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Comparison of 25G and 27G Quincke Needles' Effects on Post-Dural Puncture Headache Intensity in Spinal Anaesthesia for Caesarean Section

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ABSTRACT

Background: The size and type of spinal needle used affect post-dural puncture headache (PDPH), which varies from person to person. Thinner Quincke-type spinal needles (25G and 27G) are used to overcome this issue. Thus, this study aimed to assess the incidence and intensity of PDPH following caesarean section (CS).

Methods: This study, including a total of 170 primiparous women, was carried out in the Department of Anaesthesia, Centurion University Vishakhapatnam. The women who were scheduled for elective surgical CS under spinal anesthesia were randomly divided into groups 1 and 2, based on the type of Quincke spinal needles used during the procedure (group 1 received 25G and group 2 received 27G). For four days straight after the CS, each patient was evaluated every day, and PDPH frequency and intensity along with other associated factors, were noted.

Result: A total of 170 pregnant women of CS were included in this study. Age and weight distribution of pregnant mothers were similar in both groups, with the mean age of 27.1 years in group 1 and 26.5 years in group 2. The mean weight of both groups was 62.0kg and 60.9kg, respectively, for groups 1 & 2. The heart rate (82.8 vs 81.6bpm) and mean BP (91.0 vs 90.1mmhg) between group 1 vs group 2 was similar between the two groups. The incidence of PDPH was higher in group 1 (25G) (16.5%) patients than in group 2 patients (27G) (6.1%) ($p<0.05$).

The severity of headache revealed that the maximum number (10.6%, 09 out of 19 PDPH positive cases) of subjects had a mild type of headache. However, the number of subjects with PDPH, both mild and moderate/severe, was significantly higher in group A cases, who were administered the drug through 25 G Quincke spinal needles for CS delivery. The drug volume in the maximum number of subjects (64.1%, 109 cases out of 170) was introduced with more than 3 ml of anaesthesia drug in both groups. The attempt required to attain CSF is higher in group 2, and a finer needle takes more attempts to collect CSF

Conclusion: In terms of the severity of headache, maximum number of cases presented with mild type headaches, but the number of subjects positive for PDPH was significantly more in subjects who received the drug through 25G Quincke spinal needles for CS delivery.

1. INTRODUCTION

Dural puncture is one of the commonly used invasive approaches in clinical treatments, including spinal anaesthesia, for labor pain management or postoperative analgesia. However, accidental dural punctures can occur during these procedures, even when deliberate dural punctures are scheduled as part of spinal anaesthesia [1-3]. In such cases, there is a possibility of complications in various forms, and one of the commonest forms is developing headache, known as Post-Dural Puncture Headache (PDPH), which significantly affects the patient's recovery [2, 3]. This type of headache needs to be regarded with as potentially dangerous health issues and separated from other headache caused. It may present as a postural headache lasting longer than 24 hours and can vary from mild, moderate to severe [4, 5]. The kind of headache varies with the position of the patient after surgical procedures, and in severe cases patient is unable to stand properly [4, 5] and has lasting effects on postoperative health [4, 6-8]. Despite regional anaesthesia-induced headaches arising from various causes during the postpartum and postoperative phases (CSF), PDPH remains the most common headache associated with anesthesia-related dural puncture [9]. Thus it is recommended to minimize CSF loss after observing the symptoms during an experimental spinal block and it is highly recommended to note significant CSF loss when there was a discrepancy between the syringe and needle type used during the procedure [10].

