



Cohort Study

Incidence and associated factors of post dural puncture headache in cesarean section done under spinal anesthesia 2021 institutional based prospective single-armed cohort study

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ABSTRACT

Background: Spinal anesthesia is the most commonly used anesthesia technique for Cesarean delivery with 80%–95% prevalence. The most common complication of SA is post-dural puncture Headache which is associated with dural puncture & Cerebrospinal fluid leak. This study aimed to assess the incidence and associated factors of post-dural puncture headache.

Methods: single-armed cohort study design was employed on 412 women from May 2021 to January 2022. Study subjects were selected using systematic random sampling. Descriptive statistics for each variable, binary logistic regression, and multiple logistic regression analysis with 95% CI was carried out.

Results: The overall incidence of post-dural puncture headache in this study was 25.7%. 43.9% of Post dural headache was detected in the 1st 24 h followed by 48 h. Of those who develop Post-dural headaches, 54.1% of them had mild pain, 17.3% of them was moderate pain and 28.6% of them suffered severe pain. The multi-variable analysis indicated that BMI>30 kg/m² [AOR 2.85 95% CI: 1.91–4.25], number of attempts (>3), (AOR = 1.5, 95% CI: 1.19–1.91), and cephalic needle direction (AOR = 5.79 95% CI: 2.27–12.22), were factors associated with increased post-dural puncture headache. While large gauge needle size (AOR = 0.28 95% CI: 0.19–0.42), and greater than 3 years of experience of anesthetist (AOR = 0.44, 95% CI: 0.31–0.62) were associated with decreased incidence of post-dural puncture headache.

Conclusion: The incidence of post-dural puncture headache was higher in BMI>30 kg/m², greater than 3-time attempts during spinal anesthesia, using low gauge spinal needles, less than 3 years of experience as anesthetist and cephalic needle direction.

1. Background

According to the international headache society, PDPH is defined as a headache that occurs within 5 days of dural puncture characterized by dull bilateral pain originating in the frontal area & radiate to occiput that will worsen within 15 min of sitting/standing position, sneezing, coughing straining & improves within 15 min of lying down. This headache will be associated with neck stiffness, dizziness, photophobia, tinnitus, diplopia, plus nausea & vomiting. Those manifestations recover spontaneously within one week, or after sealing of the leak with an autologous epidural lumbar patch within 48 h. But PDPH will not associate with fever, leukocytosis, and neurologic deficit [1–9].

PDPH is a devastating complication of procedures that puncture the

dura matter such as epidural/spinal anesthesia, accidental dural puncture during spinal surgery, diagnostic lumbar puncture, myelogram & epidural injection [10–12]. Although PDPH may occur immediately after puncture of the dura, 90% occur within 3 days and 66% of the cases will start manifesting in the first 48 h of puncture [8,13].

According to the International Classification of Headache Disorders criteria, 29% of patients suffer only headaches without other symptoms. This result suggests that headache characteristic is key diagnostic criteria for the diagnosis of PDPH [6].

Even though the exact cause of PDPH is still unknown, the main cause of PDPH is CSF leakage which has an acute phase from minute to several hours associated with abrupt leakage of CSF & dropping of CSF pressure eventually results in gravitational traction on pain-sensitive

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structure & shifting of intracranial structures. In addition to this, the manifestation of PDPH secondary to CSF leakage is the result of activation of adenosine receptors that subsequently cause dilatation of intracranial arteries & veins for a compensatory increase in blood volume via Monro Kellie doctrine [11,14–16].

Obstetrics patients are at risk of developing PDPH due to their sex, age & higher rate of exposure to neuraxial blocks [4,7,17]. The pain of PDPH is severe & puts the patient in discomfort which may end up in dissatisfaction of the mother on SA, disruption of baby care, increase in the cost of health care, hospital stay & visit to the emergency department as well as it will increase risk of refusal of spinal anesthesia in a later occasion.

The main aim of this study is to assess the incidence and associated factors of PDPH after Spinal anesthesia in cesarean section in Gedeo Zone hospitals.

2. Methods

412 mothers who deliver their babies by cesarean section were recruited in this Hospital based single-arm prospective cohort study. Ethical clearance was taken from Dilla University College of health science and Medicine IRB. Informed consent was obtained from each participant after briefly discussing about the study. The study was reported by making in line with STROCCS 2021 guidelines [18]. In addition, we registered this study on the research registry's unique number of 7707 and with a hyperlink of <https://www.researchregistry.com/browse-the-registry#home/>.

