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INCIDENCE OF POST DURAL PUNCTURE HEADACHE: A COMPARATIVE ANALYSIS BETWEEN MEDIAN VERSUS PARAMEDIAN APPROACH TO SUB-ARACHNOID SPACE IN PATIENTS UNDERGOING ELECTIVE CESAREAN SECTION

Original Research

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Acknowledgement: The authors gratefully acknowledge the support of the LRH/PIHMS Ethics and Research Committee for approving this study.

Conflict of Interest: None

Grant Support & Financial Support: None

ABSTRACT

Background: Post-dural puncture headache (PDPH) is a frequent complication following spinal anesthesia, especially among obstetric patients undergoing cesarean section. This condition is more prevalent in younger females and results from cerebrospinal fluid leakage due to dural puncture. Spinal anesthesia can be administered through either the median or paramedian approach. Understanding the comparative impact of these techniques on PDPH incidence is vital for optimizing patient care in obstetric anesthesia.

Objective: To assess and compare the incidence of PDPH in obstetric patients receiving spinal anesthesia via the median versus paramedian approach during elective cesarean sections.

Methods: This prospective cohort study was conducted at Lady Reading Hospital (LRH), Peshawar, after obtaining ethical approval from the LRH/PIHMS Ethics Committee. A total of 216 obstetric patients scheduled for elective cesarean sections under spinal anesthesia were enrolled following informed consent. Patients were equally divided into two groups: 108 received the median approach and 108 received the paramedian approach. Participants were monitored for PDPH symptoms over a 72-hour postoperative period. Data collection was carried out using a structured questionnaire and analyzed using SPSS version 27. The chi-square test was used for statistical analysis, with a p-value of <0.05 considered significant.

Results: Out of 216 patients, 37 (17.1%) developed PDPH. Among these, 24 patients (22.2%) were from the median group and 13 (12.0%) from the paramedian group. The difference in PDPH incidence between the two groups was statistically significant ($p = 0.047$). The majority of PDPH cases (n=23, 10.65%) occurred within the first 48 hours. PDPH was most frequent in patients aged 18–27 years (n=17, 7.87%).

Conclusion: The study concluded that the median approach is associated with a significantly higher incidence of PDPH compared to the paramedian approach. These findings support the clinical advantage of adopting the paramedian approach in obstetric spinal anesthesia to reduce PDPH risk.

Keywords: Cesarean Section, Obstetric Anesthesia, Paramedian Approach, Post-Dural Puncture Headache, Spinal Anesthesia, SPSS, Young Adults.

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INTRODUCTION

Cesarean section is one of the most frequently performed surgical procedures worldwide, conducted either electively or emergently. Over the past decades, the global rate of cesarean deliveries has risen significantly, driven by both medical indications and non-medical factors such as maternal request, medicolegal concerns, and evolving obstetric practices (1). Anesthesia is a pivotal component of cesarean delivery, directly influencing maternal safety and neonatal outcomes. Regional anesthesia, particularly spinal anesthesia, has emerged as the preferred technique over general anesthesia, owing to its superior safety profile, decreased maternal morbidity, and better neonatal Apgar scores. Additionally, it avoids airway manipulation and reduces risks of aspiration and delayed maternal recovery (2–4) Spinal anesthesia entails the administration of a local anesthetic into the subarachnoid space, generally below the level of the L2 vertebra (5). This technique enables the mother to remain awake during delivery, facilitating early maternal-infant bonding while offering reliable surgical anesthesia. Despite its advantages, spinal anesthesia is not without complications. One of the most commonly encountered adverse effects is post-dural puncture headache (PDPH), which typically manifests within 48 to 72 hours after the procedure and is often orthostatic in nature (6). Accompanying symptoms may include neck stiffness, photophobia, tinnitus, and nausea, all of which can significantly impair postpartum recovery (7). The pathophysiology of PDPH is believed to involve persistent leakage of cerebrospinal fluid (CSF) from the dural puncture site, resulting in intracranial hypotension or compensatory cerebral vasodilation (8,9). Identified risk factors for PDPH include female gender, younger age, larger gauge needles, and a personal history of the condition (10).

