. *Reg Anesth Pain Med.* 2024;49(7):471-501. doi: 10.1136/rapm-2023-104817