All Pregnant mothers who undergo C/S under SA whose age was 18–45 were included. Patients who had Preeclampsia, migraine headache, Known Hypertensive, Known psychiatric disease, and ASA class IV and above were excluded from the study.

A structured questionnaire was prepared and a pretest was done by 5% of the study sample size. 3 days of training were given for data collectors on how to collect and organize data. The data was filled by 3 BSc nurses.

Data were gathered from patients and from their medical charts which contain patient sociodemographic data, obstetric history, intra-operative data, and postoperative data. During data, collection confidentiality was maintained at all levels of study by avoiding patient identifiers.

We used the following descriptions in this study.

Post dural puncture Headache: Fronto-occipital type of headache which occurred after spinal anesthesia which gets worth after 15 min of standing or sitting and relieved after 15minuts of lying down.

2.1. Sample size & sampling technique

The sample size was calculated by using single population formula by taking a similar study done by Tarekegn et al. in Felege hiwot hospital which showed the incidence of PDPH was 42.6% [19]. With the assumption of a 95% confidence interval and a 5% margin of error, the sample size becomes 375. With an account of a 10%, nonresponse rate a total of 412 subjects were selected in this study using a systematic random sampling technique.

2.2. Data processing and analysis

Data were checked manually for completeness and then coded and entered into EPI info version 7 then transferred to SPSS version 20 computer program for analysis. Categorical variables were summarized by number and percentage. To identify factors associated with the outcome variable (SSIs), a bi-variable logistic regression analysis was run for each independent variable and a crude odds ratio (COR) with 95% confidence intervals was obtained. Those variables that have a p-value less than or equal to 0.25 on bi-variable analysis were considered candidates for multi-variable analysis. The strength of statistical

association was measured by odds ratios (OR) with a 95% confidence interval where P-values, less than 0.05 were declared as statistically significant.

3. Results

3.1. Socio-demographic and obstetric data

From 412 study participants who were recruited for this study. Among 412 participants 7.5% of them were excluded due to some missing information and loss of follow-up. A total of 381 participants' data were included for analysis. Among 381 mothers who were involved in this study, 97.6% of them were ASA II. The median age of mothers was 27 years with an IQR of 6 years. 63.5% of mothers were in BMI value of 19.5–24.5. 95.3% of mothers undergo C/S when their gestational age was with 37–42 weeks. Only 3.6% of mothers were gravida more than 5 (Table 1).

3.2. Intraoperative data

Among 381 pregnant mothers who undergo C/S under SA 73.8% of them were come to Operation theatre for emergency C/S. In this study, only 0.8% of participants had previous PDPH history. 98.4% of SA was done in a sitting position. 24G spinal needle was used in 42.3% of mothers which was followed by 23G with 33.6%. 71.1% of the spinal needle was directed laterally. Greater than 6 attempts were done only on 4.7% of the study participant. The median total blood loss was 500 ml with an IQR of 150 ml and the median intraoperative fluid administered was 2000 ml with an IQR of 800 ml 73% of SA was conducted by students (Table 2).

3.3. Incidence of PDPH

Among 381 mothers 25.7% (98) of them developed PDPH. From those mothers who developed PDPH 43.9% of the incidence of PDPH was detected in the 1st 24 h followed by 48 h (Fig. 1) (Table 3.).

3.4. The severity of PDPH among pregnant mothers undergo C/S

Of 98 mothers who had PDPH, 54.1% of them had mild pain and 28.6% of them suffered severe pain (Fig. 2).

3.5. Factors associated with PDPH

As a result of bivariate logistic regression shows ASA, BMI, needle size, number of attempts, needle direction, and experience of anesthetist

Table 1
Socio-demographic and obstetric data of pregnant mothers.

Variable	Category	Frequency	Percent
Age	<19	12	3.1%
	20–30	292	79.7%
	31–40	77	17.2%
ASA	ASA II	372	97.6%
	ASA III	9	2.6%
BMI	<19.5	3	0.8%
	19.5–24.9	242	63.5%
	24.5–29.9	79	20.7%
	30–34.9	45	11.8%
	>35	12	3.1%
Gestational age	<37	9	2.4%
	37–42	363	95.3%
	>42	9	2.4%
Gravidity	1–5	371	97.4%
	>5	10	2.6%
Parity	0–4	371	97.4%
	>4	10	2.6%

Table 2
Pre-operative and Intraoperative data of Mothers delivered by C/S under SA.