Technological advancements have helped mitigate these risks, particularly through the use of pencil-point spinal needles like the Whitacre and Sprotte designs, which reduce tissue trauma and lower the incidence of CSF leakage (11). Spinal anesthesia can be administered via two main anatomical approaches: the median and the paramedian techniques. The median approach is traditionally more common, offering straightforward needle advancement through the interspinous ligament. However, the paramedian approach may offer advantages in certain patient populations, such as those with obesity or spinal deformities, by circumventing midline anatomical barriers (12). Though both techniques aim to achieve the same anesthetic endpoint, they differ in their trajectory and tissue planes traversed (13). Recent literature has explored the association between the chosen technique and the incidence of PDPH. While some studies suggest that the paramedian approach may be associated with a slightly lower risk of PDPH, findings have been inconsistent and often lack statistical significance (14–16). Given the ongoing uncertainty in clinical outcomes between these techniques, there is a need for focused research evaluating their impact on postoperative complications. Optimizing the approach to spinal anesthesia in obstetric patients is essential to enhancing maternal satisfaction and minimizing postpartum morbidity. Therefore, the primary objective of this study is to assess and compare the incidence of post-dural puncture headache in patients undergoing elective cesarean section when utilizing the median versus paramedian approach to the subarachnoid space.

METHODS

This comparative cross-sectional study was conducted over a period of six months at the Gynecology Operation Theatres and inpatient wards of Lady Reading Hospital, MTI Peshawar. The study aimed to evaluate and compare the incidence of post-dural puncture headache (PDPH) following the administration of spinal anesthesia via two different approaches—median and paramedian—in women undergoing elective cesarean section. A total of 216 pregnant women scheduled for elective cesarean delivery under spinal anesthesia were enrolled using a non-probability convenience sampling technique. The participants were evenly allocated into two groups: Group A (n=108), in which the spinal block was administered using the median approach, and Group B (n=108), where the paramedian approach was employed. Eligible participants included women aged between 18 and 47 years with normal spinal anatomy who consented to participate and agreed to follow-up for PDPH assessment. Patients were excluded if they had known spinal deformities, were on psychiatric medications, had a previous history of PDPH or migraine, presented with coagulation disorders, had hypersensitivity to local anesthetic agents, or fell outside the specified age range. These inclusion and exclusion criteria were established to minimize confounding factors that could influence the development of PDPH or affect anesthesia administration. Ethical approval was obtained from the institutional review board of Lady Reading Hospital prior to study initiation. All participants were briefed about the purpose and procedures of the study, and informed written consent was obtained before enrollment. Data collection was performed through direct patient interviews and structured, pretested questionnaires. Follow-up was conducted to monitor and record the occurrence of PDPH,

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with a focus on early identification based on characteristic symptoms. Data were entered and analyzed using IBM SPSS Statistics version 27. Descriptive statistics were used to summarize baseline characteristics, and the chi-square test was applied to compare the incidence of PDPH between the two groups. Statistical significance was determined at a p-value of <0.05. The study ensured confidentiality and adhered to ethical principles in the treatment and handling of participants.

