Clinical Review

OCCIPITAL NERVE BLOCKS IN THE TREATMENT OF HEADACHES: SAFETY AND EFFICACY

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Abstract—Background: Considering current limitations in known treatment options and the significant disability associated with headache disorders, investigation of additional options is needed. Although occipital nerve blocks (ONBs) are currently being utilized frequently in specialty settings, the potential role of ONBs as an alternative to opioids for the management of acute headache episodes in primary and emergency care settings is not yet understood. Objective: Our aim was to conduct a systematic literature review of the available evidence regarding the use of ONBs for the management of acute headaches, and then determine its potential for use in the emergency care setting. Techniques, medication selection, adverse reactions, frequency of use, candidates, and measures that can help improve safety were reviewed in order to better evaluate the usefulness of this tool in emergency care. Discussion: Occipital nerve blocks are technically simple procedures that are highly successful in providing dramatic pain relief results. They are also a relatively safe and beneficial alternative to other headache treatment options. Case reports and research have demonstrated that ONBs can be performed safely in outpatient settings. However, due to the paucity of literature on the use of ONBs in emergency care settings, it can only be speculated that the same outcomes can be achieved. Conclusions: Interest in the use of ONBs in acute care settings is increasing. Current evidence supports that ONBs can be delivered safely in an outpatient setting by providers who have been trained in and have practiced this procedure. Although additional research is needed, current evidence supports that ONBs can be useful in treating acute headaches in an emergency care setting. © 2015 Elsevier Inc.

Keywords—occipital nerve block; headache; technique; safety; efficacy

INTRODUCTION

Peripheral nerve blocks (PNBs), including occipital nerve blocks (ONBs), and trigger point injections (TPIs) have been receiving increased attention and support as pain-management tools, particularly for acute headache management in the outpatient setting. They could also play a role in other care settings, such as the emergency department (1–3). PNBs are injections of local anesthetics, with or without the inclusion of steroids, targeted to inhibit the activity of particular sensory nerves and reduce pain (2,4). TPIs work similarly, but are directed at the maximum point of pain rather than associated nerve fibers (4). Local anesthetics act to inhibit pain transmission through the nerve fibers by reversibly inhibiting sodium channels. They also act on unmyelinated C-fibers and thinly myelinated Aα fibers that mediate pain. As local anesthetics are not able to penetrate more thickly myelinated fibers, motor neurons are protected from being affected (5). The inclusion of a steroid is thought to provide longer-acting relief by reducing the influx of inflammatory cytokines and the formation of...
prostaglandins (6). In a nerve injury model demonstrating mechanism of action, steroids were shown to block the transmission of pain in afferent or sensory nerve fibers and decrease heat and mechanical sensitivity (7). While local anesthetics act on affected nerve fibers within a matter of minutes and last maybe a few hours, steroids usually take 24 to 48 h to take effect, but can provide much longer-lasting effects.

The greater occipital nerve (GON) is the nerve most commonly implicated in headaches (8). It is the main sensory nerve of the occipital area and derives most of its fibers from the cervical (C2) dorsal root (3,9). The application of anesthetic around these nerves is thought to interrupt the pain cycle involved with headaches, providing pain relief that often extends beyond the length of time the anesthetic is expected to be active (10). Greater occipital nerve blocks (GONBs) and lesser occipital nerve blocks (LONBs) have been used most frequently in the treatment of occipital neuralgia and cervicogenic headaches, which are defined by pain over the occipital areas (2,3,11). However, animal studies have demonstrated a functional continuum between the nerves of the upper cervical region and the trigeminal nerve (12). These findings might help to explain why patients receiving ONBs have experienced relief of pain extending into the trigeminal area (7). Both trigeminal sensory nerve fibers and C1–C2 sensory nerve fibers converge upon the trigeminal nucleus caudalis and the dorsal horn nuclei of the upper cervical spinal cord (9). Busch et al. demonstrated that an injection of local anesthetic around the GON affected the nociceptive blink reflex that is modulated by the trigeminal nerve (13). This is an important finding, suggesting the usefulness of ONBs in the management of other types of headaches, where pain may not necessarily be centered over the occipital area. Although the use of ONBs in emergency medicine is still uncommon, these findings demonstrate the potential usefulness of this tool.

