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Prevalence, Risk Factors and Clinical Features of Post Dural Puncture Headache (PDPH): A Prospective Study

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Abstract

Background: Post-dural puncture headache (PDPH), formerly known as post-lumbar puncture headache, is a well-known adverse event that follows diagnostic and/or therapeutic puncture of the dura, or accidentally, following spinal anesthesia.
Material & Methods: This prospective study was carried out on 152 patients at Shaheed Ziaur Rahman Medical College Hospital in Bogura, from 2013 to 2015 and North Bengal Medical College from 2016 to 2022, Bangladesh.
Results: A total of 152 patients were enrolled into the study where 122(80.3%) were aged between 18-28 years, 30(19.7%) were 29-39 years, 38(25%) were male and 114(75%) were female. 122(80.3%) patients were non obese (<25) and 30(19.7%) were obese (>25). 17(11.2%) patients had previous history of anaesthesia and 17(11.2%) had previous history of PDPH. On majority 100 patients were used big size needle (18-23 G) and rest of the patients were used small (23-25G). 146 (96.1%) patients position was lateral and 92(60.5%) were used less than two or equal three drops. 61(40.1%) patients were needed one attempt, 64(42.1%) were needed two and 27(27.8%) were needed greater than two. The prevalence of PDPH was found in 44(28.9%) cases out of 152 where severity of 29(65.9%) percent was mild, 20(45.5%) cases headache onset were at the first day and mean duration of headache was 2.6. There was a statistically significant association between development of PDPH and younger age (26.3±8.7 years vs 32.6±7.4, p< 0.001), female gender (p=00.009), previous history of PDPH (p<0.001), number of attempts (3.1±1.2 vs 1.2±0.8, p<0.001), small needles (p=0.04), pre LP headache (p<0.001) and CSF RBS (2.6±2.1 vs 13.8±1.3, p= 0.48).
Conclusion: This study recommends that the neurologists should be treating this population in the manner so that it may help to prevent this painful adverse event, and identification of risk variables is vital in predicting PDPH.

Keywords:- Post Dural Puncture Headache (PDPH), Lumbar Puncture (LP), Headache, Post-dural puncture headache, Incidence, Risk factors.

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INTRODUCTION

Post-dural puncture headache (PDPH), formerly known as post-lumbar puncture headache, is a well-known adverse event that follows diagnostic and/or therapeutic puncture of the dura, or accidentally, following spinal anesthesia.[1] The classical features of PDPH according to the International Classification of Headache Disorders, 3rd edition (ICHD-3) include headache that occurs within 5 days of lumbar puncture (LP), that is aggravated with standing or sitting position and relieved with lying down, and remits spontaneously within 2 weeks, or after sealing of the leak with epidural lumbar patch.[2] This particular type of headache has been an area of interest to physicians from different specialties, and several clinical studies have attempted to identify procedure and non-procedure-related risk factors in the literature. Several modifiable and non-modifiable independent risk factors for PDPH have been documented in both anesthesiology and neurology studies. Class I and II evidence regarding the development of PDPH in literature included; female gender, age between 20 and 50 years, lower body mass index (BMI), previous history of PDPH, larger needle diameter, use of cutting needles, perpendicular insertion of the needle level to the long axis of the spine, and pregnancy.[3,4,5] As a result, the incidence of PDPH vary widely in the literature, depending on the characteristics of the studied populations, and the different applied techniques. However, it was estimated that around one-third of the procedures can be complicated with headache.[3,6] The exact mechanism of headache in PDPH is still uncertain, and several theories have been proposed. The most common theory is downward stretch of pain sensitive structures when patients assume an upright position, secondary to cerebrospinal fluid (CSF) volume loss.[7] Other theories include hypersensitivity to substance P, compensatory vasodilation of intracranial blood vessels in order to maintain a constant intracranial volume (Monro-Kellie doctrine), and relative CSF hypovolemia resulting from persistent CSF leakage of CSF causing an orthostatic type of headache [8]. In this study, we aimed to evaluate the incidence, risk factors and clinical characteristics of PDPH in the inpatient setting of a tertiary hospital in Bangladesh.

