Occipital Nerve Block

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Key Points

- Anatomically, the greater occipital nerve is associated with the C2 dorsal root and ganglion and receives a contribution from the medial branch of the posterior division of the third cervical nerve.
- Occipital nerve blocks are a common component of the pain physician's armamentarium.
- Despite the relative frequency with which these blocks are performed, there is no standardized protocol, and considerable variation in technique exists.
- Occipital neuralgia, by definition, responds favorably.
- Cervicogenic and cluster headaches also appear to be prime candidates for the intervention.
- Migraineurs may obtain benefit, although the evidence is less substantial.
- Peripheral neuromodulation may be a viable option.
- Occipital nerve blocks are not predictive of the success of occipital peripheral nerve stimulation.

Introduction

Occipital nerve blocks have been performed for more than 50 years and are commonly employed in modern practice to treat pain not only in the distribution of the greater occipital nerve but also with increasing frequency in the treatment of myriad other painful conditions of the head and neck. Despite this prevalence, however, no formal, "standardized" protocol exists. Rather multiple, differing techniques for deposition of local anesthetic around the nerve have been described in the literature, making comparative analysis challenging. Regardless, evidence to date supports substantial analgesic benefit of the procedure, and future investigation may very well elucidate an even greater scope of implementation.

Anatomy

The origin of the greater occipital nerve can be traced back to the second cervical level, where an extradural convergence of root filaments forms the C2 dorsal root and ganglion, lateral to the atlantoaxial ligament and inferior to the obliquus capitis inferior. Here, the ganglion is confined to the intervertebral foramen: atlantoaxial joint ventrally, posteromedial arch of the atlas and lamina of the axis dorsally, posterior arch of the atlas rostrally, and lamina of the axis caudally. Following a horizontal course within the foramen, the second cervical nerve emerges and almost immediately divides, yielding the largest of all cervical posterior divisions and coursing below the obliquus capitis inferior and between the posterior arch of the atlas and the lamina of the axis. Here, the dorsal ramus splits into four braches, including a large medial branch known as the greater occipital nerve (GON) due to its size and anatomical course.

The subsequent path of the GON is critical to understanding the pathological states to which it is related. Following its emergence from the dorsal ramus, the GON quickly turns medially, coursing transversely and dorsally over the belly of the obliquus capitis inferior muscle and deep to the semispinalis capitis, splenius capitis, splenius cervicis, and trapezius. The nerve continues cephalad, penetrating the semispinalis capitis and trapezius and joining the occipital artery. In this area, the GON receives a contribution from the medial branch of the posterior division of the third cervical nerve, ascending parasagittally and obliquely to innervate

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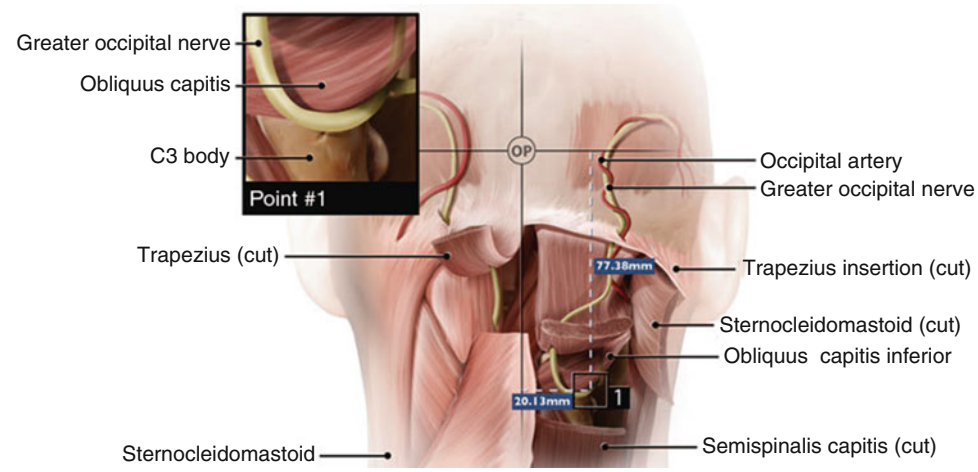

Fig. 10.1 Schematic illustration depicting compression point 1, where the nerve exits from deep to the obliquus capitis, wrapping around as it moves cranially and superficially (With permission from Janis et al. [4])

