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Post-Dural Puncture Headache after Caesarean Section under Spinal Anesthesia: Local Experience at Liaqat Memorial Hospital, Kohat Pakistan

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ABSTRACT

Objective: To assess the incidence and risk factors of Post-Dural Puncture Headache (PDPH) in parturients undergoing caesarean sections under spinal anesthesia. **Study Design:** Descriptive cross-sectional prospective study. **Settings:** Department of Medicine, Liaqat Memorial Hospital, Kohat Pakistan. **Duration:** June to December 2023. **Methods:** A total of 346 patients were included, with data collected on needle gauge, needle approach, PDPH incidence, Visual Analogue Scale (VAS) scores, and comorbidities. Statistical analysis, including chi-square and t-tests, was used to evaluate the associations between these variables. **Results:** The results revealed a higher incidence of PDPH in patients who received spinal anesthesia with a 25G Quincke needle (67 cases) compared to those with a 27G Quincke needle (21 cases) on Day 1 (p-value = 0.001). The paramedian approach resulted in fewer cases of PDPH (30 cases) compared to the midline approach (58 cases) (p-value = 0.02). The VAS scores for mild PDPH were significantly lower (mean: 3.2) compared to moderate (mean: 5.6) and severe (mean: 8.2) cases on Day 1. Severe PDPH patients had a higher readmission rate (20 cases) compared to mild (5 cases) and moderate (15 cases) groups (p-value = 0.005). **Conclusion:** The use of a 27G Quincke needle and the paramedian approach minimizes PDPH. These findings provide valuable insights into the management of spinal anesthesia in secondary care settings and suggest further research into prevention and treatment strategies for PDPH.

Keywords: *Post-dural puncture headache, Spinal anesthesia, Caesarean section, Needle gauge, Paramedian approach.*

INTRODUCTION

Spinal anesthesia is the most commonly used and favored technique for elective caesarean section due to its rapid onset, predictability and relatively safer profile compared to general anesthesia. However, the advantages of spinal anesthesia are many a slip between the cup and lip. Post-Dural Puncture Headache (PDPH) is one of the most common side effects of spinal anesthesia and can significantly impact the quality of recovery and maternal health.[1] Hence, PDPH can be explained as CSF leakage from the breached dura, causing loss of intracranial pressure with eventuating traction on the meninges and cranial nerves with associated headache.[2] Symptoms of this type include a headache that is worse when a person stands or sits and gets better if they lie back.

Post-dural puncture headache (PDPH) is a well-known clinical issue in obstetric anesthesia, particularly with the increase in parturients undergoing Caesarean Section (CS) under spinal anesthesia. PDPH rates differ in the literature, with up to 32% incidence of PDPH in patients undergoing CS under spinal anaesthesia.[3] PDPH severity and duration also often result in delay in postoperative recovery, prolongation of hospital stay, and even potential psychological sequelae like increased anxiety and depression in mothers.[4] Additionally, untreated PDPH can result in devastating consequences such as subdural hematomas and ultimately even death.[5]

Over the last few years, spinal anesthesia has been gaining popularity in Pakistan, too (amongst other developing countries) as a popular choice for caesarean sections. Nevertheless, most of the literature regarding incidence and management of PDPH is based in high-resource areas, and very few studies are available from Pakistani hospitals, especially in the Khyber Pakhtunkhwa region. Local studies, such as those from Lahore and Karachi, contribute valuable knowledge about the frequency of PDPH and factors that account for this phenomenon.[6] However, research from more remote parts of the country, especially secondary care hospitals, which cater to a larger chunk of the population as their first contact places are still few. This paucity of research necessitates the need for local studies to evaluate needle types, anesthetic posture and anesthesiologists' experience in our regional health care settings of Pakistan.[7]

