Elshafei and Mowafy
Ain-Shams Journal of Anesthesiology (2023) 15:76
https://doi.org/10.1186/s42077-023-00371-1

Ain-Shams Journal of Anesthesiology

ORIGINAL ARTICLE Open Access

Sphenopalatine ganglion block with or without greater occipital nerve block for treatment of obstetric post-dural puncture headache after spinal anesthesia: randomized controlled trial

Amr Shaaban Elshafei[1*] and Sherif M. S. Mowafy[1]

Abstract

Background Conservative treatments of post-dural puncture headache (PDPH) may be unsuccessful, and the relief that is provided is frequently insufficient. This study aimed to meticulously explore the analgesic efficacy of the sphenopalatine ganglion (SPG) block when administered alone or in conjunction with the greater occipital nerve block (GONB) for the purpose of treating PDPH and with the aid of transcranial Doppler (TCD) to evaluate the cerebral hemodynamics before and after the block.

This study was conducted on 63 women with post-partum PDPH randomized into the following: control group (Group C = 21 participants), received conservative management; SPG block group (Group S = 21 participants), received conservative management with SPG block; and combined nerve and ganglion block group (Group NAG = 21 participants), received conservative management with SPG block and ultrasound guided GONB. Visual analog score (VAS), modified Lybecker score, and transcranial Doppler (TCD) measures were used to determine PDPH severity at 0 (baseline), 1, 6, and 24 h. Additionally, the three groups' needs for EBP were noted.

Results VAS and modified Lybecker scores at 1, 6, and 24 h were statistically significantly lower in S and NAG groups compared to the control group with no statistically significant difference between S and NAG groups. With TCD, the mean velocity (MV) was significantly lower at 1, 6, and 24 h compared to baseline reading in both S and NAG groups. Also, the pulsatility index (PI) was statistically higher at 1, 6, and 24 h compared to baseline readings in S and NAG groups. There was no statistically significant difference regarding the need for EBP.

Conclusions In terms of headache relief or the need for EBP, there is no difference between individual SPG block or combined SPG block and GONB in the treatment of PDPH.

Keywords Sphenopalatine ganglion block, Greater occipital nerve block, Post-dural puncture headache, Spinal anesthesia

Background

Post-dural puncture headache (PDPH), a very common complication after a dural puncture, is more often seen in pregnant women having a cesarean section (CS) under neuraxial anesthesia. According to the literature, the incidence of PDPH after spinal anesthesia ranges between

*Correspondence:
Amr Shaaban Elshafei
amrshaaban85@gmail.com
[1] Department of Anesthesia, Intensive Care, and Pain Management, Faculty of Medicine, Zagazig University, Zagazig, Egypt

0.3% and 40% (Bezov et al. 2010; Ali et al. 2019; Chekol et al. 2021). The mechanism of nociception in PDPH is still unclear. However, it is supposed that a cerebrospinal fluid (CSF) leak from the dural hole is assumed to be the origin of the drop in intracranial pressure (ICP), which pushes downward on intracranial nociceptive structures and is exacerbated by compensatory cerebral vasodilation (Bezov et al. 2010). Management of PDPH is a challenge, and anesthesiologists are always searching for methods that may provide rapid and long-lasting relief from this disastrous consequence since the gold standard definitive treatment is the epidural blood patch (EBP) which itself might unintentionally result in dural puncture that was the root of the problem as well as the conservative therapy for PDPH may not be able to cure symptoms (Malik and Singh 2019).

The use of regional techniques and nerve blocks for the treatment of headache symptoms are well-known techniques. With promising results, the trans-nasal sphenopalatine ganglion (SPG) block, an easy block needing minimal training, has been shown to be effective in PDPH treatment. The SPG is the para-sympathetic ganglion of cranial nerve (CN) VII that is situated within the posterior nasal turbinate and encourages intracranial vasodilation (Peres et al. 2002). The SPG parasympathetic block's role in PDPH treatment may be prompted by the vasoconstriction it causes. Moreover, its relation to the trigeminal nerve may concurrently alleviate the frontal headache (Nair and Rayani 2017).

The greater occipital nerve block (GONB), which has previously been used to treat certain forms of persistent headaches such as cervicogenic headache, cluster headache, migraine, and occipital neuralgia, is another regional technique that may be utilized (Peres et al. 2002; Anthony 2000); additionally, several newly published researches indicate that patients suffering PDPH may benefit from the use of GONB which is a superficial block that may be carried out at the patient's bedside guided by ultrasonography. The greater occipital nerve is the main sensory nerve of the occipital region that arises from the dorsal ramus of cervical spinal nerve II. The neuromodulation effect as well as the reduced central sensitivity brought on by irritation of the meningial and paraspinal muscles, and blocking the dorsal horn afferent fibers of the spinal cord may all contribute to the participation of GONB in the treatment of PDPH symptoms. Furthermore, the sensitive neurons of the upper cervical cord are close to the trigeminal caudal nucleus. Consequently, its afferences may also be blocked with this technique (Xavier et al. 2020; Akyol et al. 2015; Niraj et al. 2014).

Although the published literature reported an improvement of the visual analog score (VAS) and a decreased number of patients in need of EBP when these blocks were used for treating PDPH, the available evidence is still lacking (Nair and Rayani 2017; Xavier et al. 2020; Akyol et al. 2015; Niraj et al. 2014). Furthermore, there are several clinical circumstances in which the patient may reject the treatment with EBP or in which its application may be contraindicated. Because obstetric patients are more likely to develop PDPH, we hypothesized that these less invasive techniques may be helpful for them, and in order to prevent the invasive EBP, these blocks can be introduced to the treatment of individuals who have PDPH.

Rune Aaslid first described TCD for cerebral hemodynamic assessment in the early twentieth century. TCD, which is a non-invasive safe bedside real-time cerebral hemodynamic monitoring tool has gained increasing approval as an accurate diagnostic tool in several cerebrovascular diseases. Therefore, TCD could detect the cerebral blood flow changes produced by PDPH or its treatment. The SPG parasympathetic block could induce cerebral vasoconstriction that can be monitored using TCD (Venturelli et al. 2017; Vadhera et al. 2017).

This study aimed to meticulously explore the analgesic efficacy of the SPG block when administered alone or in conjunction with the GONB for the purpose of treating PDPH and with the aid of TCD to evaluate the cerebral hemodynamics before and after the block.

