Asian Journal of Medicine and Health

Volume 21, Issue 11, Page 202-210, 2023; Article no.AJMAH.108655
ISSN: 2456-8414

Factors Predisposing to Postdural Puncture Headache after Spinal Anaesthesia among Elective Caesarean Section Patients at Thika Level 5 Hospital, Kenya

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/AJMAH/2023/v21i11937

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/108655

Original Research Article

Received: 23/08/2023
Accepted: 30/10/2023
Published: 31/10/2023

ABSTRACT

Background: Postdural puncture headache (PDPH) is a common complication following spinal anaesthesia for Caesarean section (CS). There is little data on the incidence and its predisposing factors in low-income countries. The study aimed to investigate the incidence and factors predisposing patients to PDPH after a dural puncture during a planned Caesarean section under spinal anaesthesia at Thika Level 5 Hospital, Kenya.

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Methods: A cross-sectional study design was used. Pregnant women scheduled for planned Caesarean sections under spinal anaesthesia at Thika Level 5 Hospital were randomly recruited. Data was collected during the fourth quarter of 2021. Patient factors (age, BMI, bed rest, and previous history of PDPH), healthcare provider factors (qualification, experience, and the number of dural punctures), and equipment factors (size, design, and spinal needle orientation) were evaluated to determine predisposing factors for PDPH. Sample size obtained by the use of Fisher's formula, resulting in a sample size of 103.

Results: We found the incidence of PDPH at Thika Level 5 Hospital to be 24.5%. Patient and equipment factors were found to be associated with PDPH. Among the patient factors, high BMI was found to be significant ($p = 0.039$) while among the equipment factors, traumatic needle tip design ($p = 0.049$) and the perpendicular orientation of needle bevel ($p = 0.022$) were found to be associated with PDPH.

Conclusion and Recommendations: We conclude that PDPH is a common complication following spinal anaesthesia for Caesarean section, and the incidence (24.5%) is relatively high at Thika Level 5 Hospital. High BMI, traumatic cutting spinal needle tip design and perpendicular orientation of the needle bevel are predisposing factors. Further research is needed to determine the predisposing factors of PDPH at different levels of hospitals in Kiambu County, and understand the specific mechanisms and measures to minimize the incidence PDPH

Keywords: Caesarean section; post-dural puncture headache; subarachnoid space; spinal anaesthesia.

1. INTRODUCTION

The field of anaesthesia has seen significant advancements in recent years, with spinal anaesthesia being a popular method for surgeries below the umbilicus [1]. However, one complication often associated with spinal anaesthesia is postdural puncture headache (PDPH). PDPH is defined as head pain that appears within five days of the dura being punctured. The headache is linked to the spilling of cerebrospinal fluid (CSF) through the hole created by the needle and can lead to symptoms such as subjective tinnitus and neck stiffness. A study done at Columbia found that 99% of PDPH's occur during the first three days, and 66% occur within the first 48 hours of spinal anaesthesia (Arevalo-Rodriguez et al., 2016)

The global incidence of PDPH ranges from 0.1% to 36% [2]. The incidence at KNH in 2009 was 47.5% (Muhumuza et al., 2009), and at Aga Khan University Hospital, it was 20.35% (Gisore, 2010). Other studies in the region found the incidence of PDPH within the same range as this study. In Nigeria, the incidence was 15.8% [3]; in Ethiopia, it was 20.2% [4]. The above studies show that PDPH is still a problem in Africa.

The main factors that may lead to PDPH have been classified into three categories: the patient, the healthcare provider, and the equipment used [2]. Patient-related factors are often listed as young age, prior history of PDPH, and body mass index (BMI). Some of the known critical healthcare provider-related factors include training, experience, and the number of dural punctures. The major equipment-related factors include the size of the needle, its design, and the bevel's direction. A study done by Lofty Mohammed et al. [3] found spinal anaesthesia for CS with a 29 gauge spinal needle to reduce the incidence of PDPH to 0%.

