Randomized Controlled Trial

# Greater Occipital Nerve Block at Two Levels Spares the Need for an Epidural Blood Patch for Managing Postdural Puncture Headache: A Randomized Comparative Trial

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**Background:** Anesthesia through neuroaxial approaches is an effective option for lower abdominal surgeries, but postdural puncture headache (PDPH) is often an adverse effect of this procedure.

**Objectives:** Evaluation of the effect of bilateral bi-level greater occipital nerve blocks (GONB) on the severity of PDPH and its effect on patients' quality of life.

**Study Design:** Randomized controlled trial.

**Setting:** Department of Anesthesia, ICU and Pain, Faculty of Medicine, Benha University in conjunction with multiple private centers, Cairo, Arab Republic of Egypt.

**Methods:** A total of 180 patients with PDHP were evaluated using the Numeric Rating Scale (NRS-11) to assess pain in an upright position and the 36-Item Short-form Survey Instrument (SF-36) was used to assess the effect of PDPH on quality of life. Patients were randomly divided into an intramuscular group and received an intramuscular injection. Other injection location groups were distal (DG), proximal (PG), and bilevel (BG). All groups received bilateral GONB using 2 mL of lidocaine 2% mixed with 2 mL of dexamethasone. Pain scores were evaluated at 24 hours postprocedure. At one month pain and SF-36 scores were recorded. The success rate was defined as the frequency of pain-free (NRS-11 < 4) among the trial patients. Recurrent cases received bilevel GONB and nonresponsive patients received an epidural blood patch.

**Results:** At 24 hours postprocedure, 82.8% of the total patients and all BG patients were pain-free. NRS-11 pain scores were significantly lower in BG patients than patients in other groups; 7 patients required an epidural blood patch. At one month, 114 total patients (63.3%) had a zero pain score and 95.6% of BG patients were pain-free; the BG patients had significantly lower pain scores than the other groups. Also, SF-36 scores were improved in all patients with significantly higher scores in the BG and PG groups compared to the other groups. Twenty-seven total patients had recurrent PDPH; intramuscular injection patients had a significantly higher frequency of recurrent PDPH and shorter pain-free duration. The success rate of bilevel GONB management for recurrent PDPH was 81.5%

**Limitations:** The limitations of this trial are two-fold: missing of blocking the other occipital nerves and omission of blocking at the recently defined area of the three main occipital nerves communicate.

**Conclusion:** Bilevel GONB provided was superior to single level blocks and intramuscular injection with no 24 hour postprocedure failure, a low recurrence rate, and totally negated the need for an epidural blood patch; it also significantly improved patients' quality of life. Bilevel GONB is an efficient first-line therapy for recurrent PDPH.

**Key words:** Postdural puncture headache, greater occipital nerve block, bilevel block, pain scores, SF-36 quality of life scoring

**Trial Registration:** The trial protocol was presented to the departmental committee of Benha University hospital and was approved before case collection. The GONB procedure was discussed with the enrolled patients and those accepted to undergo the procedure were asked to sign a written, fully informed consent before enrollment. After complete data collection, approval from the Research Ethics Committee of the Faculty of Medicine, Benha University was obtained with the reference number (RC: 11-3-2024) and was registered at clinical trial.com (NCT06380764).

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Neuroaxial techniques are well tolerated and effective options for labor analgesia and anesthesia for caesarean delivery and may protect high risk women against severe maternal morbidity (1). However, neuroaxial techniques still have drawbacks, especially postdural puncture headache (PDPH) and may be associated with chronic headache, back pain, and postnatal depression (2). PDPH is a relatively common acute complication of neuroaxial techniques that is traditionally considered benign and self-limiting (3), but it significantly affects patients' general health and quality of life (QoL) (4).

The presenting symptom of PDPH does not always correlate with severity of injury and almost always varies between patients, but mostly includes bilateral frontal or occipital headache that worsens on sudden upright movement, is improved when supine, and may be accompanied by neck pain, radicular symptoms into the arms, dizziness or nausea, and may worsen with coughing even when supine (5)

An epidural blood patch (EBP) provides significant relief for PDPH. For patients with severe and persistent or refractory pain despite conservative treatments, an EBP should not be delayed unless it is contraindicated (4). However, no procedure is immune against failure; the mechanisms for EBP failure are unknown (3).

Peripheral nerve blocks involving local anesthetic injection with or without adjuvants are effective and well tolerated therapies for intractable headache disorders (6). Devoghel's study in 1981 (7) achieved a success rate of 85.6% for treatment of refractory cluster headaches through a block at the pterygopalatine ganglion. This suggests that interrupting the parasympathetic pathway could prevent or treat primary headache disorders (8).

The greater occipital nerve (GON) originates from the C2-C3 segments and through its nearby muscles is divided into proximal and distal parts; the proximal part lies between obliques capitis inferior and semispinalis capitis and then passes through the semispinalis to pierce the upper trapezius muscle (9). In the distal region of trapezius fascia, the GON is crossed by the occipital artery and exits the trapezius fascia into the nuchal line about 5 cm lateral to midline (10). Functionally, the GON innervates the muscles it passes through. Its main sensory supply is in the occipital region (11).

### Hypothesis

The previous knowledge of the division of the GON's course into proximal and distal parts by muscles traversed by the nerve (9) and its functional distribution for motor supply for muscles it passes through and sensory supply for the occipital region (11) suggests that blocking the GON at both levels would be superior to intramuscular (IM) injection as a therapy for PDPH.

