



Incidence and associated factors of post-dural puncture headache among orthopaedic patients after spinal anaesthesia: a prospective cohort study

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Background: Post-dural puncture headache (PDPH) is one of a complication of spinal anaesthesia, influenced mostly by various factors including the patient's age, spinal needle size and design and sex. This headache can be severe and debilitating, preventing ambulation and limiting daily living activities.

Objective: This study assessed the incidence and associated factors of PDPH among patients who received spinal anaesthesia for orthopaedic procedures at the Debre Tabor Comprehensive Specialized Hospital from June to August 2022

Methods: Prospective cohort study design was employed using Consecutive sampling method among patients who received spinal anaesthesia for orthopaedics procedure at Debre Tabor Comprehensive Specialized Hospital from June to August 2022. Data were collected by face to face interview and direct observation based on questionnaire. The data were entered to epidata 4.6 and analyzed by SPSS version 20 software. A total 95 patients aged 16–75 was participated in study. Those independent variable that were significant on binary logistic regression at P less than 0.2, were analyzed on multivariate regression, and considered significant association with PDPH at P value less than 0.05.

Result: Ninety-five study participants were included in our study of which 19 (20%) had developed PDPH. Among patients who develop PDPH; 9.5% of the patients reported moderate pain while 10.5% experience mild PDPH and 80% of patient has no pain. The BMI and age were found to have significant association with PDPH [(P value 0.018, adjusted odds ratio 8.738, 95% CI, 1.461–52.269) and (P value 0.011, adjusted odds ratio 12.146, 95% CI, 1.753–84.170)], respectively) to PDPH.

Conclusion and recommendation: The incidence of PDPH was found to be higher in Debre Tabor Comprehensive Specialized Hospital. The hospital management and the anaesthetists should minimize the magnitude of by strictly following different preventive strategies.

Keywords: orthopaedic procedures, Post-Dural puncture headache, spinal anaesthesia

Introduction

Neuraxial anaesthesia (NA) is popular for its effectiveness in producing anaesthesia with excellent intraoperative neuromuscular paralysis and in generating analgesia for relieving post-operative pain if continuously infused^[1,2]. As the NA techniques are used popularly in clinics, post-dural puncture headache (PDPH), a common iatrogenic complication resulted from post-spinal taps or accidental dural puncture subsequent to epidural

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HIGHLIGHTS

- In this study the overall incidence of post-dural puncture headache (PDPH) was 20%.
- PDPH can be severe and debilitating.
- BMI and age are significantly associated with higher incidence of PDPH.
- Developing local protocols could be a better management option.

block, is frequently reported and becomes a challenge to health caregivers^[2,3].

Carrie and Collins define PDPH as a headache occurring after dural puncture, is typically bilateral and may occur in the frontal, occipital or both areas^[4]. It is characteristically located in the frontal or the occipital region, aggravated by the upright position and relieved by recumbency. It may be associated with nausea and vomiting, auditory and visual symptoms. Pain may radiate to the neck and neck stiffness may be present^[5]. Most headaches do not develop immediately after dural puncture but 24–48 h after the procedure, with almost all of the headaches presenting within 3 days^[6].

The physical phenomenon which causes spinal headache is explained as when the needle pierces Dura-matter and cerebrospinal fluid can leak out and pressure drops. The cushioning

effect of the fluid disappears and tension is applied directly to the cranial nerves^[7,8]. This headache can be severe and debilitating, preventing ambulation in addition to prolonging hospitalization and increasing healthcare costs. Indeed, 39% of patients with PDPH experience greater than a week of impairment in activities of daily living^[9].

Furthermore, it has been implicated in permanent disability, including cranial nerve palsy, chronic headache (sometimes necessitating surgical closure), reversible cerebral vasoconstriction syndrome, subdural haematoma, intracerebral bleeding, cerebral venous sinus thrombosis or aneurysmal rupture^[10–12].