Methods

Study design and population

Sixty-three pregnant women between the ages of 21 and 40 years old with a body mass index of less than 35 kg/m^2 and an American Society of Anesthesiology physical status II (ASA II) who were admitted to Obstetric Hospital at Zagazig University Hospitals for an elective cesarean section under spinal anesthesia between June 20, 2021, and June 30, 2022, and diagnosed with PDPH during their post-partum period with visual analog score (VAS) ≥ 4 (Corbey et al. 1997) and modified Lybecker score ≥ 2 (Lybecker et al. 1995) were included in this prospective double-blinded randomized controlled clinical study. Written informed consent was obtained from all participants before their inclusion in this trial, the institutional review board (Research Ethics Committee of the Faculty of Medicine, Zagazig University) authorized this study with the reference number (ZU-IRB#:6868/16–6-2021), and it is identified as (NCT04844229) on ClinicalTrials.gov.

The following individuals were excluded from the study: those who underwent an emergency cesarean section, those with an inadequate temporal window, convulsions, atrial fibrillation, a history of migraines or persistent headaches, hypertensive problems of pregnancy, a cerebrovascular accident, or any condition that

would prevent receiving a subarachnoid block, such as coagulopathy, infection at injection site, or history of local anesthetics allergy as well as those who rejected to participate in our trial.

The preoperative visit comprised a comprehensive history taking, physical examination, and review of laboratory testing to rule out any conditions that would pose a contraindication for the study treatments. Each participant provided written informed consent after discussions on the objectives, advantages, and possible disadvantages of the research treatments. In the operating theatre, after securing an 18G intravenous access and attaching the required monitors (electrocardiogram, pulse oximetry, non-invasive blood pressure, and capnograph), an intravenous fluid co-load of 15 mL/kg Lactated Ringer's solution was given to all individuals. Spinal anesthesia was administered while the patient was seated, and strict aseptic procedures were followed. The procedure was performed in the L3/4 or L4/5 intervertebral spaces using a disposable Quinke spinal needle of 25-gauge by paramedian approach after local anesthetic infiltration of the skin with 3 ml lidocaine 2%. Then, intrathecal injection of anesthetic drugs (12.5 mg hyperbaric bupivacaine 0.5% (2.5 mL) + 25 μg fentanyl) was done after CSF free flow over a 10-s period with no barbotage. For all subjects, spinal anesthesia was done by an anesthetist not participating in this study.

In the post-anesthesia care unit and for the next 5 days during the post-partum period, all patients were questioned and clinically examined twice daily for headaches. The diagnosis of PDPH was determined using the four International Classification of Headache Disorders (ICH-II) guidelines which include a postural headache develops within 5 days after lumbar puncture, worsens within 15 min of sitting or standing, and improves within 15 min of lying down, associated with at least one of these criteria: neck stiffness, nausea, photophobia, and tinnitus, and resolves either spontaneously within 1 week or within 48 h after effective CSF leak treatment. Classically, the patient often reports dull aching, throbbing, or pressure-type fronto-occipital headache (Jabbari and Hasanjani Roushan 2014).

Patients suffering from PDPH during the post-partum period were asked to report their headache severity after 15 min of sitting upright, using the 10-cm visual analog score (VAS) where score 0 is no headache and 10 is the worst headache conceivable (Corbey et al. 1997). Additionally, headache severity was evaluated using a modified Lybecker score (Lybecker et al. 1995) which includes the following:

- Grade 1: Mild headache that hardly affects daily activities, no bed-bound patients, no accompanying symptoms, and oral analgesics effectively relieve the pain.
- Grade 2: Moderate headaches significantly restrict daily activities and leave patients in bed for most of the day, and they call for injectable analgesia. Other symptoms may or may not be present.
- Grade 3: Severe PDPH with accompanying symptoms, complete restriction of daily activities, with patients spending the whole day in bed. Associated symptoms include a feeling of being deaf, tinnitus, dizziness, nausea, and vomiting.

All patients with visual analog score (VAS) ≥ 4 and modified Lybecker score ≥ 2 were enrolled in this study and subjected to baseline trans-cranial Doppler (TCD) evaluation and then were randomly assigned into three equal groups. These patients were hospitalized during the treatment course till the complete cure of PDPH symptoms, then after discharge, they were followed up twice daily by phone call for a total of 5 days from the time of study enrollment.

Randomization was carried out by sealed, opaque envelopes containing random numbers produced by the website (https://www.randomizer.org/).

Control group [Group C (n = 21 participants)]

In addition to increased oral fluid intake and maintained bed rest as part of the conservative PDPH treatment, patients received oral paracetamol 1000 mg/8 h, caffeine 300–500 mg/day (Panadol-Extra tablet, film-coated, GlaxoSmithKline Consumer Healthcare Holdings (US) LLC) (2 tablets were given every 8 h), and a 1000 mL 0.9% normal saline infusion during the first 4 h. Non-steroidal anti-inflammatory drugs (NSAIDs) were added in the form of 30 mg IV ketorolac, which may be repeated every 12 h if required if the aforementioned treatments did not successfully manage pain with the VAS ≥ 4 after 6 h of therapy. The VAS score, modified Lybecker score, and TCD characteristics were assessed after 1, 6, and 24 h. EBP was considered after 24 h of treatment if the pain was still not controlled with VAS ≥ 4 and modified Lybecker score ≥ 2 and after gaining patients' consent.

Bilateral sphenopalatine ganglion block group [Group S (n = 21 participants)]

This got the same conservative management as in the control group together with bilateral transnasal sphenopalatine ganglion (SPG) block.

SPG block was done with the patient lying in a supine position using 6 in. (15 cm) cotton-tipped plastic hollow applicator inserted in the nose with the swab soaked in 1.5 ml 10% lignocaine solution. The applicator was inserted parallel to the floor of the nose until resistance

was encountered. The swab was rested in the pterygopalatine fossa superior to the middle turbinate and removed after 10 min. This procedure was done again in the other nostril as well (Kumar et al. 2020). After 1 h, patients were assessed for severity of headache by VAS score, modified Lybecker score, and other successful block indictors such as bilateral lacrimation and nasal congestion as well as TCD evaluation was performed. Then, the headache severity assessment by the VAS score and modified Lybecker score were repeated at 6 h and 24 h of the block as well as the TCD measurements. If the VAS is still ≥ 4 and modified Lybecker score ≥ 2, EBP was indicated and performed after gaining patients' consent.