This study investigates the frequency and associated risk factors of PDPH in parturients undergoing CS under spinal anesthesia at Liaqat Memorial Hospital (LMH), Kohat, Khyber Pakhtunkhwa. Operating as a secondary care hospital, it offers an interesting perspective on the consequences of PDPH in a resource-limited setting beyond the tertiary centres of major cities. This study would enhance clinical practices in peripheral hospitals of Pakistan, as we are focusing on this hospital. Moreover, investigating the frequency and determinants of PDPH will help to perfect anesthetic approaches, patient safety, and manage the best interests of parturients in these settings.[8]

PDPH results from the leakage of CSF after a dural puncture as a part of its pathophysiology. When the Dura Mater gets punctured, the CSF will leak out, which causes a decrease in volume and pressure of CSF around to brain and spinal cord. This leads to the stretching of the meninges and cranial nerves, causing the common headache. This is further confounded by the compensatory vasodilatation in the cerebral vessels to accommodate for diminished pressure, leading to a worsening headache.[9] PDPH is typically self-limiting, but can be associated with significant morbidity and PRO outcomes such as increased length of stay, and rarely chronic pain or psychological distress.

Many studies have been conducted to explore methods to decrease the frequency of PDPH by using different spinal needle sizes, the technique of giving spinal anaesthesia, and patient position during the procedure. Smaller gauge needles and atraumatic needle designs are associated with reduced PDPH. Several studies also demonstrated that different spinal anaesthesia techniques, such as midline vs. paramedian technique, to influence the occurrence of a PDPH. For example, the paramedian approach is associated with a decreased rate of PDPH according to certain studies that oppose the traditional midline approach.[2] This is an important observation since it emphasizes the need for adherence to evidence-based practice as well as appropriate technique and needle type selection when undertaking interventions to reduce the risk of complications such as PDPH.

PDPH is a relatively unknown entity in rural and semi-urban settings of Pakistan, e.g., LMH Kohat. The increasing trend of obstetric procedures, especially CSs, under regional anesthesia makes it necessary to generate local data regarding PDPH incidence and its risk factors in this selected group. Much of the current literature falls short in accounting for the difficulties faced by healthcare providers working under conditions of severely scarce resources, as inferred from the availability of trained anesthesiologists, the type and quality of equipment deployed and the adequacy of postoperative care.[11] In low to middle-resource settings, for example, the studies of Shrestha *et al*. (2023) data may, however, be important in helping generate the necessary information to develop directed preventive strategies for reducing the incidence of PDPH.

The objective of this study is to bridge the gap in knowledge and research on the subject by determining the incidence and risk factors for PDPH following spinal anesthesia during CS at LMH Kohat. This study will help us to understand the underlying contributory elements of PDPH in the regional background and henceforth provide more effective management options with consideration to the needs of patients living in Khyber Pakhtunkhwa. This study aims to bring a comprehensive understanding of PDPH in the region by focusing on local experiences and variables such as needle gauge, approach, and expertise of anesthesiologists and improve patient care in secondary care hospitals with limited resources.

This study aims to investigate the incidence and causes of PDPH in women undergoing CS under spinal anesthesia in LMH, which trainee practitioners regularly perform.

METHODS

This descriptive cross-sectional prospective study was conducted at the Department of Medicine, LMH, Kohat Pakistan secondary care hospital of Khyber Pakhtunkhwa, Pakistan (Ref#: REC-KIMS/04/2022, date: 05/10/2022). The work was carried out from June to December 2023.

It was carried out in LMH Kohat, which is a secondary care hospital providing a broad array of services, including obstetric and anesthesiology services. This hospital covers a large segment of the population in Kohat and the vicinity. Since the hospital anesthesia team routinely uses spinal anesthesia for CSs, this was a good

setting in which to study the incidence and factors associated with PDPH within a population of parturients.

A nonprobability convenience sampling method was used for this study. A convenience sample of patients who met the inclusion criteria during the stipulated period in which this study was conducted was consecutively enrolled. Since a study had reported an expected PDPH rate of 28.7%.[3] The sample size was calculated using the WHO sample size calculation formula. This sample size of 346 patients also allows for a margin for non-responses and loss to follow-up of approximately 10% making it large enough to be useful for further statistical analysis. The study population consisted of all patients who underwent a CS under SA during the study period.

