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Effect of Position During Spinal Anesthesia on Postdural Puncture Headache After Cesarean Section: A Prospective, Single-Blind Randomized Clinical Trial

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Abstract

Background: The most common method of anesthesia for cesarean section is spinal anesthesia, and postdural puncture headache (PDPH) remains a major complication of this procedure. Nowadays, PDPH is a major cause of morbidity in parturients after spinal anesthesia. This headache is the third most popular reason for claims against anesthesiologists in obstetrics. The position after spinal anesthesia has been evaluated as a contributory factor in the occurrence of PDPH, but the position before spinal anesthesia has not yet been evaluated.
Objectives: This study was designed to compare the incidence of PDPH following spinal anesthesia in the sitting position and in the left lateral decubitus position in parturients who underwent elective caesarian section.
Patients and Methods: After institutional approval, 100 parturients who had been scheduled for elective caesarian section with spinal anesthesia were enrolled in the study. Following patient preparation for the neuraxial blockade, spinal anesthesia was randomly performed in the sitting or in the left lateral decubitus position. Patients were interviewed for PDPH on either postoperative day one, two, or three. The incidence and intensity of PDPH were evaluated and compared using a numeric rating scale (NRS-11).
Results: A total of 94 patients were included in the data analysis. The overall incidence of PDPH was 12.7%. In the sitting group, ten patients (20.8%) had PDPH, compared with two patients (4.3%) in the lateral group (P = 0.017).
Conclusions: Spinal anesthesia in the sitting position is more associated with significant PHDH than that in the left lateral decubitus position for patients undergoing elective caesarian section.

Keywords: Postdural Puncture Headache, Caesarian Section, Posture, Anesthesia, Spinal

1. Background

The preference for regional anesthesia for elective caesarean section increased from 69.4% in 1992 to 94.9% in 2002, and spinal anesthesia accounted for 86.6% (1, 2).

Epidural anesthesia is one of the most common methods used for anesthesia during cesarean section (3). However, spinal anesthesia is the most common regional anesthetic technique for parturients without an epidural catheter. Spinal anesthesia is known to be more technically easier, less riskier in systemic drug toxicity, and more reliable than epidural anesthesia in providing anesthesia from the midthoracic level to the sacrum (1, 4). Spinal anesthesia is usually conducted in the sitting or in the lateral position and rarely in the prone position. The lateral decubitus position is more convenient and more appropriate than other positions in ill or frail patients. The position for spinal anesthesia is usually poorly managed in spinal block for at least two causes. First, the aide frequently does not know the rationale for positioning, and second, patients are mostly insufficiently or excessively sedated.

Spinal anesthesia in the sitting position is not managed appropriately in a heavily sedated patient, and vasovagal syncope can occur. Therefore, the lateral decubitus position is more comfortable and more suitable for sedated patient (1, 5).

The positioning of parturients in the sitting position encourages flexion and facilitates the identification of the midline. It may increase the possibility of a successful block among obese parturients and cause block performance to be done quickly (1). However, among the obstetric population, small studies have been conducted demonstrating the block operator performance to be faster in the sitting position, although this benefit is offset by a slower onset time compared with that in the lateral decubitus position (1).

Similar to other neuraxial techniques, spinal anesthesia has some technical complications, such as postdural puncture headache (PDPH), hematoma, and damage to neural structures (6).

Since the first spinal anesthesia was conducted, the problem of PDPH has plagued clinicians and, more importantly, parturients (7).

PDPH is a well-known complication of spinal anesthesia, and pregnancy is a major risk factor for PDPH with the reported incidence of 0% - 30% (2).

PDPH can be a reason for incapacitation and prolonged hospital stay in the pregnancy (8). PDPH generally is a postdural headache that occurs after puncturing of the dura. PDPH continues to be a significant reason for morbidity among parturients and anxiety for physicians. PDPH usually arises within the first three days of the dural puncture in 90% of patients and within the first 48 h in 66% of patients. PDPH usually presents as a severe expanding pain over the frontal and occipital regions that extends to the neck and shoulders. The pain is worsened by shaking the head and when in an upright position. It is relieved by lying down (9). Fortunately, PDPH is generally self-limiting, and spontaneous recovery may occur in a few days (2).