The incidence of PDPH in research volunteers is ~6%^[13], in patients for whom the NA is for clinical purposes; the prevalence of PDPH ranges from 10% to over 80% in different aged patients who underwent either epidural or spinal or combined block^[9]. Investigations on the risk factors of PDPH revealed that female, younger age, perpendicular bevel orientation, previous history of PDPH, repeated dural puncture, needle gauge and design and pregnancy are factors substantially related to the occurrence of PDPH^[14–18].

Prevention and treatment of PDPH includes using smaller diameter spinal needles, using non-cutting (atraumatic) needles, inserting the needle bevel parallel to the dural fibre, prophylactic epidural blood patch, epidural morphine, intrathecal catheters and epidural or intrathecal saline, psychological and emotional support, Conservative treatment like bed rest, aggressive hydration, caffeine, antiemetic, paracetamol and non-steroidal anti-inflammatory drugs, peripheral nerve blocks. However if left untreated, 75% resolve within the first week and 88% resolve by 6 weeks spontaneously^[19–21].

PDPH results in an extra burden both for the patient and healthcare provider that will affect patient satisfaction as well as delivery of quality care. The incidence and associated risk factors of PDPH in orthopaedic patients has not been well studied in the study area and identifying its incidence and factor associated with it would increase patient satisfaction, reduced treatment cost and decrease hospital stay. Therefore in this study we aimed to assess the incidence and associated risk factors of PDPH among patients take spinal anaesthesia for orthopaedics procedures in Debre Tabor Comprehensive Specialized Hospital Debre Tabor Comprehensive Specialized Hospital.

Methods

Study setting, design, period and population

A hospital-based prospective cohort study was conducted at Debre Tabor Compressive Specialized Hospital, in North-central Ethiopia in from June to August, 2022 G.C. A total 95 patients aged 16–75 was included in this study by using a consecutive sampling method. All patients who required surgery for orthopaedic procedures was the source population and patients who undergone orthopaedic procedures under spinal anaesthesia, in Debre Tabor Comprehensive Specialized Hospital (DTCSH) during the study period were included in the study. Patient taking general anaesthesia with endotracheal tube intubation in addition to spinal anaesthesia (SA), patients who are unable to communicate due to serious illness or psychiatric problem, patient having previous diagnosis with migraine headache, patient with American Society of Anesthesiologist (ASA) classification grade III and above, common cold and history of fever, sinusitis,

hypertension, neurological disease, age older than 15 were excluded from the study. This study is reported in line with STROCCS checklist^[22] and registered at www.researchregistry.com with Research Registry UIN: researchregistry8838.

Before starting of data collection process ethical clearance paper was obtained from Debre Tabor Comprehensive Specialized Hospital University ethical review committee, permission was taken from the hospital administration.

During data collection process each patient was asked for his/her informed consent to participate in the study after brief explanation about the objectives of the study by the data collectors'.

Operational definition

Post-dural puncture headache

PDPH was defined as any headache following spinal anaesthesia that develops within 3 days after dural puncture and worsens within 15 min after sitting or standing and improves within 15 min after lying down and is also one of the following associated factors present: neck stiffness, tinnitus, hyperacusia, photophobia or nausea.

PDPH headache severity

- Mild headache: Numerical pain score (1–3) with no limitation of activity, and no treatment required
- Moderate headache: Numerical pain score (4–6) with Limited activity and regular analgesics may required
- Severe headache: Numerical pain score (7–10) with the patient confined to bed; anorexic^[23].

Photophobia

Sensation of pain in the eye resulting from exposure to bright light^[24].

Spinal anaesthesia

Injection of local anaesthetic into the cerebrospinal fluid in the spinal canal to block sensory and motor sensations before they reach the central nervous system. It is used mainly during surgery on the lower abdomen and legs^[25].

Tinnitus

A sensation of hearing ringing, buzzing, hissing, whistling or booming in one or both ears^[26].

Vomiting

Expelling of undigested food through the mouth^[27].

Data collection technique

Data collection

During data collection process the patients' age, sex and diagnosis was reviewed from the patients' chart. And before entering into the operation theatre the patient height and weight was measured and BMI was calculated and recorded on the questioner paper by the data collectors.

In the operating theatre the type and gauge of the spinal needle, and the number of spinal attempts before successful aspiration of

cerebrospinal fluid (CSF) and administration of SA was observed and recorded.

