



Cohort Study

Prone position: A possible method to decrease post dural puncture headache (PDPH) during surgery[☆]

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ABSTRACT

Objectives: Postdural puncture headache (PDPH) is a complication associated with spinal and epidural anesthesia, characterized by a very severe dull, non-throbbing positional headache along with nausea, vomiting and other symptoms. The aim of this study was to compare positional character of PDPH, where the effects of prone and supine positions during surgery were compared for the risk of the headache.

Methods: This cohort study, was carried out at (XXX) University of Medical Sciences from June 2019 to June 2020 after the approval from the Ethical Committee. 1416 patients participated in this study among whom either supine or prone positions were used for the surgery, based on the type of surgical requirements. All patients received spinal where, 18-gauge cannula was inserted and lactated ringer 4 mL per Kg per hour was used for the administration. Using an aseptic technique, a 26-gauge Quincke needle was inserted intrathecally via a midline approach into the L3-L4 or L4-L5 interspace with the patient in the sitting position. Patients received 10 mg 0.5% hyperbaric bupivacaine. 444 patients were operated in the prone position during surgery (P group) and the 972 patients were in the supine position (S group).

Results: We compared the rate of PDPH between the two groups. 3 (0.68%) patients with pilonidal sinus were operated in prone position experienced headache and 87 of those operated in supine position (8.95%) had headache ($P < 0.001$); and the odds ratio of developing headache when operated in supine position was 13.16.

Conclusions: Prone position during surgery appears to be a reliable way to reduce PDPH following spinal or epidural anesthesia.

1. Introduction

The first incidence of Postdural puncture headache (PDPH) was reported by Dr. August Bier in 1898 [1]. This complication has been the most challengeable aspect of spinal and epidural anesthesia [2], which is defined by a very severe dull, non-throbbing fronto-occipital pain, starting or aggregating in standing or sitting position and diminishing in lying situation [3]. The headache may be followed by nausea, vomiting, visual disturbances, tinnitus or temporary deafness [4].

Despite new methods and techniques to manage the pain, the PDPH remains a major complication [5], and the significance of the pain

management is critical owing to the increased use of spinal anesthesia as general anesthesia [6,7]. The incidence of PDPH is affected by many factors such as age, sex, cerebrospinal fluid (CSF) volume, local anesthetic agents; as well as some conditions such as pregnancy [8]. Two mechanisms were proposed to describe how CSF reduction can lead to the PDPH [9]. First theory described that brain stem and pain-sensitive meninges can be tensed due to excessive loss of CSF through the needle-induced orifice in the dural [10]. The other theory explains that CSF drainage leads to a vasodilatation by releasing adenosine into cranial blood circulation [11].

Based on the suggested mechanisms for PDPH, some techniques have

; PDPH, Postdural puncture headache; CSF, cerebrospinal fluid.

[☆] Research ethics for all participants to participate in this study, and informed consent was obtained. The study was carried out at AJA University of Medical Sciences after the approval from the Ethical Committee (approval code 90-03-61-14780).

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been developed to reduce the complication. Utilization of 27 Gauge needle instead of 25 G needle for induction of spinal anesthesia, has resulted in reduced frequency of the complication, however the narrowness of the needle can reduce CSF flow, where, repeated dural puncture can lead to PDPH [12]. In a study, minimal but not significantly lesser, epidural blood patch were required to control PDPH, by the use of 22 gauge lumbar puncture needles [13]. Some other studies have indicated the advantages of supine positioning after Lumbar Puncture in comparison to early ambulation, for the pain management [14].

The aim of this study is to assess whether supine or prone surgical positions during the surgery could affect the incidence of PDPH, following 48 h after spinal anesthesia.

2. Materials and methods

1416 ASA physical status classes I and II patients who underwent spinal anesthesia successfully for short time surgeries were enrolled in this cohort study from June 2019 to June 2020. Research ethics for all participants to participate in this study, and informed consent was obtained. The study was carried out at (XXX) University of Medical Sciences after the approval from the Ethical Committee (approval code X). Patients with a history of anxiety disorders, those consuming sedatives, analgesics, antidepressants, or antiepileptic drugs, those with any contraindication for spinal anesthesia and with the history of tension or migraine headache, PDPH, low back pain or spine surgery were excluded from the study. The regional anesthesia was applied via Lumbar Puncture anesthetic administration by one trained anesthesiologist. We had two groups, the first group consisted of 444 patients who were operated in the prone position during surgery for a pilonidal sinus surgery (P group) and the remaining 972 patients were in the supine position (S group) during the surgery. All patients received spinal where, 18-gauge cannula was inserted and lactated ringer 4 mL per Kg per hour was used for the administration. Using an aseptic technique, a 26-gauge Quincke needle was inserted intrathecally via a midline approach (directing the needle bevel in the longitudinal axis) into the L3-L4 or L4-L5 interspace with the patient in the sitting position. Patients received 10 mg 0.5% hyperbaric bupivacaine with an injection speed of 0.5 mL/10 s. In all cases, we performed the spinal anesthesia in setting position, where only difference was the surgical position in the respective groups.

