

Effectiveness and Accessibility: A Retrospective Comparison of Distal vs. Proximal Greater Occipital Nerve Blocks in Migraine Management

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ABSTRACT

Background: Greater occipital nerve (GON) blocks are used in migraine management. While ultrasound-guided proximal GON blocks at the C2 level (GONC2) have been suggested to provide more sustained benefit, distal landmark-guided GON blocks are used due to their simplicity and accessibility.

Objectives: To evaluate distal GON blocks as an initial procedural approach for migraine; to assess the effect of subsequent proximal GONC2 blocks in patients who did not respond to an initial distal block.

Methods: We conducted a retrospective cohort study of adult migraine patients treated at a tertiary pain clinic between May 2022 and July 2023. Patients received either distal landmark-guided GON blocks or ultrasound-guided proximal GONC2 blocks as part of routine clinical care. Monthly migraine days (MMD) were assessed at baseline, 1 month, and 3 months following treatment.

Results: The cohort included 54 patients (27 distal, 27 GONC2). Baseline characteristics were comparable between groups. A significant overall effect of time on MMD was observed ($P = 0.017$). In the distal group, MMD decreased significantly at 1 month ($P < 0.001$) but not at 3 months. In the GONC2 group, MMD decreased significantly at both 1 month ($P < 0.001$) and 3 months ($P = 0.001$). No significant between-group differences were found at 1 month ($P = 0.142$) or 3 months ($P = 0.509$).

Conclusions: Distal GON blocks provide meaningful short-term reduction in migraine frequency and represent an effective, accessible initial interventional option. Proximal GONC2 blocks demonstrate sustained benefit and may be considered in selected patients. These findings support a pragmatic, stepwise approach to procedural migraine management.

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KEY WORDS: interventional pain management, migraine, peripheral nerve block, occipital nerve block, ultrasound guidance

Migraine is a complex, chronic neurobiological disorder characterized by recurrent episodes of moderate to severe headache [1].

The trigeminocervical complex (TCC) is the primary functional relay center in the brainstem where trigeminal and upper cervical afferents converge. In migraine pathophysiology, the TCC acts as the critical hub for processing nociceptive input from the meninges and cranial vessels, which contains neurons exhibiting convergent synaptic input from both nerves, creating interconnected nociceptive pathways. These convergent neurons may be pivotal in shaping the clinical presentation of headaches [2-4]. Based on this hypothesis, greater occipital nerve (GON) blocks have been used in both treatment and short-term prevention of many types of headaches and were found to be effective and safe in several reviews [5-7].

GON nerve blockades can be administered at various sites along the nerve's anatomical course. Distal GON blocks are typically performed using anatomical landmarks without imaging guidance, whereas proximal GON blocks at the C2 level (GONC2) level are ultrasound guided [8,9].

Recent evidence suggests that ultrasound-guided GONC2 blocks may provide more prolonged or robust clinical benefits compared to distal GON blocks in the management of migraine and other headache disorders. These benefits include prolonged analgesic effects and a sustained reduction in migraine frequency for up to 3 months [10-15]. However, in clinical practice, distal GON blocks are often preferred due to their simplicity and accessibility.

The aim of this study was to evaluate the effectiveness of distal GON blocks as an initial procedural approach and to examine whether escalation to proximal GONC2

blocks in non-responders can achieve comparable reductions in migraine frequency, thereby supporting a pragmatic, stepwise treatment continuum.

PATIENTS AND METHODS

ETHICS CONSIDERATIONS

The study was approved by the Sheba Medical Center review board. Written informed consent was obtained from all patients.

PATIENT SELECTION

We conducted a retrospective cohort study of adult patients treated at the Pain Clinic at Sheba Medical Center between May 2022 and July 2023. Patient data were extracted from the institutional clinical database. Treatment allocation was determined by the treating physician based on clinical judgment, reflecting routine clinical practice.

In general, distal landmark-guided GON blocks were used as the initial interventional approach, and all patients in the study underwent this treatment first. The rationale behind this approach was that distal GON nerve blockade is simpler to perform, can be conducted efficiently in a physician's office, and does not require advanced imaging modalities or specialized equipment.

Ultrasound-guided proximal GONC2 were considered in patients with an inadequate response to an initial distal GON block, defined as the absence of a clinically meaningful reduction in migraine frequency or intensity, or a duration of significant improvement of less than one month.

Inclusion criteria included adult patients (≥ 18 years) diagnosed with episodic or chronic migraine by a neurologist or neurosurgeon specializing in pain management. Participants had also failed at least one preventive pharmacological therapy. Exclusion criteria were history of head and neck trauma, other headache and pain diagnoses, history of adverse reaction to corticosteroids or local anesthetics, medication overuse, and pregnancy.

Demographic data collected included age at first injection and sex. Clinical data included migraine characteristics, age of migraine onset, and prior prophylactic and abortive treatment history.