RESULTS

A total of 216 patients scheduled for elective cesarean section under spinal anesthesia were included in the analysis. The patients were classified as ASA physical status I or II. They were equally distributed into two groups: 108 patients received spinal anesthesia via the median approach and 108 via the paramedian approach. The age distribution revealed that 101 patients (46.8%) were between 28–37 years, 92 patients (42.6%) were aged 18–27 years, and 23 patients (10.6%) were aged 38–47 years, indicating a predominance of younger reproductive-age women in the study population. Post-dural puncture headache (PDPH) was reported in 37 out of 216 patients, representing an overall incidence of 17.1%, whereas 179 patients (82.9%) did not report any symptoms suggestive of PDPH. When comparing techniques, PDPH was observed in 24 patients (22.2%) who underwent the median approach and 13 patients (12.0%) who received the paramedian approach. The difference was statistically significant with a p-value of 0.047, indicating a higher incidence of PDPH in the median group. Additionally, 63 patients (29.17%) complained of headaches following spinal anesthesia, irrespective of classification as PDPH, while 153 patients (70.83%) remained symptom-free. This reflects the broader range of post-spinal headaches beyond PDPH criteria. Regarding the timing of symptom onset among those diagnosed with PDPH, 23 patients (10.65%) reported headache symptoms within the first 48 hours post-procedure, while 14 patients (6.48%) developed symptoms between 48 and 72 hours. This suggests that the early postoperative period is critical for monitoring PDPH. An age-wise breakdown of PDPH occurrence showed the highest frequency in younger patients: 17 patients (7.87%) were in the 18–27 age group, followed by 14 patients (6.48%) in the 28–37 age range, and only 6 patients (2.78%) in the 38–47 group. These findings support existing evidence that younger age is associated with an increased risk of PDPH.

Table 1: Frequency of Post-Dural Puncture Headache (PDPH) among Study Participants

PDPH Status	Frequency	Percentage
Yes	37	17.1
No	179	82.9
Total	216	100

Table 2: Incidence of PDPH in Median vs. Paramedian Approach

PDPH Status	Median	Paramedian	p-value
Yes	24	13	0.047
No	84	95	
Total	108	108	

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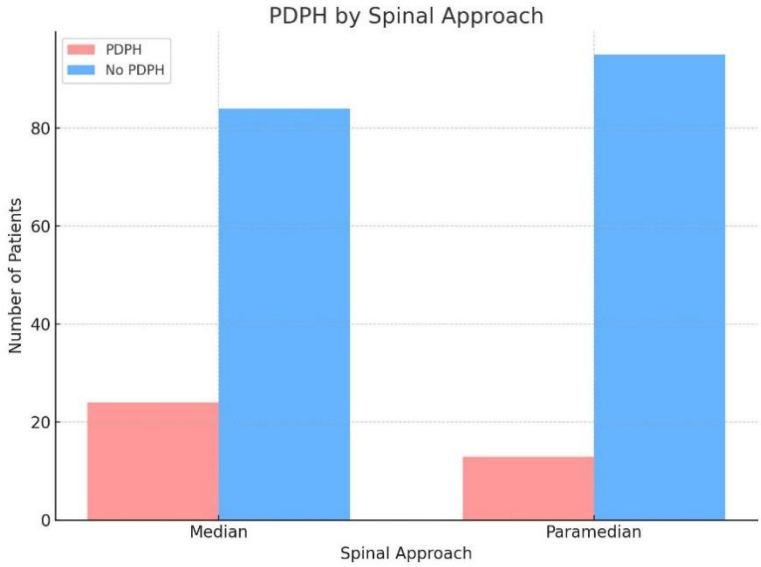


