

Original Article



Effect of Patient Position during Spinal Anesthesia on the Incidence of Post-Dural Puncture Headache after Cesarean Section

Hassam Zulfiqar¹, Hashaam Ghafoor², Muhammad Haroon Anwar³, Jawad Zahir⁴,

Farzana Mazhar Bokhari⁵, Inam Ul Haq⁶

¹ Resident Anesthesia, Holy Family Hospital, Rawalpindi / Hamad Medical Corporation, Doha

² Consultant Anesthesiologist, Hamad Medical Corporation Doha, Qatar

³ Resident Anesthesia, Department of Anesthesiology and Critical Care Medicine, Pakistan Institute of Medical Sciences, Islamabad

⁴ Consultant Anesthesiologist, Head of Department of Anesthesia, Holy Family Hospital, Rawalpindi,

⁵ Medical Officer Department of Anesthesiology and Critical Care Medicine, Pakistan Institute of Medical Sciences, Islamabad

⁶ Department of Physiology, University of Hafar Al Batin, Eastern province, Saudia Arabia

Author's Contribution

^{1,5}Substantial contributions to the conception or design of the work; or the acquisition, ⁴Final approval of the version to be published
^{2,3}Drafting the work or revising it critically for important intellectual content, ⁶Active participation in active methodology, critical review

Funding Source: None

Conflict of Interest: None

Received: July 27, 2023

Accepted: Feb 14, 2024

Address of Correspondent

Dr. Hassam Zulfiqar
Resident Anesthesia, Holy Family Hospital, Rawalpindi / Hamad Medical Corporation, Doha
drhassam148@gmail.com

ABSTRACT

Objective: To compare the incidence of post-dural puncture headache (PDPH) following spinal anesthesia in parturients undergoing elective cesarean section between the sitting and left lateral decubitus positions.

Methodology: This quasi-experimental study was conducted at Holy Family Hospital, Rawalpindi, Pakistan, from May 2022 to October 2022. A total of 120 parturients undergoing elective cesarean section under spinal anesthesia were randomly assigned to either the sitting or left lateral decubitus position group. The primary outcome was the occurrence of PDPH within 5 days postoperatively. Secondary outcomes included adverse effects such as hypotension, nausea/vomiting, and bradycardia. Data were analyzed using SPSS version 25.0. Categorical variables were compared using the chi-square test or Fisher's exact test, as appropriate, with a significance level set at $p < 0.05$.

Results: The incidence of PDPH post-procedure was significantly higher in the sitting group compared to the left lateral decubitus group (33.3% vs. 6.7%). In the sitting position group, 63.3% of women experienced hypotension, 26.7% had bradycardia, and 30.0% reported nausea/vomiting, whereas in the left lateral decubitus group, these figures were 58.3%, 21.7%, and 23.3%, respectively.

Conclusion: This study concludes that the left lateral decubitus position during spinal anesthesia for cesarean section is associated with a lower incidence of PDPH compared to the sitting position.

Keywords: Spinal anesthesia, Post-dural puncture headache, Cesarean section, lateral position, Sitting position.

Cite this article as: Zulfiqar H, Ghafoor H, Anwar MH, Zahir J, Bokhari FM, Haq IU. Effect of Patient Position during Spinal Anesthesia on the Incidence of Post-Dural Puncture Headache after Cesarean Section. Ann Pak Inst Med Sci. 2024; 21(1):80-85. doi. 10.48036/apims.v20i1.831.