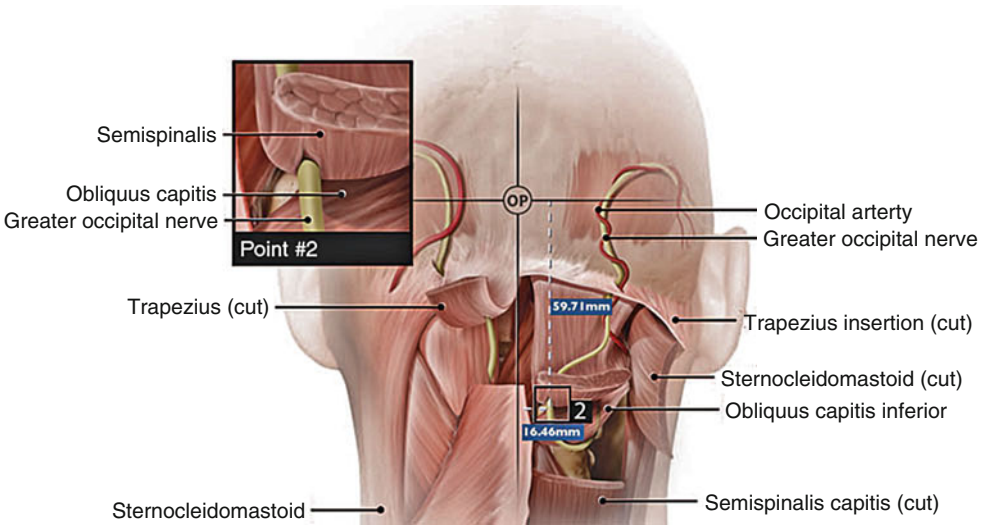

Fig. 10.2 Schematic illustration depicting compression point 2, the entrance of the nerve into the semispinalis muscle (With permission from Janis et al. [4])

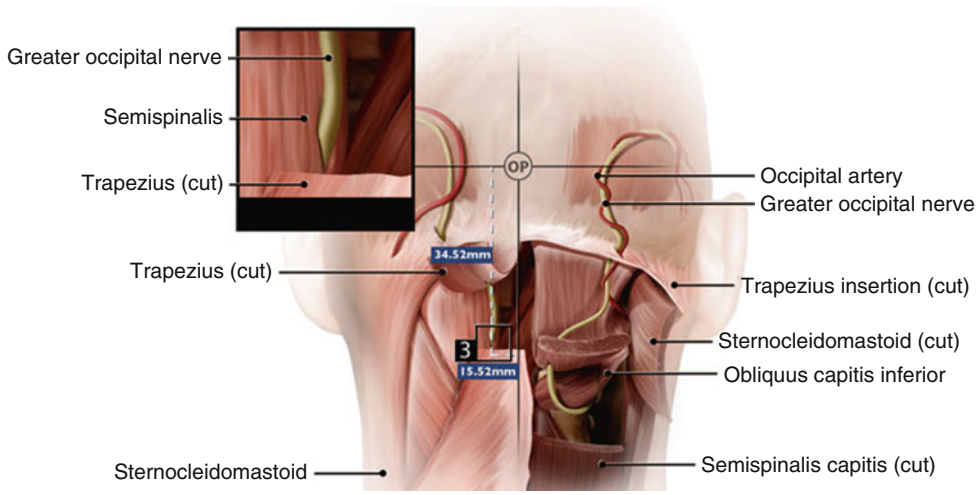

Fig. 10.3 Schematic illustration depicting compression point 3, where the greater occipital nerve exits from the semispinalis muscle (With permission from Janis et al. [4])

the posterior occiput, vertex as far as the coronal suture, and as far laterally as the mastoid [1–5].

Over this complex anatomical path exist numerous locations with the potential to create entrapment neuropathies or compression injuries. From proximal to distal, these include (Figs. 10.1, 10.2, 10.3, 10.4, 10.5, and 10.6):