The occurrence of PDPH was assessed 48 h following the operation. PDPH was defined as the occurrence of bilateral headaches within 7 days of the lumbar puncture, as per according Headache Classification Committee of the International Headache Society [15]. The study protocol was approved by the Institutional Ethics Committee and informed written consent was obtained from the patients.

After surgery, in the recovery room, all the patients were positioned in the supine position in bed for the rest of the study period.

Patients were asked for PDPH, 24 and 48 h following the surgery. Bilateral frontal or occipital pain that increased at upright position was defined as PDPH.

All the participants were given the same hydration and treatment during and after the operation. In case of headache, patient was ordered to be bed rested and were administrated Acifen (200 mg Brofen and 40 mg Cafein and 325 mg Acetaminophen). In the cases of moderate and severe PDPH, hydration with caffeine containing fluids, acetaminophen and complete bed rest were advised. If PDPH was still persistent after the above-mentioned measure, epidural blood patch was given.

3. Statistical analysis

Normal distribution of age, weight and PDPH was analyzed by the Kolmogorov-Smirnov test. Age and weight were compared among the two groups by independent sample *t*-test. To compare the ASA, physical status and PDPH among the group chi-square and Fisher exact tests (when appropriate) were used. Two tailed $p < 0.05$ was taken

statistically significant.

Unique identifying number is: researchregistry7259.

The methods have been reported in accordance with STROCCS 2021 guidelines [16].

4. Results

Overall, 1416 patients aged 16–40 years participated in this study with a mean age of 25.86 ± 10.3 years among which 1215 were aged between 15 and 34. There were no significant differences between BMI, sex, and patients' age among the two groups ($P < 0.001$) (Fig. 1). The distribution of surgeries is presented in Table 1. Kolmogorov-Smirnov test for weight and PDPH showed normal distribution [17]. Three (0.68%) of the patients in group P complained of having PDPH, whereas 87(8.95%) patients in group S experienced PDPH. There was a significant difference in incidence of PDPH between groups. The odds ratio of 13.16 with the confidence interval of 95% showed that patients operated in supine position are at 13.16 times increased risk of developing PDPH (Fig. 1).

5. Discussion

Post-operative complications are commonly known to be associated with the type of surgery or the anesthesia used [18,19]. Anesthesia-associated complications can be avoided in simple ways which results in more desirable outcomes and patient satisfaction, postoperatively [20,21]. One of the most challengeable aspect of spinal and epidural anesthesia is PDPH [22]. PDPH is the most common complication following the use of spinal anesthesia that is reported in 0.16%–1.3% population [23,24]. Despond et al. applied spinal anesthesia to patients between the ages of 18–45 years and they found an incidence of PDPH of 20% in the female group, and 5.5% in the male group indicating that the results found a significantly higher incidence in females. However, our study does not report such findings [25]. The results of this study show that the incidence of PDPH is less in prone position in comparison to supine position during surgery. Some preventive methods have been suggested for reducing PDPH, like caffeine, Epidural blood patching and corticosteroids [26]. Some other factors are needle size, postural orientation and design [27]. The Quincke type is the standard needle with a medium cutting bevel and the orifice at the needle tip [28]. It has been shown that there is no significant difference in postdural puncture headache between different sizes of the needle. Since the best preventive measures even fail, here we have studied effect of surgical position of the patient on reduction of the PDPH. A recent study has also reported that the type of spinal needle, the age of the patient, surgery type, experience of the physician, and the physical state/fatigue of the physician are strongly correlated to the incidence of