PROCEDURE AND FOLLOW-UP

For both techniques, injectates contained 8 mg dexamethasone diluted in 4 ml of 1% lidocaine per nerve. The distal GON block was performed using anatomical landmarks, as described in prior cadaveric studies [16,17]. GON was

localized by palpating the external occipital protuberance and the mastoid process. A line connecting these landmarks was divided into three equal parts, and the medial third was targeted as the injection site. A 2-cm radius circle centered on this medial trisection point was used as the injection site, based on cadaver studies showing that the GON, often with the occipital artery, emerges reliably in this area, particularly in its inferolateral quadrant.

For the GONC2 block, treatment was conducted using a technique as described in Pingree and colleagues [9]. Patients were placed in the prone position with flexion of head and neck. The ultrasound transducer was placed in a transverse orientation along the middle to identify external occipital protuberance and then moved laterally until identification of the obliquus capitis inferior (OCI) muscle. This placement allowed the identification of the GON, which lies between OCI and semispinalis capitis muscle. The semispinalis capitis muscle is superficial to the nerve. The injectate was then injected using an 80 mm ultrasound needle using lidocaine 1% and adding dexamethasone 8 mg.

OUTCOME MEASURES

The outcome was the change in monthly migraine days (MMD), as measured at baseline, 1 month, and 3 months post injection. Data were collected during scheduled follow-up visits at the pain clinic or, when necessary, through structured telephone interviews.

STATISTICAL ANALYSIS

Statistical analyses were performed using IBM Statistical Package for the Social Sciences statistics software, version 29.0.1.0 (Build 171) (SPSS, IBM Corp, Armonk, NY, USA) and GraphPad Prism version 10 (GraphPad Software, San Diego, CA, USA). Continuous variables are presented as mean $\pm$ standard deviation (SD). Categorical variables are presented as frequencies and percentages.

Baseline comparability between treatment groups was assessed using independent sample *t*-tests for continuous variables and Fisher's exact test for categorical variables. Changes in MMD across time points were analyzed using two-way analysis of variance (ANOVA) with Tukey's multiple comparisons test for post-hoc within-group comparisons (baseline vs. 1 month, baseline vs. 3 months, and 1 month vs. 3 months). Between-group differences in MMD at each time point were compared using independent sample *t*-tests. A *P*-value of < 0.05 was considered statistically significant for all analyses.

RESULTS

DEMOGRAPHICS AND CLINICAL CHARACTERISTICS

A total of 54 patients were included in our study, 27 in each treatment group (distal GON and GONC2). Baseline demographic and clinical characteristics are presented in Table 1. The groups were well matched, with no statistically significant differences in age at headache onset, age at first injection, sex distribution, migraine subtype (episodic vs chronic), hemicranial pattern, headache location, status migrainosus tendency, aura presence, emetic presentation, photophobia/phonophobia, menstrual dominance, cervicogenic component, responder status for abortive and preventive treatments, injection laterality (unilateral or bilateral), number of injections administered, and baseline monthly migraine days (MMD). The predominance of female patients reflects the well-documented higher prevalence of migraines in women.

Table 1. Demographic characteristics and baseline clinical data

	Distal GON blocks (n=27)	GONC2 blocks (n=27)	P-value
Age at first injection (years)	40.89 ± 15.81	35.6 ± 13.97	0.195
Female sex, n (%)	22 (81.5)	25 (92.6)	0.42
Baseline MMD	17.78 ± 8.73	19.1 ± 8.34	0.558

Values are presented as mean ± standard deviation unless otherwise specified

GON = greater occipital nerve, MMD = monthly migraine days

PRIMARY OUTCOME ANALYSIS

Both treatment approaches were associated with reductions in MMD over the follow-up period. MMD outcomes by treatment group and time point are summarized in Table 2.

In the distal GON group, MMD decreased significantly at 1 month following treatment. However, the effect was attenuated by 3 months and was no longer statistically significant compared to baseline. In the GONC2 group, MMD decreased significantly at 1 month, and this reduction was maintained at 3 months. Between-group comparisons demonstrated no statistically significant differences in MMD at either 1 or 3 months post-treatment.

REPEATED-MEASURES ANALYSIS

Two-way repeated-measures ANOVA demonstrated a significant main effect of time on MMD ($P = 0.017$), indicating overall improvement following intervention. There was no significant interaction between time and treatment group ($P = 0.135$), suggesting a similar pattern of change over time in both groups. Detailed within- and between-group comparisons are presented in Table 2.

DISCUSSION

In this retrospective cohort study, both distal greater occipital nerve (GON) blocks and ultrasound-guided proximal GON blocks at the C2 level (GONC2) were associated with clinically meaningful reductions in MMD in migraine patients who had failed prior preventive therapies.