METHODS

This systematic review examines the available literature on the usefulness of ONBs for the treatment of various types of headaches, looking primarily in outpatient settings. Our objective was to then determine whether ONBs could be delivered safely and could be used effectively for the treatment of acute headaches in emergency medical care settings.

INCLUSION CRITERIA

We selected articles based on the following inclusion criteria: patients must have been adults (16 years and older) who have suffered a diagnosed headache disorder; different types of headaches diagnosed must have been treated with ONBs; and ONBs must have been conducted in outpatient medical care settings. Randomized controlled trials, observational studies, case reports, and systematic reviews were included.

SEARCH STRATEGY

The search strategy was designed by the lead author (C. L. Voigt) with input from the coauthor (M.O. Murphy). A librarian at our institution’s research facility was consulted to help refine the search strategy. The author (C. L. Voigt) searched the electronic PubMed database from 1997 to 2013 using the following key terms/phrases: occipital block, nerve block and headache, nerve block and migraine, and headache management. All article titles meeting the inclusion and search criteria were reviewed first, followed by abstracts, then full English-language articles. Additional relevant articles that may have been overlooked in the initial database search were identified by reviewing citations and references from the chosen articles. If any questions arose about the relevancy of a title, abstract, or article, the lead author (C. L. Voigt) consulted with the coauthor (M. Murphy).

SELECTION OF ARTICLES

Articles looking at the effectiveness of ONBs, duration of pain relief, the frequency/interval of nerve blocks performed, adverse effects, technique, and the medications/dosages given were targeted. Focus was placed on finding the most recent research-based evidence related to the use of occipital blocks. Figure 1 shows the progression of article selection and the numbers of articles at each step.

RESULTS

Five randomized controlled trials (RCTs) were identified on the use of ONBs in the management of headaches. Table 1 summarizes the characteristics of these RCTs. Three were double-blind trials, one was a single-blind trial, and one was an open-label trial (7,14–17). Two of the double-blind studies focused on cluster headaches and the third on cervicogenic headaches. These studies were small, comparing 10 to 25 subjects to controls. Each demonstrated statistically significant results showing an improvement in headache symptoms, with relief lasting from 1 day to 8 months. Ashkenazi et al. completed the single-blind study that compared the use of local anesthetic plus steroid to local anesthetic alone, but only included results measured at 20 min (16). Both the experimental and the control groups showed an equally successful response. The open-label RCT compared ONBs and cognitive behavioral therapy (16).
However, this study was considered incomplete because of the high dropout rate among subjects in the cognitive behavioral therapy group. A major challenge in designing RCTs is that the use of a local anesthetic vs. a placebo is immediately noticeable to subjects. Other challenges include the distinct identification of different headache types and the multifactorial nature of headaches and influencing factors.

Twelve observational studies regarding the use of ONBs were reviewed (8,9,18–27). Their characteristics are summarized in Table 2. They varied in size from 10 to 150 subjects and included cluster headache, chronic migraine, cervicogenic headache, post-concussive headache, chronic tension-type headache, and chronic daily headache. In the majority of these longitudinal studies, occipital blocks were trialed after the patients failed other treatment options. In each of these studies, excluding the one looking at tension headaches, at least 50% of subjects reported improvement. These observational studies also showed significant improvement of allodynia associated with migraines, as well as photophobia and phonophobia. Patients reported significant improvement in anxiety, depression, ability to complete activities of daily living, and an improvement in overall quality of life (22).

Seven case studies were reviewed and are summarized in Table 3 (28–34). Each demonstrated significant results with the use of occipital blocks in the treatment of headaches. Rozen reported on a case of a 25-year-old woman with migraines associated with right-sided hemiparesis, aphasia, and hemisensory disturbances (29). A bilateral block of the GON was given using a local anesthetic and steroid. At 5 min post injection, the ptosis and aphasia had resolved and, at 1 h, the patient was headache free with no motor symptoms. Tobin and Flitman presented the case of a patient suffering from migraines who was allergic to local anesthetics (31). Therefore, the patient was injected multiple times during the course of several months with varying doses of methylprednisolone to the LON or GON. The authors reported that there seemed to be a specific dosage range, which is >40 mg and <80 mg, which provided optimal benefit. They also concluded that steroids appear to confer benefit in patients with migraine, although there is a longer onset of relief. Onset of pain resolution in this patient was between 18 h and 5 days. In the only case report from an emergency department setting, Scattoni et al. describes the effectiveness of administering ONBs for an episodic cluster headache (30). They also propose the use of ONBs in emergency care settings as an abortive therapy.