1. The space between the vertebral bones of C1 and C2
2. The atlantoaxial ligament as the dorsal ramus emerges

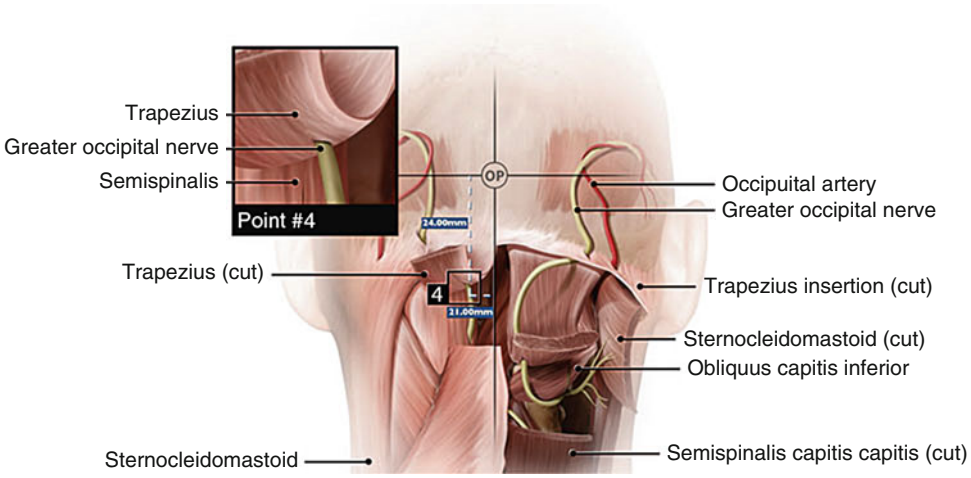

Fig. 10.4 Schematic illustration depicting compression point 4, where the nerve enters the trapezius (With permission from Janis et al. [4])

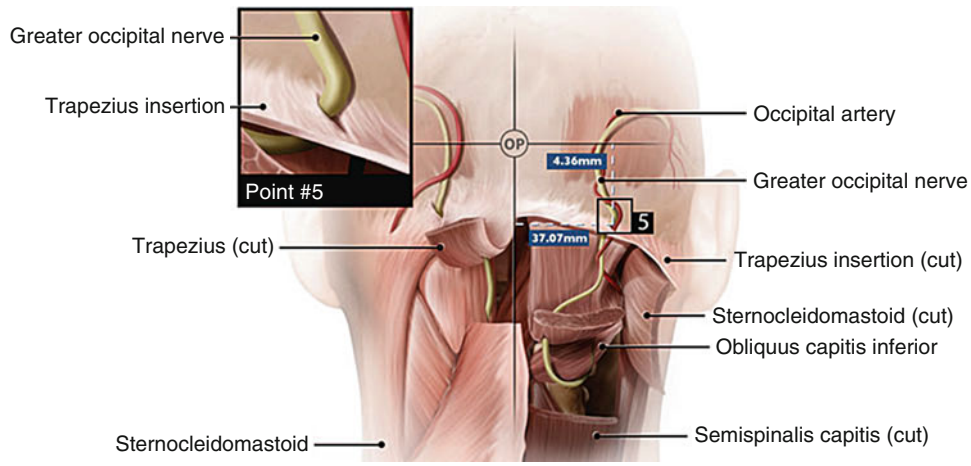

Fig. 10.5 Schematic illustration depicting compression point 5, where the nerve enters the trapezius insertion (With permission from Janis et al. [4])

3. The deep to superficial turn around the inferiolateral border of the obliquus capitis inferior muscle and its tight investing fascia
4. The deep side of semispinalis capitis, where initial piercing can involve entrapment in either the muscle itself or surrounding fascia
5. The superficial side of semispinalis capitis, where completion of nerve piercing muscle and its fascia again poses risk
6. The deep side of the trapezius as the nerve enters the muscle
7. The tendinous insertion of the trapezius at the superior nuchal line
8. The neurovascular intertwining of the GON and the occipital artery

Traumatic extension injuries (i.e., whiplash) have also been proposed as potential causes, although a definitive mechanism by which such injury could occur has yet to be fully elucidated (Fig. 10.7) [7–9].

Technique

As with all interventional procedures, a thorough and in-depth understanding of the relevant anatomy is an absolute a priori requirement to both successful neural blockade and minimization of potentially deleterious consequences. Unfortunately, despite the common frequency with which this block is internationally performed, there exists no standardized protocol for performing the procedure in either daily clinical practices or peer-reviewed medical literature.