Introduction

Spinal anesthesia is routinely administered for cesarean section; however, it can result in a significant complication known as post dural puncture headache (PDPH). The frequency of cesarean section is rapidly increasing across the globe. Countries such as the Dominican Republic (58 percent), Egypt (55 percent), Brazil (55 percent), Venezuela (52.4%), and Turkey (53.1%) have notably

high rates of cesarean section, with more than fifty percent of infants being delivered through this method. Among developed countries in which the incidence of cesarean section is still found elevated include United States (32 %) and Australia (32%).^{1,2} Presently, spinal anesthesia is considered as one of the preferred anesthetic technique for conducting caesarean sections. Due to its various benefits, including the prevention of neurotoxicity associated with general anesthesia, cost-effectiveness, ease of

administration, quick onset, reduced risk of aspiration, and avoidance of airway manipulation, spinal anesthesia is the preferred method for non-complicated elective cesarean deliveries.³⁻⁷ Although, this type of anesthesia is related to several issues, for instance, nausea, vomiting, hypotension, urinary retention, and post dural puncture headache (PDPH).⁸

Post-dural puncture headache (PDPH) is considered a significant complication among patients who undergo spinal anesthesia.⁹⁻¹¹ Following the spinal anesthesia, PDPH incidence differs from 0.3 percent to 40 percent. As per the criteria outlined in International Classification of Headache Disorders, the post-dural puncture headache refers to a kind of headache that emerges during five days following the dural puncture, which deteriorates in the upright position and reduces with the lying down. It can be accompanied by the neck stiffness, photophobia, nausea, vomiting and tinnitus.^{12,13} Although the precise mechanism of the PDPH is unknown, there are two plausible theories; first, reducing cerebrospinal fluid (CSF) pressure exerts tension on intracranial structures. These structures are sensitive to pain, which causes the typical headache. Second, a compensatory vasodilatation results from the escape of CSF.¹⁴ The pain due to PDPH is very intense and leads to significant distress for the patient. It can possibly lead to the mother's dissatisfaction with the spinal anesthesia, disturbance in the baby care, increased hospital stay and enhanced health care facility expenses as well as frequent visit to hospital emergency department. Also, it may enhance the chance of refusal of spinal anesthesia by patients in future.

Several risk factors that contribute to the development of post-dural puncture headache including the design and size of the spinal needle, the direction of needle bevel, the number of dural punctures carried out, age, pregnancy status and previous history of PDPH after cesarean section. In addition to these factors, the posture of patient during the dural puncture plays an important part in influencing the incidence of post-dural puncture headache.¹⁶⁻¹⁸

Generally, the spinal anesthesia can be administered among patients in either sitting position or lateral position.¹⁹ The lateral decubitus position has emerged as an interesting approach that helps in reducing the risk of PDPH because of its feasibility as well as patient satisfaction. The sitting position of patients is associated with higher CSF pressure compared to the lateral decubitus position, which could hypothetically result in a bigger hole and a more protracted leakage. Additionally, dislocation of the brain matter as well as meninges occurs earlier among

patients in the sitting position, leading to more indications. The descending movement during lateral position does not take place which reduces the risk of developing PDPH. Several studies have reported a considerably lower rate of post-dural puncture headache among patients of lateral position group when compared to patients in sitting position group. However, there is a limited number of randomized controlled trials (RCTs) on this topic, which is a major limitation.²⁰

A study carried out in Fatemeh Health Facility of Hamdan (Iran) by Davoudi and colleagues reported that there was a significantly lower rate of PDPH in the lateral decubitus position (4.3%) when compared with sitting position (20.8%). None of the patients in lateral group while 20.8% patients in the sitting position group had nausea & vomiting.²¹ Another most recent randomized controlled study carried out in Adıyaman, Turkey by Doğukan and teammates (2023) highlighted that post-dural puncture headache was noticed among five (9.4%) patients in the sitting position group while only one (1.9%) patient in the lateral position group. The prevalence of nausea & vomiting among patients of sitting position was 58.5 percent and 75.5 percent while in lateral position group was 76.5 percent and 90.2 percent, respectively.²² A recent study performed by Kumar and companions elucidated that the incidence of post-dural puncture headache was found more among patients in sitting position group (12.0%) when compared with patients in lateral position group (1.0%) in 1st postoperative day.²³ A meta-analysis conducted by Zorrilla-vaca and fellows demonstrated that the lateral decubitus position was related to a significant decrease in the PDPH incidence when compared to the sitting position. However, only three out of seven RCTs were included in the meta-analysis that showed an important reduction in the incidence of PDPH with the lateral decubitus position.²⁰

Local data in this area are also scarce. Therefore, the current study was conducted to compare the frequency of PDPH after spinal anesthesia in the sitting position and the left lateral decubitus position among parturients undergoing elective cesarean section.