PDPH was first described by August Bier in 1898. The incidence of PDPH after spinal anesthesia in obstetric anesthesia is 1% - 6%. The risk factors of PDPH after spinal anesthesia are needle size, direction of bevel, needle design, number of lumbar puncture attempts, age, sex, pregnancy, and previous history of PDPH (9-13).

In pregnancy, PDPH is a serious iatrogenic reason for patient morbidity after spinal anesthesia. This headache is the third most popular reason for claims against anesthesiologists in obstetrics. In the review of articles, no study has been found on the role of parturients' position during spinal anesthesia in PDPH in obstetrics.

2. Objectives

The study was performed to evaluate the effects of patients' position in PDPH among parturients undergoing elective caesarian section.

3. Patients and Methods

This prospective randomized clinical trial was performed between October 2013 and July 2014 in Fatemieh Hospital, Hamadan, Iran, after obtaining ethical clearance from the institutional ethics committee (3209/9/35/16/P/D).

A written informed consent was obtained from all patients prior to the study. A total of 100 parturients aged 19 - 49 years with the American society of anesthesiologists (ASA) physical status I-II were enrolled in this study. The patients were randomly allocated to either the sitting or the left lateral decubitus position group. The randomization scheme for the two groups was generated using the randomization.com website (http://www.randomization.com). Our exclusion criteria were parturients with contraindication for spinal anesthesia, history of migraine headaches, more than one puncture, any obstetric complications, and chronic use of analgesics.

After pre-anesthetic evaluation, routine monitoring, i.e., non-invasive blood pressure, pulse oximetry, and electrocardiography, was instituted in for all patients in the operation room. No sedative was prescribed for the patients to provide successful lactation.

All parturients received 10 mL/kg crystalloid solution before spinal anesthesia as prehydration.

Spinal anesthesia was administered with 2 mL of 0.5% hyperbaric bupivacaine (AstraZeneca; 10 mg) plus 1 mL sufentanil (5 μg) by a 24-gauge Quincke spinal needle either in the sitting or in the left lateral decubitus position. The needle was introduced with the bevel parallel to the sagittal plane. The technique was lumbar puncture in the midline approach at the L3-L4 interspinal space using a standard precaution and procedure.

In the left lateral decubitous position, parturients lay on their left side parallel to the rim of the operating table, their thighs were bent on their belly, and their neck was flexed to enable the forehead to be as close as possible to the knees. Data were collected by an unaware nurse.

The intensity of PDPH was assessed postoperatively using a numeric rating scale (NRS-11) immediately on either postoperative day (POD) one, two, or three as described to the parturients during the preoperative visit. NRS-11 is an 11-point numeric scale for patient self-reporting of pain intensity. On the scale, 0 is the absence of headache, 1 - 3 mild pain (nagging, annoying, and interfering slightly with activities of daily living [ADL]), 4 - 6 is moderate pain (interferes significantly with ADL), and 7 - 10 is severe pain (disabling; unable to perform ADL).

During follow-up in the ward, an unaware nurse charted the pain intensity using the NRS-11 scale.

The following factors were evaluated: age, weight, height, body mass index (BMI), PDPH and PONV.

Student's independent sample t test was used to compare age, weight, BMI, and height between the two groups, and the chi-square test was used to assess the relationship between position and complications (PDPH and PONV).

The Mann–Whitney U test was used to determine the significant differences in the values of quantity variables without normal distribution, such as the day of onset of headache, head severity score, mean sensory block duration, and sensory block level between the two groups. P value less than 0.05 was considered statistically significant. All statistical calculations were performed using the SPSS version 16 software.

4. Results

A total of 100 parturients who had been scheduled for elective caesarian section with ASA I or II status were randomly distributed into two groups (Table 1).