2. MATERIALS AND METHODS

A cross-sectional study design was used to investigate the incidence and factors predisposing patients to PDPH after a dural puncture in patients who delivered via planned Caesarean section under spinal anaesthesia at Thika Level 5 Hospital in Kiambu County, Kenya. The study was conducted in the fourth quarter of 2021.

The sample size was calculated using Fisher's formula (as cited in Mugenda & Mugenda, [5]) at a 95% level of significance. The formula resulted in a sample size of 103

Data collection involved a researcher administering questionnaires containing open-ended and closed-ended questions. Closed-ended questions were used primarily to facilitate the coding and analysis of responses, while open-ended questions allowed participants to provide more detailed and specific answers.

Patients scheduled for elective Caesarean sections at Thika Level 5 Hospital were recruited for the study by the research team the evening before the surgery. Participants who consented were selected using systematic random sampling and signed a consent form. The Principal investigator and assistants conducted interviews with participants and filled out the first part of the questionnaires. The anaesthetists administering the anaesthesia filled out the second part of the questionnaire after administering spinal anaesthesia. Caesarean sections are performed at Thika Level 5 Hospital per its protocol. The patient is pre-loaded with 500 ml to 1000 ml of normal saline one hour before being taken to the operating room. The patient is also given a premedication dose of 2 grams of ceftriaxone and 500 mg of metronidazole intravenously. When the patient is brought into the operating room, she is secured to the physiological monitors and baseline readings of their EKG, blood pressure, SPO2, and heart rate are taken.

The patient is subsequently placed in a sitting position, and an aseptic lumbar puncture is carried out. A mixture of fentanyl 25 mcg and bupivacaine 7.5–10 mg is injected into the subarachnoid area. To prevent aortocaval compression, the patient is subsequently placed in a supine position with a left lateral tilt. A pinprick or cold cotton sensation is used to test the block, aiming at least T6 at its maximum level before the surgery commences. A prophylactic antiemetic is administered to the patient (10 mgs of Metoclopramide or 4 mgs of Ondansetron). Additionally, 5 mg of ephedrine is given to prevent hypotension.

A screen blocks the patient's view of the surgical site, and verbal communication with the patient is maintained. Intravenous crystalloids are also given during the surgery and for 6 hours post-operative until the patient can resume oral feeding. After surgery, the patient is observed in the recovery room for about an hour before being transferred to the post-natal ward.

The principal researcher followed up with patients three days post-operatively to establish the presence of any headaches and to evaluate the severity of the headaches using a visual analogue scale (VAS). The PDPH criteria for this study included any headache that develops within 72 hours of a dural puncture, worsens when standing or sitting and improves when lying down, and is accompanied by symptoms such as nausea, photophobia, and stiff neck. Patients who met the criteria for PDPH were treated conservatively.

3. RESULTS

A good number of the participants were between 20 and 26 years of age. The range in age was from 20 to 42 (interquartile range (IQR) 8). More than half of the participants, 58 (56.9%), had attained secondary school education. Less than half of the participants, 48 (47.1%), were self-employed, while the majority were married, 96 (94.1%). About half (51%) were obese, and the mean BMI was 31.3 (SD of 5.9).

Table 1. Demographic Characteristics of the Study Participants ($n = 102$)

Variable	Frequency	Percent
Age		
$20-25yrs$	19	18.6
$26-30yrs$	40	39.2
$31-35yrs$	25	24.5
$36-40yrs$	15	14.8
Over 40yrs	3	2.9
Level of Education		
Primary School	17	16.7
Secondary School	58	56.9
College/University	27	26.4
Employment Status		
Employed	16	15.7
Unemployed	38	37.3
Self-Employed	48	47.0
Marital Status		
Married	96	94.1
Single	5	4.9
Divorced	1	1.0
Patients BMI		
Health weight (18.5 - 24.5)	11	10.8
Overweight (25.0- 29.9)	39	39.2
Obesity (30.0 and above)	52	51.0

Of the 102 respondents, 89 (87.3%) reported having had prior anaesthesia before. Among the 89 respondents who had previous anaesthesia, 77 (75.5%) had received spinal anaesthesia, and 23 (29.9%) of them reported having experienced a headache then. Of the 102 participants, 27 (26.5%) reported experiencing headaches after receiving spinal anaesthesia. After further evaluation, 25 (24.5%) were found to have experienced a headache that met the PDPH criteria (Table 2).