The positioning and design of the spinal needle used during the procedure are among the factors affecting the risk and severity of PDPH [11, 12]. Although fibroblastic development is crucial for healing dural holes, proper spinal needle placement without related tissue damage may not promote sufficient repair [13]. However, since bloody taps stimulate local tissue during trauma, they are linked to a reduced risk of PDPH [14, 15]. Similarly, the orientation of the needle bevel is important;..

cutting-tip punctures with specific orientations lower the likelihood of PDPH compared to spreading bevel needles [12]. Two primary mechanisms contribute to the development of PDPH. The CSF leak first causes intracranial hypotension during upright positioning, pulling on pain-sensitive intracranial tissues. Secondly, the Monro-Kellie doctrine indicates that vasodilatations compensate for decreased CSF volume, exacerbating headaches

Direct visualization, myelography, cisternography, and manometric studies all provide evidence supporting the connection between CSF leaks and the onset of PDPH [16]. The incidence of PDPH has significantly decreased in recent years due to advancements in spinal needle design [17]. Despite the technological difficulties associated with smaller needles, PDPH rates are significantly lower with smaller-gauge needles, such as 27 G pencilpoint designs. Similarly, published literature hints that smaller bore size Quincke needles, like the 27G, have a lower relative risk of PDPH than larger bore size Quincke needles, like the 25G [11]. In this study, we aimed to compare the intensity of PDPH between 25G and 27G Quincke needles during spinal anaesthesia for CS, considering the relationship between needle size, tip design, and PDPH severity. A detailed investigation of needle size and design could provide valuable insights into reducing the risk of PDPH and improving patient outcomes in the form of intensity of PDPH and other associated factors in the study population.

2. METHOD & MATERIALS

In this quasi-experimental investigation, two needle types—the 25G and 27G Quincke varieties—were used to compare the incidence of PDPH following CS section with spinal anaesthesia. The study was conducted at the different hospital MoU's with Centurion University ,Vizianagaram ,Vishakhapatnam. Patients hospitalized to the gynaecology and obstetrics inpatient department for elective CS. The study includes a total of 170 subjects who meet the inclusion criteria and are admitted to the Gynecology & Obstetrics inpatient at different Hospitals in Vizianagaram Vishakhapatnam, India. (MOU's with CU).

This study was cleared by the institutional ethics committee (IEC) via reference No NIMSUR/IEC/2022/365

Inclusion Criteria

a. A pregnancy with a normal fetal heart rate is a requirement for inclusion.

b. Individuals between the ages of 20 and 35 planned for an elective CS.

c. Grades I and II from ASA.

Criteria for Exclusion

a. Refusal of the patient b. Spinal anaesthesia is contraindicated for neurological, hemodynamic, infectious, or haemostatic causes. c. A C-section in an emergency d. Severe pre-eclampsia or spinal anaesthesia failure e. Unwilling to take part in this research. The International Headache Society defines PDPH as a headache that arises seven days after a dural puncture and goes away fourteen days later [18, 19]. And as per the guidelines, we have

classified the PDPH as Mild PDPH, moderate and severe. A thorough physical examination was performed to rule out patients with other issues, written informed consent was obtained, and the procedure was explained to the patients during the pre-anaesthesia checkup at least 24- hours before surgery. Patients were divided into two groups at random using odd and even numbers. Subarachnoid block (SAB) was administered using a 25G and 27G Quinke-style spinal needle in two groups (n=85 for each group). At the L3-4 intervertebral area, spinal anaesthesia was administered using containing 2.0– 3.0ml of 0.5% hyperbaric bupivacaine. Following a CS, each patient was evaluated every day for four days in a row. PDPH incidence and intensity were noted as the development of PDPH and its severity were the main outcome variable of the study. On the morning before surgery, the patient was placed supine with left lateral displacement by placing a wedge beneath the right hip upon arrival in the operating room. An automatic noninvasive arterial blood pressure monitor and a pulse oximeter were used. The mean arterial pressure, systolic pressure was recorded at baseline. The institutional ethics body provided its ethical clearance. Each participant received a thorough explanation of the study's aims, and confidentiality was guaranteed to each patient. After obtaining appropriate informed written consent, the study was executed. A well stryctured questionnaire was used to collect all the relevant information from all the recruited subjects. Individual questionnaires were reviewed at the conclusion of the data collecting day to ensure they were filled out accurately and consistently

With the assistance of STATA software version 17, the analysis was done after the data was stored in a database and cleaned before final analysis. Every continuous variable's frequency distribution was examined. The mean, percentage, and standard deviation were used in case of continuous variables. To determine the association between various variables, chi-square, independent t-test, analysis of variance (ANOVA), and correlation were performed.