Two systematic reviews were evaluated. Tobin and Flitman reviewed 21 articles regarding the use of ONBs in the treatment of headache (35). They concluded that there was sufficient evidence to support the use of ONBs in the treatment of cervicogenic headache, cluster headache, and occipital neuralgia. Although there was no double-blind RCT supporting the use of ONBs in migraine, they advocated that several observational studies available demonstrated favorable results. The
<table>
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<tr>
<th>First Author, Year</th>
<th>Type of Study</th>
<th>Type of Headache</th>
<th>No. of Subjects</th>
<th>Patients Receiving Benefit</th>
<th>Length of Results</th>
<th>Adverse Effects</th>
<th>Technique</th>
<th>Medication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambrosini, 2005</td>
<td>Double blind</td>
<td>Unilateral GONB</td>
<td>23 (13 target and 10 control; received just lidocaine)</td>
<td>12/13 target 0/10 control</td>
<td>8 days to 8 months</td>
<td>Pain at injection site (n = 2)</td>
<td>Suboccipital fossa midway between the occipital protuberance and mastoid process, inserted until hit bone</td>
<td>12.466 mg long-acting betamethasone; 5.26 mg rapid-acting betamethasone; 0.5 mL 2% lidocaine</td>
</tr>
<tr>
<td>Leroux, 2011</td>
<td>Double blind</td>
<td>Unilateral GONB × 3 and 48–72 h apart</td>
<td>43 (21 target, 22 control)</td>
<td>20/21 target 12/22 control Decreased use of analgesics and higher satisfaction</td>
<td>Difficult to determine based on study parameters Block used as bridge with prophylactic use of verapamil</td>
<td>Pain at injection site (n = 32); Noncluster headache (18/14)*</td>
<td>Suboccipital 1/3 the distance between the occipital protuberance and mastoid process until hit bone; injected in three directions from site</td>
<td>Cortivazol 3.75 mg</td>
</tr>
<tr>
<td>Naja, 2006</td>
<td>Double blind</td>
<td>GONB and LONB for all, and facial block for 16/25</td>
<td>50 (25 target, 25 control)</td>
<td>50% improvement in pain scores, decreased analgesic use, decreased duration/frequency of headache, improved nausea/vomiting photo/phonoophobia, and activity limitations</td>
<td>Mean no. of days with pain relief = 3.67 (1.52 for control)</td>
<td>None</td>
<td>Nerve stimulator guided 1 cm below line between the occipital protuberance and the mastoid at site most sensitive to simulation</td>
<td>3 mL 2% lidocaine; 3 mL 2% lidocaine with epinephrine 1:200,000; 2.5 mL 0.5% bupivacaine; 0.5 mL or 25 µg fentanyl; 1 mL or 150 µg clonidine. Total 10 mL given divided between sites (3 mL/site)</td>
</tr>
<tr>
<td>Ashkenazi, 2008</td>
<td>Single blind</td>
<td>Bilateral GONB and trigger point injections (n = 12)</td>
<td>37</td>
<td>37 (measured at 20 min) No difference was noted between the treatment and the control groups</td>
<td>1–7 days</td>
<td>None</td>
<td>1/3 the distance between the occipital protuberance and the mastoid process (2 mL)</td>
<td>4.5 mL 2% lidocaine; 4.5 mL 0.5% bupivacaine; 1 mL 40 mg triamcinolone or saline Each received 10 mL</td>
</tr>
<tr>
<td>Gale, 2002</td>
<td>Nonblinded</td>
<td>Comparing repeated nerve block and cognitive behavioral therapy</td>
<td>68 (34 each group)</td>
<td>30/34 patients dropped out of the cognitive behavioral treatment program to return to receiving NB 1/34 NB patients dropped out</td>
<td>None reported (patients receiving NB on 1- to 3-week intervals for 7–8 years)</td>
<td>Lateral border of the trapezius muscle in its attachment to the nuchal line.</td>
<td></td>
<td></td>
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</table>