Table 2. Incidence of PDPH ($n = 102$)

Variable	Frequency	% of Total
Patient experienced headache after Spinal anaesthesia		
Yes	27	26.5
No	75	73.5
Headache meets PDPH criteria		
Yes	25	24.5
No	2	2.0

A cross-tabulation of the number of patients who experienced PDPH and the time lapse between administration of the spinal anaesthesia and onset of the headache revealed that among the 25 patients whose headaches began after receiving spinal anaesthesia, 10 (40%) reported that a headache meeting the PDPH criteria started within 12 hours of administration of anaesthesia. Those whose headache began between 12 and 24 hours after receiving spinal anaesthesia were 12 (48%), and for two participants, the headache occurred between 24 and 48 hours after the spinal anaesthesia.

We further assessed the severity of the headache that met the PDPH criteria using the visual analogue scale (VAS), and thirteen (52%) of the 25 participants who said they had a headache that met the PDPH criteria reported moderate severity on the Visual Analogue Scale (VAS). Only 1 (4% of patients) reported severe headaches, whereas 11 (44%) said they had mild ones.

Most of the patients 12(48%) who experienced PDPH after spinal anaesthesia were aged between 26 and 30 years, with seven (28%) aged between 31 and 35 years. The Chi-square test did not show any statistical significance between the means of the two groups (p = 0.854).

Most patients (68%) who reported experiencing PDPH had a BMI above 30.0. Only 8 (32%) with a BMI of less than 30.0 reported experiencing headaches meeting the PDPH criteria (AOR = 4.251; 95% Cl = 1.817-5.7612 p = 0.039).

Table 3. Time-Lapse before Patient Experienced Headache * Headache Meets PDPH Criteria Cross tabulation (n = 25)

Variable			Headache meets PDPH criteria	
			Frequency	Percent
Time-lapse before the onset of headache	0 - 12 Hrs	Within headache meets PDPH criteria (n = 25)	10	40.0
	13 - 24 Hrs	Within headache meets PDPH criteria (n = 25)	12	48.0
	25 - 48 Hrs	Within headache meets PDPH criteria (n = 25)	2	8.0
	Over 48 Hrs	Within headache meets PDPH criteria	1	4.0

Table 4. Age * Headache Meets PDPH Criteria Crosstabulation (n = 25)

Variable			Headache meets PDPH criteria	
			Frequency	Percent
Age in Years	20 - 25 Yrs	Within headache meets PDPH criteria (n = 25)	1	4.0
	26 - 30 Yrs	Within headache meets PDPH criteria (n = 25)	12	48.0
	31 - 35 Yrs	Within headache meets PDPH criteria (n = 25)	7	28.0
	36 - 40 YRS	Within headache meets PDPH criteria (n = 25)	3	12.0
	Over 40 Yrs	Within headache meets PDPH criteria (n= 25)	2	8.0

Patients below 30 years generally had a lower BMI, while those over 30 had a higher BMI. We, therefore, concluded that BMI was significantly different for at least one of the age groups ($F_{2, 97} = 1.419$, $p > 0.001$).

Among the 25 respondents who experienced headaches after receiving spinal anaesthesia, 8(32%) had experienced a headache from past spinal anaesthesia. The result also revealed that 17 (68%) reported headaches that met PDPH criteria but had no previous experience of a headache after the past spinal anaesthesia. However, this was not statistically significant (p= 0.909).