Variables	Category	Frequency	Percent
Urgency of surgery	Elective	100	26.2%
	Emergency	281	73.8%
Previous PDPH	No	378	99.2%
	Yes	3	0.8%
Position during SA	Sitting	375	98.4%
	Lateral	6	1.6%
Needle size	22	89	23.4%
	23	128	33.6%
	24	161	42.3%
	25	3	0.8%
Needle direction	Cephalic	107	28.1%
	Lateral	271	71.1%
	Caudal	3	0.8%
Number of attempt	1-5	363	95.3%
	>6	18	4.7%
Total blood loss	<500	122	32.1%
	500-1000	256	67.1%
	>1000	3	0.8%
Fluid administered	1000-2000	242	66.1%
	2100-3000	129	31.3%
	>3100	10	2.6%
	Student	154	40.4%
Experience of anesthetist	1-3 years	105	27.6%
	3-5 years	101	26.5%
	>5 years	21	5.5%

had an association with incidence of PDPH. These variables were entered into multivariable logistic regression and the analysis shows BMI, needle size, number of attempts, needle direction, and experience of anesthetist were significantly associated with the incidence of PDPH. According to our result, pregnant mothers whose BMI was >30 kg/m² had a 2.85 increased risk of developing PDPH than mothers with normal BMI (AOR = 2.85 95% CI: 1.91-4.25). As our result demonstrated SA done with cephalic needle direction increased the incidence of PDPH by 5.7 times (AOR = 5.79 95% CI: 2.27-12.22). While using a large needle size (25G) reduced the happening of PDPH by 72% with (AOR = 0.28 95% CI: 0.19-0.42). The incidence of PDPH was reduced by 66% when SA was done by an anesthetist whose experience is greater than 3 years (AOR = 0.44, 95% CI: 0.31-0.62) and performing more than 3 attempts rise incidence of PDPH by 1.5 times (AOR = 1.5, 95% CI: 1.19-1.91) (Table 4).

3.6. Incidence of back pain

As our result discovered the incidence of acute back pain was 40.9%. Of 156 patients who had acute back pain, 59% of them reported mild pain (Table 5).

4. Discussion

Nowadays 80%-95% of C/S are performed by spinal anesthesia due to its simplicity, fast onset, excellent sensory & motor block due to the parturient being awake she feels childbirth, early breastfeeding as well as good postoperative analgesia with avoidance of airway obstruction & risk of aspiration [20-23]. Even-though SA is considered to be safe it is not complication-free. The most common iatrogenic complication of SA is post-dural puncture Headache which is associated with dural puncture & Cerebrospinal fluid leak [3,11,21,24-27].

Even though the exact cause of PDPH is still unknown, the main cause of PDPH is CSF leakage which has an acute phase from minute to several hours associated with abrupt leakage of CSF & dropping of CSF pressure eventually results in gravitational traction on pain-sensitive structure & shifting of intracranial structures. In addition to this, the manifestation of PDPH secondary to CSF leakage is the result of activation of adenosine receptors that subsequently cause dilatation of intracranial arteries & veins for a compensatory increase in blood volume via Monro Kellie doctrine [11,14-16].

As evidence revealed the incidence of PDPH range from 0 to 42.6% after spinal anesthesia & 81% after accidental dural puncture [28-30].

As this study shows the incidence of PDPH was 25.7% which is comparable with the study done in Dire Dawa East Ethiopia, Kenya, Cairo Egypt, and others [29-31]. The incidence of PDPH found in our

Table 3
Incidence of PDPH among pregnant mothers undergo C/S based on time.

Variables	Category	Frequency	Percent
Incidence of PDPH based on time	At 12 h	9	9.2%
	At 24 h	43	43.9%
	At 48	27	27.5%
	At 72	9	9.2%
	At 4th day	6	6.1%
	At 5th day	4	4.1%