Table 1. Patient Characteristics[a]

Variable	Sitting Position (n = 48)	Lateral Decubitus Position (n = 46)	P Value
Age, y	26.37 (5.49)	27.36 (5.48)	> 0.05 (NS)
Height, cm	158.83 (5.25)	159.84 (7.24)	> 0.05 (NS)
Weight, Kg	76.47 (13.99)	73.14 (15.37)	> 0.05 (NS)
BMI, Kg/m^2	30.23 (4.65)	28.48 (4.72)	> 0.05 (NS)

[a]Values are expressed as mean (SD).

Among the patients, 48 had successful one dural puncture in the sitting position and 46 in the lateral decubitus position. Six patients were excluded from the study because of more than one dural puncture had been attempted. No patients were switched to general anesthesia.

The overall incidence of PDPH was 12.7% (12 patients out of 94). Ten patients (20.8%) had PDPH in the sitting group and only 2 patients (4.3%) in the lateral group (P = 0.017) (Table 2).

Table 2. Incidence of PDPH in Various Times[a]

Variable	Sitting Position (n = 48)	Lateral Decubitus Position (n = 46)	P Value
Incidence of PDPH	10 (20.8)	2 (4.3)	0.017
Incidence of PDPH on POD 1	5 (10.4)	0	> 0.05 (NS)
Incidence of PDPH on POD 2	7 (14.6)	1 (2.2)	> 0.05 (NS)
Incidence of PDPH on POD 3	9 (18.8)	2 (4.3)	0.03

Abbreviation: POD, post-operative day.
[a]Values are expressed as No. (%).

The intensity of the PDPH was higher in the sitting group on the first, second and third postoperative days (P = 0.0001) (Table 3). The highest sensory block level in the sitting group and in the lateral group was T5 and T4 (thoracic vertebrae), respectively (P = 0.002). The mean sensory block duration in the sitting group and in the lateral group was 141 and 138 min, respectively (P = 0.32).

The incidence of nausea and vomiting (concomitant symptom of PDPH) in the sitting position parturients (20.8%) was remarkably more common than that in the left lateral decubitous position parturients (P = 0.001) (Table 4). None of the patients with PDPH required an epidural blood patch to relieve symptoms. No significant relationship was observed between PDPH and parturients' BMI in both groups (P = 0.074).

Table 3. Difference in Intensity of PDPH in Various Times[a,b]

Variable	Sitting Position (n = 48)	Lateral Decubitus Position (n = 46)	P Value
Intensity of the PDPH on POD 1	0.4 (1.19)	0	0.0001
Intensity of the PDPH on POD 2	0.58 (1.5)	0.06 (0.44)	0.0001
Intensity of the PDPH on POD 3	1.04 (2.44)	0.11 (0.52)	0.0001

[a]Values are expressed as mean (SD).
[b]Severity of headache measured by NRS-11 scale (0 - 10).

Table 4. Patient Variables[a]

Variable	Sitting Position (n = 48)	Lateral Decubitus Position (n = 46)	P Value
Sensory block level (L4, L5)	5.02 (0.82)	4.69 (0.93)	0.002
Sensory block duration, min	141.14 (18.54)	138.69 (19.16)	> 0.05 (NS)
Nausea	10 (20.8)	0	0.001
Vomiting	5 (10.4)	0	> 0.05 (NS)
Nausea and Vomiting	10 (20.8)	0	0.001

[a]Values are expressed as mean (SD) or No. (%).

5. Discussion

This study showed that the incidence and intensity of PDPH were higher in the sitting position than in the lateral position in cesarean section.

This study used a rigorous definition of PDPH as a postdural headache in the frontal or occipital area, and its symptoms are aggravated by assuming the sitting position and are alleviated by recumbency. One of the most important reasons for longer stay in the hospital and increase in total expenditure of parturients is PDPH, and it is a complication that should not be treated lightly. PDPH is a direct consequence of the puncture hole in the dura, which results in the loss of cerebrospinal fluid (CSF) at a rate exceeding production. Loss of CSF causes the downward displacement of the brain and the stretching of sensitive supporting structures. The other reason for PDPH may be the

distention of blood vessels, which compensate for the loss of CSF because of the fixed volume of the skull (14, 15).