All patients were followed for three days' postoperatively. The first visit was done on 12 h of postoperative, and the last visit was conducted on 72 h after the operation.

Patients who developed headache within 72 h postoperatively were assessed for positional influence. That headache that occurs or worsens within 15 min of upright position and improves within 30 min of resuming to the recumbent position was considered as PDPH.

And then the severity of the PDPH was evaluated by using Numerical Rating Scale. Values 1–3 was considered as mild headache, 4–7 as moderate headache, and > 7 was considered as severe headache.

Those patients which does not complain headache within 72 h of postoperative period were considered as not developing PDPH.

Data quality control method

The quality of data was managed by giving adequate training for the data collectors and pretest was done on 5% of the population before actual data collection has started. During data collection, regular supervision and follow-up were performed appropriately. Each data point was crosschecked for completeness and consistency every day.

Data entry and analysis

The data were coded and entered into Epi Data 4.6 computer software by the Principal investigator. And then it was transferred into SPSS version 20 to run descriptive statistics and to test statistical association between the independent and the outcome variable/ PDPH.

Each independent variable was analyzed using binary logistic regression analysis; the odds ratio together with the 95% confidence interval was calculated to test for the association between the possible predictors and outcome variables. A P value of less than 0.2 was fitted for the final model and entered into a multivariate logistic regression to determine independent predictors of PDPH. P value of less than 0.05 were considered significant on multivariate logistic regression.

Results

Sociodemographic characteristics of the participant

A total of 95 patients who underwent orthopaedic procedures were enrolled in this study. Out this 66 (69.5%) were males and 29 (30.5%) were females. Most of them (86.3%) were ASA class I patients while the rest 13 (13.7%) were ASA class II patients. More than half the patients 52 (54.7%) were age categorized; 30–60 years old, while 28 (29.5%) patients were aged; 15–29 years old. The rest 15 (15.8%) patients were age older than 60 years. The minimum and a maximum age of the patients were 16 and 75 years old, respectively. Among patients which were participated in the study, 12 (12.6%) were under weight (BMI; <18.5 kg/m²), 73 (76.8%) were Normal BMI (18.5–24.9 kg/m²) and 10 (10.5%) patients were Obese (> 24.9) (Table 1).

Table 1

Sociodemographic characteristics of patients undergoing spinal anaesthesia for orthopaedics procedures in DTCSH, 2022 G.C

Variables	Category	Frequency	Percentage (%)
Age	15–29	28	29.5
	30–60	52	54.7
	> 60	15	15.8
Sex	Male	66	69.5
	Female	29	30.5
BMI	< 18.5	12	12.6
	18.5–24.9	73	76.8
	25–29.9	10	10.5
ASA class	ASA1	82	86.3
	ASA2	13	13.7

ASA, American Society of Anesthesiologist.

Intraoperative characteristics of participants'

Spinal anaesthesia was given using sitting position in 93 (97.9%) patients. 22, 23 Gauge, Qincke type of spinal needle and IV cannula was used in all patients that were participated in the study. Spinal anaesthesia was given after one attempt in 50 (52.6%) patient, on the second attempts in 31 (32.6%) patients and more than two attempts in 14 (14.7%) patients (Table 2).

The incidence, severity and associated symptoms of PDPH

Among 95 patients who underwent orthopaedics procedure under SA 19 (20%) develop PDPH within 72 h of the operation. Among 19 patients who developed PDPH 11 (57.9%) of patients were males. More than half of them 10 (52.6%) developed PDPH within the first 12 h of postoperative time and none of them had severe pain from the PDPH (Table 3).

Table 2

Intraoperative characteristics of participants' during orthopaedic operative procedures under SA in DTCSH, 2022 GC

Variables	Count	Percent (%)
Position of the patient during spinal anaesthesia		
Sitting	93	97.9
Lateral	2	2.1
Gauge of the spinal needle used		
18	21	22.1
22	64	67.4
23	10	10.5
Type of spinal needle used		
Sprotte	—	—
Quincke	76	80
Whitacre	—	—
Tohy needle	—	—
IV cannula	19	20
No. spinal attempt		
One attempt	50	52.6
Two attempt	31	32.6
More than two attempt	14	14.7

SA, spinal anaesthesia.

