

## Short Communication

## The Effect of Stretching Exercises and Caffeine Tablets on Reducing Headache after Spinal Anesthesia; A Randomized Clinical Trial

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### Abstract

**Background:** We performed this study to compare the effect of caffeine and stretching exercise on post-dural puncture headache (PDPH).

**Materials and Methods:** In this Randomized Clinical Trial, 160 candidates for elective inguinal hernia surgery or varicocele surgery in Shahid Modarres Hospital in Tehran, were assigned into the following groups using a computer-generated randomization table: caffeine group received caffeine tablet (200 mg TDS); exercise group received stretching exercise; caffeine combine exercise group received caffeine tablet (200 mg TDS), and stretching exercise and control group received placebo tablets. After the end of the surgery, up to 48 h, the Visual analog scale (VAS) was recorded every 6hours by the same clinician

**Results:** The occurrence of PDPH was less in the caffeine and exercise combined group than in the control group. Also, the headache was more severe in the control group than in the caffeine group. Furthermore, the need for rescue analgesics was more in the control group than in the caffeine group.

**Conclusion:** Caffeine and exercise combined had better outcomes than placebo regarding PDHP.

**Keywords:** Post-dural puncture headache (PDHP), Caffeine, Stretching exercise, Varicocele, Hernia

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### Introduction

Spinal anesthesia is a type of regional anesthesia that is performed by injecting local anesthesia into the intrathecal space. The most common complication is post-dural puncture headache (PDPH), an unpleasant complication that can develop after spinal anesthesia. Its incidence is between 2% to 40% and depends on various factors such as size and type of needle (1-3).

Female gender, younger age, and pregnancy are

known risk factors for PDPH. Young adults are at higher risk for PDPH than older people (14% vs. 7%) since the dura mater have less elasticity and less likely to rupture (4, 5). When the CSF volume decreases to about 10% of the total cerebrospinal fluid (CSF), vasodilation occurs to compensate and leads to PDPH (6). PDPH usually occurs within 1-2 days after spinal anesthesia. Its Characteristic criteria are a severe frontal or occipital headache that increases with

movement, upright posture, and cough (5). Involvement of the cranial nerves may occur and stretch of them may lead to the facial motor deficit (nerve VII), hypoacusis (nerve VIII), abducens palsy (nerve VI), visual and auditory impairment (1, 7, 8).

Various methods are used to treat patients with PDPH. Most patients are treated with conservative methods such as paracetamol, caffeine, bed rest, and hydration until CSF would restore with additional fluid intake (9, 10). But in severe cases, an epidural blood patch (EBP) should be used. Despite all treatments, PDPH may persist for about one week (1-3, 9, 10).

Caffeine is a non-invasive, safe, and most common treatment for PDPH and was first reported in 1949 as a treatment for it. Caffeine is a central nervous system (CNS) stimulant and inducing cerebral vasoconstriction may result to treat PDPH. Caffeine affects cerebral vasoconstriction by blocking adenosine receptors, decreases cerebral blood flow, decreases intracranial pressure (ICP), and increasing CSF production by stimulating sodium-potassium pumps (11, 12).

Due to the high prevalence and unpleasant feelings for the patient, using appropriate methods can prevent this problem. In this study, we investigated the effect of caffeine as a preventive method and also stretching exercises to reduce the PDPH incidence.

## Methods

**Ethical approval:** The study was approved by a biomedical research ethics committee by code IR.SBMU.RETECH.REC.1397.1389 and was registered in the Iranian registry clinical trial (coded IRCT20190131042569N1).

**Patient selection and randomization:** after approval of the ethical committee in Shahid Modarres hospital (Tehran, Iran), 160 patients who were scheduled for elective inguinal hernia or varicocele were enrolled in this study after informed consent.

**Inclusion criteria were:** The American society of anesthesiologists (ASA) physical status I–II, aged 20–60 years, candidate for elective inguinal hernia or varicocele surgery. Patients were not entered to the study if they had a psychiatric or neurological disorder,

allergy to caffeine, hypertension, or intolerance to caffeine, or had consumed caffeinated beverages within the previous 4 hours.

