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Original

Needle penetration *versus* local anesthetic injection: which causes more pain during cranial nerve blocks for chronic migraine?

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Abstract

Background
Peripheral nerve blocks and sphenopalatine ganglion blocks are widely used in the treatment of chronic migraine. Although generally considered minimally invasive, procedural discomfort may affect patient acceptance and adherence. The relative contribution of needle penetration and local anesthetic injection to pain perception remains poorly characterized.

Objective
To compare pain associated with needle penetration and local anesthetic injection during a standardized 360-degree headache block protocol in patients with chronic migraine.

Methods
Eight women (mean age 46 ± 17 years) diagnosed with chronic migraine according to ICHD-3 criteria underwent bilateral greater occipital, lesser occipital, auriculotemporal, and supraorbital nerve blocks using 1 mL of 2% lidocaine per site administered through a 30-gauge insulin needle. Bilateral transnasal sphenopalatine ganglion blocks were also performed. Pain intensity was rated on a 0–10 numerical scale immediately after needle penetration and again after anesthetic injection. At the end of the procedure, patients rated overall procedural discomfort.

Results
Across 8 patients, 64 nerve block sites were evaluated. Pain was significantly higher during 2% lidocaine injection than during needle penetration (5.5 ± 3.2 vs. 3.7 ± 3.0; $p < 0.001$). Severe pain (scores 8–10) was reported at 20 of 64 sites 31.3% (20/64) during injection, compared with 9 of 64 sites 14.1% (9/64) during needle penetration. The supraorbital nerve block showed the highest mean pain scores during both needle penetration (4.8 ± 3.2) and anesthetic injection (6.0 ± 2.9). Nasal discomfort during the sphenopalatine ganglion block was mild (1.3 ± 1.8). Overall procedural discomfort was 6.4 ± 2.1.

Conclusions
In patients with chronic migraine undergoing a 360-degree headache block protocol, pain related to local anesthetic injection exceeded that associated with needle penetration. The supraorbital region appeared particularly sensitive. Strategies aimed at reducing injection-related pain may improve patient tolerance and acceptance of repeated interventional headache procedures.

Keywords:
Anesthetics,
Local pain measurement,
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Peripheral nerves,
Migraine disorders,
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Introduction

Peripheral nerve blocks have emerged as an important therapeutic option for patients with migraine and other headache disorders. Common targets include the greater occipital, lesser occipital, auriculotemporal, and supraorbital nerves. These procedures are typically performed in an outpatient setting, are minimally invasive, and can provide meaningful symptom relief (1–4). Because the therapeutic effect is often temporary, repeated procedures at 2–4-week intervals may be required, making patient comfort an important factor in long-term treatment adherence (2,4).

Pain associated with nerve block procedures may result from two distinct mechanisms: mechanical stimulation during needle penetration through the skin and subcutaneous tissues, and chemical or pressure-related stimulation produced by the injection of the local anesthetic near the target nerve (5). Pain perception is multifactorial and may be influenced by several variables, including individual pain thresholds, hormonal status, recent pain experiences, ongoing headache activity, and psychological factors such as anxiety and anticipation (6).

Another interventional procedure increasingly used in the management of headache disorders, including migraine, is blockade of the sphenopalatine ganglion. This ganglion represents a key center for modulating the cranial parasympathetic pathway, making it a significant therapeutic target in interventional protocols (7). This technique is frequently combined with peripheral nerve blocks in clinical practice, particularly in patients with refractory or chronic headache syndromes (8–10).

Despite the widespread use of these interventions, there is limited information regarding the relative contribution of needle penetration and anesthetic injection to the overall pain experienced during the procedure (1,2,4,8,9). In our service, it is routine practice to perform bilateral blocks of the greater occipital, lesser occipital, auriculotemporal, and supraorbital nerves, in combination with a bilateral sphenopalatine ganglion block, using a standardized protocol. The present study was designed to provide preliminary clinical observations on pain perception during these procedures, specifically comparing discomfort associated with needle penetration and local anesthetic injection.

Methods

Eight women (mean age 46 ± 17 years) diagnosed with chronic migraine according to the International Classification of Headache Disorders, 3rd edition (ICHD-3), were included in this study. All procedures were performed in an outpatient clinical setting. The patients spontaneously requested to undergo the nerve block procedures without any form of sedation.

A 30-gauge insulin needle was used for all injections. 2% lidocaine was administered in a volume of 1 mL at each injection site. Bilateral blocks of the greater occipital, lesser occipital, auriculotemporal, and supraorbital nerves were performed in all patients.

Immediately after needle penetration, patients were asked to rate the intensity of pain using a numerical rating scale ranging from 0 (no pain) to 10 (worst pain imaginable). Following the injection of 1 mL of 2% lidocaine, pain intensity was reassessed using the same scale.