Anatomical landmark identification [3, 10], point of maximal tenderness isolation [11], typical headache pain reproduction [11], ultrasonic Doppler flowmetry-assisted occipital artery localization [12], nerve stimulator guidance [13], and ultrasound image assistance [9] have all been employed in an effort to reproducibly identify the appropriate injection site. Nevertheless, the exact location for deposition of injectate varies widely in published studies in terms of both mediolateral and rostrocaudal orientation. All too often, no formal

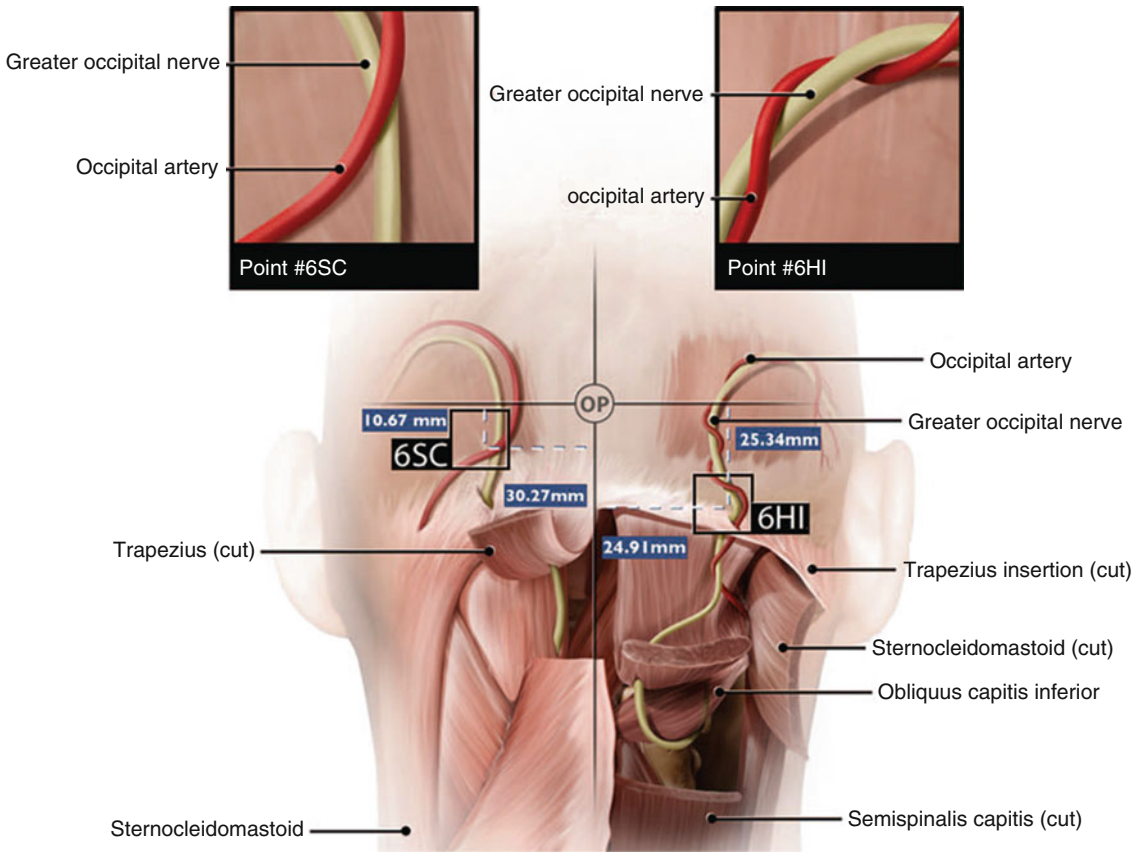

Fig. 10.6 Schematic illustration depicting compression point 6. Different types of greater occipital nerve–occipital artery relationships are shown. *SC* single cross, *HI* helical intertwining (With permission from Janis et al. [4])

protocol is described at all, with authors simply stating that medications are injected in the "region of the greater occipital nerve" [14]. Clinically these discrepancies in localization may be serendipitously alleviated somewhat by the not inconsequential injectate volumes employed, frequently five or even as many as 10 ml [15]. As such, any notion of specificity is rendered suspect at the very least and quite implausible at most, as in so doing yields procedures more akin to general field blocks than selective peripheral neural blockade.

Many authors employing landmark identification suggest palpation of the occipital artery, which frequently courses just lateral to the nerve. However, several pertinent issues may conspire to obscure such identification. One, anatomical variations to conventionally accepted neurovascular association are common. Two, the zone of palpation lies cephalad to typical hairlines, which may make palpation infeasible in the overly hirsute. Three, the occipital artery quite often lacks the vasodynamic bounding of more sizable vessels and thus may not be easily discernable, especially in patients of excess habitus. For these reasons, ultrasonic Doppler flowmetry may be employed to increase the likelihood of arterial localization, with purported increases in success rate and density of blockade, along with decreases in symptoms of vascular uptake as compared to more traditional approaches.