Objective of the Study

The objective of this study was to evaluate the incidence, risk factors and clinical characteristics of PDPH in the inpatient setting of a tertiary hospital in Bangladesh.

MATERIAL AND METHODS

This prospective study was carried out on 152 patients at Shaheed Ziaur Rahman Medical College Hospital in Bogura, from 2013 to 2015 and North Bengal Medical College from 2016 to 2022, Bangladesh. Aspects of demographic information included age, gender, height, weight, and BMI. Prior to LP, all patients underwent a comprehensive history review, thorough neurological examination, standard laboratory testing (complete blood count, renal function, liver, electrolyte, and coagulation profile), as well as brain imaging (MRI or CT scan). The surgery was carried out using a midline approach on all patients, administering local injections of lidocaine 1% or 2% at the L4-L5 or L3-L4 intervertebral space levels. LP procedure includes passively extracting CSF,

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changing the stylet before removing the spinal needle, and putting the needle bevel parallel to the dural fibers. Regardless of the procedure's initial position, the CSF opening and closure pressures were monitored using a manometer while the patient was lying lateral to the body with relaxed and partially extended legs. In each case, routine CSF analysis was performed to measure the amounts of protein, glucose, red blood cells (RBCs), and white blood cells (WBCs). The hospital's ethical review committee granted its clearance. Version 20.0 of the IBM SPSS program was utilized for the statistical analysis.

RESULTS

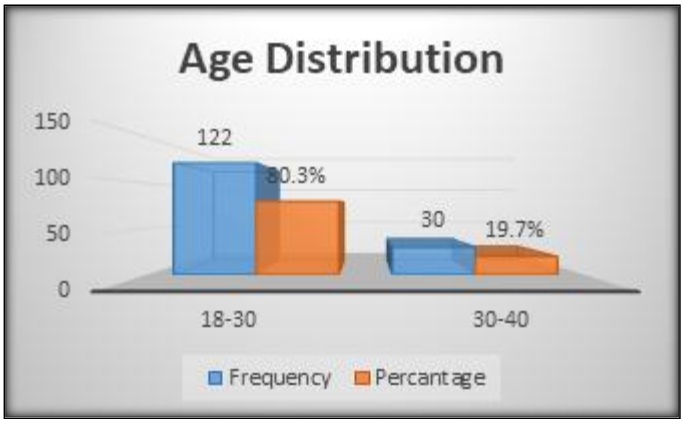

Figure 1: Age distribution of the study patients.

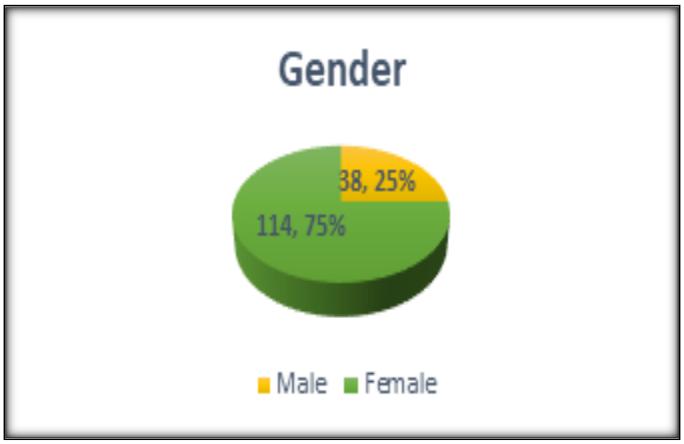

Figure 2: Gender distribution of the Study patients

A total of 152 patients were enrolled into the study where 122(80.3%) were aged between 18-28 years, 30(19.7%) were 29-39 years, 38(25%) were male and 114(75%) were female. [Figure 1,2]