In addition, all patients underwent bilateral sphenopalatine ganglion blockade using a cotton-tipped applicator technique. The applicator (tubular cotton swab) was advanced until resistance was encountered at the vomer, positioning the cotton tip near the posterior aspect of the middle turbinate. A tubular cotton swab was soaked in 2% lidocaine and inserted into the nostril while the patient was positioned in the lateral decubitus position with the head tilted approximately 45° downward. To maintain adequate saturation of the cotton tip throughout the procedure, 0.5 mL of 2% lidocaine was slowly injected through the lumen of the tubular applicator using a 16-gauge Jelco catheter. The applicator remained in place for 10 minutes to allow adequate mucosal absorption of the anesthetic.

At the conclusion of the procedure, each patient was asked to rate the overall experience, including both the peripheral nerve blocks and the sphenopalatine ganglion blocks, on a numerical scale ranging from 0 to 10, taking into account the overall discomfort and pain associated with the treatment.

Results

Across the 8 patients, a total of 64 injection sites were evaluated. The overall pain scores were higher during the injection of the local anesthetic than during needle penetration. For needle penetration, the mean pain score was 3.7 ± 3.0, with a median of 4.0 and an interquartile range of 1.0–6.0. During anesthetic injection, the mean pain score increased to 5.5 ± 3.2, with a median of 6.0 and an interquartile range of 3.0–8.0. Patients reported severe pain (scores 8–10) at 20 of 64 sites (31.3%) during lidocaine injection, compared with 9 of 64 sites (14.1%) during needle penetration. Pain scores ranged from pain scores ranged from 0 to 10 for both procedures. These findings indicate that patients generally perceived greater discomfort during the injection of the local anesthetic than during needle insertion through the skin or scalp ($p<0.001$, Wilcoxon matched-pairs signed rank test; Figure 1). Despite the relatively high pain scores reported by some participants, the discomfort was brief and typically lasted only a few seconds.

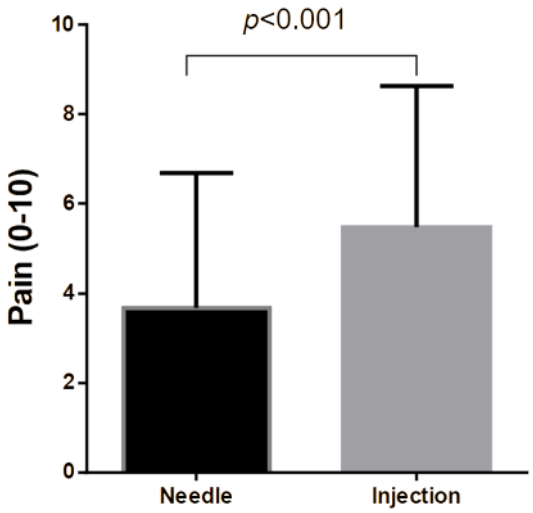


Figure 1. Comparison of patient-reported pain during two stages of the nerve block procedure: needle penetration through the skin or scalp and injection of 2% lidocaine in the vicinity of the target nerve.

The pain perceived during needle penetration through the skin or scalp varied among the nerve block sites. The highest mean pain score was observed at the supraorbital nerve block site (mean 4.8 ± 3.2; median 4.0), followed by the lesser occipital (mean 3.6 ± 3.3; median 2.0), greater occipital (mean 3.4 ± 2.2; median 3.0), and auriculotemporal (mean 2.9 ± 2.1; median 2.5) sites. Pain scores ranged from 0 to 10 for the lesser occipital and supraorbital nerve block sites, from 1 to 8 for the greater occipital site, and from 0 to 8 for the auriculotemporal site. Although the supraorbital site showed the highest pain scores, no statistically significant differences were observed among the four nerve block sites during needle penetration. In 9 of 64 procedures (14.1%), pain was rated between 8 and 10 on the 0–10 numerical rating scale, indicating a high level of discomfort, although the sensation was transient and lasted only a few seconds.

The pain perceived during the injection of the local anesthetic near the target nerve varied among the nerve block sites. The highest mean pain score was observed at the supraorbital nerve block site (mean 6.0 ± 2.9; median 7.0), followed by the greater occipital (mean 4.9 ± 3.2; median 4.5), lesser occipital (mean 4.4 ± 3.6; median 4.0), and auriculotemporal (mean 4.4 ± 3.1; median 4.0) sites. Pain scores ranged from 0 to 10 for the greater occipital, lesser occipital, and supraorbital nerve blocks, and from 0 to 8 for the auriculotemporal nerve block. The interquartile ranges were 3.0–7.8 for the greater occipital, 1.0–8.0 for the lesser occipital, 1.3–7.8 for the auriculotemporal, and 3.5–8.0 for the supraorbital nerve block sites. Figure 2 shows the pain was perceived as significantly greater at the supraorbital site when compared with the greater occipital and auriculotemporal sites.