Methodology

A quasi-experimental study was conducted at Holy Family Hospital in Rawalpindi, Pakistan, spanning from May 2022 to October 2022. Approval from the institutional review board was obtained to conduct this study. Prior to data collection, all participants were briefed about the study's objectives, and written informed consent was

obtained from each participant. The study included 120 women who underwent elective cesarean section under spinal anesthesia.

Inclusion criteria of the study were: women aged 18 years and older, gestational age of 37 weeks or more, and ASA physical status I/II. The exclusion criteria were: known or suspected allergy to local anesthetics, contraindication to SA, history of headache or neurological disorder, and refusal to participate in the study. The respondents were randomly allocated in 2 groups utilizing a computer-generated randomization sequence: sitting position (60 women) or lateral position (60 women). All the SA procedures were performed by an experienced anesthesiologist using a 25G pencil-point needle at the L3-4 or L4-5 intervertebral space. The dosage of bupivacaine was 10-12 mg depending on the height of the patient and 0.75% heavy Bupivacaine was used.

Primary outcome of study was incidence of post-dural puncture headache (PDPH) defined as a headache that developed during seventy-two hours following the SA and was relieved by lying down. The secondary outcomes were incidence of other complications for instance, hypotension, bradycardia, and nausea/vomiting.

Data on patient demographics, obstetric history, and anesthesia-related factors were collected using a standardized questionnaire. Sample size of the study was calculated based upon a previous study that reported an incidence of PDPH of 30% in sitting position while 10% in lateral position. Assuming a power of 80% and a two-sided alpha of 0.05, a sample size of 120 participants (60 in each group) was needed to identify a significant difference in PDPH incidence between participants of both groups.

All data were analyzed using SPSS version 25.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were employed to summarize the data. Continuous variables were compared using Student's t-test or the Mann-Whitney U test, as appropriate. Categorical variables were compared using the chi-square test or Fisher's exact test, as appropriate. A p-value below 0.05 was considered statistically significant.

Results

A total of 120 women were enrolled in the study, with 60 assigned to the sitting position group and 60 to the lateral position group. There were no significant differences

between the two groups in terms of baseline characteristics, including age, gestational age, BMI, and obstetric history. This information is summarized in Table I. The incidence of PDPH was higher in sitting position group as compared to lateral group.

Table I: Baseline characteristics of study population

Characteristic	Sitting Position Group (n=60)	Lateral Position Group (n=60)	P-value
Age (yrs) mean \pm SD	30.75 \pm 3.54	29.77 \pm 2.32	0.26
BMI (kg/m ²) mean \pm SD	25.38 \pm 2.68	26.38 \pm 2.38	0.190
Gestational Age (weeks), mean \pm SD	38.5 \pm 1.1	38.6 \pm 1.0	0.69
Nulliparous, n (%)	24 (40.0)	22 (36.7)	0.72
Previous cesarean section, n (%)	18 (30.0)	20 (33.3)	0.75
History of headache, n (%)	14 (23.3)	13 (21.7)	0.85

It was found that sitting position group 33.3% of the patients had PDPH. However, in lateral position group only 6.7% had PDPH. The difference is statistically significant with a p value of less than 0.05. Further details regarding time of onset of PDPH are shown in table II. However, the frequency of complications related to PDPH were not significantly different between both groups as shown in table III.

Table III: Incidence of post dural puncture headache.