[Table 1] shows the clinical feather of the study patients where 122(80.3%) patients were non obese (<25) and 30(19.7%) were obese (>25). 17(11.2%) patients had previous history of anaesthesia and 17(11.2%) had previous history of PDPH. On majority 100 patients were used big size needle (18-23 G) and rest of the patients were used small (23-25G). 146 (96.1%) patients position was lateral and 92(60.5%) were used less than two or equal three drops. 61(40.1%) patients were needed one attempt, 64(42.1%) were needed two and 27(27.8%) were needed greater than two.

[Table 2] revealed the prevalence and severity of PDPH patients who underwent spinal anesthesia. The prevalence of PDPH was found in 44(28.9%) cases out of 152 where severity of 29(65.9%) percent was mild, 20(45.5%) cases headache onset were at the first day and mean duration of headache was 2.6.

There was a statistically significant association between development of PDPH and younger age (26.3±8.7 years vs 32.6±7.4, p< 0.001) , female gender (p=00.009), BMI<25(P=0.04), previous history of PDPH (p<0.001), number of attempts (3.1±1.2 vs 1.2±0.8, p<0.001), small needles (p=0.04), pre LP headache (p<0.001) and CSF RBS (2.6±2.1 vs 13.8±1.3, p= 0.48). [Table 3]

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Table 1: Clinical features of study patients who underwent spinal anesthesia

Variables	Frequency	Percentage
BMI		
<25(Nonobese)	122	80.3
>25(Obese)	30	19.7
Previous history of anesthesia		
Yes	17	11.2
No	135	88.8
Previous history of PDPH		
Yes	17	11.2
No	135	88.8
Needle size		
18	5	3.3
20	21	13.8
21	33	21.7
22	41	27.0
23	26	17.1
24	16	10.5
25	10	6.6
Position		
Sitting position	146	96.1
Lateral position	4	2.6
Number of drops		
Less than or equal to three	92	60.5
Greater than three	60	39.5
Number of attempts		
One	61	40.1
Two	64	42.1
Greater than two	27	17.8

Table 2: Prevalence and severity of PDPH patients who underwent spinal anesthesia

Variables	Frequency	Percentage
PDPH		
Yes	44	28.9
No	108	71.1
Severity		
Mild	29	65.9
Moderate	12	27.3
Severe	3	6.8
Headache onset (days)		
1	20	45.5

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2	17	38.6
3	7	15.9
4	0	0.0
Headache duration in days (Mean ±SD)	2.6±2.4	

Table 3: Factors associated with PDPH of patients who underwent spinal anesthesia

Variable	**Number of patients with PDPH, n (%)**	**Number of patients without PDPH, n (%)**	**P Value**
Age (Mean ±SD)	26.3±8.7	32.6±7.4	<0.001*
Gender			
Male	6(13.64)	32(29.63)	0.009‡
Female	38(86.36)	76(70.37)	
BMI			
<25(Non-obese)	26(59.09)	110(90.16)	0.04‡
>25(Obese)	18(40.90)	12(9.84)	
Previous history of PDPH			
Yes	12(27.27)	5(4.63)	<0.001‡
No	32(72.27)	103(95.37)	
Number of attempts	3.1±1.2	1.2±0.8	<0.001*
Needle size			
Big needles (20G. 21G & 22G)	28(63.64%)	24(24%)	0.04‡
Small needles (23 G,24 G,25 G)	16(36.36%)	84(84%)	
Pre-LP headache			
Yes	31(70.45)	7(6.48)	<0.001‡
No	13(29.54)	101(93.51)	
CSF RBCs (Mean ±SD)	2.6±2.1	13.8±1.3	<0.048*

‡Chi-Squared ($\chi 2$) test and *t-test was applied to reach the significant level.