Nasal discomfort associated with the sphenopalatine ganglion block was generally mild. On a 0–10 numerical rating scale, the mean nasal discomfort score was 1.3 ± 1.8, with a median of 1.0 and a range from 0 to 6. The 25th percentile was 0 and the 75th percentile was 1.75, indicating that most patients reported little or no nasal discomfort during the procedure. Only a small number of patients experienced moderate discomfort, as reflected by the maximum score of 6.0. These findings suggest that the transnasal sphenopalatine ganglion block using a cotton-tipped applicator was generally well tolerated. Despite the small volume of local anesthetic used (0.5 mL per nostril), some patients reported drainage of the anesthetic solution into the oropharynx, resulting in a transient bitter taste. This occurred as the lidocaine trickled posteriorly through the nasopharynx and was generally well tolerated, without leading to interruption of the procedure.

At the end of the procedure, which included bilateral blocks of the greater occipital, lesser occipital, auriculotemporal, and supraorbital nerves as well as bilateral sphenopalatine ganglion blocks, patients rated the overall discomfort and pain associated with the treatment with a mean score of 6.4 ± 2.1 on a 0–10 numerical rating scale (median 6.0; range 3–10) (Figure 3). Despite the multiple injections and nasal applications performed, the overall experience was generally rated as moderate, with 75% of patients reporting scores below 7.8.

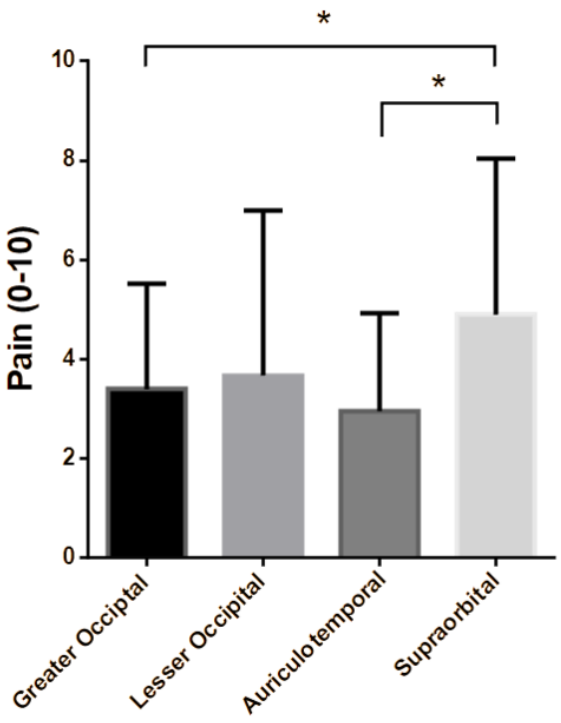


Figure 2. Pain perceived by the patient during skin penetration with the insulin needle (using a 30-gauge, 8-mm), rated on a 0–10 numerical pain scale, at each injection site in relation to the nerve targeted for blockade. Pain was perceived as significantly greater at the supraorbital site when compared with the greater occipital and auriculotemporal sites.

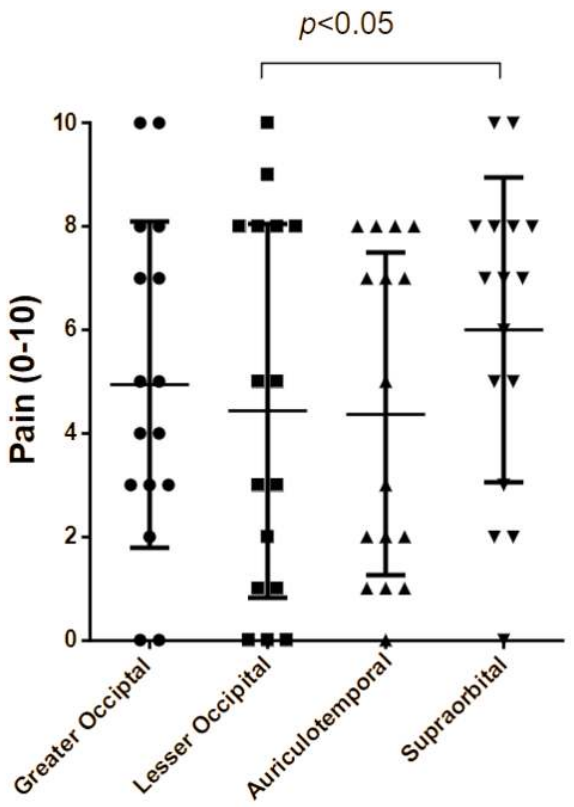


Figure 3. Pain perceived by the patient during the injection of 1 mL of 2% lidocaine after needle penetration through the skin or scalp. No statistically significant differences were observed among the nerve block sites, except for a significantly higher pain score at the supraorbital nerve block site compared with the lesser occipital nerve block site (Tukey's multiple comparisons test, $p < 0.05$).