### Objectives

Our trial aimed to evaluate the effect of bilateral GON block (GONB) at 2 levels (bilevel) on PDPH severity and its effect on QoL as well as its effect on the frequency of application of an EBP in comparison to bilateral one-level block and intramuscular injection through a 3 month observation period.

## Methods

The trial protocol was presented to the departmental committee of Benha University hospital and was approved before case collection. The GONB procedure was discussed with the enrolled patients and those accepted to undergo the procedure were asked to sign a written, fully informed consent before enrollment. After complete data collection, approval from the Research Ethics Committee of the Faculty of Medicine, Benha University was obtained with the reference number (RC: 11-3-2024) and was registered at clinical trial.com (NCT06380764).

### Study Protocol

All patients who had received spinal anesthesia and developed PDPH were clinically evaluated for their data recorded; for their pain severity the Numeric Rating Scale (NRS-11) was used; pain effect on QoL was determined using the 36-Item Short-form Survey (SF-36). These measurements were applied at preprocedure and one month postprocedure. At the end of the trial, patients' outcome evaluation was graded according to

the Odom criteria. Patients who reported persistence, deterioration, or recurrence of pain were considered as being nonresponsive to the procedure failure and were shifted to undergo an EBP.

## Exclusion Criteria

Reasons for being excluded from our trial included: patients with PDPH who were improving on conservative treatment and refused further interventions; headache secondary to local or systemic disease; cervical radiculopathy; coagulopathy or maintained on anticoagulants; diabetes mellitus; and patients dependent on routine analgesia for other causes. Also, patients who declined to participate in the trial or declined to sign the written consent, and patients who were missed during follow-up were not included in the trial.

## Inclusion Criteria

Patients who developed PDPH and did not improve on conservative therapies, required a definitive pain-relieving management, and did not tolerate conventional analgesics were enrolled in the trial as long as they did not meet any of the exclusion criteria.

### *Sample Size*

Our null hypothesis was to get more pain relief with the use of block at both levels that was manifested as significantly higher success rate after bilateral GONB at both levels in comparison to blocking at either level and to intramuscular injection. A rigorous sample size calculation was conducted using G*Power 3.1.9.2 (Heinrich Heine University) (12). To achieve a trial power of 80% with an alpha level of 0.05 and an effect size of 0.20, the F-test model determined that 38 patients per group were necessary. To account for potential attrition, 45 patients were enrolled in the trial, ensuring sufficient statistical power to draw reliable conclusions.

### *Randomization & Grouping*

The Excel software (2007, Microsoft, Redmond, WA, USA) for yielding sequences of 1:1:1:1. Odd number dropping was used to categorize patients into 4 groups according to the procedure. These sequences were printed on cards and enveloped. Patients were asked to choose a card and to present it to the anesthesiologist responsible for performing the procedure. Patients in the IM group received an intramuscular injection, PG and DG groups received bilateral proximal and distal GONB, respectively, and the BG group received a bilevel GONB at proximal and distal levels on both sides.

### *Evaluation Tools:*

1. The NRS-11 was used to assess pain while the patients was upright. The scale measures pain as 0 (no pain) to 10 (intractable pain) (13).
2. The SF-36 encompasses 8 subscores that evaluate bodily pain, general health, mental health, physical functioning, role-emotional, role-physical, social functioning, and vitality. The items of these 8 subscales were scored and a total score was calculated (14,15).
3. The Odom criteria are a 4-grade scale for evaluating interventional outcomes, ranging between poor and excellent, and are applied at the 3 month follow-up (16).

## Injection Solution Preparation

The injection solution was prepared by mixing preservative-free lidocaine 2%; 2 mL containing 40 mg with 2 mL of dexamethasone; 8 mg divided into two 3 mL syringes and injected 2 mL on each side using 1-1.5 inch needle of 25-30 gauge to achieve bilateral block at one level or intramuscular infiltration. For patients in the BG group who received bilateral blocks at 2 levels, the mixture of 2 mL of lidocaine with 2 mL dexamethasone was divided into 4 syringes each contained 20 mg of lidocaine mixed with 2 mg dexamethasone and injected bilaterally to block the proximal and distal parts of the GON.

## Procedures

### *1. GONB*

The occipital artery was localized, while the patient was setting with a flexed neck, at the point of meeting of the medial third and the lateral two-thirds of a line drawn extending from the ipsilateral mastoid process to the external occipital protuberance, then the GON was located on the medial side of the artery (17) where it exits out of the trapezius fascia into the nuchal line about 5 cm lateral to midline (10). For assurance of GON localization, pressure was applied, and the resultant tenderness indicated the site of the nerve. The injection performed distally at the site of nerve localization and proximal injection was performed at 1.5 cm lateral to the sagittal plane and 3 cm below to the level of the external occipital protuberance. Similarly, an injection was repeated on the other side to achieve bilateral block (18).

### *2. Bilateral Suboccipital Intramuscular Injection*

Sub-occipital intramuscular injection of the pre-

pared solution was carried out on both sides while the patient was setting with maximally flexing the neck to expose these muscles (19).

