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INFLUENCE OF SUBARACHNOID NEEDLE ADVANCEMENT UPON POST DURAL PUNCTURE HEADACHE IN JORDANIAN PARTICIPANTS

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INTRODUCTION

The subarachnoid mode of anesthesia is commonly used for cesarean section because it has a rapid action and has a reliable sensory blockade with minimal fetal complications.[1] The post-dural puncture headache is a distressing complication after the procedure and the incidence of PDPH is almost between 2%-40%.[2,4]

The mechanism of headache is not fully understood; the complication usually refers to the CSF leakage, which decreases the intracranial pressure. The lower intracranial pressure stimulates the vascular dilatation to compensate for the pressure.[5,6] Needle features, such as thickness, tip type, and the angle of dural penetration, are the main factors that determine the occurrence of headache.[1] Studies have shown variable incidences of PDPH based on these factors, with rates reported as 2.8% for 26-gauge atraumatic needles, 6.8% for 27-gauge pencil-point needles, and 0% for 25-gauge pencil-point needles.[7]

There are many cranial parameters that should be mentioned in order to understand the mechanism of headache. Intracranial pressure (ICP), cerebrospinal opening pressure (OP), closing pressure (CP), craniospinal elastance (ECS), and pressure volume index (PVI) are the main factors in order to understand the headache mechanism.[8]

Our objective is to evaluate the differences between the effects of the two needle advancement techniques (transverse and sagittal needle advancement) and their association with the occurrence of headaches.

METHODS

Study Design

Our study is a retrospective, conducted at Prince Rashed Bin Alhassan Hospital, Royal Medical Services, Irbid, A 150 female were planned for elective cesarean section, between the period of June 2023 to June 2024.

Data Collection

Revealing an incidence of PDPH of 15% in the transverse group and 2% in the sagittal group, the power was an 80% ($\beta = 0.2$) and a significance level of 5% ($\alpha = 0.05$), a minimum of 71 patients per group was required. To account for potential dropouts or incomplete data, the final sample size was increased to 150 patients, with 74 categorized into Group I (sagittal) and 76 to Group II (transverse).

All patients were injected with subarachnoid anesthesia using a 25-gauge Quincke needle. And classified into two groups according to the type of approach: sagittal (Group I; n=74) and transverse (Group II; n=76). Preoperative administration of 10 ml/kg Ringer's lactate solution was standardized. Subarachnoid needle placement was conducted in the sitting position, followed by the administration of 2.5 ml of 0.5% hyperbaric bupivacaine intrathecally. Patients were then positioned supine.

Statistical Analysis

Student's t-test was used to compare the variables, while the chi-squared test was used to analyze the data. A p-value of less than 0.05 was considered statistically significant.

RESULTS

Most participants (94%) required only one dural puncture (93.2% in Group I and 94.7% in Group II), while 6% required more than two attempts (6.8% in Group I and 5.3% in Group II). PDPH occurred in 9.3% of participants, with a significantly higher incidence in Group II (15.8%) compared to Group I (2.7%) (*P-value* = 0.006). The mean VAS-S score was similar between the groups (7.96 ± 1.09 overall, 7.97 ± 1.07 in Group I, and 7.95 ± 1.11 in Group II; *P-value* = 1.00). The onset of PDPH varied, with 57.1% occurring on day 1 (100% in Group I and 50% in Group II), 28.6% on day 2 (0% in Group I and 33.3% in Group II), and 14.3% on day 3 (0% in Group I and 16.7% in Group II).

PDPH was recorded in 14 subjects (9.3%): 2 subjects (2.7%) in Group I and 12 subjects (15.8%) in Group II. The PDPH was lower in group 1; the incidence was significant, and the P value was less than 0.005. However, there were no significant differences between the two groups in terms of VAS scores for headache intensity or the day of headache onset (P > 0.05) (**Table 1**). Subjects with PDPH were more likely to have undergone more than two puncture trials (21.4% vs. 4.4%, P = 0.005) and transverse needle advancement (85.7% vs. 47.8%, P < 0.005) (**Table 2**). Multivariate logistic regression analysis revealed that more than two dural puncture trials (OR: 8.6; 95% CI: 1.5-48.5, p-value = 0.015) and transverse needle advancement (OR: 8.2; 95% CI: 1.6-40.9, p-value = 0.011) were independent predictors of PDPH as shown in **Table 3.**

Table 1: Demographic and clinical characteristics between study groups.

Variable	Group I N = 74	Group II N = 76	Overall N = 150	P-value
Age (years), Mean (SD)	31.12 (1.82)	30.95 (1.78)	31.04 (1.80)	0.50
ASA, n (%)				0.50
I	50 (67.6%)	55 (72.4%)	105 (70%)	
II	24 (32.4%)	21 (27.6%)	45 (30%)	
Number of DP trials, n (%)				0.70
1	69 (93.2%)	72 (94.7%)	141 (94%)	
> 2	5 (6.8%)	4 (5.3%)	9 (6.0%)	
PDPH, n (%)	2 (2.7%)	12 (15.8%)	14 (9.3%)	**0.006**
VAS-S, Mean (SD)	7.97 (1.07)	7.95 (1.11)	7.96 (1.09)	1.00
Days of onset, n (%)*				> 0.05
1	2 (100%)	6 (50%)	8 (57.1%)	
2	0 (0%)	4 (33.3%)	4 (28.6%)	
3	0 (0%)	2 (16.7%)	2 (14.3%)	

Abbreviations: DP, dural puncture, PDPH, post-dural puncture headache, VAS, visual analogue scale.
* Percentage was taken to the number of patients who had PDPH.