Patients were randomly allocated into four groups using a computer-generated randomization chart to receive oral tablet caffeine 0.2 g, as a caffeine group (group 1, n =40), as an exercise group (group 2, n =40), as a Caffeine combine exercise group (group 3, n =40), or Placebo tablet as a controlled group (group 4, n = 40). As the first patients gave a visual analog scale guide, then a peripheral 18- gauge intravenous (i.v.) cannula was inserted. All patients received 20 mL/kg of normal saline solution as a pre-hydration measure over 30 min. Baseline heart rate (HR), mean arterial pressure (MAP), and hemoglobin oxygen saturation (SpO<sub>2</sub>) were recorded in the operating room before anesthesia and every five minutes during the procedure. For all cases in the study, the spinal anesthesia was performed with the same Anesthesiologist with 5 years of experience, and with a 25 gauge Quincke spinal needle in the sitting position.

The needle insertion point was in L3-4 or L4-5 level and after confirmation of clear CSF, three mL bupivacaine 0.5% was injected to intrathecal space. After confirmation of sensory and motor block surgical procedure started. All operations were done by the same surgeon. At the end of the procedure, patients were transferred to the recovery room with monitoring of hemodynamics and sensory level.

Caffeine was administrated 3 times a day (TDS) from the post-anesthesia care unit (PACU), and exercise too. The severity of headache was scored and assessed by 10-point (VAS) with 0=no headache and 10=worst headache imaginable, and according to the degree of pain given by the patient, classification of headache severity was done as follows: No headache=0, mild headache<3, moderate headache 4–6 and severe headache >6.

After the end of the surgery, the Patient's VAS was recorded every 6h until 48h by the same clinician blinded to the study and then for 3 days after hospital discharge to complete 5 days after the procedure. When headaches failed to resolve within 1 hour by bed rest and fluids, it was managed by 5 mg morphine (Intramuscular), and the total amount of analgesic

requirements was calculated.

With a test power of 95%, and a type I error rate of 0.05, the sample size was calculated as 40 in each group. Quantitative variables were represented as mean  $\pm$  SD and qualitative variables were represented as a number (percentage). The normality of the quantitative variables was verified using the Shapiro-Wilk test and Normal quantile plot. Since all the quantitative variables were abnormally distributed, a comparison was made between the four groups in terms of quantitative variables using the Mann-Whitney test and in terms of qualitative variables using Pearson's chi-square or Fisher-Exact tests. All hypothesis tests were performed on a 2-sided basis. The significance level in all tests was 0.05.

## Results

In this study, 160 patients undergoing surgery under spinal anesthesia at Shahid Modarres Hospital in Tehran were randomly divided into four groups (caffeine group, exercise group, caffeine combine exercise group, controlled group) each of them had 40 patients; equal groups. The demographic parameters were similar in the four study groups. According to the obtained results, all patients had no significant change in hemodynamic intraoperative.

The incidence of headache and back pain at any time during the 1st 3 days following all groups are listed in Table 1 & 2 The incidence of headache and back pain at a defined time during the 1st 5 days had no statistical difference.

The overall prevalence of headache at any time within the 1st five days following the caffeine group was five cases (3.7%) on the first day, 4 cases on the second day, and 1 case on 3th day, and in 4th and 5th days, no patient had a headache.

In the exercise group the prevalence was 3 cases (3.7%) on the first day, 2 cases on the second day, and 3rd, 4th, and 5th days no patient had a headache. In the combined group, no patient had a headache within the 1st five days.

Within the 1<sup>st</sup> five days following the control group was ten cases (3.7%) on the first day, ten cases on the second day, and five cases on the 3rd day and in

4th and 5th days, no patient had a headache.

The overall prevalence of back pain at any time within the 1st five days following the caffeine group was five cases (3.7%) on the first day, 4 cases on the second day, and 1 case on 3th day, and 4th and 5th days no patient had back pain.

Within the exercise group the prevalence was 3 cases (3.7%) on the first day, 2 cases on the second day, and 3rd, 4th, and 5th days no patient had back pain. In the combined group, the prevalence was 2 cases (3.7%) on the first day, one case on the second and 3rd day, 4th and 5th days no patient had back pain.

Within the 1st five days following the control group was ten cases (3.7%) on the first day, 6 cases on the second day, and 2 cases on the 3rd day, and 4th and 5th days no patient had headaches.

## Discussion

Post-dural puncture headache is defined as a severe and intense headache that spreads across the frontal and occipital areas and radiates to the neck and shoulders. 90% of headaches occur within the first 3 days of the procedure and 66% start within the first 48 hours. Headaches can occur immediately after a dural puncture (10, 13-15).