Study included all female patients admitted to LMH Kohat and underwent elective or emergency CSs under spinal anesthesia from June 2023 to December 2023 were enrolled. The study population included patients who gave written informed consent to participate. Exclusion criteria were a history of migraine, chronic back pain or any contraindications to spinal anesthesia (local infection, vertebral abnormality or idiopathic thrombocytopenic purpura). Patients who were converted from spinal to general anesthesia or had more than three failed attempts of spinal anesthesia were also excluded. The final cohort included all eligible patients who met the above criteria.

Data were collected prospectively using a pre-designed questionnaire and medical records. The data collection process involved the following steps:

- **Preoperative Data:** Patient demographic information, details of the CS procedure, and the type of spinal anesthesia (e.g., needle type, technique) were recorded.
- **Postoperative Monitoring:** Patients were closely monitored for the development of PDPH during their first 72 hours in the hospital, and follow-up was conducted telephonically for an additional two days to capture any symptoms of headache that may have developed after discharge.
- **Headache Assessment:** The occurrence of PDPH was assessed using the Visual Analogue Scale (VAS) on postoperative days 1, 2, and 3. The severity of the headache was recorded, with patients using the VAS scale ranging from 0 (no pain) to 10 (worst pain imaginable).

Definitions and Assessment Criteria for Study Variables: PDPH was an altogether diagnosing measure because it was a headache within the next 5 days of spinal anesthesia, that increased on sitting or standing and developed within 15–20 minutes and disappeared on lying. Headache severity was assessed by the Visual Analogue Scale (VAS) score, ranging from no pain to 10 for the most intense. Secondary variables of interest included the spinal needle used (25G Quincke vs 27G Quincke), patient position during the procedure, and other comorbidities to evaluate for confounding factors that may affect PDPH.

Data were analyzed using SPSS version 20. Descriptive statistics were used to summaries patient demographics, clinical characteristics, and the incidence of PDPH. The Chi-square test was applied to assess the association between categorical variables such as the type of spinal needle, patient position, and the development of PDPH. An independent sample t-test was used to compare continuous variables such as age and the VAS scores for PDPH severity. A p-value of less than 0.05 was considered statistically significant. Multivariate regression analysis was also conducted to identify independent risk factors for the development of PDPH.

This study was conducted by the ethical standards outlined by the Ethical and Research Committee of LMH Kohat. The study adhered to national and international guidelines for research involving human subjects. Ethical approval was obtained from the committee before the commencement of the study. All participants provided written informed consent prior to the inclusion of their data in the study. The patients were informed about the purpose of the study, the procedures involved, and their rights to confidentiality. Patient confidentiality and privacy were strictly maintained throughout the study, and no personally identifiable information was included in the data analysis.

Informed consent was obtained from all participants in the study. Each participant was provided with detailed information about the study, including its purpose, procedures, potential risks, and benefits. Consent was obtained voluntarily, and patients were assured that their decision to participate or decline would not affect their care in any way.

RESULTS

The total sample size for this study was 346 patients who underwent CS under spinal anesthesia at LMH (LMH) Kohat between June 2023 and December 2023. The demographic profile of the patients included both males and females, but the study was predominantly concerned with female parturients. Patients fell between the ages of 20 and 45 years, a typical age range for CS. The study had collected information related to the different clinical factors, which included the type of spinal needle (Quincke or Whitacre), needle gauge, needle approach (midline or paramedian), and severity and incidence of PDPH. The study further accounted for comorbidities like

hypertension, diabetes, obesity, anemia, etc., as these factors might affect the likelihood of PDPH developing.