$P<0.05$ is considered to be a statistically significant value.

3. RESULT

The mean age of the subjects was 28.8±3.4 years, mean weight in kgs was 61.5±6.9, mean heart rate was 82.2±9.5bpm, mean SBP was 90.6±8.1mmHg, and the mean drug volume in ml was 2.9±0.2. The incidence of PDPH was 11.9% (19 positive out of 170), a single attempt was required in the maximum number (81.2%) of subjects for drug delivery required compared to

18.8% for repeat cases. Failed attempts were seen only in 5.3% (08 out of 170 cases) (**Table 1)**.

Table 1: General characteristics of patients	
Variables	**Mean±SD, Frequency (%)**
Mean age (years)*	26.8±3.4
Mean weight (kgs)*	61.5±6.9
Heart rate (bpm) *	82.2±9.5
SBP (mmHg)*	90.6±8.1
Drug volume (ml)	2.9±0.2
PDPH Yes No	 19 (11.4) 148 (88.6)
No. of attempts 1 2	 138 (81.2) 32 (18.8)
Failed attempts 0 1	 143 (94.7) 08 (5.3)
Headache Intensity Yes No	 19 (11.2) 148 (88.8)

* Continuous variables are presented in mean and standard deviation

The two groups were comparable in terms of mean age, weight, systolic blood pressure, heart rate (P>0.05) and volume of anaesthetic drug used during the procedure **(Table 2)**. PDPH

Table 2: Comparative analysis of different parameters between the groups.			
Variable	**Group A (25G) (n=85)**	**Group B (27G) (n=85)**	***P* value**
Age (Years) [Mean ±SD]	27.1 ±3.6	26.5±3.6	0.259
Weight (kg) [Mean± SD]	62.0±6.8	60.9±7.0	0.299
Heart rate (bpm) *	82.8±10.0	81.6±9.1	0.399
BP (mmhg)*	91.0±9.1	90.1±7.1	0.493
Drug volume (ml)	2.8±0.2	2.9±0.2	0.706

frequency was 6.7% (5/85) in Group II and 16.7% (14/85) in Group I. the difference was statistically significant between the two groups **(*P*<0.035).** Among the 19 PDPH positive subjects, 13 subjects had mild form of headache as compared to 06 with moderate to severe form of headache. When the stratification was made between the two groups, there was a statistically significant difference among the subjects with both mild (10.6%) and moderate/severe (5.6%) significantly higher in group A (25G group) compared to mild (4.7%) and moderate/severe (1.2%) respectively in group B (27 group), despite more

attempts and required for drug delivery in group B than group A **(Table 3).**

Table-3: Incidence and other information related to post-dural puncture headache			
Variable	**Group A (25G) (n=85)**	**Group B (27G) (n=85)**	***p* value**
PDPH			
No	71 (85.3)	77 (93.9)	0.035
Yes	14 (16.5)	05 (6.1)	
Headache intensity			
No headache	71 (83.0)	77 (90.6)	0.050
Mild Moderate/Severe	09 (10.6)	04 (4.7)	
	05 (5.6)	01 (1.2)	
No. of attempts needed			
1	73 (85.9)	65 (76.5)	0.116
2	12 (14.1)	20 (23.5)	
Failed attempts			
0	85 (100.0)	58 (87.9)	0.001
1	0 (0.0)	8 (12.1)	
Anaesthetic drug used (mean±SD)			
<3 ml	31 (36.5)	30 (35.3)	0.873
≥ 3ml	54 (63.5)	55 (64.7)	