Figure 1 FDPH by Spinal Approach

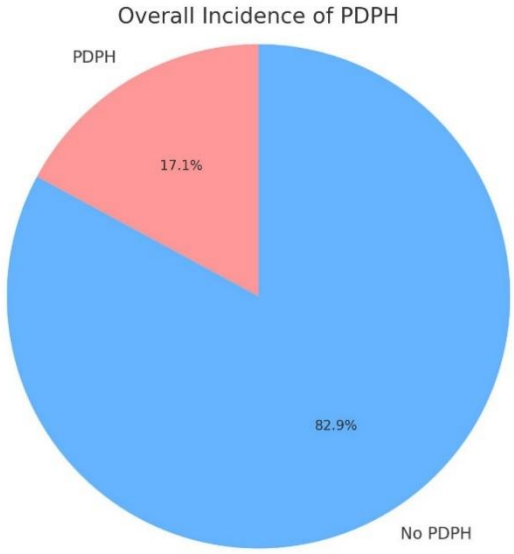
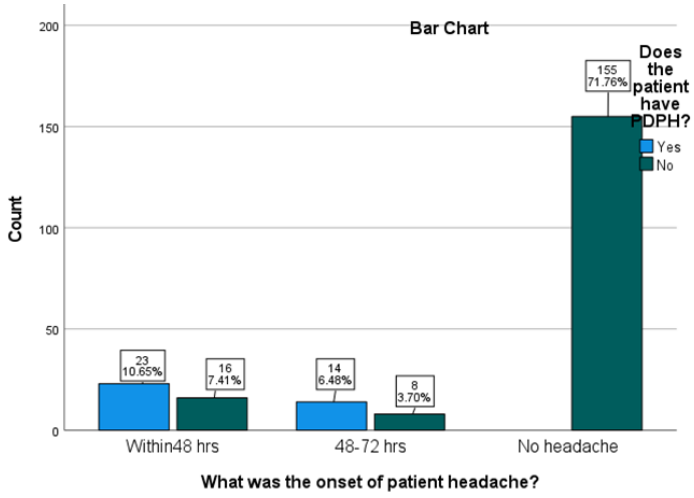
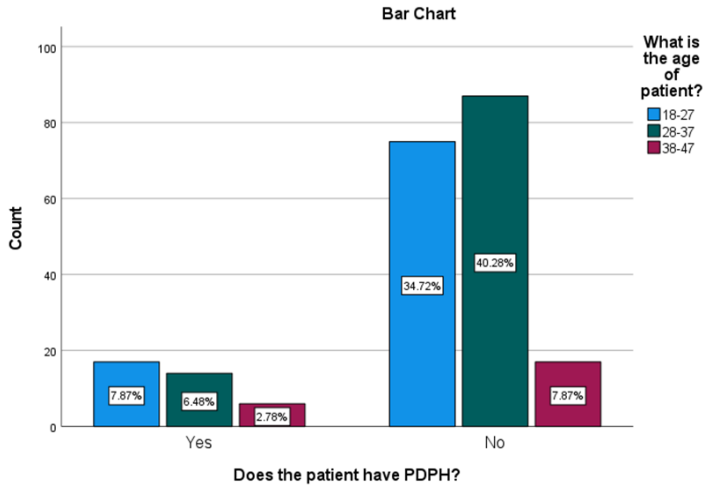


Figure 2 Overall Incidence of PDPH





DISCUSSION

The present study investigated the incidence and contributory factors associated with post-dural puncture headache (PDPH) among obstetric patients undergoing elective cesarean section under spinal anesthesia. An overall PDPH incidence of 17.1% was identified, aligning with previous reports that have documented rates ranging between 15% and 20% among similar obstetric cohorts (17). This consistency with the existing literature supports the external validity and reliability of the study findings and highlights PDPH as a persistent postoperative concern in obstetric anesthesia. A significant observation in this study was the reduced incidence of PDPH among patients receiving spinal anesthesia via the paramedian approach compared to those who underwent the median technique. The incidence in the paramedian group was 12.0%, notably lower than the 22.2% recorded in the median group, with the difference reaching statistical significance (p=0.047). This finding is in accordance with existing evidence that associates the paramedian approach with reduced dural traction and tissue disruption, potentially leading to a lower likelihood of CSF leakage and subsequent headache. The anatomical trajectory of the paramedian route, bypassing midline structures and offering more direct access to the subarachnoid space, may account for its relative safety profile in this context (18,19). Such results have clinical implications in terms of procedural selection