PDPH	Sitting Position Group (n=60)	Lateral Position Group (n=60)	P-value
Incidence of PDPH, n (%)	20 (33.3%)	4 (6.7%)	0.00
Day of onset, n (%)			
Day 1	4 (6.7%)	0 (0.0%)	0.00
Day 2	6 (10.0%)	3 (5.0%)	
Day 3	5 (8.3%)	0 (0.0%)	
Day 4	3 (5.0%)	1 (1.7%)	
Day 5	2 (3.3%)	0 (0.0%)	
No PDPH	40 (66.7%)	56 (93.3%)	
Total	60 (100.0%)	60 (100.0%)	

Table III: Incidence of complications.

Complications	Sitting Position Group (n=60)	Lateral Position Group (n=60)	P-value
Hypotension, n (%)	38 (63.3)	35 (58.3)	0.63
Bradycardia, n (%)	16 (26.7)	13 (21.7)	0.64
Nausea/vomiting, n (%)	18 (30.0)	14 (23.3)	0.49

Discussion

The patient positioning during spinal anesthesia for a cesarean section is an important factor that can significantly affect the postoperative outcomes. One of the most significant concern, is the incidence of post-dural puncture headache. PDPH is a common complication associated with spinal anesthesia. Therefore, current study was carried out to compare the frequency of PDPH following spinal anesthesia in the sitting position and in the left lateral decubitus position among parturient who underwent elective caesarean section. To acquire appropriate results, total 120 women were included in the study and divided equally in two groups (60 women in sitting position group and 60 women in lateral position group).

The mean age of the women in sitting position group was 30.75 ± 3.54 years while in the lateral position group was 29.77 ± 2.32 years. The findings of our research are comparable with a most recent research undertaken by Doğukan et al who reported that mean age of the women in sitting position group was 29.23 ± 5.09 years while in lateral position group was 29.39 ± 4.28 years.²² Another study carried out by Dinesh et al indicated that mean age of the women in sitting position group was 25.333 ± 2.229 years while in left lateral position group was 26.083 ± 3.263 years.⁵ Similarly in another study, mean age of the women in sitting position group was 26.7 ± 4.8 years while in lateral position group was 26.4 ± 4.8 years.²³ The difference in presentation of age groups can be due to geographical as social and cultural practices of the area associated with marriage and pregnancy.

It has been reported in literature that the PDPH incidence was observed less among patients with increased BMI who experienced cesarean section.²⁴ However since there was no statistical difference between baseline characteristics of both populations, we can safely say that BMI did not influence the outcomes of our study.

It is significant to mention here that the incidence of PDPH was observed more among women of sitting position group than the women of lateral position group. The incidence of PDPH in sitting position group was 33.3% (20 women) while in lateral position group was only 6.7% (4 women). Our findings are supported by a number of studies which showed a statistically significant and lower incidence of PDPH in lateral position as compared to sitting position.^{2,6,21,22} The results of a similar study performed by Hussain et al showed that 20.0% (9 women)

in sitting position group while only 4.4% (2 women) in lateral position group had post dural puncture headache.²

Similarly, the results of another study conducted by Demilew et al also corroborated that later position is better than sitting position with regards to post dural puncture headache. As the incidence of PDPH was 79.2% (19 women) in sitting position group while 20.8% (5 women) in lateral position group.⁶

In another study undertaken by Davoudi et al. the incidence of PDPH was 20.8% (10 women) in sitting position group while 4.3% (2 women) in lateral position group.^[21] Similarly Doğukan et al also highlighted in their study that lateral position was more effective than sitting position in preventing PDPH. They asserted that in sitting position group, 9.8% (5 women) and in lateral position group, only 1.9% (1 woman) had post dural puncture headache.²²