Although multiple techniques have been described, the clinical or statistical superiority of one method over competing approaches has never been validated. The practitioner, therefore, is left with myriad options from which to choose, depending on their personal experience, comfort level, and skill set. At the very least, it would appear that identification of the inion is a prerequisite to block performance, as is a topographical appreciation for the underlying subcutaneous and intermuscular course of the nerve.

Isolating a suitable location for injection is only one aspect of the procedure, however, which leads to the choice of injectate. Published study protocols have varied widely, including the use of both short- and long-acting local anesthetics, sometimes but not always including epinephrine, with or without a number of different steroids, plus or minus additives including but not limited to opioids and alpha-2 agonists. Botulinum toxin has also been employed with some success. Additionally, the chosen injectate volumes are far from uniform, with a single milliliter employed in some trials and as much as 10 ml in others.

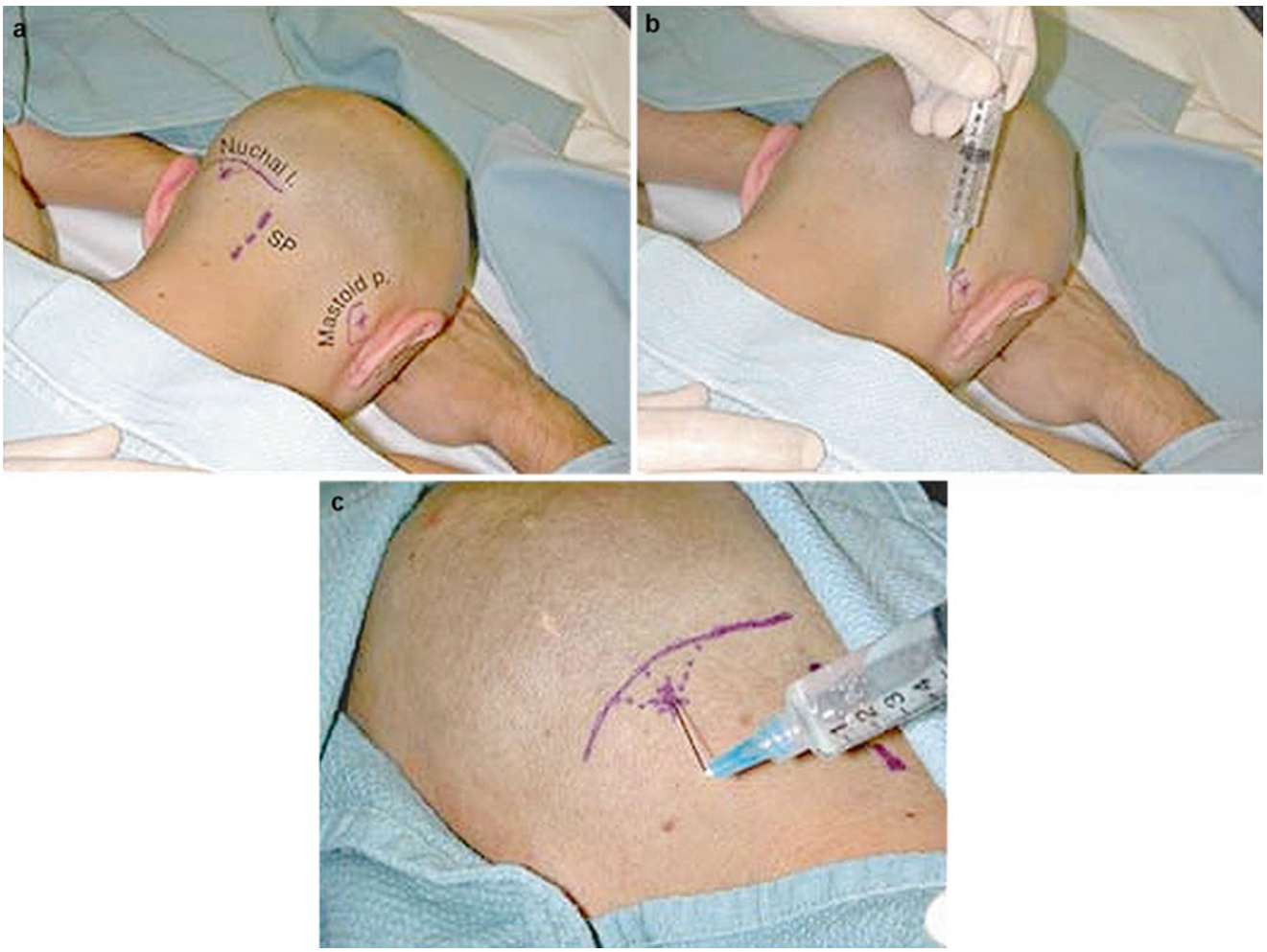

Fig. 10.7 (a) Surface anatomy of the occipital area. (SP spinous processe). (b) Lesser occipital nerve injection at the mastoid process. (c) Greater occipital nerve blockade at the superior nuchal ridge. Anatomic landmarks for greater and lesser occipital nerve block (From Chelly [6]. Copyright ©2009 Lippincott Williams & Wilkins)