***3. EBP***

Patients who showed manifestations of block failure within 24 h after injection, received a lumbar EBP under noninvasive monitoring in the theater. The patient was positioned in the lateral decubitus position; lumbar area was sterilized and the epidural space previously used for receiving the previous neuroaxial anesthesia was identified. Twenty mL of venous blood was obtained aseptically and slowly injected at the level near to that previously used for spinal anesthesia while the patient was monitored for the extent of pain severity until complete pain relief was achieved (20).

### Post-procedural Evaluation

- Patients were assessed for pain severity at 1 h and 3 h after IM injection or GONB and then every 6 hours for 24 hours before discharge with NRS scores of < 4 were taken as the cutoff point for no pain.
- Injection site was inspected to assure of absence of hematoma formation
- Patients were asked to attend the outpatient clinic for assessment weekly for one month, then once a month for 3 months.

### Study Outcome

The trial outcome is the procedural success rates that were defined as pain relieve in the upright position at 24 h postprocedure to NRS < 4 and within one month to pain-free (NRS = 0) levels with no impact on QOL.

### Management of Failed Cases

- All patients who showed no pain improvement (NRS > 4) at 24 h were prepared to receive EBP before discharge.
- All cases failed to reach pain free (NRS=0) levels at 1 month postprocedure or developed recurrent PDPH during 3 month follow-up, were assigned to receive a second session of bilateral bi-level GONB and those failed to respond to this second session of GONB were prepared to receive EBP.

### Statistical Analysis

Statistical analyses were performed using IBM® SPSS® Statistics software (Version 22, 2015; Armonk, USA). The significance of the intragroup differences was assessed using one-way ANOVA test, and chi-square test for the differences in percentage of data. The extent of change in the collective FS-36 score at 3 months postinterventional was calculated as the percentage of the difference relative to the pre-interventional scoreand the difference was divided on the preinterventional score and the resultant value was multiplied by 100. The median values of SF-36 scores and the percentage of its change were calculated and compared using the Mann-Whitney U test to get the significance of difference at $P < 0.05$.

## Results

The preliminary evaluation included 195 patients who complained of headache after neuroaxial anesthesia or labor analgesia; 4 patients were maintained on analgesia for other indications, 3 patients had manifest diabetes mellitus, 3 patients had cervical radiculopathy, 5 refused the procedures, and these 15 patients were excluded. One hundred and eighty patients were randomly divided into the 4 trial groups (Fig. 1). There were insignificant differences between the data of the enrolled patients (Table 1).

All procedures were completed uneventfully without complications or shift to EBP due to procedural failure. Concerning the 24 h pain data, 14 patients (7.8%); 10 patients (22%) of BG and 4 patients (8.9%) of PG groups reported NRS score of zero in an upright position and 135 patients (75%) were pain-free with NRS pain score of 1-3 for a total 24 h success rate of 82.8%. At 24 h postinjection, all patients who received bi-level GONBs were pain-free with NRS < 4 in an upright position. The frequency of patients that had a pain score of < 4 after 24 h was significantly lower with IM injection than GONB, irrespective of block level and was significantly higher with proximal than distal GONB.

Moreover, the mean value of NRS pain score was significantly lower with bi-level GONBs than single-level GONBs and IM injection. Further, the mean value of NRS pain score was significantly lower with proximal than with distal GONB and IM injection with insignificantly lower score with distal GONB than IM injection (Table 2, Fig. 2).

Unfortunately, 7 patients showed no or minimal pain relieve at the end of 24 h postintervention and were shifted to have EBP. These 7 women were 4 patients of IM group (8.9%) and 3 women of the total women who received one-level GONB (3.3%) with insignificantly ($P = 0.171$) higher 24 h procedural failure

rate with IM injection (Fig. 2). These 7 patients were excluded from further statistical analyses at the end of one month and 3 month of follow-ups.

At the one month follow-up, 114 patients (63.3%) had NRS pain score of zero with significantly higher frequency of pain-free patients in BG (95.6%) group than other groups. The frequency of pain-free patients was significantly higher among patients of PG (83.3%) than patients of DG (46.5%) or IM (39%) groups with significantly higher frequency of pain-free patients with Distal GONB than with IM injection. Moreover, mean value of NRS pain score at one month was significantly lower for patients of BG group than other groups. The reported mean value of one month pain score for patients of PG group was significantly lower than that reported with IM injection, but was insignificantly lower than mean scores of patients who received distal GONB. Pain scores of patients in the DG group was insignificantly lower compared to that of patients who received the IM injection (Table 3).

Preliminary evaluation detected serious impact of headaches on patients' QOL and daily activities with insignificant differences between SF-36 scores of patients in all groups. At the end of one month postintervention, the median value of SF-36 improved significantly ($P < 0.001$) in all groups in comparison to at-intervention scores. The median value of SF-36 was significantly ($P< 0.001$) higher in BG and PG groups in comparison to median value of scores of patients of IM and DG groups. The differences between median val-