One patient (Patient 3), who had three years of prior experience with botulinum toxin injections for migraine treatment, reported that Botox applications were more uncomfortable and painful compared to the nerve blocks.

Discussion

This preliminary observation suggests that, during cranial nerve blocks, pain related to anesthetic injection may exceed that of needle penetration, even when using a fine insulin needle. This finding challenges the common perception that the needle puncture is the primary source of discomfort (5,11). The 360° blockade protocol expands upon international recommendations by systematically combining bilateral blocks of key craniofacial peripheral nerves and the sphenopalatine ganglion, while upholding the technical principles of standardization, safety, and anatomical precision advocated by the American Headache Society (12). Given the high number of injections required, optimizing the procedure's tolerability is crucial to minimizing discomfort, fostering treatment adherence, and enabling repeated treatments when clinically indicated.

Several mechanisms may explain increased pain during injection: tissue distension from injected volume, chemical irritation from lidocaine, local pressure effects in confined anatomical spaces and the proximity to sensitive nerve branches (13).

The supraorbital region showed higher pain scores, possibly due to thinner soft tissue coverage, a confined anatomical space, and a high sensory innervation density (14).

Pain perception varied among patients, highlighting the influence of individual factors such as baseline pain sensitivity, migraine activity at the time of the procedure, and psychological state (15–17). Furthermore, these findings can be interpreted in light of central sensitization—a pathophysiological mechanism characteristic of the chronification of migraine, involving a sustained increase in the excitability of central nociceptive neurons. Cutaneous allodynia, a clinical manifestation of this process, is significantly more frequent in patients with chronic migraine and is associated with higher attack frequency, pain intensity, and functional impairment, reflecting persistent alterations in nociceptive processing (15,18).

Previous studies have demonstrated that interventions such as cold application or vibration can reduce pain associated with needle insertion (11,19). These methods were not used in this study, and their effect on injection-related pain remains unclear. Given that nerve blocks may cause significant discomfort in some patients, the use of procedural sedation could be considered in selected cases. However, logistical and financial constraints often limit this option. Additionally, the sphenopalatine ganglion block, although effective, may contribute to patient discomfort due to intranasal manipulation (7,20).

Limitations

The main limitations of this study include the small sample size, the absence of a control group, the subjective nature of pain assessment, and the lack of standardization regarding the phase of the migraine attack, recent headache activity, menstrual cycle, or hormonal status at the time of the procedure. These factors may have influenced individual pain perception.

In addition, a selection bias may have been present. All patients voluntarily requested the procedure and chose to undergo the nerve blocks without sedation. Therefore, individuals with significant needle phobia or a low tolerance for injection-related procedures were likely underrepresented in this cohort. As a result, the pain scores observed in this study may underestimate the discomfort that could be experienced in a more general population of patients with migraine. Another limitation is that all participants had chronic migraine. Patients with migraine, particularly those with chronic migraine, frequently exhibit cutaneous allodynia and altered pain processing related to central sensitization. Consequently, pain perception during

needle penetration and anesthetic injection may differ from that of individuals without migraine. Therefore, the findings of this study may not be directly generalizable to other populations undergoing similar procedures.

These findings should be interpreted as exploratory and hypothesis-generating.

Analysis of the present data suggests that the 360-degree headache block protocol, consisting of bilateral blocks of eight peripheral nerves combined with bilateral sphenopalatine ganglion blockade, is associated with a substantial degree of procedural pain and discomfort. Although all patients completed the entire procedure, visible signs of distress were frequently observed, including facial grimacing, groaning, verbal expressions of pain, and other behavioral manifestations suggestive of anxiety and discomfort.

These observations raise an important ethical consideration. While the procedure is generally safe and well tolerated, clinicians should carefully weigh the expected therapeutic benefits against the transient but sometimes intense discomfort experienced by the patient. Whenever feasible, particularly in highly anxious individuals or in those requiring repeated procedures, the option of sedation may be considered.

If sedation is used, it should preferably be administered by an anesthesiologist in an appropriate hospital or procedural setting. Although serious adverse events related to peripheral nerve blocks and sphenopalatine ganglion blockade are uncommon, adequate monitoring, including continuous cardiac rhythm assessment, pulse oximetry, and immediate availability of resuscitation equipment and trained personnel, is recommended to ensure patient safety in the event of an unexpected complication.

Conclusion

In this small series of patients with chronic migraine, pain associated with local anesthetic injection was more intense than that caused by needle penetration in most cases. The supraorbital region appeared particularly sensitive. These observations suggest that strategies to reduce injection-related discomfort may improve patient tolerance to cranial nerve blocks. Further studies with larger samples are needed to better characterize pain mechanisms and optimize procedural techniques.

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