Our study further disclosed that among 20 women of sitting position group who had PDPH, 6.7% (4 women), 10.0% (6 women), 8.3% (5 women), 5.0% (3 women) and 3.3% (2 women) had day of onset 1, 2, 3, 4 and 5, respectively. However, among 4 women of lateral position group who had PDPH, 5.0% (3 women) had day of onset 1 and only 1.7% (1 woman) had day of onset 4. The findings of a study conducted by Sharma et al demonstrated that in sitting position group, the PDPH incidence was 9.0% (6 women), 14.9% (10 women), 17.9% (12 women) and 4.5% (3 women) on postop days 1, 2, 3 and 4, respectively. However, in lateral position group, the PDPH incidence was 4.5% (3 women) on postop days 1 & 2 and 1.5% (1 woman) on postop day 3.¹⁶

The results of another study done by Chakraborty et al highlighted that among 12.6% (19 out of 150 women) of sitting position group who had PDPH, the incidence was 4.0% (6 women), 4.7% (7 women), 3.3% (5 women) and 0.7% (1 woman) on postop days 1, 2, 3 and 4, respectively. Likewise, among 10.6% (16 out of 150 women) of lateral position group who had PDPH, the incidence was 3.3% (5 women), 4.7% (7 women), 2.0% (3 women) and 0.7% (1 woman) on postop days 1, 2, 3 and 4, respectively.²⁵ So, from above discussion it is cleared that majority of the patient who will suffer from PDPH, the onset of symptoms will likely occur on 1st and 2nd post operative day. These are the days when patients' recovery is of upmost priority and PDPH will not only hamper patients' recovery but also the affect the quality of care a mother can provide to her newborn. Therefore, prevention of PDPH is the key to better outcome.

Furthermore our study revealed that lateral position group was found better than sitting position group with regards to complications such as hypotension, nausea & vomiting and bradycardia. Among patients of sitting position group, the frequency of hypotension, bradycardia and nausea / vomiting was 63.3%, 26.7% and 30.0% while in lateral position group was 58.3%, 21.7% and 23.3%, respectively.

A study conducted by Sharma et al reported that the frequency of nausea & vomiting was more prevalent among patients of sitting position group than among patients of lateral position group (17.9% & 13.4% versus 4.5% & 1.4%). The difference was statistically significant.¹⁶ But the findings of a study undertaken by Kumar et al highlighted that there was an insignificant difference between both groups regarding incidence of nausea and vomiting.²³ The findings of a study done by Chakraborty et al highlighted that the incidence of hypotension was 22.7 percent in sitting position group while 27.3 percent in lateral position group.²⁵ Doğukan et al asserted in their study that frequency of nausea & vomiting in sitting position group was 58.5% and 75.5% while in the lateral position group was 76.5% and 90.2%, respectively. The heterogenous results from different studies may have been influenced by the geographical factors as well local pharmacological and genetic factors of the population.

However, based on above discussion we can safely say that lateral position for spinal anesthesia is safer than sitting position as it decreases the incidence of PDPH. However, there is heterogenic data available regarding advantages of lateral position over sitting position in terms of hemodynamics, nausea and vomiting.

Conclusion

Study concluded that lateral position during spinal anesthesia for cesarean section is associated with a lower incidence of PDPH as compared to the sitting position.