At 1 month following treatment, no statistically significant difference was observed between the distal and

Table 2. Monthly migraine days at baseline, 1 month, and 3 months following treatment

	Distal GON blocks (n=27)	GONC2 blocks (n=27)	P-value (between groups)
MMD at baseline	17.78 ± 8.73	19.1 ± 8.34	0.558
MMD at 1 month	8.08 ± 8.33	11.7 ± 9.11	0.142
MMD reduction at 1 month	9.7 ± 9.1	7.4 ± 7.9	–
Within-group P-value (baseline vs. 1 month)	< 0.001	< 0.001	–
MMD at 3 months	15.15 ± 9.62	13.3 ± 10.68	0.509
MMD reduction at 3 months	2.63 ± 7.8	5.8 ± 8.6	–
Within-group P-value (baseline vs. 3 months)	0.173	0.001	–

Values presented as mean ± standard deviation

Within-group P-values were derived from Tukey's multiple comparisons test (two-way ANOVA)

Between-group P-values were derived from independent sample t-tests

GON = greater occipital nerve, MMD = monthly migraine days

proximal approaches. This comparable early efficacy supports the use of distal GON blocks as the initial interventional strategy, particularly given their simplicity and lack of need for ultrasound guidance.

Previous studies have suggested that proximal GON blocks, particularly when performed under ultrasound guidance, may provide superior or more sustained benefit compared with distal landmark-guided approaches [10-14], possibly due to closer anatomical targeting of the nerve at its origin. In our cohort, although the proximal GONC2 group demonstrated a more sustained effect at 3 months, overall improvement did not significantly differ between groups. These findings suggest that meaningful clinical benefit can be achieved with a distal approach in many patients, reserving proximal techniques for selected cases.

The therapeutic effect of both approaches likely reflects modulation of shared nociceptive pathways within the trigeminocervical complex [2-4]. Even when performed distally, interruption of peripheral afferent input may be sufficient to reduce central sensitization and reduce migraine frequency.

From a clinical perspective, these findings support a stepwise approach: initiating treatment with a distal GON block and reserving ultrasound-guided GONC2 blocks for patients with inadequate or short-lived response. Importantly, insufficient response to a distal block does not preclude benefit from subsequent proximal intervention.

Overall, this study confirms the role of distal GON blocks as an accessible and effective first-line procedural option in refractory migraine management.

LIMITATIONS

The retrospective and non-randomized observational design, combined with the relatively small sample size, introduces potential selection bias. Moreover, treatment allocation was influenced by physician judgment, which may have affected patient selection based on factors such as variability in prior treatment responses and clinical characteristics. The study reflects real-world clinical decision-making rather than a prospectively defined treatment algorithm, limiting the ability to generalize findings. Accordingly, the results should be considered preliminary and hypothesis-generating. Future randomized prospective studies aimed at minimizing variability between patient populations, prior treatment responses, and physician-driven selection bias are needed. Such studies, utilizing predefined response-based protocols, are essential to validate these observations. Moreover, future research should evalu-

ate additional outcomes beyond monthly migraine days, including changes in medication usage, alterations in headache characteristics and intensity, as well as improvements in quality-of-life metrics. These clinically meaningful endpoints will provide a more comprehensive understanding of treatment efficacy and its broader impact on patients' well-being.

CONCLUSIONS

In this retrospective cohort, both distal and proximal greater occipital nerve blocks were associated with reduced migraine frequency in patients with refractory migraine. Comparable short-term efficacy supports the use of distal GON blocks as an accessible first-line interventional option. Proximal ultrasound-guided GONC2 blocks may offer additional benefit in selected patients, and lack of response to a distal block does not preclude subsequent improvement with a proximal approach. These findings support a response-based, stepwise strategy, pending prospective validation.

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The old poets little knew what comfort they could be to a man.

Sarah Orne Jewett (1849–1909), American novelist, short story writer and poet, best known for her local color works set along or near the southern coast of Maine

You may not be able to change the world, but at least you can embarrass the guilty.

Jessica Mitford (1917–1996), English-American author, communist activist and one of the Mitford sisters

Capsule

Targeted use of computed tomographic coronary angiography in acute chest pain

In this multicenter randomized TARGET-CTCA trial, **Lee** et al. evaluated whether selective coronary computed tomographic angiography (CCTA) improves outcomes in emergency department patients with acute chest pain after myocardial infarction had been excluded but who remained at intermediate cardiovascular risk. Patients were assigned to targeted CCTA or standard care. Targeted CCTA improved diagnostic accuracy, identified clinically significant coronary artery disease more frequently,

and resulted in more appropriate preventive therapies and coronary revascularization. The strategy reduced subsequent major adverse cardiovascular events without increasing unnecessary invasive procedures. These findings support the selective use of CCTA in carefully chosen intermediate-risk patients rather than routine imaging for all individuals presenting with chest pain.

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Capsule

Pulmonary denervation for heart failure-related pulmonary hypertension

Pulmonary hypertension secondary to left-sided heart failure is associated with poor prognosis and limited treatment options. In this randomized trial, **Zhang** et al. evaluated catheter-based pulmonary artery denervation in addition to guideline-directed medical therapy. Pulmonary denervation significantly reduced clinical worsening, recurrent heart failure hospitalizations, and pulmonary artery pressure compared with medical therapy alone.

Functional capacity and quality of life also improved during follow-up, while the procedure demonstrated an acceptable safety profile. The study results suggest that pulmonary artery denervation may become a novel interventional therapy for patients with heart failure-associated pulmonary hypertension.

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