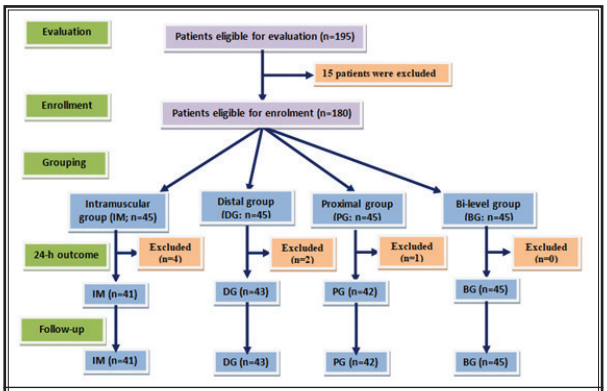


Fig. 1. *Patients' flowchart*

Table 1. *Patients' enrollment data*

| Data | Group | IM | DG | PG | BG | *P* value |
|---|---|---|---|---|---|---|
| Age (year) | | 30 ± 5.1 | 29 ± 3.4 | 29.6 ± 3.9 | 30.2 ± 3.9 | 0.533 |
| Gender | Male | 19 (42.2%) | 22 (48.9%) | 17 (37.8%) | 20 (44.5%) | 0.759 |
| | Female | 26 (47.8%) | 23 (51.1%) | 28 (62.2%) | 25 (55.5%) | |
| BMI (kg/m$^2$) | | 29.9 ± 2.5 | 29.5 ± 2.4 | 29.4 ± 2.3 | 29.8 ± 2.4 | 0.801 |
| Type of surgery | Cesarean section | 16 (35.5%) | 18 (40%) | 23 (51.1%) | 20 (44.5%) | 0.905 |
| | Hernia repair | 15 (33.3%) | 10 (22.2%) | 9 (20%) | 11 (24.4%) | |
| | Anal surgeries | 3 (6.7%) | 6 (13.3%) | 4 (8.9%) | 6 (13.3%) | |
| | Urinary surgery | 4 (8.9%) | 5 (11.1%) | 5 (11.1%) | 3 (6.7%) | |
| | Orthopedic surgery | 7 (15.6%) | 6 (13.3%) | 4 (8.9%) | 5 (11.1%) | |
| Time of onset of PDPH after spinal anesthesia (h) | | 6.1 ± 1.5 | 5.6 ± 1.3 | 5.9 ± 1.5 | 6.2 ± 1.2 | 0.291 |

*P* value indicates the significance of difference between groups at cutoff point $P<0.05$.

Table 2. *Patients' pain data at 24-h after interventions*

| | IM | | DG | | PG | | BG | |
|---|---|---|---|---|---|---|---|---|
| Score | Frequency | Mean | Frequency | Mean | Frequency | Mean | Frequency | Mean |
| 0 | 0 | 3.6±1.5 | 0 | 3.1±1.2 | 4 (8.9%) | 2.2 ± 1.3 | 10 (22%) | 1.2 ± 0.8 |
| 1-3 | 31 (69%) | | 33 (73%) | | 36 (80%) | | 35 (78%) | |
| ≥4 | 14 (31%) | | 12 (27%) | | 5 (11.1%) | | 0 | |
| P1 | | | 0.641 | 0.095 | 0.013 | < 0.001 | < 0.001 | < 0.001 |
| P2 | | | | 0.030 | | 0.00006 | 0.00002 | < 0.001 |
| P3 | | | | | | | 0.023 | 0.00002 |

IM: Intramuscular injection; P1 indicates the significance of difference versus IM group; P2 indicates the significance of difference versus Distal group; P3 indicates the significance of difference versus Proximal group; *P* value is significant at cutoff point of < 0.05.

ues of SF-36 scores were insignificant between IM and DG groups and between BG and PG groups.

The percentage of change in SF-36 score at end of one month was significantly higher in BG group than in IM and DG groups, but was insignificantly higher than in PG group. Also, the percentage of change in SF-36 score was significantly higher in PG group than IM group, while the difference was insignificant between DG and both of IM and PG groups (Table 3). Qualitatively, at the end of the one month postintervention, 165 patients (95.4%) reported improved QOL and resumption of most daily activities especially personal and childcare, while 8 patients assured absence of change in QOL, but they can deal with their daily activities better than at intervention. Five of these 8 patients had received a distal block (11.6%) and 3 had received an IM injection

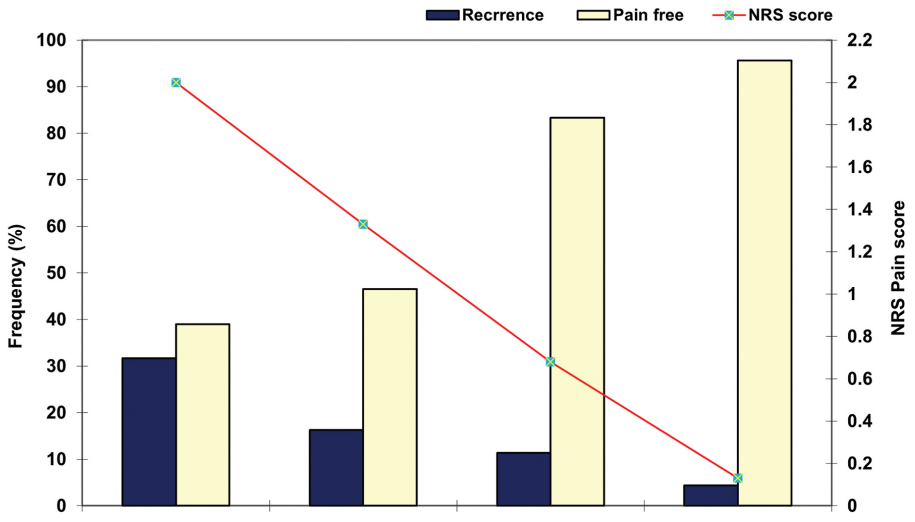


Fig. 2. *The frequency pain-free and recurrence among the studied patients and the mean vale of NRS pain score at 24-h after intervention.*