References

1. Betran AP, Ye J, Moller A, et al. Trends and projections of caesarean section rates: global and regional estimates. *BMJ Global Health*. 2021;6:e005671. <https://doi.org/10.1136/bmigh-2021-005671>
2. Hussain R, Jamshed S, Khan F, Khan SBN, Khan ZS, Khomusi MM. Lateral versus sitting positions during induction of spinal anaesthesia for elective caesarean section: a comparative study. *Pak J Surg*. 2019; 35(3): 224-9. http://pjs.com.pk/journal_pdfs/jul_sep19/224.pdf
3. Ali I, Iftikhar H, Rahman HU, Majeed K, Khalid U, Latif H. Effect of lower limb compression stockings on hemodynamic stability in obstetric patients undergoing lower segment cesarean section under spinal anaesthesia. *Pak Armed Forces Med J*. 2023; 73(2): 456-9. <https://doi.org/10.51253/pafmj.v73i2.8109>
4. Anup NR, Anil Kumar MR, Raghavendra Babu T, Shetty SM, Gurudutt CL, Paul R. A randomized study to assess the effect of position during induction of spinal anaesthesia on incidence of postdural puncture headache after elective caesarean section in adult parturient. *J Cardiovasc Dis Res*. 2021; 12(3): 1286-93. <https://www.jcdronline.org/admin/Uploads/Files/6244372e267ab8.98019270.pdf>
5. Dinesh Babu D, Vidjai Vikram S, Subramanian SB, Lazarus SP, Kumar KS, Rajaraman R. A Study on the effect of lateral and sitting positions in spinal anesthesia for cesarean sections. *Indian J Anesth Analg*. 2020; 7(1): 33-40. <https://doi.org/10.21088/ijaa.2349.8471.7120.5>
6. Demilew BC, Tesfaw A, Tefera A, Getnet B, Essa K, Aemro A. Incidence and associated factors of postdural puncture headache for parturients who underwent cesarean section with spinal anesthesia at Debre Tabor General Hospital, Ethiopia; 2019. *SAGE Open Med*. 2021; 9: 1-7. DOI: 10.1177/205031212111051926. <https://doi.org/10.1177/205031212111051926>
7. Jouryabi AM, Imantalab V, Sedighinejad A, Alavi CE, Biazar G, Ghanaie MM, et al. Post-dural puncture headache in cesarean section; frequency and risk factors: a report from the north of Iran. *Caspian J Neurol Sci*. 2021; 7(4): 202-8. <https://doi.org/10.32598/CJNS.7.27.2>
8. Ferede YA, Nigatu YA, Agegnehu AF, Mustofa SY. Incidence and associated factors of post dural puncture headache after cesarean section delivery under spinal anesthesia in University of Gondar Comprehensive Specialized Hospital, 2019, cross sectional study. *Int J Surg Open*. 2021; 33: 100348. <https://doi.org/10.1016/j.ijso.2021.100348>
9. Karami T, Karami N, Rastgo H. Comparison of the effect of paramedian and median methods on postdural puncture headache among candidates for elective cesarean sections undergoing spinal anesthesia. A double blind clinical trial. *Pediatr Anesth Crit Care J*. 2021; 9(2): 116-22. DOI: 10.14587/paccj.2021.19a <https://doi.org/10.1016/j.amsu.2021.102226>
10. Nasir Z, Mahboob S, Mehmood T, Haider SZ. Post dural puncture headache: a comparison of midline and paramedian approach of spinal anesthesia. *Pak Armed Forces Med J*. 2020; 70(4): 1188-92. <https://www.pafmj.org/index.php/PAFMJ/article/view/5119>
11. Atashkhoei S, Samudi S, Abedini N, Khoshmaram N, Minayi M. Anatomical predicting factors of difficult spinal anesthesia in patients undergoing cesarean section: an observational study. *Pak J Med Sci*. 2019; 35(6): 1707-11. <https://doi.org/10.12669/pjms.35.6.1276>
12. Thakur S, Sharma A, Kaushal S, Sharma A, Sharma N, Thakur PS. Incidence and risk factors of "postdural puncture headache" in women undergoing cesarean delivery under spinal anesthesia with 26g quincke spinal needle, experience of medical college in rural settings in India 2019: a prospective cohort study design. *J Pharm Bioall Sci*.