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and anesthetic technique optimization, especially in high-risk populations. Age was another critical factor influencing PDPH incidence. The highest frequency of PDPH was observed among younger patients, particularly in the 18–27 year age group. This trend aligns with the physiological understanding that younger individuals possess more elastic dura mater and relatively higher cerebrospinal fluid pressures, increasing susceptibility to CSF hypotension and resultant headache after dural puncture (20). The distribution of PDPH across age groups in this study reinforces the need for risk stratification and tailored anesthetic approaches in younger obstetric patients to mitigate postoperative complications. The temporal profile of PDPH in the studied population was also consistent with established clinical patterns. The majority of cases emerged within 48 hours following the procedure, underscoring the early postoperative period as a critical window for surveillance and intervention. This timing aligns with documented onset patterns reported in earlier studies, where PDPH typically develops between 12 and 72 hours post-spinal anesthesia (21,22). Such findings emphasize the importance of early recognition and prompt management to reduce patient discomfort and hospital stay duration. Interestingly, while 29.17% of patients reported headaches post-procedure, only 17.1% fulfilled diagnostic criteria for PDPH. This highlights the need to differentiate true PDPH from other etiologies of headache in the postoperative period. Factors such as psychological stress, sleep deprivation, dehydration, and surgical anxiety may contribute to non-PDPH headaches, a distinction well-documented in clinical anesthesia literature (8,23). Accurate classification is essential for guiding appropriate treatment strategies and avoiding unnecessary interventions.

One of the strengths of this study lies in its focus on a well-defined obstetric population undergoing elective cesarean sections, thereby limiting variability due to emergency procedural factors. The equal distribution of participants across the two anesthetic approaches further adds to the comparative reliability of the results. However, the study is not without limitations. The use of a non-probability convenience sampling method introduces the potential for selection bias, which may affect generalizability. Moreover, the absence of blinding and randomization could contribute to observer and procedural bias. Another notable limitation is the lack of control for needle gauge and type, variables known to significantly impact PDPH incidence. These procedural factors should have been standardized or at least reported to enhance methodological rigor. Additionally, while the study identified incidence and early onset, it did not assess PDPH severity, duration, or its impact on postpartum recovery metrics such as mobilization, breastfeeding initiation, or length of hospital stay. Future research should incorporate these parameters to provide a more comprehensive understanding of PDPH burden. The potential role of needle insertion angle, bevel orientation, and the anesthetist's experience also remains unexplored and warrants further investigation. Despite these limitations, the findings offer meaningful insights into procedural optimization for spinal anesthesia in obstetric patients. The observed reduction in PDPH incidence with the paramedian approach supports its consideration as a preferred technique, particularly in younger women who are inherently at higher risk (24). The recommendation to adopt non-traumatic spinal needles and individualized patient assessment can serve to further minimize PDPH and enhance maternal recovery outcomes. Collectively, the evidence reinforces the critical role of anesthetic technique in shaping patient experience and supports ongoing refinement of best practices in obstetric anesthesia.

CONCLUSION

This study concluded that the choice of spinal anesthesia technique significantly influences the incidence of post-dural puncture headache in obstetric patients undergoing elective cesarean section. The median approach was associated with a higher occurrence of PDPH compared to the paramedian approach, particularly among younger women. Most cases presented within the early postoperative period, reinforcing the need for vigilant monitoring during this critical timeframe. These findings emphasize the importance of technique selection in minimizing postoperative complications and enhancing maternal comfort. Incorporating the paramedian approach in routine obstetric anesthesia practice may serve as a practical strategy to reduce PDPH incidence and improve patient outcomes.

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AUTHOR CONTRIBUTION

Author	Contribution
Syed Numan Shah*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Aiman	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Junaid Khan	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Saba Gul	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Zabih Ullah	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Shahid Ullah	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published
Ahmad Ullah	Contributed to study concept and Data collection Has given Final Approval of the version to be published
Muhammad Ishaq	Writing - Review & Editing, Assistance with Data Curation

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