The duration of bed rest was classified into short (< 6 hours [74.1%]) and long (> 6 hours [25.9]). Though most participants who experienced headaches had few hours of bed, there was no significant relationship between the hours of bed rest and PDPH (p = 0.385).

The results showed that in cases where a student anaesthetist administered spinal anaesthesia, 13 (52%) of the respondents reported experiencing PDPH. Anaesthetists with less than two years of experience had the highest Incidence of PDPH after a dural puncture, 15 (60%), while-as those with 11- 20 years had only 1 (4%) incidence of PDPH, and those with over 20 years had no case of PDPH reported. However, the incidence of PDPH was not statistically significantly influenced by the healthcare professional's experience (p = 0.841).

The researcher also sought to establish any relationship between the frequency of headaches and the number of dural punctures. Among the 25 respondents who reported PDPH, 8 (32%) had only one attempted dural puncture, 10 (40%) had two attempted dural punctures, and 5 (20%) had three attempts on the dura. In this study, 68% of patients with more than one dural puncture experienced PDPH. However, the number of dural punctures and PDPH were not statistically significantly associated (p = 0.081).

Nearly all patients (93%) had spinal anaesthesia administered using the Quincke needle, while only 6 % and 1% received spinal anaesthesia using the Whitacre and Sprotte needles, respectively. The G25 needle was used in most procedures, accounting for 57 (56%). The traumatic cutting needle design was used in 93.1% of the dural puncture procedures. Out of all the respondents, 66 (64.7%) had dural punctures performed with the needle bevel orientated perpendicular to the spinal fibres.

Quincke spinal needle was used in 23 (92%) of those who developed PDPH. In 11 (44%) cases, the needle size was Gauge 22, and in the other 12 (48%), the size was Gauge 25. Only 2 (8%) cases were reported using the Whitacre needle, and the needle size in both cases was Gauge 22.

These differences, however, showed no statistical significance (p = 0.306). This study evaluated the incidence of PDPH between the traumatic cutting tip needle and the atraumatic pencil tip needle. When a traumatic cutting needle was utilized, 23 (92%) participants developed PDPH compared to only 2 (8%) when the atraumatic pencil tip needle was used. This difference was statistically significant (AOR 11.550; 95% CI 0.458-7.393; p = 0.049). The likelihood of developing PDPH. increased 1.84 times when traumatic cutting point needles were used. The number of patients who developed PDPH when the traumatic cutting needle was used at a perpendicular orientation to the spinal fibres was 16 (64%) compared to 7 (28%) when a parallel angle was used. When an atraumatic pencil tip needle was used, only 1 (4%) developed a headache for each orientation. This difference was statistically significant (aOR 4.017; 95% CI 1.297-19.241; p = 0.022).

Rising from the bed was reported as a significant aggravating factor by 22 (88%) of the patients, while only 6 (24%) of the patients said that lying down aggravated the headache; only 1 (4%) participant reported taking analgesics as an aggravating factor.

Most patients (80%) said analgesics helped relieve headaches. Neck stiffness, nausea, and lower back pain were the most typical symptoms exhibited by most patients at 64%, 36% and 36%, respectively.

Most patients (88%) got relief after bed rest as treatment, while (84%) recovered after being prescribed analgesics. Coffee was used in 8 (32%) of the patients, and only 1 (4%) patient used other drugs to treat PDPH.

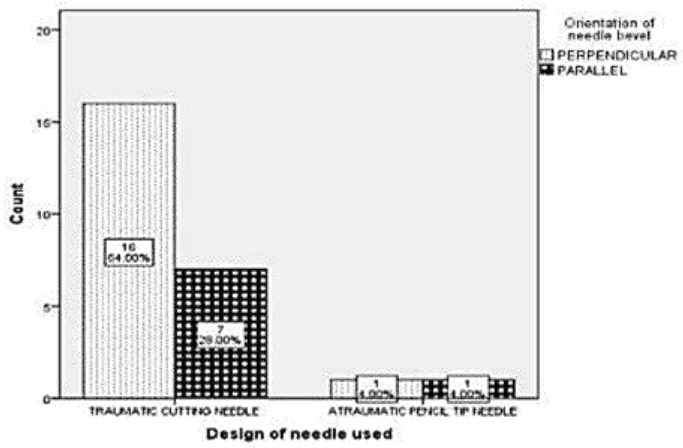

Fig. 1. Design & Orientation of Needle where Headache Meets PDPH Criteria (n=25)