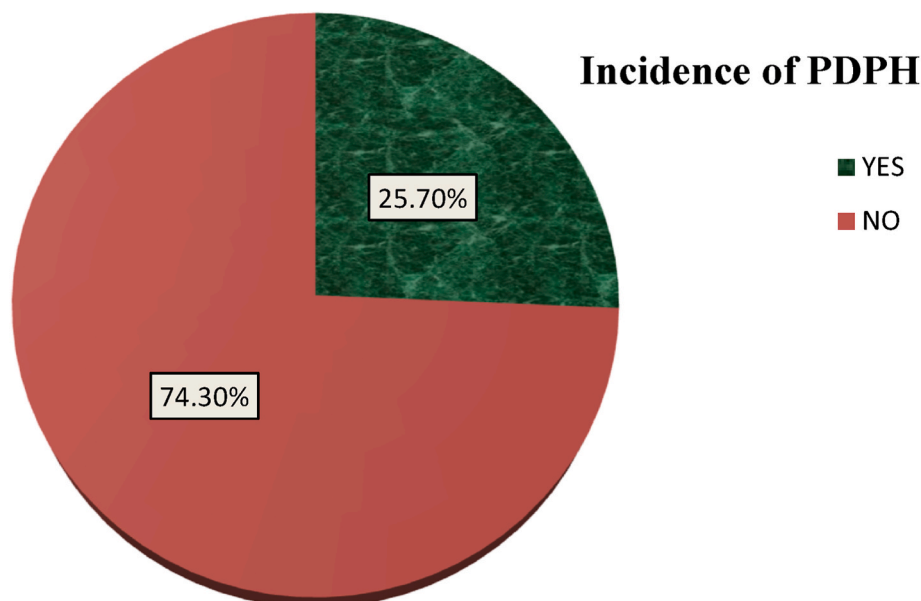


Fig. 1. Incidence of PDPH among pregnant mothers undergo C/S.

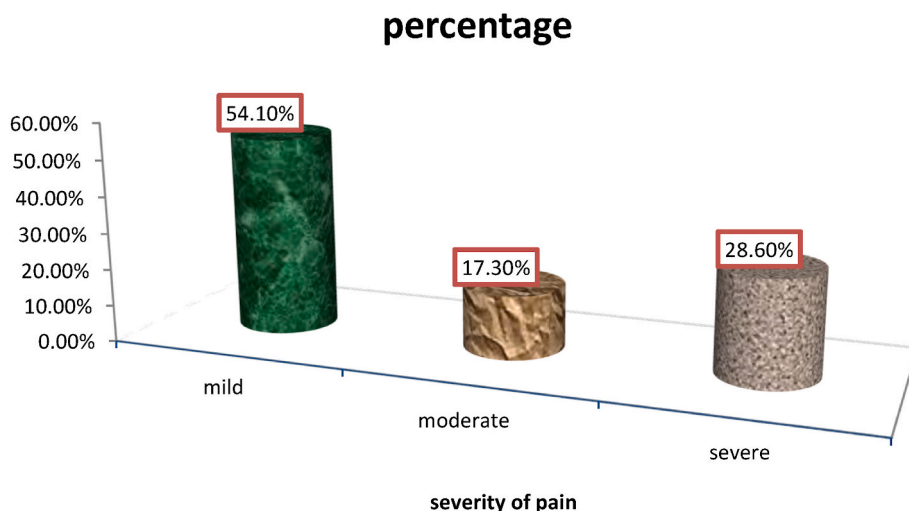


Fig. 2. Severity of PDPH among m-others delivered by C/S under SA in DURH,2021.

Table 4
Factors associated with PDPH among mothers undergo C/S under SA.

Variables	Category	AOR	95% C-I for AOR		P value
			Lower	Upper	
ASA		2.000	.29	13.86	.483
BMI	>30Kg/m2	2.85	1.91	4.25	.000
Needle size	25G	.28	.19	.42	.000
NOA	>3	1.5	1.19	1.91	.001
Needle direction	Cephalic	5.79	2.75	12.22	.000
Experience	>3 years	.44	.31	.62	.000

Table 5
Incidence of back pain and its severity among mothers undergo C/S under SA.

The severity of Back pain	Frequency	Percent
Mild	92	59.0%
Modarete	53	34.0%
Severe	11	7.1%

study was lower than the result of the study conducted at Felege Hiwot Referral Hospital, North West Ethiopia which shows an incidence of 42.6%. This might be attributed to the large needle size they used 20% 21G while we used a needle size minimum of 22G [19].

Khraiseel et al., Dagmar Oberhofer et al. and Mohammed et al. found that the incidence of PDPH in parturients was 6.3%, 14.3%, and 15.8% respectively. Their finding was lower than our result. The main reason for such difference was the needle size used in their study which was more than 25G and they used both cutting and non-cutting needle-type while we performed SA with cutting type of needle size 22-25G [10,32, 33].