Table 3. *The outcomes of PDPH patients at 1-m after interventions*

| Data | Group | IM (n = 41) | Distal (n = 43) | Proximal (n = 44) | Bi-level (n = 45) | P1 | P2 | P3 |
|---|---|---|---|---|---|---|---|---|
| NRS pain score | Frequency of patients had NRS=0 | 16 (39%) | 20 (46.5%) | 35 (83.3%) | 43 (95.6%) | 0.003 | 0.0001 | < 0.001 |
| | | | | | | | 0.0021 | < 0.001 |
| | | | | | | | | 0.013 |
| | Mean (± SD) | 2 ± 2.3 | 1.33 ± 1.7 | 0.7 ± 1.7 | 0.13 ± 0.65 | 0.116 | 0.0026 | < 0.001 |
| | | | | | | | 0.076 | 0.00003 |
| | | | | | | | | 0.040 |
| SF-36 score | At time of intervention | 25 (20-50) | 25 (20-50) | 25 (20-50) | 25 (20-50) | 0.491 | 0.222 | 0.368 |
| | | | | | | | 0.674 | 0.368 |
| | | | | | | | | 0.667 |
| | At end of 1-m follow-up | 50 (25-75) | 50 (40-75) | 62.5 (50-75) | 67.5 (50-75) | 0.358 | < 0.001 | < 0.001 |
| | | | | | | | < 0.001 | < 0.001 |
| | | | | | | | | 0.401 |
| | % of change | 81.2 (0-170) | 100 (0-200) | 100 (20-238) | 107.7 (50-275) | 0.897 | 0.048 | 0.0044 |
| | | | | | | | 0.061 | 0.019 |
| | | | | | | | | 0.465 |

(7.3%) with insignificant intergroup difference. No patient in either BG and PG groups reported no-change in QOL with significant difference compared to patients of DG group, but insignificant differences compared to patients of IM group.

Through 3 month follow-up, 27 patients (15.6%) had recurrent PDPH; 13 (31.7%), 7 (16.3%), 5 (11.4%) and 2 (4.4%) in IM, DG, PG and BG groups, respectively. The frequency of recurrent PDPH among patients received IM was significantly higher than among patients of other groups with insignificant differences between the recurrence rates among patients received GONB. As regards to time of recurrence, 5 patients of IM group had early recurrence; 2 patients at 2 wk and 3 patients at 3 wk visits. At the one month visit, 12 patients had recurrent headache; 8 patients of IM, 3 of DG and one of PG groups. At the 2 month visit, 10 patients had recurrence; 2 of BG group and 4 patients of each of PG and DG groups. Collectively, mean pain-free duration for patients who had recurrent PDPH was significantly ($P$ = 0.0003) longer in patients received GONB (45 ± 19 days) than in patients received IM injection (25.5 ± 9.2 days) (Fig. 3).

The 24 h procedural success rate was 96.1% among the total trial population where 7 patients received EBP at the end of 24 h for headache resistant to respond, while at the end of 3 months, it was 93.1% because 12 patients (6.9%) required EBP; 6 patients (13.3%) of IM group, 4 patients of DG (8.9%) and 2 patients of PG (4.4%) groups with insignificant differences between these groups. No patient of BG group required EBP with significant differences than IM and DG groups, but insignificant difference in comparison to PG group.

The success rate of bi-level GONB as a management for recurrent PDPH was 81.5% where 5 of the 27 patients who developed recurrence; one in PG and 2 in each of IM and DG groups had persistent headache that did not properly respond to bi-level GONB and received EBP as a final resort.

During the 3 month follow-up, 84 patients (48.6%) remained pain-free without analgesia and 62 patients (35.8%) were pain-free but occasionally receive nonsteroidal analgesia. On contrary, 24 patients (13.9%) were maintained on regular nonsteroidal analgesia and 3 patients (1.7%) received occasional opioids. The frequency of patients who were maintained without analgesia was significantly higher in BG and PG groups, but was insignificantly higher in DG group in comparison to IM group, and was significantly higher in BG group, but was insignificantly higher in PG group in comparison

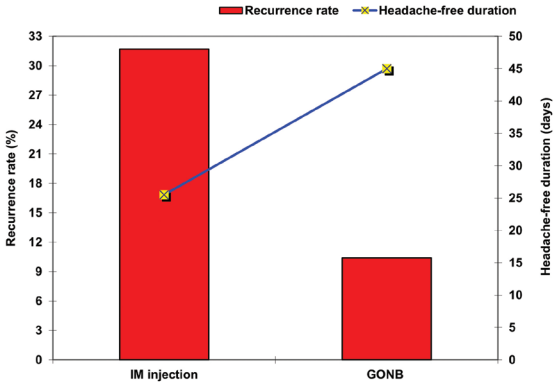


Fig. 3. *The frequency and the headache-free duration of patients had recurrent PDPH during 3-m follow-up.*
Bakshi SG, Gehdoo RSP: Incidence and management of post-dural puncture headache following spinal anaesthesia and accidental dural puncture from a non-obstetric hospital: A retrospective analysis. *Indian J Anaesth*. 2018 Nov;62(11):881-886. doi: 10.4103/ija.IJA_354_18.