The spinal dura mater is a tough membrane and is the outer layer of the meninges surrounding the brain and the spinal cord. When the dura mater is perforated, the CSF leaks through it until it is closed either by intervention or through healing. Failure to close the dural perforation may lead to adhesions, continuous CSF leakage, and risk of infection.

The fibroblastic proliferation of the surrounding tissue and blood clot facilitate the process of healing of the dura mater. The fibroblastic proliferation emerges from the cut edge of the dura. It is possible that a spinal needle carefully placed in the subarachnoid space does not promote dural healing as trauma to adjacent tissue is minimal. The healing of the dura is longer in the sitting position than in the lateral decubitus position because the intervertebral spaces are more evident in the sitting position. Therefore, the block is performed more easily and is less traumatic, and the CSF leakage is longer. Second, CSF pressure in the sitting position is 40 cmH_2O and that in the lateral position is 5 - 20 cmH_2O. In the sitting position, this higher CSF pressure can make a larger hole in the dura and can cause a prolonged CSF leak. Third, the needle is perpendicular to the outer dura fiber in the sitting position, thus causing a larger hole and more CSF leakage (15, 16).

The incidence of PDPH can be as low as 5% with smaller-diameter, non-cutting, "pencil-point" spinal needles and as high as 86% with large-bore needles (4, 16).

The incidence of PDPH is estimated to be 0% - 5% following spinal anesthesia in parturients (11).

Etezadi et al. reported an incidence of 10.8% PDPH with a 25-gauge Quincke spinal needle in parturients (9).

In our study, the incidence of PDPH was 12.7% with a 24-gauge Quincke spinal needle. Similar to previous studies, PDPH was significantly lower when the spinal block was performed in the lateral decubitus position than in the sitting position (14, 17).

In our study, the highest sensory block level in the sitting group and in the lateral group was at T5 and T4, respectively. Our finding is in contrast to the one that reported a greater spread of isobaric bupivacaine up to the T4 level in the sitting position compared with the lateral position. This study included 70 Pakistani patients of both genders aged more than 60 years undergoing spinal anesthesia. Conversely, in our study, hyperbaric bupivacaine solutions were used in 100 parturients aged 19 - 49 years scheduled to undergo elective caesarian section (18).

One of the non-specific symptoms of PDPH is nausea and vomiting. Similar to the work of Moosavi Tekyes et al. (18), the incidence of nausea and vomiting was more common in the sitting position group in the present study.

We found no significant difference in the mean sensory block duration between the sitting and the left lateral decubitous position. This finding is not consistent with that of Shahzad et al. which reported that the duration of sensory block was shorter in the lateral decubitus position (17). This difference may be due to the fewer amounts of hyperbaric bupivacaine injected in the lateral decubitus position compared with the sitting position in their study.

Although Ghaleb found that the incidence of PDPH was greater in patients with lower BMI (16), no significant relationship was found between PDPH and BMI in the present study.

This study has some limitations. As we did not have isobaric bupivacaine, we had to use hyperbaric solution, which is gravity dependent. Moreover, spinal anesthesia in parturients is usually is done using small needles and a variety of spinal needles. Thus, more studies are necessary to assess the effect of position on the incidence of PDPH. Furthermore, parturients should be followed for at least one week to evaluate the delayed onset of PDPH.

5.1. Conclusion

The result of this study suggests that the incidence of PDPH following spinal anesthesia in the sitting position is more common than that in the left lateral decubitous position in elective caesarian section.

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Footnotes

Authors' Contribution: Study concept and design: Maryam Davoudi and Reza Ebadian; acquisition of data: Reza Ebadian; analysis and interpretation of data and drafting of the manuscript: Masoud Tarbiat; critical revision of the manuscript for important intellectual content: Maryam Davoudi and Masoud Tarbiat; statistical analysis: Masoud Tarbiat; administrative, technical, and material support: Maryam Davoudi and Puran Hajian; study supervision: Masoud Tarbiat.

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