What this implies, of course, is that there is either insufficient evidence at this stage to ascribe superiority of one medication regimen over another or, perhaps equally likely, there is simply no appreciable advantage to be elucidated. For instance, Naja et al. [16] injected 3 ml of a 10-ml mixture that included 3 ml of lidocaine 2 %, 3 ml of lidocaine 2 % with epinephrine 1:200,000, 2.5 ml of bupivacaine 0.5 %, 0.5 ml of fentanyl 50 mcg/ml, and 1 ml of clonidine 150 mcg/ml. The authors suggest that this mixture demonstrates superior longevity that exceeds the expected duration of action of the local anesthetic alone. However, Arner et al. [17], using 0.5 % bupivacaine alone, obtained analgesia that exceeded the expected duration of effect in 18/38 consecutive patients treated for peripheral neuralgia. Thus, the incremental improvements in dose response attributable to additives remain uncertain.

Lastly, there exists some evidence to substantiate the efficacy of frequently repeated injections over single interventions to achieve prolonged analgesia. Naja et al. [18] performed occipital nerve blocks repeatedly in 47 patients with cervicogenic headache and were able to achieve a 6-month period of pain relief in 96 %. Interestingly, the authors found that the number of blocks required to reach this end point could be predicted by adding one injection for every 3 years of headache history. Similarly, Caputi and Firetto [19] succeeded in obtaining a 50 % or greater reduction in the total pain index in 23/27 patients using repetitive local anesthetic-only blocks in the treatment of chronic migraineurs.

Indications

1. Occipital neuralgia
2. Cluster headache
3. Cervicogenic headache
4. Migraine

5. Cancer pain in the region [10]
6. Headache associated with muscular spasm or tension [10]
7. Anesthesia of posterior scalp [10]
8. Postconcussive headaches
9. Atypical orofacial pain [20]
10. Abnormal head movements, tinnitus, and dizziness associated with history of trauma [21]
11. Postdural puncture headache [13]
12. Rescue treatment for headaches proving recalcitrant to other measures
13. As an adjuvant to medication-overuse headache

Likely Ineffective

1. Tension headache
2. Hemicrania continua
3. Chronic paroxysmal hemicrania

Contraindications

1. Patient refusal
2. Bleeding diathesis
3. Local or systemic infection
4. Local neoplastic disease

Evidence-Based Review

In recent years, numerous studies have been published demonstrating the efficacy of GONB in multiple chronic pain and other conditions. Quite surprisingly, however, there are few randomized, double-blind, placebo-controlled trials, and the preponderance of evidence available is confounded by methodological discrepancies in diagnosis, technique, treatment, and outcome. Regardless, the available evidence does suggest that several conditions are likely to respond favorably to GONB. Perhaps this ambiguity in diagnostic response is more attributable to insufficient understanding of underlying pathophysiology and resultant overlap in ascribed diagnoses. Alternatively, the functional anatomical convergence of the occipital afferents and the trigeminal nerve complex in the proximal cervical spinal cord may render multiple distinct disease states susceptible to the same intervention. Evidence for this theory is supported by multiple findings. Goadsby et al. [22] showed that the cervical dorsal horn and trigeminal nucleus caudalis show increased metabolic activity during stimulation of the occipital nerve, suggesting that the second-order neurons overlap in their nociceptive processing. This finding was supported by the work of Piovesan et al. [23], who elicited pain in the distribution of the trigeminal nerve, including parasympathetic activation suggestive of trigeminal autonomic activation, during sterile water injection over the greater occipital nerve. More recently, Busch et al. [24, 25] have shown decreases in the nociceptive blink reflex area and increase in the reflex latency following occipital nerve blockade. The functional connectivity between cervicooccipital afferents and the trigeminal nerve complex would, as it appears, be central to the evidentiary link between GONB and its efficacy in the conditions described below. However, the response of primary headache disorders, in addition to occipital neuralgia, to GONB is felt by some to subvert the block's value as a diagnostic tool [26].