Combined nerve and ganglion block group [Group NAG (n = 21 participants)]

The same conservative management as in the control group together with a combined block of bilateral transnasal SPG block and bilateral ultrasound-guided greater occipital nerve block (GONB) was received.

While the patients were lying prone, bilateral ultrasound-guided greater occipital nerve block was done using a high frequency (6–13 MHz) probe of Siemens Acuson X300 machine placed in transverse orientation lateral to external occipital protuberance parallel to the superior nuchal line to detect occipital artery where the nerve is located medial to it 1.5 in.; then a 20-gauge needle was inserted out of plane to avoid vascular injury. Four milliliters of treatment solution containing 2.5 mg/ml bupivacaine and 1 mg/ml dexamethasone (prepared by adding 2 ml bupivacaine 0.5% + 1 ml dexamethasone + 1 ml saline) was injected on each side. Block was confirmed by ipsilateral anesthesia of the scalp area supplied by greater occipital nerve (Türkyilmaza et al. 2016), and then, these patients were assessed for VAS score, modified Lybecker score, and TCD after 1, 6, and 24 h of the block. If the VAS is still ≥ 4 and modified Lybecker score ≥ 2, EBP was indicated and performed after gaining patients' consent.

Transcranial Doppler was performed to measure mean flow velocity (MV), and the Gosling pulsatility index (PI) for all included patients in a supine position by using Siemens Acuson X300 ultrasound machine equipped with 2–5 MHz probe. The probe was placed after gel application in the right temporal window which is positioned between the ear and lateral orbital margin above the zygomatic bone on the temporal squma to identify the right middle cerebral artery (MCA), and then, the probe was fixed in the same place and measurements (MV, PI) were repeated for three times with the third reading was taken and recorded. All the measurements were taken by the same anesthesiologist who is experienced in neurosonology (Bathala et al. 2013).

The severity of the headache was assessed by VAS score and modified Lybecker score, as well as TCD measurements were performed at 0 (baseline), 1, 6, and 24 h where 0 is the time of enrollment before receiving any medication, and all other evaluations were performed 1 h after starting the treatment either conservative medications alone or with the block and was repeated at 6 and 24 h after treatment.

Our study is double-blind research. Participants were not aware of their group allocation, and the experienced operator who performed all TCD measurements was not aware of the patient group.

Sample size calculation

The sample size is calculated using (open Epi) program, assuming that the visual analog score (VAS) was (2.2 ± 1.14) in PDPH patients who received medical treatment combined with SPG block versus (4 ± 0.67) in medical treatment group (Yılmaz et al. 2020). The sample was found to be 63 subjects allocated into three groups (21 patients in each group), at a confidence interval of 95% and power of test 80.

Data collection

Patient age, body mass index, preoperative hemoglobin level, intra-operative estimated blood loss, and number of spinal attempts, as well as the time interval between lumbar puncture and PDPH occurrence were recorded.

The VAS score, modified Lybecker score, and TCD measurements at 0 (baseline), 1, 6, and 24 h where 0 is the time of enrolment before getting any medication and all subsequent assessments were carried out after beginning treatment. Additionally, the three groups' need for EBP were noted and recorded.

Our primary outcome was to explore the analgesic efficacy of the SPG clock either alone or in combination with the GONB in PDPH treatment using the VAS and modified Lybecker scores, and the secondary outcomes include the need for EPB as well as the effects of these interventions on cerebral blood flow using TCD measurements.

Statistical analysis

The information was input into a computer and analyzed using IBM SPSS software, version 20.0 (Armonk, NY: IBM Corp.). The phrase number and percentage were used to convey qualitative data. To establish if the distribution was normal, the Shapiro–Wilk test was utilized. The range (minimum and maximum), mean, standard deviation, and median were used to characterize quantitative data. The results were found to be significant at the 5% level. The chi-square test was performed to compare categorical variables across various groups, and the

Monte Carlo correction for chi-square was applied when more than 20% of the cells had an anticipated count less than 5, F: F. to compare between more than two periods or phases, an ANOVA with repeated measurements for pairwise comparisons, a post hoc test (Bonferroni corrected) is used for normally distributed quantitative variables. For quantitative variables with abnormally distributed distributions, apply the Kruskal–Wallis test to compare more than two studied groups. Use the one-way ANOVA test for quantitative variables with normally distributed data to compare more than two groups. *P* values of 0.05 or less and 0.001 or less, respectively, were considered statistically significant.

Results

Within the specified timeframe of our investigation, a total of two thousand six hundred forty-six pregnant females were admitted for elective cesarean section. Among them, four hundred seventy-eight parturients (18.1%) underwent the procedure under general anesthesia, while the remaining two thousand one hundred sixty-eight (81.9%) received spinal anesthesia. Notably, out of the individuals who received spinal anesthesia, a subset comprising sixty-five individuals (2.9%) were subsequently diagnosed with post-dural puncture headache (PDPH) during the post-partum period. These patients were carefully assessed for their eligibility to be included in our study, but two patients declined participation, leaving a total of sixty-three consenting individuals who were randomly assigned to one of the three study groups (Fig. 1).

Upon analyzing the data, no statistically significant differences were observed among the three groups in terms of patients' characteristics such as age, body mass index (BMI), and preoperative hemoglobin levels. Furthermore, there were no statistically significant differences detected in the number of spinal attempts, estimated intra-operative blood loss, and the time interval between lumbar puncture and the onset of PDPH across the three groups (Table 1).