The pathogenesis of PDPH remains unclear, but it is believed to be caused by leakage of CSF into the epidural space through a tear in the dura. A decrease in CSF volume leads to a decrease in intracranial pressure and a downward movement of pain-sensitive intracranial structures, including veins and meninges. Headaches after a dura puncture classically worsen in an upright position. Cerebrovascular vasodilation due to decreased ICP can also contribute to the development of headaches (15-17). The MRI studies have shown that as compensation for the reduced CSF, central venous dilation occurs. This dilation was believed to be the source of the "pressure" felt by most patients with PDPH (18).

**Table 1:** Number of patients in the intervention and placebo groups who experienced headaches. Headache scores of 0-1 were indicative of no headache, while scores of 2-3 indicated a headache.

Headache	first-day score		second-day score		third-day score	
	0-1	2-3	0-1	2-3	0-1	2-3
Number of patients in caffeine group	35	5	36	4	39	1
Number of patients in exercise group	37	3	38	2	40	0
Number of patients in COMBINE (caffeine + exercise) group	40	0	40	0	40	0
Number of patients in PLACEBO group	30	10	30	10	35	5

**Table 2:** The patients in the intervention and placebo groups who experienced back pain. Back pain scores of 0-1 were indicative of no back pain, while scores of 2-3 indicated back pain.

Back pain	first-day score		second-day score		third-day score	
	0-1	2-3	0-1	2-3	0-1	2-3
Number of patients in caffeine group	35	5	36	4	39	1
Number of patients in exercise group	37	3	38	2	40	0
Number of patients in COMBINE (caffeine + exercise) group	38	2	39	1	39	1
Number of patients in PLACEBO group	30	10	34	6	38	2

This problem is most often treated as outpatient treatment, but sometimes it causes patients to be readmitted. Various treatment methods have been suggested for its treatment (paracetamol, caffeine, bed rest, and hydration). Bed rest and hydration is the most common conservative treatment for mild PDPH, as well as oral caffeine until CSF would restore with additional fluid intake but in severe PDPH patients, the gold standard treatment for PDPH is Epidural Blood Patch (3, 19). However, this invasive procedure carries a risk of infection, seizures, back pain, and exacerbation of the headache (14, 20).

Epidural administration of saline, caffeine, theophylline, sumatriptan, adrenocorticotrophic hormone, dextran patch, morphine sulfate, and bed rest are some of the other plans to treat PDPH. Caffeine therapy is a safe and non-invasive alternative treatment for PDPH. However, caffeine has only rarely been studied for this indication (3, 4, 10, 20). The proposed mechanism of action of caffeine affects cerebral vasoconstriction by blocking adenosine receptors, decreases cerebral blood flow, decreases ICP, and

increasing CSF production by stimulating sodium-potassium pumps (10, 14, 15, 21, 22). Prevention of PDPH and its early treatment allows early ambulation and early discharge from the hospital.

The study conducted by Riveros Perez et al showed that the combined prophylactic medications (IV administration of Cosyntropin, epidural saline, and epidural morphine used after a dural puncture has a great effect to reduce the incidence of PDPH and the need for blood patch in obstetric patients (10, 23).

Another study showed that VAS scores were significantly lower in the group that received intravenous caffeine than control. The incidence of moderate and severe headache was significantly higher in the control than in the caffeine group; besides, analgesic demand was significantly lower in the caffeine group (11).

The study conducted by Chao-Jie Yang et al showed that The incidence of PDPH in the Aminophylline group was significantly lower than control (24). However, it has been demonstrated that a prophylactic regimen with epidural saline, epidural

morphine and intravenous cosyntropin used after accidental dural puncture exhibits great potential to decrease PDPH and the need for EBP in obstetric patients (23).

Our study had several limitations. The most important of them are limited sample size and also only one kind of spinal needle was used. For future studies on PDPH, we suggest evaluate PDPH by various kind of spinal needles with our preventive method and bigger sample volume and using IV administration of caffeine and compare it with other medications to recognize more citable results (10, 14, 15).

Our RCT was designed to assess the effectiveness of prophylactic exercise and oral caffeine in preventing PDPH in patients receiving spinal anesthesia. The main finding in this study was a greater reduction in the incidence of PDPH in the combined caffeine and exercise groups than in the control group. Our findings also show that headaches are more severe in the control group than in the caffeine group. In addition, the need for analgesics was greater in the control group than in the caffeine group.

## Conclusion

The prophylactic effects of caffeine for PDPH may be similar to its therapeutic effect due to increased CSF production, decreased ICP, and decreased cerebral blood flow. According to this study, caffeine, in addition to helping to treat headaches, can also be used as prophylaxis, which can be effective in improving patient satisfaction.

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## Conflicts of Interest

The authors declare that they have no conflict of interest.

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