Vázquez-Justes D, Yarzábal-Rodríguez R, Doménech-García V, Herrero P, Bellosta-López P: Effectiveness of dry needling for headache: A systematic review. *Neurologia (Engl Ed)*. 2022 Nov-Dec;37(9):806-815. doi: 10.1016/j.nrleng.2019.09.010.

to the frequency in DG group, with insignificant difference between BG and PG groups (Table 4).

According to the Odom outcome criteria, 120 patients (66.7%) found the procedural outcome was excellent, 30 patients (16.7%) documented good outcome of the applied procedures, while 19 patients (10.6%) and 11 patients (6.1%) found outcomes are fair or poor, respectively. The frequencies of patients had excellent and good outcomes were significantly higher with bi-level blocks than IM injection and distal block, but were insignificantly higher than with proximal block. Also, the frequency of excellent and good outcomes with proximal block was significantly higher than with IM injection, but was insignificantly ($P$ = 0.427) higher than that of distal block with insignificant difference between distal block versus IM injection (Table 4).

## Discussion

The applied procedures for management of PDPH provided excellent outcomes with a total success rate of 93.1% and reduced the need for EBP for only 12 patients (6.9%) who had headaches resistant to or recurrent after local management. Differentially, GONB, irrespective of the level of block, provided a success rate of 95.6%, which indicated its efficacy as man-

Table 4. *The post-procedural analgesia and Odom's outcome criteria of patients of the studied groups.*

| Outcome | Group | IM (n = 41) | Distal (n = 43) | Proximal (n = 44) | Bi-level (n = 45) |
|---|---|---|---|---|---|
| Post-procedural analgesia | No | 11 (26.8%) | 18 (41.9%) | 23 (52.3%) | 32 (71.1%) |
| | Occasional/Nonopioid | 15 (36.6%) | 16 (37.2%) | 18 (40.9%) | 13 (28.9%) |
| | Regular/Nonopioid | 13 (31.7%) | 8 (18.6%) | 3 (6.8%) | 0 |
| | Occasional/Opioid | 2 (4.9%) | 1 (2.3%) | 0 | 0 |
| | P1 | | 0.362 | 0.0054 | < 0.001 |
| | P2 | | | 0.263 | 0.0042 |
| | P3 | | | | 0.072 |
| Odom's outcome criteria | Excellent | 16 (35.6%) | 28 (62.2%) | 34 (75.6%) | 42 (93.3%) |
| | Good | 13 (28.9%) | 8 (17.8%) | 6 (13.3%) | 3 (6.7%) |
| | Fair | 10 (22.2%) | 5 (11.1%) | 4 (8.9%) | 0 |
| | Poor | 6 (13.3%) | 4 (8.9%) | 1 (2.2%) | 0 |
| | P1 | | 0.088 | 0.0017 | < 0.001 |
| | P2 | | | 0.427 | 0.0013 |
| | P3 | | | | 0.212 |

agement for PDPH and coincided with recent studies that assured the efficacy of GONB for management of various types of craniofacial headaches, cluster headache (21,22), migraine (22,23), cervicogenic (22) and as postoperative analgesia for patients had posterior fossa craniotomy (24). Also, the reported success rate for GONB, irrespective of block level, goes in hand with previous studies evaluated the effectiveness of GONB as a treatment for PDPH (25-28).

At 24 h postinjection, bi-level GONB provided superior outcomes than one-level GONB, at either proximal or distal level, where all patients of BG group were pain-free and 10 patients had zero pain score, while among those received proximal block 40 patients (88.9%) were pain-free and 4 of them had a pain score of zero, and among patients received distal block 33 patients (73%) were pain-free, but no patient had a pain score of zero. The 24 h success rate was significantly lower for patients of DG group compared to patients of BG and PG groups.

Similarly, Azzi et al. (25) retrospectively documented the effectiveness of ultrasound-guided GONB as a minimally risky procedure for management of PDPH patients who failed to respond to conservative treatment. Also, Arab et al. (29) reported significant improvement of the frequency, duration and severity of headache secondary to medication-overuse with GONB. Thereafter, Niraj & Critchley (26), who provided GONB for patients, had failure of medical management and reported durable pain relieve for 86% of patients and Elsayed et al. (27) reported 24 h success rates of 60% and 84% with distal and proximal block, respectively, but with an insignificant difference despite of the significantly lower NRS scores of patients with proximal blocks. However, this study (27) was criticized for multiple points; the insignificant difference in success rates between proximal and distal GONB and this might be attributed to the small sample size; 25 patients per group; pain was evaluated only in the sitting position, while the impact of PDPH is mainly manifest in standing and this deleteriously affects patients' QOL and daily activities, especially regarding personal and child care. On the contrary, the current trial evaluated pain in the upright position so as to evaluate the impact of PHPD and its management on patients' QOL. Another point is the short duration of follow-up for only 48 h after the intervention and this did not allow to detect recurrence of headache and no comments about the need for EBP as a last resort was provided, while the present trial detected 27 cases of recurrent PDPH during follow-up for 3 months and these cases were managed with bilateral bi-level GONBs that succeeded to provide pain-free analgesia in 22 patients (81.4%).