DISCUSSION

This study set out to assess the prevalence, risk factors, and clinical characteristics of PDPH at Bangladesh's Shaheed Ziaur Rahman Medical College Hospital and North Bengal Medical College. A 28.9% of the participants in this study experienced PDPH. According to the literature, the reported prevalence of PDPH varies, ranging from 10 to 40%, depending on a number of procedural and non-procedural factors.[9,10] Older studies have historically shown a greater incidence, which is likely related to the use of large gauge, cutting spinal needles. After the invention of smaller gauge needles and the alteration of spinal needle tips, the incidence of PDPH drastically decreased from 66% in a study from 1898 to about 11%.[11,12] Our results were consistent with those of other regional studies where PDPH was diagnosed in 27.6%,[13] and 28.7% of patients,[14] despite the fact that cutting needles of various

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gauge sizes were employed in those studies. However, in a related trial utilizing 22G or 24G non-cutting needles, the incidence of PDPH was 17.5% after 24 hours and 21.6% immediately following the procedure.[15] The risk of PDPH with a 20-22 G needle was shown to be 11.0% when using traumatic needles compared to 4.2% with atraumatic needles in a 2018 meta-analysis of 110 trials,[16] indicating a 60% reduction in occurrence. Instead of procedural-related factors, the clinical characteristics of our patients could be used to explain the increased frequency in our study. The majority of our patients had known risk factors, like being female, having a low BMI, and experiencing headaches before LP. Additionally, the participants in the aforementioned meta-analysis were often older (mean age was 38.6 years), and there were fewer female participants (61.7%) than in our study. The design of our prospective trial, in which patients are assessed following LP and specifically asked if they have headaches, may also be a contributing factor. Only patients who experience headaches are included in many retrospective PDPH studies because of this. In the current study, the majority of patients (84.1%) experienced headaches within the first two days following the surgery, which lasted an average of 2.6 days. This is consistent with research results that show that 66% of PDPH begin within the first 48 hours of LP and approximately 90% within the first 72 hours.[17] Our cohort's headache duration, however, appeared to be shorter than in other studies, where only a quarter of patients recover within two days of beginning and more than half recover by day four [18]. This may be because the majority of our patients have mild to moderate headaches, which generally respond well to conventional medical treatment. Since PDPH hardly ever manifests between 5 and 14 days following the surgery, none of our patients experienced PDPH after 4 days of LP, which is consistent with the literature.[18] The current study confirms some earlier findings for PDPH risk variables in the literature, such as young age, female gender, low BMI, headache before to LP, prior PDPH history, and number of puncture attempts.[4,19] According to certain research young age and female gender are the most significant and well-documented risk factors for the development of PDPH.[6,7,20] In our study, patients with PDPH had a mean age of 26.3 years, which was 6.3 years younger than the average age of those without headaches. But according to a number of studies, women under the age of 40 had a 3-5 times higher chance of getting PDPH,[17] which was consistent with the findings of Amorim and colleagues,[20] who reported that the incidence of the disease was highest between the ages of 31 and 50 years. Over 60 PDPH cases are uncommon, and studies have consistently demonstrated that as people age, their chances of developing PDPH decline.[19] The chance of developing PDPH was 6.33 times higher in females than in males, which was higher than the values in the literature. Amorim and colleagues revealed a 2.25 times higher risk in females,[21] which was comparable to Wu and colleagues,[22] meta-analysis, which discovered that the risk was twice as high in females, regardless of other factors. Regardless of age, Flaatten and colleagues reported a 3 times risk.[23] Differences in pain perception, variations in the dura's flexibility, psychosocial factors, and hormonal influences on the responsiveness of cerebral blood vessels are some of the potential underlying etiologies for age- and gender-related variations in