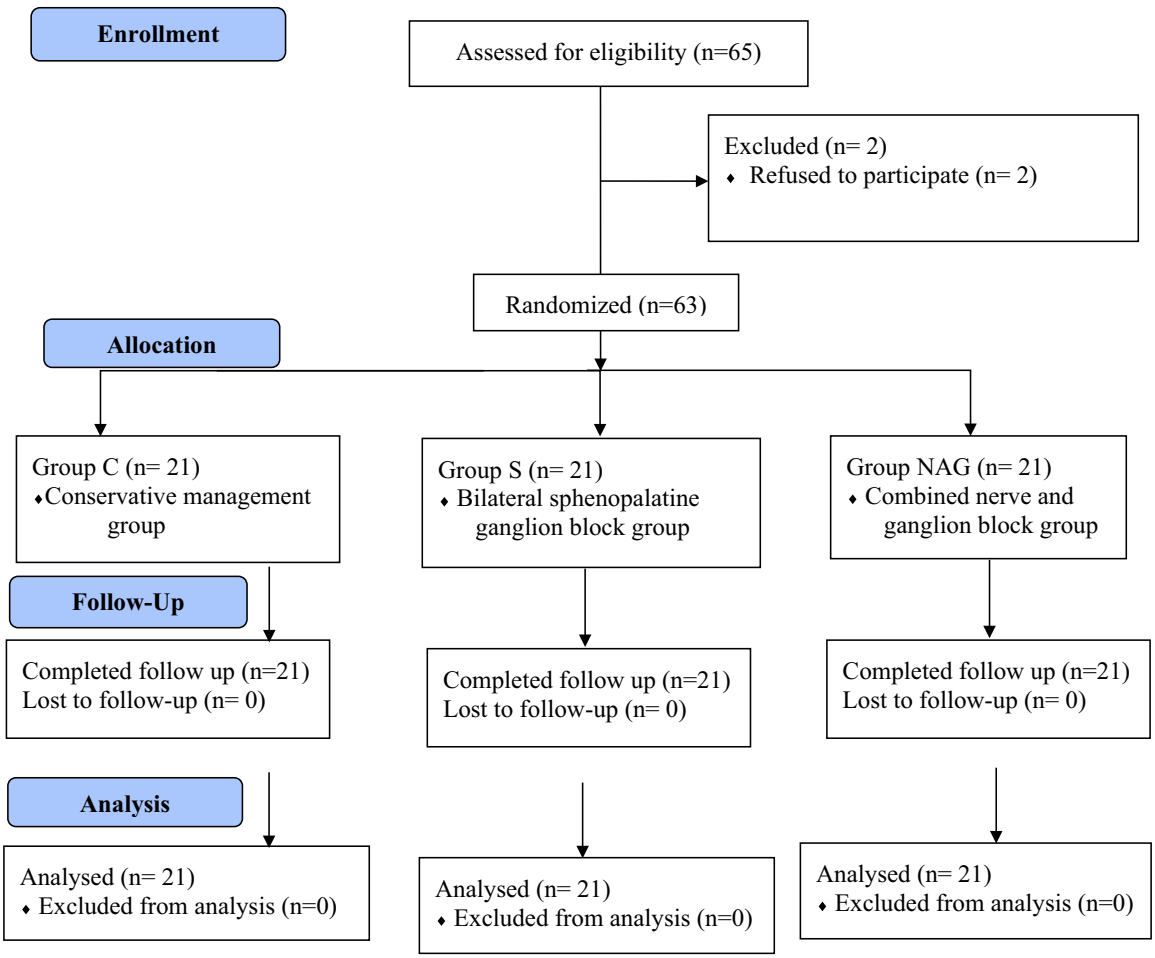

Fig. 1 Study flow diagram

Table 1 Patients and clinical characteristics of the three studied groups

Characteristics	Group C ($n=21$)	Group S ($n=21$)	Group NAG ($n=21$)	*P* value
Age (years)	26.1 ± 4.15	26.24 ± 4.04	26.14 ± 4.26	0.994
BMI (kg/m^2)	26.71 ± 3.21	26.71 ± 2.92	26.38 ± 3.07	0.921
Preoperative hemoglobin level (g/dL)	10 ± 0.94	9.89 ± 0.94	9.99 ± 0.97	0.907
Number of spinal attempts				
One attempt, number (%)	18 (85.7%)	18 (85.7%)	18 (85.7%)	0.760
Two attempts, number (%)	2 (9.5%)	3 (14.3%)	1 (4.8%)	
Three attempts, number (%)	1 (4.8%)	0 (0%)	2 (9.5%)	
Estimated intra-operative blood loss (mL)	1000 ± 142.3	1003.8 ± 149.18	971.43 ± 166.26	0.756
Time interval between LP and PDPH occurrence (hour)	19 ± 7.46	17.14 ± 6.51	20.19 ± 7.76	0.396

Group C control group, *Group S* bilateral sphenopalatine ganglion block group, *Group NAG* combined nerve and ganglion block group, *n* total number of subjects in each group, *BMI* body mass index, *LP* lumbar puncture, *PDPH* post-dural puncture headache

Data were expressed as mean ± SD, number, and percentage

F F for one-way ANOVA test, χ^2 chi-square test, $P<0.05$ is significant

VAS score was used to evaluate PDPH severity showing no statistically significant difference of its mean values at baseline readings at the time of enrollment in the three studied groups while the VAS mean values at 1, 6, and 24 h were highly statistically significantly lower in the group S and group NAG compared to the control group with no statistically significant difference between the S and NAG groups (Fig. 2). The severity of PDPH was also evaluated by modified Lybecker score showing no statistically significant difference at the baseline readings. However, when compared to the control group, its mean values indicated a statistically significant difference in group S and group NAG with both groups exhibiting substantial pain reduction at 1, 6, and 24 h. There was no statistically significant difference when group S compared to group NAG (Fig. 3).

TCD measurements (MV and PI) were performed at the time of enrollment (baseline readings), showing no statistically significant difference between MV and PI in the three studied groups, while the mean values of MV were found to be highly statistically significantly different between the three studied groups at 1, 6, and 24 h. The MV values were significantly lower in both group S and group NAG compared to the control group at 1, 6, and 24 h after the blocks were done. Also, the mean values of PI were statistically significantly different as it was significantly higher in the S and NAG groups compared to the control group at 1, 6, and 24 h after enrollment (Table 2).