The application of IM injection improved pain severity, but provided the lowest 24 h success rate and the highest frequency of recurrent cases and need for EBP in comparison to GONB. The reported success rate of IM injection goes in hand with that previously reported by Abdelraouf et al. (19) who reported significantly lower pain scores at 24 h in comparison to IM injection of saline and this could be considered as a weak point for this article. Also, the current results of IM injection coincided with Shaboob & Salman (28) who reported significantly lower pain scores with GONB than IM in-

jection, despite the reported improvement with both procedures. However, this study (28) was criticized for assessment of pain scores after one month, which could not evaluate the procedural effect within the first 24 hours after the intervention and so patients were discharged home without assuring the procedural success. On the contrary, the current trial detected IM procedural failure in 4 cases (8.9%), which required EBP during the first 24 hours after the procedure; a finding indicated the necessity of 24 h evaluation.

The reported higher success rate with proximal block might be attributed to the block of the main nerve trunk before differentiating into muscular and sensory branches so provided an effect equal to that of both distal block and IM injection. Moreover, the lower success rate of distal block might be attributed to the previously documented presence of communications between greater, lesser and third occipital nerves below and lateral to the external occipital protuberance (30). In line with this attribution, a recent study defined a triangular posterior area of the scalp including the distribution area or areas of the greater, lesser, and the third occipital nerve and advised blocking of the occipital nerves in this triangular area rather than blocking a single occipital nerve (31).

The reported success rate both at 24 h and one month after bilateral bi-level block might be attributed to taking advantages of the other 3 procedures. In support of the efficacy of bi-level GONB, Karaoğlan et al. (32) reported slight improvement of outcomes of single GONB on repetitive injections or single GONB combined with onabotulinium toxin A for control of migraine.

In support of the efficacy of GONB over IM injection, the post-intervention pain-free duration for patients had recurrent headache was significantly longer in patients received GONB than IM injection. Moreover, the frequency of patients who were maintained on analgesia during follow-up was significantly higher among patients received IM injection and distal block than patients of other groups. Furthermore, the frequency of patients described outcomes as excellent or good was significantly higher with proximal or bi-level block than IM injection or distal block. Additionally, for patients who had recurrent PDPH, bi-level GONB provided a success rate of 81.5% and only 5 cases required EBP, a finding indicating the efficacy of bi-level GONB over other procedures.

The reported success rates with GONB might be attributed to blocking of the referred sensory inputs by blocking the nerve at both levels. In support of this suggestion, Vázquez-Justes et al. (33) in a systemic review found just dry needling was as effective as other interventions and was associated with significant improvements in functional and sensory outcomes.

The applied minimally invasive local therapy for PDPH provided rapid and effective analgesia with low failure and recurrence rates. Further, the applied lines significantly improved patients' QOL through the resolution of the disastrous impact of headache on daily activities and general wellbeing. Bilateral bi-levels GONB provided an effect superior to bilateral one-level block and to intramuscular injection with no 24 h failure, low recurrence rate and totally abolished the need for EBP. Also, bi-level GONB is an efficient first line of therapy for patients who had recurrent PDPH with 85.6% success rate.

### Limitation

The use of combination bupivacaine and dexamethasone did not allow distinguishing the effect of each.

## Conclusions

The reported marvelous outcomes of bilateral bi-level GONB allowed recommending it as a suitable therapy for PDPH that has to be applied as early as possible without the trial for conservative therapies. Also, other similar trial using bupivacaine alone or with other drugs with analgesic effect to distinguish the effect of each are recommended.

## References


1. Wang F, Lü Q, Wang M, et al. Ultrasound-guided caudal anesthesia combined with epidural anesthesia for caesarean section: A randomized controlled clinical trial. *BMC Pregnancy Childbirth* 2024; 24:105.
2. Kearns RJ, Broom MA, Lucas DN. Long-term effects of neuraxial analgesia. *Curr Opin Anaesthesiol* 2024; 37:227-233.
3. Carroll JR, Lansinger O, Do HM, Dodd R, Mahaney K, Li D. Mechanism of chronic iatrogenic CSF leak following dural puncture-ventral dural leak: Case report. *Reg Anesth Pain Med* 2024; 49:293-297.
4. Thon JN, Weigand MA, Kranke P, Siegler BH. Efficacy of therapies for post dural puncture headache. *Curr*

*Opin Anaesthesiol* 2024; 37:219-226.