4. DISCUSSION

Postdural puncture headache (PDPH) is a common complication associated with spinal anaesthesia [3]. According to the international headache society (HIS,2018), the headache usually starts within five days of the dural puncture and lasts up to fourteen days. The occipital or frontal region of the head is the specific location where the pain is experienced. PDPH is particularly common in obstetric patients and can significantly impact their quality of life [6]. Factors predisposing to PDPH have been classified into factors associated with the patient, healthcare provider and the equipment used to administer the anaesthesia [7].

Most participants were between the ages of 26 and 30, and the majority had a BMI of 30 or above. According to this study, the incidence of PDPH was 24.5%, which is within the global range of incidence (0.1-36%) [2]. This relatively high incidence is similar to that of a study by Mohamed et al., 2017 indicating that PDPH is still a problem in Africa. The high incidence of PDPH at Thika Level 5 Hospital could be due to the use of traumatic cutting tip needles that have been shown in this study to increase the incidence of PDPH.

The study also looked at four patient factors that could predispose to PDPH: age, BMI, previous history of PDPH, and duration of bed rest. The study found that age was not a significant risk factor for PDPH. This agrees with a study by Schmittner et al., 2010, who concluded that no significant differences were found between PDPH incidences in different age groups. However, other studies have demonstrated a direct relationship between age and PDPH. Ghaleb et al., 2012 revealed that the incidence of PDPH was higher in patients between the age of 18 and 30 years, Obesity (BMI>30) was a significant risk factor for PDPH. This finding is supported by a previous study that found link between obesity and PDPH [8]. Obesity is associated with several physiological changes that could predispose to PDPH. Contrarily other studies have found lower BMI associated with an increased incidence of PDPH. According to Peralta et al. [9], in parturients who received spinal anaesthesia, the incidence of PDPH was 56% in patients with BMI less than 31.5 kg/m2 compared to 39% in those with BMI greater than 31.5 kg/m2.

We established that previous history of PDPH after a prior history of spinal anaesthesia were not significant risk factors for PDPH. However, several studies have shown that patients with a previous history of PDPH have a 2- 3 times higher risk of developing a new attack of PDPH compared to patients with no prior history [10,11].

While the highest incidence of PDPH occurred when the experience of the anaesthetist administering anaesthesia during the procedure was less than two years, there was no significant statistical relationship between the experience and the incidence of PDPH.

In contrast to our finding, a recent study by Hailu et al. [12] found that the experience of the anaesthetist was significantly associated with PDPH in that lumbar puncture performed by

anaesthetists with more than three years of experience reduced the incidence by 56% compared to anaesthetists with less than three years' experience.

Our study established no significant statistical relationship between the number of dural punctures and the occurrence of PDPH. Our findings agreed with a study done by Dagmar Oberhofer et al [13], which showed that the number of attempts had no association with the incidence of PDPH. However, a recent study has shown that a higher number of lumbar puncture attempts are associated with an increased risk of PDPH [12].

The comparison between G22 and G25 needles showed that needle size did not have a significant relationship with the onset of PDPH. In contrast to our study, Girma et al. [14], found that using spinal needle G25 reduced the incidence of PDPH by 72%. Another Egyptian study found that using a fine spinal needle reduced the occurrence of PDPH in elective Caesarean sections to zero per cent [3]. The findings of our study may be attributed to the small sample size.