Cervicogenic Headache

Multiple studies have repeatedly shown positive responses to GONB in patients with cervicogenic headaches. Naja et al. [16] in a randomized, double-blind, placebo-controlled clinic trial investigated the efficacy of GONB and lesser occipital nerve block in patients with a diagnosis of cervicogenic headache. The facial nerve was also blocked in this study in patients with pain that extended into the orbital area. Using nerve stimulator guidance for localization, the authors injected 10 ml of a mixture containing 2 % lidocaine, 0.5 % bupivacaine, epinephrine, fentanyl, and clonidine to prolong duration of effect. The procedure reduced VAS and TPI scores by 50 % ($P = 0.0001$), as well as reducing associated symptoms including duration and frequency of headache and analgesic consumption ($P < 0.05$). In a prospective, open-label, case-series follow-up study that involved repeat injections as needed, the authors were able to achieve a 6-month period of pain relief in 96 % of the study participants in the setting of medication tapering. The study patients received an average of 5.3 injections, and the authors concluded that following the initial injection, patients would require one additional injection for each 3 years of headache history to achieve 6 months of relief. Multiple other unblinded studies have corroborated the findings of Naja et al. [27–29].

Cluster Headache

Cluster headache, like cervicogenic headache, has shown statistically significant improvement when treated by GONB in a number of studies. In a double-blind, randomized, placebo-controlled trial, Ambrosini et al. [30] randomized patients with cluster headache to receive 2 % lidocaine with either short- or long-acting betamethasone or normal saline. Headaches resolved in 85 % of patients, lasted for more than 4 weeks in 61 % and more than 4 months in 38 %. Retrospective analyses have also concluded that cluster headaches may respond to GONB. Afridi et al. [31] injected

3 ml of 2 % lidocaine plus 80 mg of methylprednisolone into a subgroup of patients with refractory cluster headache and found complete resolution in 53 % and partial resolution in an additional 16 %. The mean duration of benefit in this population from a single injection was 17 days. Likewise, Peres et al. [32] injected 14 cluster headache patients with 3 ml of 1 % lidocaine and 40 mg of triamcinolone, with 64 % of the study population rendered headache-free following injection and a mean duration of benefit of 13 days.

Occipital Neuralgia

According to the second edition of the International Headache Classification (ICHD-2), efficacy of GONB is, by definition, assumed. That is, in addition to the appropriate symptom complex and physical examination findings, pain must be, at least temporarily, alleviated by blockade of the occipital nerve. As such, prospective investigations determining response in patients presumed to have the diagnosis are rendered redundant. Retrospective analyses have been carried out, however. Anthony [14], using diagnostic criteria that included "unilateral occipital headache … with or without referral to the ipsilateral orbital or supraorbital areas, circumscribed tenderness over the GON … and hypoalgesia, hyperalgesia or dysaesthesiae in the area of distribution of the GON," found complete headache relief in 75 of 86 patients treated with GONB. The mean duration of relief in this study was 31 days when 160 mg of methylprednisolone was incorporated into the injectate. In another retrospective analysis performed by Tobin and Flitman [11], patients received GONBs if they had "significant headache pain … and if pressure on an ON reproduced their headache pain." In this group of patients, the authors achievewd a 78 % success rate with local anesthetic and steroid and quite interestingly noted that systemic medication overuse increased the rate of failure threefold, more so in migraneurs than in patients diagnosed with occipital neuralgia.

Migraine Headaches

The evidence supporting GONB in migraneurs is not as compelling as it has been in other conditions (see above), but the procedure has been shown beneficial in some patients nonetheless. In a prospective, open-label, single-treatment-arm study, Weibelt et al. [33] decreased the number of headache days per month by at least 50 % in 78/150 patients, and 90/150 reported their symptoms to have subjectively improved. In a double-blind, controlled, crossover study, Piovesan et al. [34] found that GONB did not reduce the number or duration of migraine attacks, but did conclude that the intensity of headache symptoms was reduced 60 days following the injection. In a prospective, open-label, uncontrolled study, Caputi and Firetto [19] used GONB and supraorbital nerve blocks in on migraine patients whose physical examination was notable for tenderness to palpation over the respective nerves. The authors injected these areas until the tenderness had diminished to less than half its baseline value and noted that 5–10 injections would produce lasting and increasing benefit for as much as 6 months in 85 % of the patients studied. Afridi et al. [31] found benefit with GONB in patients with intractable migraine, obtaining complete or partial (>30 % improvement) response in 46 % of the injections, with a median duration of response of 30 days. Notably, the authors found no correlation between local anesthesia over the distribution of the GON and migrainous response. Gawel and Rothbart [35] retrospectively reviewed GONB with local anesthetic and steroid in their own migraine population and found that 54 % of patients with non-posttraumatic migraineurs felt "significantly better" for up to 6 months following the injection. The authors also noted that in patients with a diagnosis of posttraumatic migraine, the benefit was greater, with 72 % of patients reporting such benefit. The improved response rate in posttraumatic migraineurs has been substantiated by other studies, including Tobin and Flitman [11] who obtained 100 % efficacy (12/12) in post-concussive migraineurs.