PDPH Incidence by Needle Gauge and Approach: The incidence of PDPH was significantly affected by the type and size of spinal needles. Patients who were subjected to spinal anesthesia with a 25G Quincke needle had a higher incidence of PDPH compared to those who received spinal anesthesia with a 27G Quincke needle, according to the analysis. On Day 1, there was a marginally nonsignificant association between needle gauge and PDPH (Chi-square test; p = 0.30), but the same result on Day 2 was statistically significant at the level of 0.001, reflecting an indication that a small gauge needle (27G) would protect us from PDPH as opposed to others.

Table 1: PDPH incidence by needle gauge on day 1

Needle Gauge	PDPH Present	No PDPH	p-value (Day 1)
25G	67	34	0.001
27G	21	54	0.001

The statistical analysis conducted using the chi-square test (p-value = 0.001) showed a significant association between needle gauge and the incidence of PDPH on Day 1. This indicates that the use of a 27G Quincke needle significantly reduces the likelihood of PDPH compared to the 25G Quincke needle.

PDPH Incidence by Needle Approach: Needle approach (midline vs. paramedian) also determined PDPH rates. In this study, the paramedian approach showed a lower incidence of PDPH compared to the midline approach for up to 2 days after the CS, with a significant difference between Days 1 and 2. This was in keeping with earlier studies, which alluded to the possibility that with a paramedian approach, PDPH can be minimized. The chi-square test for an association between needle technique and PDPH on Day 1 was significant with a p-value of 0.02, indicating that the paramedian technique may be protective against the risk of developing a PDPH.

Table 2: PDPH incidence by needle approach on day 1

Needle Approach	PDPH Present	No PDPH	p-value (Day 1)
Midline	58	43	0.02
Paramedian	30	68	0.02

Visual Analogue Scale (VAS) Scores: Patients who developed PDPH were evaluated on Days 1, 2, and 3 by their VAS scores to assess their tolerance of pain. The mean VAS scores of the patients with mild PDPH were lower than those with moderate and severe PDPH. Table 2 shows the mean ± SD of VAS scores during Day 1, Day 2, and Day 3 among the different severity groups.

Table 1: VAS Scores by PDPH Severity

PDPH Severity	Day 1 Mean (SD)	Day 2 Mean (SD)	Day 3 Mean (SD)
Mild	3.2 (1.1)	3.0 (1.3)	2.5 (1.2)
Moderate	5.6 (1.3)	4.8 (1.2)	4.0 (1.5)
Severe	8.2 (1.0)	7.4 (1.3)	6.5 (1.4)

VAS scores were positively correlated with the worst severity of PDPH. For all three days, severe PDPH patients had the highest VAS scores, and mild cases showed lower vision scores, showing lower pain levels.

PDPH Outcomes and Readmission Rates: Concerning outcomes, patients who had a PDPH were more often readmitted and required additional treatment. There was a very high rate of readmission for PDPH management in the severe PDPH group (p = 0.005). These patients experienced more severe PDPHs and further required caffeine infusions or epidural blood patches, whereas those of mild or moderate severity all recovered with conservative measures.

Table 4: Outcome based on PDPH severity

PDPH Severity	Discharged	Readmitted for Treatment	p-value
Mild	85	5	0.005
Moderate	55	15	0.005
Severe	40	20	0.005

Patients with more severe PDPH were readmitted at a higher rate, highlighting an important avenue for improving management protocols in patients who go on to develop more severe headaches.