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PDPH.[22,24] BMI Similar to prior observations in the literature, lower BMI was discovered to be an independent risk factor for PDPH in our investigation. In a study of 99 patients who had an unintentional dural puncture, Faure and colleagues found that the incidence of PDPH was 25% in patients with BMI greater than 30 kg/m2 and 45% in individuals with BMI less than 30 kg/m2.[25] Another study by Peralta and colleagues that looked at 13,2013 pregnant women who had spinal anesthesia discovered that the incidence of PDPH was 56% in patients with a BMI less 31.5 kg/m2, and 39% in those with a BMI beyond 31.5 kg/m2 (P=0.0004).[26] In addition, it was discovered that morbid obesity reduced the prevalence of PDPH in multiple studies.[27] However, increased intra-abdominal pressures linked with higher BMI may aid in closing dural tears created during LPs. Al Hashel et al. hypothesized mechanisms underlying the relationship between BMI and PDPH risk are still under debate. In our cohort study, the majority of patients reported headache prior to LP, and a statistically significant over 70% of them experienced the development of PDPH. Similar findings were made by Kuntz and colleagues,[27] who discovered that PDPH incidence was about 70% in patients with headaches 1 week before to the surgery, compared to 30% incidence in those without headaches. Furthermore, a different study discovered that among the general community,[13] individuals with PDPH reported a history of headache in 67% of cases, compared to 38% of patients without PDPH. One explanation might have to do with nociceptive central sensitization, which increases the likelihood of developing PDPH following LP in patients who had headaches prior to LP.[28] Amorim and colleagues,[7] found that 19% of patients with prior history of PDPH developed second PDPH, which was similar to our findings, where 22.6% of patients with prior PDPH developed new attack of PDPH. Previous history of PDPH was estimated to have a 2-3 times higher risk for developing a new attack of PDPH compared to patients who had never developed PDPH before.[19,29] The underlying clinical traits of this subset of patients, which predispose them to subsequent PDPH, are probably responsible for the increased incidence of PDPH in those with a history of PDPH.[21] In our study, a higher number of LP attempts increased the chance of PDPH. Two documented subarachnoid punctures have been demonstrated to increase the risk of developing PDPH.[30] Repeated punctures increased the incidence of PDPH, according to a prospective research conducted on 8,034 individuals who received LP while under spinal anesthesia.[31,32] Interestingly, it was discovered that having more RBCs in CSF was inversely associated with developing PDPH; however, multivariate analysis did not support this conclusion. One possibility is that the blood's coagulating properties may act as a patch for the dural tear caused by LP, which was noted in a small number of instances.[33] Other investigations, however, were unable to detect a meaningful association between PDPH and RBC counts.[32] Furthermore, our cohort's results were consistent with those reported in the literature in that there was no correlation between LP location, position, amount of time spent resting after LP, or post-LP fluids and PDPH.[13,32,34] In our study, there was no correlation between having a neurologist's experience and developing PDPH. There is no conclusive evidence in the literature linking medical experience with PDPH. Our results

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were consistent with those of other research, wherein after 300 diagnostic LPs in one study,[20] and after 501 LPs in another,[27] there was no operator experience influence on developing PDPH. This discovery, however, conflicts with previous past studies. According to one study,[35] the incidence of PDPH was 2-times greater in anesthesiologists with less experience compared to those with more experience (2.5% vs. 1.2%). Another study,[36] found that the most junior practitioners had a double the incidence of PDPH when compared to consultants, albeit this result was not statistically significant (0.2% vs. 0.13%, p>0.05).

CONCLUSIONS

Our clinical practice research supported previous research on PDPH. The majority of patients experienced mild to moderately severe dull aching or throbbing headaches that often began during the first two days of the treatment, lasted an average of 2.4 days, and were of mild to moderate severity. Younger age, female gender, lower BMI, pre-procedure headache, prior history of PDPH, and number of LP attempts were independent risk factors. This study recommends that the neurologists should be treating this population in the manner so that it may help to prevent this painful adverse event, and identification of risk variables is vital in predicting PDPH. To support our findings, these results need to be verified in additional multicenter investigations including bigger cohorts.

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