In this study, 54.1% of study participants had a mild type of pain. This result is consistent with the result of Mohammed et al. which indicated 61.9% of parturients had mild pain(10). It is also in line with other findings [32]. In contrast to our finding result of Dawit et al. showed, that only 11% of the mothers had mild pain. The possible explanation for this dissimilarity is the needle size used in their study was large size needle which is responsible for the leakage of a large amount of CSF [29].

As a result of multivariable logistic regression analysis shown needle size, the number of attempts, BMI, needle direction, and experience of anesthetists were significantly associated with the incidence of PDPH.

As our result shows using Spinal needle number 25G reduces the

occurrence of PDPH by 72% with an AOR of 0.28 which was statistically significant with $p < 0.0001$. This finding is in agreement with to study conducted by Dawit et al. which indicated that SA has done with 18G and 20G spinal needles had a 3 times higher chance of developing PDPH than the one performed by 25G and 26G(29). Our finding is consistent with the finding of Carrazana et al., Kassa et al. and Hassan Mohammad [4,7,30].

In our study repeated attempts increases the incidence of PDPH by 1.5 times with a CI of 1.19–1.91 which was statistically significant with $p = 0.001$. This finding is consistent with the result of Tarekegn et al. which indicated that repeated attempts increase the incidence of PDPH 4 times than the one that had a single attempt [19].

According to Dawit and his colleagues finding mothers who undergo spinal anesthesia with a single attempt had a 62.6% less likely chance of developing PDPH than mothers who had SA with multiple attempts which is in line with our finding [29]. in addition, our finding is comparable to other studies [4,7,33].

In contrast to our findings study done by Dagmar Oberhofer et al. showed that the number of attempts has no association with the incidence of PDPH. This inconsistency occurred might be due to a difference in sample size where 56 parturients in their study while we used 381 study participants [32].

In our finding BMI greater than 30 kg/m² increases the rate of PDPH by 2.85 times with a CI of 1.91–4.25 which was statistically significant with $p < 0.001$.

According to our findings inserting a spinal needle with a cephalic opening, direction increases the incidence of PDPH 5.7 times more than caudal and lateral direction with a CI of 2.75–12.22 which was statistically significant with $p < 0.001$. This result is in agreement with the finding of Bicak et al. which indicated that the cephalic direction of the needle increases the occurrence of PDPH with $P = 0.019$ [34].

SA performed by an anesthetist who had more than 3 years of experience reduces the occurrence of PDPH by 56% when compared to an anesthetist who had less than 3 years of experience with an AOR of 0.44 which was statistically significant with $p < 0.001$. This result is divergent from the findings of other studies which showed the experience of anesthetists had no association with the incidence of PDPH. This difference might be explained by in our study most of the SA procedures were done by graduate students while in other studies most of the procedure was done by a certified anesthetist [29,31].

In our study, 46.9% of PDPH occurred in the 1st 24 h followed by 27.5% in 48 h. This result is consistent with the outcome of Mohammed et al. and Bicak et al. which showed that the incidence of PDPH was higher within 24 h [10,34].

In this study, 40.9% Of study participants developed acute back pain

which was mild in 59% of parturients.

The limitations of this study are due to scarcity of budget we didn't collect the data from multi-centers.

5. Conclusion

The incidence of post-dural puncture headache is 25.7%. 43.9% of PDPH happens in the first 24 h and 54.1% of them are mild. The finding of this study showed that incidence of post-dural puncture headache was associated with BMI > 30 kg/m², more than 3-time attempts during spinal anesthesia, using low gauge spinal needles, the experience of anesthesiologists less than 3 years' and cephalic needle direction. Therefore, identifying the risk and managing is essential steps to reduce the high incidence of postural puncture headaches. We recommend the researchers do this study in multi-centers and also recommend doing randomized control trials on the impact of BMI in PDPH with large sample sizes.

Ethics approval and consent to participate

This study was approved by the Dilla University College of Health Science and Medicine Institutional review board. Written informed consent for participation in the study was obtained from all patients.

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Author contribution

All Authors have contribution in this study.

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Consent for publication

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Availability of data and materials

The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

Provenance and peer review

Not commissioned, externally peer-reviewed.

Declaration of competing interest

None.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.amsu.2022.103729>.

Abbreviations

ASA	- American Society of Anesthesiologists
AOR	- Adjustable odd ratio
BMI	- Body mass index
CI	- Confidence interval
COR	Crud odd ratio
C/S	Cesarean Section
CSF	Cerebro-spinal fluids
PDPH	post-dural puncture headache
SA	- Spinal anesthesia

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