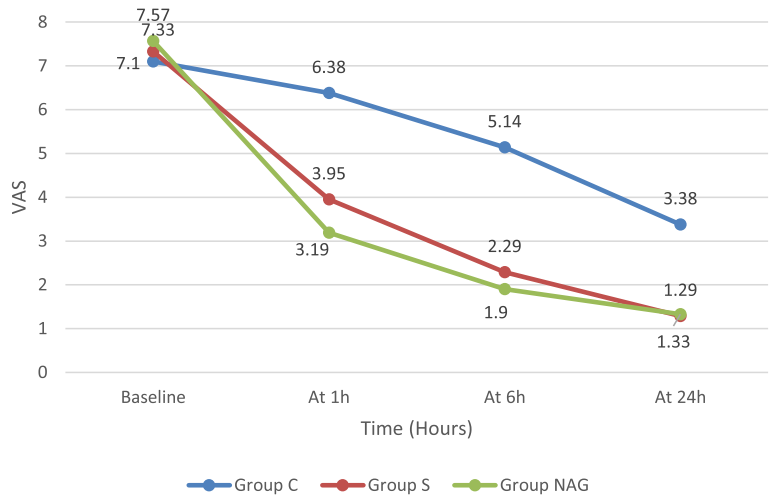

Fig. 2 Visual analog score (VAS) at different timings between the three groups. Group C, control group; Group S, bilateral sphenopalatine ganglion block group; Group NAG, combined nerve and ganglion block group

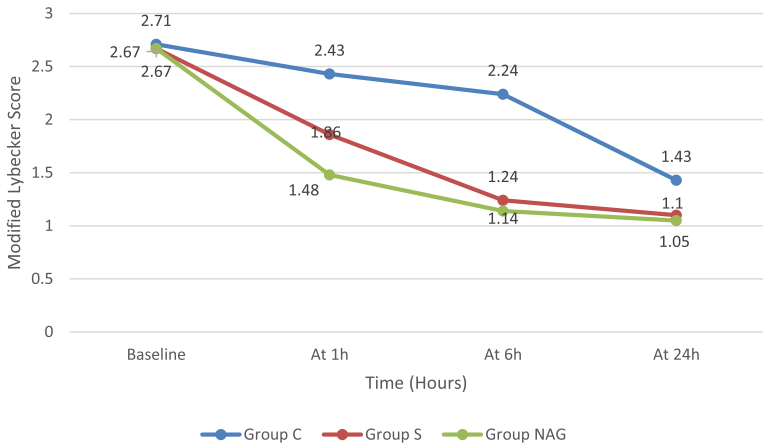

Fig. 3 Modified Lybecker score at different timings between the three groups. Group C, control group; Group S, bilateral sphenopalatine ganglion block group; Group NAG, combined nerve and ganglion block group

Table 2 TCD parameters at different timings between the three studied groups

Variables	Group C ($n=21$)	Group S ($n=21$)	Group NAG ($n=21$)	*P* value
Mean velocity (cm/s)				
Baseline MV	82.52 ± 4.29	81.58 ± 4.69	82.52 ± 4.68	0.743
MV at 1 h	82.54 ± 3.87	69.86 ± 6.28[a]	69.16 ± 5.53[a]	< 0.001
MV at 6 h	81.83 ± 3.76	67.37 ± 6.23[a]	66.50 ± 4.75[a]	< 0.001
MV at 24 h	80.61 ± 3.31	65.15 ± 5.65[a]	64.30 ± 4.55[a]	< 0.001
Pulsatility Index				
Baseline PI	0.62 ± 0.05	0.63 ± 0.04	0.64 ± 0.04	0.512
PI at 1 h	0.66 ± 0.04	0.69 ± 0.04[b]	0.69 ± 0.04[b]	0.018
PI at 6 h	0.67 ± 0.04	0.72 ± 0.04[b]	0.72 ± 0.04[b]	0.001
PI at 24 h	0.69 ± 0.03	0.72 ± 0.04[b]	0.71 ± 0.05[b]	0.030

Data were expressed as mean ± SD. One-way ANOVA test

TCD transcranial Doppler, *Group C* control group, *Group S* bilateral sphenopalatine ganglion block group, *Group NAG* combined nerve and ganglion block, *n* total number of subjects in each group, *MV* mean velocity, *PI* Pulsatility Index

[a] MV was highly and significantly lower in the S and NAG groups than in the control group at 1, 6, and 24 h

[b] PI was significantly higher in S and NAG groups compared to the control group at 1, 6, and 24 h

By comparing the mean velocity at different timings within each group, there was a highly statistically significant difference, with the MV found to be highly and significantly lower at 1, 6, and 24 h compared to baseline reading in both group S and group NAG. Also, by comparing the PI at different timings, a highly statistically significant difference was found between them as PI was significantly higher at 1, 6, and 24 h compared to baseline readings in the S and NAG groups, while in the control group, a statistically insignificant difference was found when comparing both MV values at 1, 6, and 24 h to the baseline reading while the PI was statistically higher at 24 h compared to baseline reading (Table 3).

There was no statistically significant difference between the studied groups regarding the need for EBP. No patients required EBP in the NAG group, and only one patient was indicated for EBP in group S compared to 3 patients in the control group who were indicated for EBP (Table 4).

Discussion

Management of PDPH is often a challenge for most anesthesiologists. For years, conservative treatments with bed rest, aggressive hydration, analgesics, and/or caffeine have been considered the cornerstone management allowing PDPH and its associated symptoms to be tolerable giving time for the primary physiologic problem (i.e., the dural hole) to heal. Yet, these treatments may not be successful, and the obtained relief is often inadequate especially in parturients with severe PDPH (Giaccari

Table 3 TCD parameters at different timings compared to baseline reading in each group

Variables	Baseline	At 1 h	At 6 h	At 24 h	*P* value
Group C (*n* = 21)					
MV (cm/s)	82.52 ± 4.29	82.54 ± 3.87	81.83 ± 3.76	80.61 ± 3.31	0.213
PI	0.62 ± 0.05	0.66 ± 0.04[b]	0.67 ± 0.04[b]	0.69 ± 0.03[b]	0.004
Group S (*n* = 21)					
MV (cm/s)	81.58 ± 4.69	69.86 ± 6.28[a]	67.37 ± 6.23[a]	65.15 ± 5.65[a]	< 0.001
PI	0.63 ± 0.04	0.69 ± 0.04[b]	0.72 ± 0.04[b]	0.72 ± 0.04[b]	< 0.001
Group NAG (*n* = 21)					
MV (cm/s)	82.52 ± 4.68	69.16 ± 5.53[a]	66.50 ± 4.75[a]	64.30 ± 4.55[a]	< 0.001
PI	0.64 ± 0.04	0.69 ± 0.04[b]	0.72 ± 0.04[b]	0.71 ± 0.05[b]	< 0.001

Data were expressed as mean ± SD. Repeated measure ANOVA test

TCD transcranial Doppler, *Group C* control group, *Group S* bilateral sphenopalatine ganglion block group, *Group NAG* combined nerve and ganglion block, *n* total number of subjects in each group, *MV* mean velocity, *PI* Pulsatility Index, *baseline reading* reading at the time of enrollment