The results of this study demonstrated a connection between the incidence of PDPH and the spinal needle's design. (AOR = 11.550; 95% confidence interval [CI] = 0.458-7.393; p= 0.049). The likelihood of developing PDPH increased by 1.84 times when traumatic cutting-point needles were used. These findings point to a significant relationship between the incidence of PDPH and the needle design used during the procedure. Our study agreed with a 2017 study conducted in China, where PDPH occurrences were found to be lower with the pencil tip atraumatic spinal needle than with the traumatic cutting spinal needle [15]. According to a recent study by Bohara et al. [16], using a G25 Quincke needle was linked to a higher risk of postdural puncture headache than using a G22 Whitacre needle [17-20].

The orientation of the needle during the procedure was found to have a significant relationship to the incidence of PDPH. Compared to parallel alignment, the perpendicular orientation of the needle was 0.89 times more likely to result in PDPH (AOR 4.017; 95% confidence interval = 1.297- 19.241; p = 0.022). This finding corroborates a study by Bicak et al. 2019, which found that the orientation of the needle was a significant factor associated with PDPH. Our result also agreed with a recent study by Girma et al. [14].

5. CONCLUSION

Almost a quarter of patients had PDPH, and only BMI was shown to be a significant patient factor that can predispose a patient to PDPH. Concerning healthcare provider factors, while those who experienced headaches were more when less experienced anaesthetists administered the anaesthesia, this did not show any significance. We established that the design of the spinal needle and the orientation of the bevel of the spinal needle during the injection of the drugs were significant equipment risk factors for PDPH.

This study provides valuable insights into the risk factors for PDPH following spinal anaesthesia and offers practical recommendations for reducing it during elective Caesarean sections. We recommend that women of reproductive age be advised to control their body weight and maintain a normal BMI during pregnancy. The Kiambu County government should endeavor to provide atraumatic pencil-point spinal needles. The parallel orientation of the bevel during the administration of spinal anaesthesia should be the norm in order to reduce the incidence of PDPH among patients undergoing elective CS. Further research is needed to determine the predisposing factors of PDPH at different levels of hospitals in Kiambu County, and understand the specific mechanisms and measures to minimize the incidence PDPH.

6. LIMITATIONS

This study has several limitations that should be considered when interpreting the findings. Firstly, the study's sample size was relatively small and was conducted in a single facility, which may limit the generalizability of the results. Secondly, the study was based on self-reported data, which may be subject to bias and other forms of measurement error. Thirdly the study only examined a limited number of risk factors for PDPH. It did not consider other potential risk factors, such as the volume of spinal anaesthesia injected, the use of adjuvants, or the use of prophylactic measures.

ETHICAL APPROVAL AND CONSENT

The study was approved by the institutional review board of Thika Level 5 Hospital. Informed consent was obtained from all participants, and the confidentiality of the participants was maintained throughout the study. The study was