4. DISCUSSION

There is a higher risk of severe PDPH, and other adverse effects are reported after using general anaesthesia for Caesarean sections [11]. Publicly available data indicate that the overall incidence of PDPH ranges significantly across these studies. The variation has been reported to be between as low as 0% in some studies and as high as about 37% in others [20, 21]. The reported incidence of PDPH, particularly in young females with a 25G Quincke spinal needle varies from 4% to 40% [22, 23]. A consequence of spinal anesthesia, headache during dural puncture is thought to be caused by CSF leaking during the procedure [12]. Therefore, using general or spinal anaesthesia through dural puncture needs careful attention, considering that PDPH has the potential to cause significant complications, and cases of PDPH symptoms lingering for months or years [8]. Therefore, when performing spinal anesthesia, anaesthesiologists are encouraged to optimize controllable aspects such as spinal needle size and shape to prevent PDPH. Parturient had the highest incidence of PDPH, which helps to explain why females overall experience a greater frequency of PDPH [24]. The diagnosis of a dural puncture headache is based on how the pain relates to body position; sitting or standing exacerbates it, while resting flat alleviates or diminishes it [5, 25].

The study, which included 170 pregnant women undergoing CS, provides important new information about how spinal needle size affects the frequency and intensity of PDPH. There are notable differences in the frequency and severity of PDPH as well as procedural challenges when comparing 25G with 27G Quincke needles. These findings on the incidence and severity of PDPH are consistent with those of other reports that have already been published earlier across the globe [26-28]. The results show that the incidence of PDPH was statistically significantly higher in the 25G needle group (16. 5%) than in the 27G needle group (6. 6.1%). The pathogenesis of PDPH, according to the Monro-Kellie doctrine, involves CSF leakage from the puncture site during the procedure, which causes intracranial hypotension and hence the PDPH of different intensities among patients [16, 29]. CSF loss is reduced, and these

mechanisms are mitigated by smaller needles, such as the 27G, which produce smaller dural defects [12].

The finer needle necessitates more effort to obtain CSF, notwithstanding the benefits of the 27G needle in lowering the incidence of PDPH. This is in line with findings suggesting that thinner gauge needles could complicate procedures technically and extend their duration [26]. A compromise between reducing the risk of PDPH and ensuring operational

efficiency is required because the increased number of attempts may cause patient discomfort and procedural fatigue for doctors [11, 12].

The study emphasizes the importance of choosing the right needle size based on procedural specifications and patient-specific characteristics. Although the 27G needle has a definite advantage in reducing the incidence of PDPH, technological difficulties in some clinical settings may restrict its use [11, 30, 31]. In high-risk groups such as pregnant women receiving CS, clinicians must balance the advantages of lower PDPH risk against the possibility of increased procedural complexity.

Strategies for maximizing procedural success include better management through improved needle design with a smaller bore size or enhanced clinician training. Furthermore, examining the role of preventive epidural blood patches or alternative needle orientations as supplementary interventions may provide valuable insights into reducing the incidence and severity of PDPH.

5. CONCLUSION

PDPH is a self-limiting and nonfatal syndrome; however, due to its postural nature, patients are unable to perform daily tasks and often experience anxiety and depression. This study provides important new information about how spinal needle size affects the frequency and intensity of PDPH in pregnant women undergoing Caesarean sections. These results align with the well-established theory that smaller-gauge needles cause less dural trauma, which reduces CSF leakage and mitigates the pathophysiological mechanisms of post-traumatic stress disorder.

Despite the obvious advantages of the 27G needle in reducing the incidence of PDPH, the study highlights procedural problems, such as the increased number of attempts required to extract CSF, which can lead to patient pain and technical difficulties. The clinical consequences emphasize the importance of selecting the appropriate needle size based on the procedure's circumstances and the characteristics of each patient. If practitioners are well-trained to manage the procedural challenges of the 27G needle, it may become the preferred method for reducing the incidence of PDPH, especially in high-risk groups like pregnant women. To maximize procedural success and effectiveness, future research should focus on enhancing spinal needle designs. Results could be improved further with better physician training and adjunct therapies

such as preventative epidural blood patches. These advancements could lead to safer and more efficient aesthetic procedures, ultimately enhancing patient satisfaction and recovery.

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