5. Bakshi SG, Gehdoo RSP. Incidence and management of post-dural puncture headache following spinal anaesthesia and accidental dural puncture from a non-obstetric hospital: A retrospective analysis. *Indian J Anaesth* 2018; 62:881-886.
6. Wahab S, Kataria S, Woolley P, et al. Literature review: Pericranial nerve blocks for chronic migraines. *Health Psychol Res* 2023; 11:74259.
7. Devoghel JC. Cluster headache and sphenopalatine block. *Acta Anaesthesiol Belg* 1981; 32:101-107.
8. Boezaart AP, Smith CR, Zasimovich Y, et al. Refractory primary and secondary headache disorders that dramatically responded to combined treatment of ultrasound-guided percutaneous suprazygomatic pterygopalatine ganglion blocks and non-invasive vagus nerve stimulation: A case series. *Reg Anesth Pain Med* 2024; 49:144-150.
9. Janis JE, Hatef DA, Ducic I, et al. The anatomy of the greater occipital nerve: Part II. Compression point topography. *Plast Reconstr Surg* 2010; 126:1563-1572.
10. Güvençer M, Akyer P, Sayhan S, Tetik S. The importance of the greater occipital nerve in the occipital and the suboccipital region for nerve blockade and surgical approaches--an anatomic study on cadavers. *Clin Neurol Neurosurg* 2011; 113:289-294.
11. Nair AS. Bilateral greater orbital nerve block: Efficacy in post¬dural puncture headache. *Saudi J Anaesth* 2018; 12:159-160.
12. Faul F, Erdfelder E, Lang AG, Buchner A. G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods* 2007; 39:175-191.
13. Williamson A, Hoggart B. Pain: A review of three commonly used pain rating scales. *J Clin Nurs* 2005; 14:798-804.
14. Becker N, Thomsen AB, Olsen AK, Per Bech P, Eriksen J. Pain epidemiology and health related quality of life in chronic non-malignant pain patients referred to a Danish multidisciplinary pain center. *Pain* 1997; 73:393-400.
15. Saris-Baglama RN, Dewey CJ, Chisholm GB, E Plum. Quality metric health outcomes™ scoring software 4.0. Lincoln, RI: Quality Metric Incorporated 2010; p.138.
16. Odom GL. Neurosurgical care of the severely injured patient. *J Am Med Assoc* 1958; 168:2087-2090.
17. Mosser SW, Guyuron B, Janis JE, Rohrich RJ. The anatomy of the greater occipital nerve: Implications for the etiology of migraine headaches. *Plast Reconstr Surg* 2004; 113:693-700.
18. Young WB, Marmura M, Ashkenazi A, Evans RW. Expert opinion: greater occipital nerve and other anesthetic injections for primary headache disorders. *Headache* 2008; 48:1122-1125.
19. Abdelraouf M, Salah M, Waheb M, Elshall A. Suboccipital muscles injection for management of postdural puncture headache after cesarean delivery: A Randomized-Controlled Trial. *Maced J Med Sci* 2019; 7:549-552.
20. Buddeberg BS, Bandschapp O, Girard T. Post-dural puncture headache. *Minerva Anestesiol* 2019; 85:543-553.
21. Gordon A, Roe T, Villar-Martínez MD, Moreno-Ajona D, Goadsby PJ, Hoffmann J. Effectiveness and safety profile of greater occipital nerve blockade in cluster headache: A systematic review. *J Neurol Neurosurg Psychiatry* 2023; 95:73-85.
22. Castillo-Álvarez F, de la Bárcena IH, Marzo-Sola ME. Greater occipital nerve block in the treatment of headaches. Review of evidence. *Med Clin (Barc)* 2023; 161:113-118.
23. Vanderpol J, Kennedy G, Ahmed F, Jonker L. Efficacy of greater occipital nerve block treatment for migraine and potential impact of patient positioning during procedure: Results of randomised controlled trial. *Clin Neurol Neurosurg* 2024; 239:108210.
24. Nassar H, Sarhan K, Gamil M, Elgohary M, El-Hadi H, Mahmoud S. Ultrasound-guided greater occipital nerve block in children undergoing posterior fossa craniotomy: A randomized, controlled trial. *J Neurosurg Anesthesiol* 2024; 36:159-163.
25. Azzi A, Saliba E, Stephan J, Saba H, Hallit S, Chamandi S. Correlates of post-dural puncture headache and efficacy of different treatment options: A monocentric retrospective study. *Br J Pain* 2022; 16:228-236.
26. Niraj G, Critchley P. Management and outcomes of persistent headache after accidental dural puncture in the obstetric population: A 9-year prospective audit. *Headache* 2023; 63:71-78.
27. Elsayed AA, Elsawy TTD, Abdul Rahman AE, Arafa SKH. Bilateral greater occipital nerve block; Distal versus proximal approach for postdural puncture headache: A randomized clinical trial. *Pain Physician* 2023; 26:475-483.
28. Shaboob IA, Salman SA. Greater occipital nerve block or suboccipital intramuscular injections are effective for management of postdural puncture headache: A placebo-controlled study. *SVU-IJMS* 2023; 6:227-240.
29. Arab A, Khoshbin M, Karimi E, Saberian G, Saadatnia M, Khorvash F. Effects of greater occipital nerve block with local anesthetic and triamcinolone for treatment of medication overuse headache: An open-label, parallel, randomized, controlled clinical trial. *Neurol Sci* 2022; 43:549-557.
30. Tubbs RS, Salter EG, Wellons JC, Blount JP, Oakes WJ. Landmarks for the identification of the cutaneous nerves of the occiput and nuchal regions. *Clin Anat* 2007; 20:235-238.
31. Sağlam L, Gayretli Ö, Coşkun O, Kale A. The triangular area between the greater, lesser, and third occipital nerves and its possible clinical significance. *Surg Radiol Anat* 2024; 46:185-190.
32. Karaoğlan M. Addressing limitations of single GON blockade treatment and repetitive intervention with GON block or onabotulinum toxin A in chronic migraine- part 2 of three men in a boat study. *Clin Neurol Neurosurg* 2024; 240:108242.
33. Vázquez-Justes D, Yarzábal-Rodríguez R, Doménech-García V, Herrero P, Bellosta-López P. Effectiveness of dry needling for headache: A systematic review. *Neurologia (Engl Ed)* 2022; 37:806-815.