[a] MV was significantly decreased in the S and NAG groups compared to the baseline reading

[b] PI was significantly increased in the three groups compared to the baseline reading

Table 4 The need for EBP among the studied groups

Variables	Group C (*n* = 21)	Group S (*n* = 21)	Group NAG (*n* = 21)	*P* value
The need for EBP				
No, number (%)	18 (85.7%)	20 (95.2%)	21 (100%)	0.311
Yes, number (%)	3 (14.3%)	1 (4.8%)	0 (0%)	

Data were expressed as number and percent

Group C control group, *Group S* bilateral sphenopalatine ganglion block group, *Group NAG* combined nerve and ganglion block, *n* total number of subjects in each group, *EBP* epidural blood patch

χ^2 chi-square test

et al. 2021). EBP is considered the "gold standard" treatment. There is some recent evidence reported that EBP provides complete or partial relief of PDPH in around 50–80% of the patients with serious possible complications including another dural puncture, infection, meningitis, seizures, and neural deficits (Giaccari et al. 2021; Kwak 2017; Patel et al. 2020).

Several alternatives have been proposed as peripheral nerve blocks such as the trans-nasal SPG block which can be easily performed at the bedside (Gonçalves et al. 2018). Also, GONB with recent literature considering it a part of the standard PDPH management (Nair et al. 2018; Youssef et al. 2021), making these less invasive techniques (i.e., SPG block and GONB) attractive therapeutic options that may eliminate the need for EBP. To the best of our knowledge, this is the first randomized double-blinded controlled trial to investigate the analgesic efficacy of using the SPG block either alone or in combination with GONB for PDPH treatment.

PDPH is proposed to be due to cerebral vasodilatation mediated by parasympathetic nerve fibers that have synapses in the SPG. Thus, blocking SPG reduces the parasympathetic flow to cerebral vessels allowing cerebral vessels to return to their normal diameter, therefore relieving the symptoms of PDPH (Gonçalves et al. 2018; Youssef et al. 2021).

In our study, the addition of SPG block to the conservative treatment significantly relieved PDPH and its associated symptoms. This improvement was evident by a significant decrease in the VAS and modified Lybecker score at 1, 6, and 24 h after the block administration compared to the control group.

This is in accordance with the previous studies of bilateral trans-nasal SPG block for PDPH treatment, reporting a safety profile and rapid relief of headaches. Cohen et al. in their study used bilateral SPG block on 13 parturients and reported that SPG block was effective in the treatment of moderate-to-severe PDPH (Cohen et al. 2009). Patel et al. published a retrospective study on 72 patients comparing bilateral SPG block and EBP for the treatment of PDPH. They found better pain relief after an hour in the SPG block group compared to the EBP group. While after 24 h, no significant difference was found in either group with more complications observed with EBP (Patel et al. 2016). Also, Kent and Mehaffey reported complete pain relief in three patients with confirmed

PDPH after bilateral SPG block (Kent and Mehaffey 2015).

Moreover, in recently published studies by Antunes et al. (Antunes et al. 2018), Puthenveetitil et al. (Puthenveettil et al. 2018), and Albaqami et al. (Albaqami et al. 2022), they suggest that SPG block as an effective initial promising PDPH treatment modality for the quick control of severe headache with no reported complications and recommend it to be a first-line therapy for these patients.

In the present study, we proposed that the use of combined SPG block and GONB in the same patient could provide higher success rates compared to SPG block alone as both blocks act on two different pathways in PDPH pathogenesis. Our results found that the combined block and SPG block significantly improved PDPH symptoms with clinically significant drops in both VAS and modified Lybecker scores at 1, 6, and 24 h after the block administration in both groups when compared to the control group. However, the pain scores did not differ significantly when the SPG block group was compared to the dual block group.

In a case series of 7 patients confirmed with PDPH diagnosis following failed conservative treatments, Malik and Singh described the successful use of the dual GONB and SPG block with rapid and maintained headache relief and they recommend this dual block to be offered as rescue management to all patients with moderate to severe PDPH (Malik and Singh 2019).

The available literature on the effectiveness of the SPG block and GONB individually for the management of PDPH has proven their worth. While there is no data on the dual nerve and ganglion block yet, our results did not find any difference when individual SPG block or combined block was used in PDPH management regarding either headache relief or the need for EBP. Before declaring the superiority of either the individual block or the dual block, more data on successfully treated patients is required. After reviewing the available scarce literature, it seems reasonable to routinely offer SPG block in addition to conservative treatment to all cases with moderate to severe PDPH and the dual block could be offered to patients who did not receive complete relief after the individual SPG block before the invasive EBP procedure.

In the current study, TCD was used for cerebral hemodynamic evaluation before and after the block. Our results confirmed the change in MV and PI measurements after the SPG block was performed in groups S and NAG compared to the control group with a significant decrease in MV values and higher PI values at 1, 6, and 24 h. Also, within the same group, MV values showed a significant decrease at 1, 6, and 24 h after block administration compared to baseline reading before the block was performed in both S and NAG groups. Additionally, the PI values were significantly higher at 1, 6, and 24 h compared to baseline readings in the S and NAG groups. In the control group, an insignificant difference was found when comparing both MV values at 1, 6, and 24 h to the baseline reading while the PI was higher at 24 h compared to baseline reading.

These significant differences could be explained by blocking the parasympathetic fibers that have synapses in the SPG with reversal of the reflex vasodilatation secondary to CSF leak and restoring the normal diameter of cerebral vessels after performing SPG block. The linear relationship between the pulsatility index and the intracranial pressure (ICP) is well established, and it is well known that PI could be considered as an indirect estimate of ICP. Additionally, PI corresponds to the distal cerebral vascular resistance (CVR), and its rise may indicate a rise in distal CVR. Naqvi et al. recognized that low PI may be due to arteriolar vasodilation while cerebral vasoconstriction may increase the PI (Naqvi et al. 2013).