Table 3
The incidence of PDPH and associated symptoms among patients underwent orthopaedics procedures in DTCSH

Variables	Count	Percentage (%)
PDPH		
Yes	19	20
No	76	80
The time in which headache occurred		
Within 12 h	10	52.6
Between 12 and 72 h	9	47.4
Associated symptoms with PDPH		
Tinnitus	16	30.2
Neck stiffness	15	28.3
Photophobia	12	22.6
Nausea and vomiting	10	18.9
Severity of the headache using numerical pain rating scale		
No pain	76	80
Mild pain	10	10.5
Moderate pain	9	9.5
Sever pain	—	—

PDPH, post-dural puncture headache.

Binary logistic regression

On binary logistic regression, the sex of patients, type of spinal needle was not significantly associated with the outcome variable PDPH with *P* values of 0.225, 0.44, respectively.

BMI of the patient and age of the patient were significant on binary regression with *P* less than 0.2, and were introduced into multivariate analysis to control the co-founding (Table 4).

Multivariate analysis

In this study, age of the patient was significantly associated with the development of. The Patients with age group of 30–59 years

Table 4
Binary logistic regression of each independent variable with the outcome variables

Independent variables	PDPH (n=95)			COR (95% CI)
	Yes, n (%)	No, n (%)	<i>P</i> value	
Sex				
Male	11 (16.67)	55 (83.33)	0.20	1
Female	8 (27.59)	21 (72.41)	0.225	1.905 (0.673–5.390)
Age				
15–29	8 (28.57)	20 (71.443)	0.022	1
30–60	5 (9.62)	47 (90.38)	0.448	1.667 (0.446–6.232)
> 60	6 (40.00)	9 (60)	0.009	6.267 (1.569–25.024)
No. spinal attempt				
One attempt	3 (6.00)	47 (94.00)	0.001	1
Two attempt	14 (45.16)	17 (54.84)	0.322	2.611 (0.391–17.426)
More than two attempt	2 (14.29)	12 (85.71)	0.059	0.202 (0.039–1.060)
BMI				
< 18.5	—	12 (100)	0.026	1
25–29.9	6 (60)	4 (40)	0.007	6.923 (1.707–28.076)
Type of spinal needle				
Sprotte	—	—	0.048	1
Quincke	14 (18.42)	62 (81.58)	0.444	1.582 (0.489–5.118)

COR, Crudes Odds Ratio; PDPH, post-dural puncture headache.

were 12 times more likely to develop PDPH with the adjusted odds ratio (AOR) (12.146), 95% CI (1.753–84.170).

The BMI of the patient was also significantly associated with the outcome variable PDPH. The probability of developing PDPH found to be 9 times higher in patients with BMI of 25–29.9 with the AOR (8.738), 95% CI (1.461–52.269).

Number of spinal attempt is protective factor for PDPH in this study. So, the spinal attempt is more than two is 92.6% less likely as compared to those patients having spinal anaesthesia in two attempt or less with the AOR (0.074), 95% CI (0.006–0.894) *P* value 0.041 (Table 5).

Discussion

PDPH is the most common reason for litigation in anaesthesia as shown in the data obtained from the ASA’s Closed claims analysis project^[28]. Different researches showed different values of the prevalence of PDPH.

In this study the overall incidence of PDPH was 20%. Which is lower than the study conducted in xx, Gondar and Wolaita sodo University^[6,21,29]. In contrast to this study incidence of PDPH in orthopaedic patients is lower in studies conducted in Iran, Germany and USA which found to be 10%, 5.9% and 2%, respectively^[3,30,31]. The possible reason for the difference would be use of small gauge needle sizes which ranges from 18 to 23G in this study.