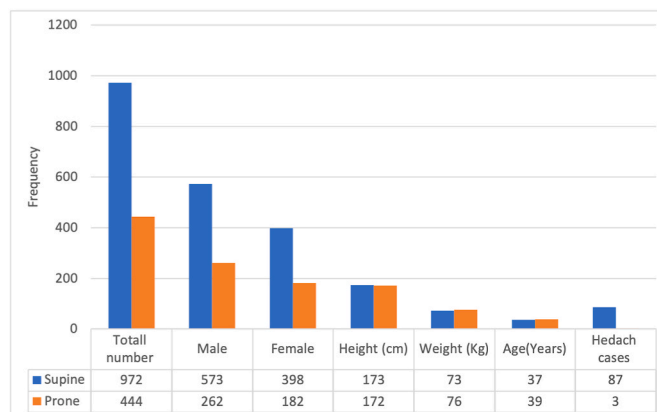


Fig. 1. Frequency of headache among patients in the supine and prone position.

Table 1
Most common types of operations studied.

| Operation | Numbers | Percentage |
|-------------------------|---------|------------|
| Varicocele Surgery | 615 | 43.4 |
| Pilonidal sinus Surgery | 444 | 31.3 |
| Arthroscopic Surgery | 138 | 9.7 |
| Hydrocele Surgery | 219 | 15.4 |

PDPH [29].

Some studies have already addressed the role of postdural puncture patient positioning in PDPH reduction, however a significant number of controversies are seen too. Dogan M et, al. concluded that prone position during surgery has less frequently resulted in PDPH than supine. A detailed look at the method reveals that they have selected the groups from two special surgery patients. It is inevitable to select prone surgery position among some patients; therefore, this can be homogenized best between studies selecting the same type of surgeries in the prone position (namely anorectal surgeries).

Clive E Handler et al. [30] conducted a study where it was reported that prone position is not associated with the reduction in lumbar puncture headache. A randomly allocated trial was designed in which patients were divided in two diagnostic lumbar puncture groups followed by a bed rest period of 4 h. Only 46 patients were included for the outcome assessment. In the present study we found that prone position during surgery can lead the reduction in the incidence of PDPH compared to supine position. This phenomenon is likely due to the decreased CSF leakage as a result of increased intra-abdominal pressure in prone position during surgery. Therefore, this position can be a suitable for the prevention of PDPH, along with the use of thin bevel needles, acute angle of insertion, epidural blood patch or placement of saline. Nonetheless, a study reports that 20 and 29 gauge needles in 11–28% and 2% of the cases lead to PDPH, respectively [31].

It was proposed that an increase in intra-abdominal pressure in the prone position during surgery or using tight abdominal binders during the post dural-puncture can block the rise in epidural pressure, hence it can block CSF leakage out of orifice, preventing PDPH [32]. Many studies and reviews have shown that prone position during surgery of the patients after the induction of the spinal anesthesia results in reduction of PDPH frequency, postoperatively [33]. Also, some studies have suggested a role for pre-lumbar puncture position in reducing the frequency of PDPH [34]. Lumbar puncture in sitting position results in more frequent PDPH in comparison to lateral decubitus position [35].

6. Conclusion

The study was not cost-effective, required a larger sample size and was therefore, prone to biases. The incidence of PDPH in the patients who were in prone position during surgery is less than those who were in a supine position. Studies are needed to compare the effect of needle size and patient position for confirmation.

Provenance and peer review

Not commissioned, externally peer-reviewed.

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Availability of data and material

Data sharing not applicable to this article as no datasets were generated or analyzed during the current study.

Consent to participate

From the under 16 years old was given by a parent or legal guardian.

Consent for publication

Not applicable.

Author contribution

Dr. Reza Alizadeh and Dr. Ziba Aghsaiefard: conceptualized and designed the study, drafted the initial manuscript, and reviewed and revised the manuscript. Dr. Bahar Fereydoon nia and Dr. Mojtaba Mostafazadeh: Designed the data collection instruments, collected data, carried out the initial analyses, and reviewed and revised the manuscript. Dr. Masoud Hashemi: Coordinated and supervised data collection, and critically reviewed the manuscript for important intellectual content.

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No funding was secured for this study.

Ethical approval

All procedures performed in this study involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Registration of research studies

1. Name of the registry: ResearchRegistry
2. Unique Identifying number or registration researchregistry7259
3. Hyperlink to the registration (must be publicly accessible): <https://www.researchregistry.com/browse-the-registry#home/registrationdetails/6168bdd495ebf4001e8a4777/>

Guarantor

Reza Alizadeh.

Declaration of competing interest

The authors deny any conflict of interest in any terms or by any means during the study.

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