Other Uses

The implications of convergence between the trigeminal nerve complex and occipital afferents suggest that the infiltration of medications around the GON may have applications well beyond typical occipital neuralgia. For instance, a recent prospective, randomized, single-blind, clinical study investigated the efficacy of nerve stimulator-guided GONB for the treatment of postdural puncture headache, with 68.4 % of the patients achieving complete relief after one to two blocks, with the remaining 31.6 % experiencing relief after three or four injections [13]. Given the side effect profile of epidural blood patches, this study raises the possibility of an equally effective treatment with far less risk, especially in the immunocompromised and/or anticoagulated postsurgical population.

Another potential avenue of pursuit in GONB involves the mitigation of withdrawal symptoms in patients being treated for chronic medication-overuse headaches. Afridi et al. [31] noted that in patients treated for migraine, there was no statistically significant association between block response and medication overuse. Data from Tobin and Flitman [11] is less supportive, but these authors still demonstrated a 56 % success rate even in those patients overusing abortive agents. In fact, the response rate in medication overusers

was quite similar between the two studies, 20/31 (65 %) in Afridi et al. vs. 14/25 (56 %) in Tobin and Flitman's. Considering the difficulty with which many patients with medication-overuse headache wean from their pharmaceuticals, a procedure with the potential to moderate their course would certainly be advantageous.

Occipital Nerve Stimulation

Occipital nerve stimulation has become an increasingly popular modality for treating intractable headaches. In 1999, Weiner et al. [36] reported on a small group of patients with occipital neuralgia who had beneficial effects from subcutaneous neural stimulation. Since that initial report, use of occipital nerve stimulation has extended to more global headache diagnoses, such as migraine [1, 37, 38]. In the past, practitioners have used occipital nerve blocks to predict success with occipital nerve stimulation. However, recent studies show that occipital blocks are not useful for predicting success with occipital stimulation [39, 40]. Indeed, the most recent publication of the ONSTIM trial by Saper and others shows that response to occipital nerve block was not part of inclusion criteria [41].

Cautions

Despite the volume of scientific literature available supporting the use of GONB and the evidence for benefit in a number of clinical conditions, the results must be taken with caution. There are no uniform methods for GONB application, nor were the patient populations studied homogenous. Additionally, with rare exceptions, the bulk of data currently available was derived from uncontrolled investigations, confounding any conclusions that may be drawn. Determining whether the study findings are the result of the explicitly stated pathophysiological associations or more serendipitous interactions will require more focused investigation.

Another issue that clearly needs to be further delineated relates to the location of injection and the tissues through which the needle passes. Although advocated as primary block of the GON, it seems rather obvious that injections performed more medially and caudally, where the GON exits the semispinalis capitis, are in fact also infiltrating local anesthetic into the paraspinal muscles. In effect, this represents a trigger-point injection in addition to any neural blockade that may be taking place and may be responsible, at least in part, for the finding by Afridi et al. [31] that anesthesia in the distribution of the greater occipital nerve did not correspond to degree of pain relief. This situation is made all the more ambiguous by the propensity of many practitioners to inject not according to any distinct anatomical location but rather in the area of greatest tenderness to palpation or reproduction of typical headache symptoms. Specifically, what is being "blocked" during such procedures is unclear, and as such, the mechanism of underlying pathophysiologic modification and subsequent clinical improvement remains uncertain.

Conclusions

Occipital nerve block has been, and will almost certainly remain, a frequently implemented tool in the pain physician's armamentarium. The procedure has proven effective for several conditions, including, by definition, occipital neuralgia, but also cervicogenic and cluster headaches. There also appears to be a role for treatment in migraineurs, although further investigation is needed. Despite the prevalence of the block, numerous technical variances obscure definitive conclusions.

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