The most likely reason for PDPH is thought to be CSF leakage from the dural rip^[16]. Multiple numbers of attempt during spinal anaesthesia leads to multiple dural perforation and continuous leakage of CSF^[16,32]. This study showed that two or more attempt during spinal anaesthesia is associated with the incidence PDPH. This finding is supported with studies that were conducted in Gondar Referral and Teaching Hospital, Wolaita sodo University, Jordan and Cuba^[6,21,32,33]. However few studies report no significant relationship between number of spinal attempt and PDPH^[34,35].

BMI was one of the sociodemographic factors which was associated with the outcome variable. In this study, patients with BMI of greater than 24.9 were 8.738 more likely to develop PDPH than patients with BMI of less than 18.5 which is consistent with the Study conducted in University of California, San Diego, USA^[13], Indicates; BMI more than or equal to 25 kg/m² (obese) were more likely to experience PDPH than those non Obese patients (<25 kg/m²). Some studies were also support this finding^[36,37].

Young individuals (20–30 years old) have a higher incidence of PDPH, while those over 60 and those under 13 have a lower prevalence. This may be as a result of the reduced CSF pressure at both extreme ages^[19,38]. In a study which was carried out in

Table 5
Multivariate analysis of age, BMI, and number of spinal attempt of SA

Variable	Category	<i>P</i> value	AOR	95% CI
Age	30–59	0.011	12.146	1.753–84.170
BMI	25–29.9	0.018	8.738	1.461–52.269
No. spinal attempt	> 2 attempt	0.041	0.074	0.006–0.894

AOR, adjusted odds ratio; SA, spinal anaesthesia.

Dhulikhel Hospital, Kavre, Nepal found a significant relationship between PDPH and age group of the patient. Patients with age group 18–30 years old was more likely to develop PDPH as compared to patients with age group of 31–45 years^[39]. However this study revealed patients age group 30–59 years old were more likely to develop PDPH as compared to patients with age group of 15–29 years.

Several studies have revealed that women are 2–3 times more likely than males to develop PDPH. Although the cause of these observations is unclear, it might be hormonal variations, female-specific pain sensitivity, or any other factors^[38]. Despite others this study found, sex of the patient was not significantly related to PDPH (AOR 0.501, 95% CI; 0.087–2.887) which coincides with some other studies like a study in Kavre, Nepal^[39].

In our study the majority of patients have experienced mild (10.5%) and moderate (9.5%) PDPH pain, which is the same as studies conducted in Ghana^[40], Croatia^[41]. Study in Himalayan Institute of Medical Sciences (HIMS), Dehradun which is also reported mild to moderate pain among patients taking SA for obstetric and non-obstetric operations^[42].

In present study most of the patient developed PDPH within 12 h of postoperative period 52.6% while the rest (47.4%) develop PDPH between 12 and 72 h of post-spinal anaesthesia. This result was similar with the study that was conducted in Nepal^[39].

Strength and limitation of the study

This study is conducted on orthopaedic patients, which shows the magnitude of the case on that particular group. We ensure the validity of this by having clear research question and using appropriate design. However, due to time and financial constraint it is a single centre study.

Conclusion

The incidence of PDPH in the current study was found to be higher as compared to other studies, which were conducted in western countries. Majorities of patients report there PDPH as mild headache which require bed rest and some functional limitation after SA. This study also revealed the BMI and age of patients have been significantly associated with PDPH.

Ethics approval and consent to participate

An ethical permission was obtained from a research ethics committee of Debre Tabor University college of Health sciences. The permission was taken from Debre Tabor Referral Hospital. Informed consent was secured from all study participants after telling them the aim, benefit and risk of participating in the study. The anonymity participants' information was kept confidential.

Consent

Informed consent was taken from study participants after telling them the aim of the study, benefit, harm of participating in the study, and they have been told as they can withdraw from the study at any step if they feel so. Written informed consent was obtained from the patient for publication and any accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request. Written informed consent was obtained from the patient's parents/legal guardian

for publication and any accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

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Author contribution

All authors equally participated in write-up of the proposal, data entry, data analysis and final manuscript preparation. The final manuscript is read and approved by all authors.

Conflicts of interest disclosure

The authors declare that there is no conflict of interests.

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Availability of data and materials

Data and materials will be shared upon reasonable request.

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