Vadhera et al. investigated the TCD role in cerebral blood flow evaluation of post-partum patients with PDPH and the response to the treatment therapy, and they documented the usefulness of TCD measurements in the detection of cerebral vasodilatation reversal after PDPH treatment with sumatriptan and caffeine (Vadhera et al. 2017). Also, the role of using TCD to predict obstetric patients who are at high risk for PDPH after spinal anesthesia was recently described by Mowafy et al. (Mowafy and Abd Ellatif 2019), and in another study, they also used TCD to assess how nebulized dexmedetomidine (DEX) affect the cerebral blood vessels of postpartum patients with PDPH and they found that adding dexmedetomidine nebulization to PDPH management significantly decrease pain scores that could be attributed to DEX analgesic and cerebral vasoconstrictive effects which was documented by the TCD measurements (Mowafy and Ellatif 2021). More recently, Abdelhaleem in her study verified the success of SPG block in patients diagnosed with PDPH with the help of TCD and concluded that SPG block is proven to be effective in PDPH management and TCD is a useful objective assessment tool of SPG block success (Abdelhaleem 2021).

With the TCD help which is considered an effective objective monitoring tool, the current study showed a decrease in MV with an increase in PI that could be mainly explained by the parasympathetic fibers block in SPG which supports the cerebral vasodilatation theory as one of the main PDPH causes.

Our study is subjected to some limitations including firstly, our recruited candidates are pregnant women who underwent spinal anesthesia for elective CS and later diagnosed with PDPH during their postpartum period.

We decided to include obstetric patients who are at high risk for PDPH that is commonly seen in these patients after neuraxial anesthesia (Choi et al. 2003). However, with the clear cerebral physiologic changes and responses associated with pregnancy, different responses may be observed in non-pregnant females and males. Most of the literature using TCD in pregnant and postpartum women found that middle cerebral artery MV gradually decreases during the gestation with a quick rise and return of MV to the level of non-pregnant ladies in the first post-partum days (Serra-Serra et al. 1997; Caglayan et al. 2019). According to Anzola et al. study, they documented a higher MV in parturients during the early postpartum period than in age-matched non-pregnant ladies which may exceed 100 cm/s threshold without any evidence of intracranial spasm, accrediting this to the compensation for blood loss during delivery (Anzola et al. 2017). Secondly, there is no standard universal definition for grading the severity of PDPH as well as using the VAS score is a subjective assessment. Subsequently, we combined the VAS score with the modified Lybecker score to assess the severity of PDPH in our research in a trial to increase the severity grading accuracy and decrease the subjective bias. Thirdly, our study is a single-center study, and the sample size is relatively small to examine the secondary outcomes (i.e., the need for EBP). Thus, further large well-designed studies are highly recommended.

Conclusions

In conclusion, our study findings suggest that there is no significant difference between administering an individual SPG block or a combined SPG block with GONB for the management of PDPH. Both approaches showed comparable efficacy in providing headache relief and reducing the need for EBP. It is important to note that further research is highly needed to establish the superiority of either the individual SPG block or the combined nerve and ganglion block. However, based on the available evidence, it is reasonable to consider offering SPG block as an additional treatment option alongside conservative measures for postpartum patients with moderate to severe PDPH. This recommendation highlights the potential benefits of integrating SPG block into the standard management approach for this specific patient population.

Abbreviations

CS	Cesarean section
CSF	Cerebrospinal fluid
EBP	Epidural blood patch
GONB	Greater occipital nerve block
MV	Mean velocity
PDPH	Post-dural puncture headache
PI	Pulsatility index
SPG	Sphenopalatine ganglion
TCD	Transcranial Doppler
VAS	Visual analog score

Authors' contributions

SM was the major contributor to the data analysis and writing the manuscript. AE revised the data analysis and the manuscript, and he was the major contributor to the data collection. All authors read and approved the final manuscript.

Availability of data and materials

The data used and/or analyzed during this study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

Written informed consent was obtained from all participants before their enrollment in this trial, and the institutional review board (The research ethical committee of the Faculty of Medicine, Zagazig University) approval was obtained with the reference number (ZU-IRB#:6868/16–6-2021). This trial was registered under ClinicalTrials.gov (NCT04844229).

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

Received: 13 December 2022 Accepted: 9 September 2023
Published online: 18 September 2023

References

Abdelhaleem NFA (2021) Verification of sphenopalatine ganglion block success using transcranial Doppler in management of patients with postdural puncture headache. Pain Physician 24:661–668
Akyol F, Binici O, Kuyrukluyildiz U, Karabakan G (2015) Ultrasound-guided bilateral greater occipital nerve block for the treatment of post-dural puncture headache. Pak J Med Sci 31(1):111–115
Albaqami MS, Alwarhi FI, Alqarni AA (2022) The efficacy of sphenopalatine ganglion block for the treatment of postdural puncture headache among obstetric population. Saudi J Anaesth 16:45–51
Ali HM, Mohamed MY, Ahmed YM (2019) Postdural puncture headache after spinal anesthesia in cesarean section: experience in six months in 2736 patients in Kasr El aini teaching hospital – Cairo University. Egypt J Anaesth 30(4):383–386
Anthony M (2000) Cervicogenic headache: prevalence and response to local steroid therapy. Clin Exp Rheumatol 18:59–64
Antunes C, Jesus T, Ferreira S, Coutinho A, Magalhaes J (2018) Sphenopalatine ganglion block for postdural puncture headache. J Pain Relief 7:315
Anzola GP, Brighenti R, Cobelli M, Giossi A, Mazzucco S, Olivato S, Pari E, Piras MP, Padovani A, Rinaldi F, Turri G (2017) Cerebral haemodynamics in early puerperium: a prospective study. Ultrasound 25:107–114
Bathala L, Mehndiratta MM, Sharma VK (2013) Transcranial Doppler: technique and common findings (part 1). Ann Indian Acad Neurol 16(2):174–179
Bezov D, Lipton RB, Ashina S (2010) Post-dural puncture headache: part I diagnosis, epidemiology, etiology, and pathophysiology. Headache 50:1144–1152
Caglayan HZB, Nazliel B, Cinar M, Ataoglu E, Moraloglu O, Irkec C (2019) Assessment of maternal cerebral blood fow velocity by transcranial Doppler ultrasound before delivery and in the early postpartum period. J Matern Fetal Neonatal Med 32:584–589
Chekol B, Yetneberk T, Teshome D (2021) Prevalence and associated factors of post dural puncture headache among parturients who underwent cesarean section with spinal anesthesia: A systemic review and meta-analysis, 2021. Ann Med Surg 66:102456