Figure 1: VAS scores by PDPH severity

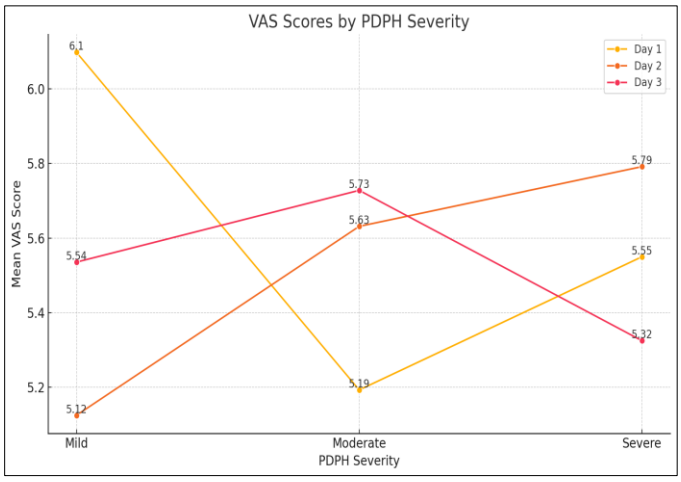
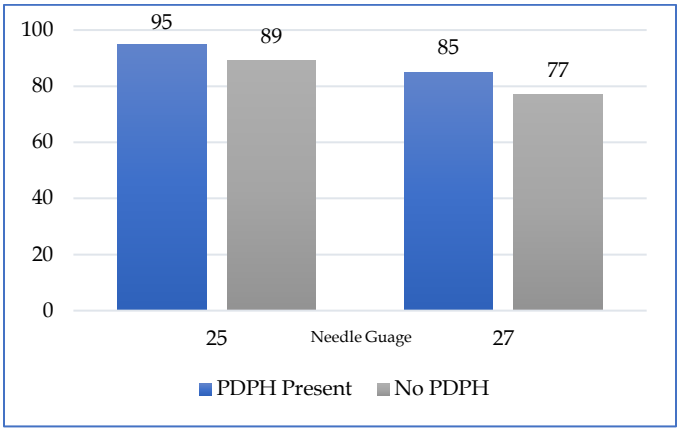


Figure 1: PDPH incidence by needle gauge & approach



This graph reveals the PDPH variety from moderate to severe cases, showing an increase in VAS scores with severity, indicating that severe cases have high pain intensity. In contrast, mild cases have low pain intensity.

DISCUSSION

These findings of the study have revealed a few significant features about PDPH in parturients undergoing CS under spinal anesthesia at LMH, Kohat. The potential for interesting preliminary data- A significantly greater incidence of PDPH overall in this cohort when using a 25G Quincke needle compared to a 27G Quincke needle. In addition, the study showed a significantly lower PDPH incidence of spinal anesthesia using a paramedian approach compared to a midline approach. Similarly, needle size was associated positively with VAS scores (Figure 3) and the severity of pain in PDPH. Conclusion: These data highlight the importance of both needle gauge and technique in the prevention of PDPH. In addition, the study illuminated that many of these patients progressed to severe PDPH and were ultimately readmitted for further management, thus highlighting the necessity for early recognition and treatment.

This study presents new insights into the occurrence of PDPH after spinal anesthesia in Pakistan, specifically in secondary care facilities such as LMH Kohat. Though PDPH is a well-known global complication, there are still few studies done in this regard in KPK province, which has a limited number of studies published on the topic. Secondary care hospitals are understudied as previous studies have mainly concentrated on tertiary care centres or high-resource settings, where factors causing PDPH might be different, and they may not always be applicable in secondary care contexts. What makes this study unique is the in-depth proof of concept for an association between needle gauge, approach to the dura and its effect on the development of PDPH from a regional perspective.

The findings of this study are similar to several international studies examining the relationship between needle gauge and technique with PDPH global research. For example, studies in Europe and the United States have revealed that when a 27G Quincke needle is used in the USA and Europe for epidural anaesthesia, the frequency of PDPH is lower.[12] In several studies, the paramedian approach also observed a reduced incidence of PDPH.[7] Our results are consistent with this report that the 27-gauge needle and paramedian approach offer a preventive mechanism against PDPH.

Nevertheless, the incidence of PDPH in our study was higher than that reported by some Western studies. For instance, a study conducted by Lakhe *et al*.(2023) in Nepal observed PDPH in 7.01% of patients after LSCS, which suggests a lower incidence rate than the current study.[13] This could be due to several reasons, including different types of healthcare infrastructure, the needle used and the skill level of the anesthesiologists. Moreover, differences in patient populations and regional factors may be an additional reason these figures are inconsistent.