- 2022; 14: S209-13.
<https://doi.org/10.4103/jpbs.jpbs.72.22>
13. Diwakaran R. PDPH after Cesarean Section (CS) delivery under spinal anesthesia: an observational study. *Eur J Mol Clin Med.* 2022; 9(1): 973-7. https://ejmcm.com/article_16925_f03e69fda51d87bbd753857dc6591c37.pdf
 14. Eldoushy EE. Effect of supine versus sitting position on post-dural puncture headache among patients receiving spinal anesthesia. *Egypt J Health Care.* 2023; 14(1): 919-33. <https://doi.org/10.21608/ejhc.2023.291748>
 15. Girma T, Mergia G, Tadesse M, Assen S. Incidence and associated factors of post dural puncture headache in cesarean section done under spinal anesthesia 2021 institutional based prospective single-armed cohort study. *Ann Med Surg.* 2022; 78: 103729. <https://doi.org/10.1016/j.amsu.2022.103729>
 16. Sharma HM, Khandelwal M, Beniwal S, Gurjar SS, Sharma S. Comparison of sitting versus lateral decubitus position during spinal anaesthesia on the occurrence of post-dural puncture headache in patients undergoing lower segment caesarean section: a randomised controlled trial. *Indian J Anaesth.* 2022; 66: 738-40. <https://doi.org/10.4103/ija.ija.725.21>
 17. Weji BG, Obsa MS, Melese KG, Azeze GA. Incidence and risk factors of postdural puncture headache: prospective cohort study design. *Perioper Med.* 2020; 9: 32. <https://doi.org/10.1186/s13741-020-00164-2>
 18. Biswal D, Mishra J, Sahu BP, Jena S, Nayak SR. Postdural puncture headache incidence with 25G and 27G Quincke needles after spinal anesthesia for elective cesarean section. *Asian J Med Sci.* 2023; 14(2): 51-4. <https://doi.org/10.3126/ajms.v14i2.49632>
 19. Olawin AM, Das JM. Spinal anesthesia. Treasure Island (FL): StatPearls Publishing; 2023. <https://www.ncbi.nlm.nih.gov/books/NBK537299/>
 20. Zorrilla-Vaca A, Makkar JK. Effectiveness of lateral decubitus position for preventing post-dural puncture headache: a meta-analysis. *Pain Physician.* 2017; 20: E521-9. <https://www.painphysicianjournal.com/current/pdf?article=NDQxNQ%3D%3D&journal=105>
<https://doi.org/10.36076/ppj.2017.E529>
 21. Davoudi M, Tarbiat M, Ebadian MR, Hajian P. Effect of position during spinal anesthesia on postdural puncture headache after cesarean section: a prospective, single-blind randomized clinical trial. *Anesth Pain Med.* 2016; 6(4):e35486. <https://doi.org/10.5812/aapm.35486>
 22. Doğukan M, Bıçakçioğlu M, Yılmaz N, Duran M, Uludağ Ö, Tutak A, et al. The effect of spinal anesthesia that is performed in sitting or right lateral position on post-spinal headache and intraocular pressure during elective cesarean section. *Niger J Clin Pract.* 2023; 26(1): 90-4. <https://doi.org/10.4103/njcp.njcp.401.22>
 23. Kumar MR, Aarthi D. Effect of position on incidence of post-dural puncture headache in patients undergoing caesarean section: a comparative study. *Int J Sci Res Arch.* 2023; 8(1): 655-61. <https://doi.org/10.30574/ijrsra.2023.8.1.0144>
 24. Beyaz SG, Ergönenç T, Saritaş A, Şahin F, Ülgen AM, Eman A, et al. The interrelation between body mass index and post-dural puncture headache in parturient women. *J Anaesthesiol Clin Pharmacol.* 2021; 37(3): 425-9. <https://doi.org/10.4103/joacp.JOACP.249.19>
 25. Chakraborty A, Sinha A. The incidence of post dural puncture headache following spinal anaesthesia: a comparison of sitting versus lateral decubitus position. *Int J Contemp Med Res.* 2016; 3(7): 2096-9. https://www.ijcmr.com/uploads/7/7/4/6/77464738/ijcmr_753_jul_6.pdf