conducted per the ethical principles of the Declaration of Helsinki.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Olawin AM, Das JM. Spinal anaesthesia. InStatPearls [Internet] 2021 July StatPearls Publishing Arevalo-Rodriguez I, Ciapponi A, Roqué-Figuls M, Munoz L, Cosp XB. Posture and fluids for preventing post- dural puncture headache. Cochrane Database of Systematic Reviews. 2016;(3).
2. Jabbari A, Alijanpour E, Mir M, Rabiea SM, Rupani MA. Post spinal puncture headache, an old problem and new concepts: Review of articles about predisposing factors. Caspian journal of internal medicine. 2013;4(1):595-602.
3. Mohammed AD, Ayyuba R, Salisu I, Nagoma AU, Owolabi LF, Ibrahim A. An analysis of post-dural puncture headache in obstetric patients: A study from Kano, Nigeria. Trop J Obstet Gynaecol. 2017;34:16-20.
4. Basazinew CD, Aragaw T, Alemitu T, Bekalu G, Keder E, Agazhe A. Incidence and associated factors of postdural puncture headache for parturients who underwent Caesarean section with spinal anaesthesia at Debre Tabor General Hospital, Ethiopia: SAGE; 2021.
5. Mugenda OM, Mugenda GA. Research methods: Quantitative and qualitative approaches. africa centre for technology studies (ACTS) –Press, Nairobi Kenya; 2003.
6. Kassa A, Beyen T, Zenu Z. Post dural puncture headache (PDPH) and associated factors after spinal anaesthesia among patients in the university of Gondar referral and teaching hospital, Gondar, North West Ethiopia. J Anesth Clin Res. 2015;6:536.
7. Weji BG, Obsa MS, Melese KG. et al. Incidence and risk factors of postdural puncture headache: Prospective cohort study design. Perioper Med. 2020;9:32.
8. Serbulent GB, Tolga E, Aykut S, Fath S, Ali MU, Ali E, Burcu D. The interrelation between body mass index and post-dural puncture headache in parturient women. J Anesthesiol Clin Pharmacol. 2021;37 (3):425-429
9. Peralta F, Higgins N, Lange E, Wong CA, McCarthy RJ. The relationship of body mass index with the incidence of postdural puncture headache in parturients. Anesthesia & Analgesia. 2015;121(2):451-6.
10. Ghaleb A, Khorasani A, Mangar D. Post-dural puncture headache. International journal of general medicine. 2012:45-51.
11. Amorin JA, Valenga MM. Postdural puncture headache is a risk factor for new postural puncture headache. Cephalalgia. 2008;28:5-8
12. Hailu S, Getachew H, Hailu S, Abebe T, Seifu A, Regassa T, Girma T, Dastew B, Zemedkun A, Neme D, Teshome D. Effectiveness of ketofol versus propofol induction on hemodynamic profiles in adult elective surgical patients: A randomized controlled trial. International Journal of Surgery Open. 2021;37:100392.
13. Oberhofer D, Jokić A, Skurić J, Vukelić M, Šklebar I, Tonković D. Incidence and clinical significance of post-dural puncture headache in young orthopaedic patients and parturients. Periodicum Biologorum. 2013;115(2):203-8.
14. Girma T, Mergia G, Tadesse M, Assen S. Incidence and associated factors of post-dural puncture headache in cesarean section done under spinal anaesthesia 2021 institutional based prospective single-armed cohort study. Annals of Medicine and Surgery. 2022 Jun 1; 78:103729.
15. Xu H, Liu Y, Song W, Kan S, Liu F, Zhang D, Ning G, Feng S. Comparison of cutting and pencil-point spinal needle in spinal anaesthesia regarding postdural puncture headache: A meta-analysis. Medicine. 2017 Apr;96(14).
16. Bohara C, Maharjan R, Regmi S, Regmi G, Kunwar R, Shrestha A. A Comparison of Incidence of Post Dural Puncture Headache Using 25G Quincke and 25G Whitacre Needle in Obstetric Patients Undergoing Caesarean Section under Spinal Anesthesia. Med Phoenix. 2021 Jul 19;6(1):28-31.
17. Lotfy Mohammed E, El Shal SM. Efficacy of different size Quincke spinal needles in reduction of incidence of Post-Dural Puncture Headache (PDPH) in Caesarean Section (CS). A randomised controlled

study. Egyptian Journal of Anaesthesia. 2017;33(1):53-58.

18. Alnold M. Headache Classification Committee of International Headache Society (IHS): International Classification of Disorders. Sage Publications; 2018.
19. Schmittner MD, Terboven T, Dluzak M, Janke A, Limmer ME, Weiss C, Bussen DG, Burmeister MA, Beck GC. High incidence of post-dural puncture headache in patients with spinal saddle block induced with Quincke needles for anorectal surgery: A randomised clinical trial. International Journal of Colorectal Disease. 2010 Jun; 25: 775-81.
20. Bıçak M, Salık F, Akelma H. Is there an effect on the development of postdural puncture headache of dural punction made with the spinal needle in three different orientations during spinal anaesthesia applied to pregnant patients? Journal of Pain Research. 2019 Nov 22:3167-74.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/108655