Choi PT, Galinski SE, Takeuchi L, Lucas S, Tamayo C, Jadad AR (2003) PDPH is a common complication of neuraxial blockade in patients: a meta-analysis of obstetrical studies. Can J Anaesth 50:460–469
Cohen S, Sakr A, Katyal S, Chopra D (2009) Sphenopalatine ganglion block for postdural puncture headache. Anaesthesia 64:574–575
Corbey MP, Bach AB, Lech K, Frørup AM (1997) Grading of severity of postdural puncture headache after 27-gauge Quincke and Whitacre needles. Acta Anaesthesiol Scand 41(6):779–784
Giaccari LG, Aurilio C, Coppolino F, Pace MC, Passavanti MB, Pota V, Sansone P (2021) Peripheral nerve blocks for postdural puncture headache: a new solution for an old problem? in vivo 35:3019–29
Gonçalves LM, Godinho PM, Durán FJ, Valente EC (2018) Sphenopalatine ganglion block by transnasal approach in post-dural puncture headache. J Clin Anesth 48:50
Jabbari A, Hasanjani Roushan MR (2014) Impact of postdural puncture headache after diagnostic lumbar puncture. Caspian J Intern Med 5(2):56–58
Kent S, Mehaffey G (2015) Transnasal sphenopalatine ganglion block for the treatment of postdural puncture headache in the ED. Am J Emerg Med 33:1714
Kumar R, Verma VK, Prasad SC (2020) Comparative evaluation of conservative management and sphenopalatine ganglion block for postdural puncture headache: a randomized controlled trial. Bali J Anesthesiol 4(4):183–187
Kwak KH (2017) Postdural puncture headache. Korean J Anesthesiol 70(2):136–143
Lybecker H, Djernes M, Schmidt JF (1995) Postdural puncture headache (PDPH): onset, duration, severity, and associated symptoms. An analysis of 75 consecutive patients with PDPH. Acta Anaesthesiol Scand. 39(5):605–12
Malik S, Singh SK (2019) A novel NAG (nerve and ganglion) dual block for PDPH: an observational study in seven patients of refractory post dural puncture headache (PDPH) using combined greater occipital nerve (GON) and sphenopalatine ganglion (SPG) Blocks. J Anaesthesia Crit Case Rep 5(1):14–17
Mowafy SMS, Abd Ellatif SE (2019) Transcranial Doppler role in prediction of post-dural puncture headache in parturients undergoing elective cesarean section: prospective observational study. J Anesth 33(3):426–434
Mowafy SMS, Ellatif SEA (2021) Effectiveness of nebulized dexmedetomidine for treatment of post-dural puncture headache in parturients undergoing elective cesarean section under spinal anesthesia: a randomized controlled study. J Anesth 35(4):515–524
Nair AS, Rayani BK (2017) Sphenopalatine ganglion block for relieving postdural puncture headache: technique and mechanism of action of block with a narrative review of efficacy. Korean J Pain 30(2):93–97
Nair AS, Kodisharapu PK, Anne P, Saifuddin MS, Asiel C, Rayani BK (2018) Efficacy of bilateral greater occipital nerve block in postdural puncture headache: a narrative review. Korean J Pain 31:80–6
Naqvi J, Yap KH, Ahmad G et al (2013) Transcranial Doppler ultrasound: a review of the physical principles and major applications in critical care. Int J of Vasc Med 2013:1–13
Niraj G, Kelkar A, Girotra V (2014) Greater occipital nerve block for postdural puncture headache (PDPH): a prospective audit of a modified guideline for the management of PDPH and review of the literature. J Clin Anesth 26(7):539–544
Patel R, Urits I, Orhurhu V, Orhurhu MS, Peck J, Ohuabunwa E et al (2020) A comprehensive update on the treatment and management of postdural puncture headache. Curr Pain Headache Rep 24(6):24
Patel P, Zhao R, Cohen S, Mellender S, Shah S, Grubb W (2016) Sphenopalatine ganglion block (SPGB) versus epidural blood patch (EBP) for accidental postdural puncture headache (PDPH) in obstetric patients: a retrospective observation. Poster Presentation at: 32nd Annual Meeting of the American Academy of Pain Medicine. pp 18–21
Peres MFP, Stiles MA, Siow HC, Rozen TD, Young WB, Silberstein SD (2002) Greater occipital nerve blockade for cluster headache. Cephalalgia 22:520–522
Puthenveettil N, Rajan S, Mohan A, Paul J, Kumar L (2018) Sphenopalatine ganglion block for treatment of post-dural puncture headache in obstetric patients: an observational study. Indian J Anaesth 62(12):972–977
Serra-Serra V, Kyle PM, Chandran R, Redman CW (1997) Maternal middle cerebral artery velocimetry in normal pregnancy and postpartum. Br J Obstet Gynaecol 104:904–909
Türkyilmaza EU, Eryilmaza NC, Güzeya NA, Moraloglu O (2016) Bilateral greater occipital nerve block for treatment of post-dural puncture headache. Rev Bras Anestesiol 66(5):445–450
Vadhera RB, Babazade R, Suresh MS, Alvarado MC, Cruz AL, Belfort MA (2017) Role of transcranial Doppler measurements in postpartum patients with post-dural puncture headache: a pilot study. Int J Obstet Anesth 29:90–91
Venturelli PM, Brunser AM, Gaete J, Illanes S, López J, Olavarría VV, Reccius A, Brinck P, González F, Cavada G, Lavados PM (2017) Reliability of hand-held transcranial Doppler with m-mode ultrasound in middle cerebral artery measurement. J Med Ultrasound. 25(2):76-81. 10
Xavier J, Pinho S, Silva J, Nunes CS, Cabido H, Fortuna R et al (2020) Postdural puncture headache in the obstetric population: a new approach? Reg Anesth Pain Med 45(5):373–376
Yılmaz M, Yılmaz VK, Turan AZ, Turkay U, Terzi H, Türker YG et al (2020) Transnasal sphenopalatine ganglion block for treatment of post-dural puncture headache in obstetric population. South Clin Ist Euras 31(4):335–339
Youssef HA, Abdel-Ghaffar HS, Mostafa MF, Abbas YH, Mahmoud AO, Herdan RA (2021) Sphenopalatine ganglion versus greater occipital nerve blocks in treating post-dural puncture headache after spinal anesthesia for cesarean section: a randomized clinical trial. Pain Physician 24:443–451

Publisher's Note