Several studies from other countries describe similar predictors of PDPH. A study in Uganda, by Hakizimana *et al*. (2023), reported a 32.5% incidence of PDPH among pregnant women undergoing CS under a spinal block, which is very interestingly in line with the huge incidence observed in our study.[11] In contrast, countries with good healthcare infrastructure, like the US, have studies that report lower incidence rates. However, different clinical practice styles, needle design and advanced anesthesia techniques may explain this.

Although studies conducted in Pakistan on PDPH in parturients under CS have been done by Nasir *et al*. (2020) and Tahir *et al*. Brock D *et al* (2024) even with such adaptations to the NP role, yet it fails to provide comprehensive data specifically for secondary care hospitals in regions like Khyber Pakhtunkhwa.[6,7] research done in Pakistan is mostly from tertiary care centres, which gives us no idea regarding the incidence and management of PDPH in smaller settings that have minimal resources. This study fills that void and provides critical regional hospital data.

Several studies in Pakistan have investigated the occurrence and risk factors of PDPH in obstetric patients undergoing cesarean sections. For instance, Aijaz *et al*. (2023) discovered that the incidence of PDPH was notably higher in patients who received spinal anesthesia through a median approach compared to those who had the paramedian approach.[1] Similarly, research by Tahir *et al*. (2024) highlighted the reduced incidence of PDPH when using a 27G needle, which aligns with the findings of the present study.[6] These studies, however, focus primarily

on tertiary care centres, and this study provides novel insights from a secondary care hospital setting.

While some studies on PDPH have been conducted in tertiary hospitals, this study provides valuable local data from a secondary care hospital, addressing a significant gap in the literature. The findings are consistent with reports from other parts of Pakistan and South Asia but provide a deeper understanding of PDPH incidence and management in a more constrained healthcare environment.

CONCLUSION

This study aimed to investigate the frequency and risk factors of PDPH in parturients undergoing CSs under spinal anesthesia at LMH, Kohat. The findings revealed that the incidence of PDPH was significantly influenced by the type of spinal needle used, with the 25G Quincke needle associated with a higher incidence of PDPH compared to the 27G Quincke needle. Furthermore, the paramedian approach for spinal anesthesia was found to reduce the incidence of PDPH, corroborating similar findings in previous studies. The severity of PDPH was also linked to higher VAS scores, and patients with severe PDPH were more likely to require readmission for further management.

These results align with the study's objectives and reinforce the importance of needle gauge and approach in minimizing the occurrence of PDPH. The study also highlights the need for early recognition and effective management of PDPH, particularly in secondary care hospitals with limited resources. The findings provide valuable local data to guide clinical practices and improve patient outcomes in such settings.

LIMITATIONS

One limitation of this study is the non-randomized sampling approach, which may introduce bias in the selection of participants. Additionally, this study focused only on parturients undergoing CS and did not explore the broader population of patients receiving spinal anesthesia for other surgical procedures. Future research could explore PDPH incidence on a broader range of surgical procedures under spinal anesthesia, including those in non-obstetric settings. Moreover, the study could benefit from a larger sample size to increase the generalizability of the findings.

Another potential area for future research is the investigation of additional factors contributing to PDPH, such as the role of anesthesiologist experience, intraoperative positioning, and postoperative care practices. Additionally, interventional studies exploring the efficacy of various pharmacologic and non-pharmacologic treatments for PDPH could help optimize patient care.

SUGGESTIONS / RECOMMENDATIONS

Future recommendations include adopting smaller gauge needles, particularly the 27G Quincke needle, and considering the paramedian approach for spinal anesthesia to reduce the risk of PDPH. Further research with larger sample sizes and more diverse patient populations is needed to confirm these findings and explore additional factors influencing PDPH. Additionally, exploring preventive and therapeutic interventions for PDPH could greatly enhance patient care in obstetric anesthesia.

CONFLICT OF INTEREST / DISCLOSURE

The authors declare no conflict of interest in the conduct of this study. There was no financial or personal interest that could have influenced the outcomes of the study.

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