Table 2: Post Dural puncture headache correlates with demographics and subarachnoid block.

Variable	PDPH, N = 14	No PDPH, N = 136	P-value
Age (years), Mean (SD)	30.96 (1.80)	31.80 (1.68)	0.084
ASA, n (%)			> 0.05
I	10 (71.4%)	95 (69.9%)	
II	4 (28.6%)	41 (30.1%)	
Number of DP trials, n (%)			**0.039**
1	11 (78.6%)	130 (95.6%)	
> 2	3 (21.4%)	6 (4.4%)	
Level of SAB, n (%)			> 0.05
L3-L4	9 (64.3%)	91 (66.9%)	
L4-L5	5 (35.7%)	45 (33.1%)	
History of SAB, n (%)	10 (71.4%)	97 (71.3%)	> 0.05
History of PDPH, n (%)	2 (14.3%)	17 (12.5%)	> 0.05
Needle advancement, n (%)			**< 0.005**
Sagittal	2 (14.3%)	71 (52.2%)	
Transverse	12 (85.7%)	65 (47.8%)	

Abbreviations: SAB, subarachnoid block, PDPH, post-dural puncture headache, DP, dural puncture.

Table 3: Logistic regression model for the prediction of PDPH.

Predictor	OR	95% CI		P-value
		Lower	Upper	
Number of DP trials				
>2 – 1	8.62	1.53	48.5	0.015
Needle advancement				
Transverse – sagittal	8.16	1.63	40.9	0.011

Abbreviation: OR, odds ratio, CI, confidence interval, PDPH, post-dural puncture headache, DP, dural puncture.

DISCUSSION

Post-dural puncture headache (PDPH) is a common complication following spinal anesthesia, particularly in obstetric procedures like cesarean sections. In this retrospective study, we assessed the influence of the transverse or sagittal use of 25-gauge Quincke subarachnoid needle advancement on PDPH in subjects assigned for cesarean section.

The 25-gauge Quincke subarachnoid needle induced a less incidence of post Dural puncture headache using the sagittal technique than the transverse one.[9] Subarachnoid anesthesia is a frequently chosen anesthesia technique in cesarean section. Unfortunately, post Dural puncture headache is an important hazard. Post Dural puncture headache frequency ranges between 2% and 40% according to needle thickness, needle type, and patient factors (2-4). Post Dural puncture headache was recorded in 14 subjects (9.3%) in this investigation.

Alterations in needle technology possess a great influence on post Dural puncture headache development. Thinner subarachnoid needles and needles with a pencil-point tip are correlated with less post Dural puncture headache.[5,6] Quincke needles are less expensive and more frequently used in subarachnoid block. They create a larger hole in the dura mater, leading to more CSF leak and higher incidence of post Dural puncture headache. To avoid this issue with Quincke needles, sagittal advancement of the needle is recommended. Post Dural puncture headache risk could be minimized using sagittal advancement.[1]

Using a 27-gauge Quincke subarachnoid needle on post Dural puncture headache in subjects assigned for minor non-obstetric surgery, the incidence of post Dural puncture headache with transverse advancement was remarkably higher (22.6%) compared to sagittal advancement (3.8%).[10] In another study, 28.7% of patients experienced post Dural puncture headache, with needle size, number of cerebrospinal fluid drops, and multiple trials being significant independent predictors. Needle gauge was identified as the strongest independent predictor of post Dural puncture headache before surgery.[11] Similarly, using a 26-gauge Quincke subarachnoid needle in obstetric surgery, transverse advancement resulted in higher PDPH incidence (14%) compared to sagittal advancement (8%).[12] The lack of statistical significance in some findings could be attributed to the small sample sizes in these studies.[12]

Our investigation performed a multivariate logistic regression analysis to assess whether there was an independent association between subarachnoid needle advancement and post Dural puncture headache. Transverse needle advancement was identified as an independently correlated factor, increasing the risk for post Dural puncture headache.

Other factors associated with post Dural puncture headache include patient position.[13] physician experience.[14] and the number of puncture trials required for successful dural penetration. . Multivariate analysis in our investigation confirmed that two or more puncture trials independently influenced the risk of post Dural puncture headache.

Our study has several strengths, which is the use of multivariate logistic regression analysis to identify independent predictors of PDPH, which adds robustness to our findings. Furthermore, the relatively large sample size enhances the statistical power and generalizability of our results. The focus on a homogeneous population undergoing cesarean section reduces confounding variables. Despite its strengths, our study is not without limitations. being retrospective study may introduce bias. In addition, the past history of primary headache should be assessed, which may affect the incidence of PDPH. In the Future we need a larger study with a prospective design and systemic review study. Investigating the role of primary headache disorders and other patient-related factors in PDPH risk could provide a more comprehensive understanding of this consequence.

CONCLUSION

Transverse advancement of 25-gauge needle (Quink subarachnoid) and the number of insertion attempts are independent factors that contribute to post-dural puncture headache, in patients undergoing subarachnoid anesthesia for cesarean section. While the sagittal needle advancement reduces the risk of headache significantly.

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