GONB, greater occipital nerve block; LONB, lesser occipital nerve block. * Pain noted at the injection site in 18 out of 21 from experimental group and 14 out of 22 controls. (18/21 target & 14/22 control)
<table>
<thead>
<tr>
<th>First Author, Year</th>
<th>Type of Study</th>
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<th>No. of Subjects</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Ashkenazi, 2005 (18)</td>
<td>Prospective GONB with or without trigger point injections</td>
<td>Migraine with brush allodynia</td>
<td>19</td>
<td>17 (89.5%) headache improved at 20 min; 19 improvement in allodynia</td>
<td>Only measured at 20 min</td>
<td>None reported</td>
<td>2 cm lateral to occipital protuberance</td>
<td>2 mL 2% lidocaine and 5 mg triamcinolone; TPI with lidocaine only</td>
</tr>
<tr>
<td>Busch, 2007 (19)</td>
<td>Prospective GONB</td>
<td>Cluster</td>
<td>15</td>
<td>9 (6 relief x 24 h; 1 relief x 72 h; 1 no pain improvement, but improvement in autonomic symptoms x 72 h; 1 cessation of interval headache)</td>
<td>3 days</td>
<td>Halfway between the occipital protuberance and mastoid process</td>
<td>5 mL 1% prilocaine</td>
<td></td>
</tr>
<tr>
<td>Caputi, 1997 (20)</td>
<td>Prospective Repeated injections on alternate days; 5–10 either supraorbital (16) or GONB (11)</td>
<td>Migraine</td>
<td>27 (without aura-23; with aura 6)</td>
<td>23 (85%) Decreased use of analgesics; decreased number of migraines</td>
<td>Out to 6 months</td>
<td>None</td>
<td>GON-2 cm lateral and 2 cm inferior to the greater occipital protuberance based on points sensitive to palpation</td>
<td>0.5–1 mL 0.5% bupivacaine</td>
</tr>
<tr>
<td>Leinish-Dahlke, 2005 (21)</td>
<td>Prospective Bilateral GONB</td>
<td>Chronic tension-type headache</td>
<td>15</td>
<td>1</td>
<td>Several weeks</td>
<td>Injection site pain (n = 3); Bradycardia (n = 1), appeared to be a vasovagal reaction</td>
<td>50 mg prilocaine (5 mL); 4 mg dexamethasone (1 mL); 6 mL split between two sites</td>
<td></td>
</tr>
<tr>
<td>Peres, 2002 (22)</td>
<td>Prospective Unilateral GONB</td>
<td>Cluster</td>
<td>14</td>
<td>11 (79%) (9 with headache free period/2 with reduced intensity/frequency)</td>
<td>Measured out to 2 weeks</td>
<td>None</td>
<td>Lateral border of the trapezius muscle in its attachment to the nuchal line</td>
<td>3 mL 1% lidocaine; 40 mg triamcinolone</td>
</tr>
<tr>
<td>Rothbart, 2000 (23)</td>
<td>Prospective GONB and LONB</td>
<td>Chronic cervicogenic headache</td>
<td>100</td>
<td>Mean pain score improved from 8.6 to 2.3/10; mean depression rating improved from 7.3 to 2.5; anxiety improved from 6.6 to 2.2; ability to complete ADLs improved 97/100; quality of life improved 95/100</td>
<td>7.15 days</td>
<td>None</td>
<td>Suboccipital until it hit the bone (aspiration negative) Injected at site in three directions</td>
<td>4–6 mL 0.375% bupivacaine</td>
</tr>
<tr>
<td>Weibelt, 2010 (24)</td>
<td>Prospective Unilateral (n = 48) and bilateral (n = 102) ONBs</td>
<td>Chronic (transformed) migraine</td>
<td>150</td>
<td>90 (60%); Additional 47 (31%) reported significant improvement that failed to last &gt;1 week</td>
<td>Measured at 30 days</td>
<td>Tenderness at site (n = 150); vasovagal presyncope (n = 19); brief syncope (n = 2); transient hypophonia and dysphagia (n = 3); transient SOB (n = 1)</td>
<td>10 mL bupivacaine and 20 mg triamcinolone each side</td>
<td></td>
</tr>
<tr>
<td>Young, 2008 (25)</td>
<td>Prospective Unilateral GONB ×1–2 with confirmation of anesthesia</td>
<td>Migraine, unilateral with trigeminal distribution</td>
<td>24</td>
<td>64% improvement in pain; 75% improvement in allodynia; 67% improvement in photophobia</td>
<td>Mean 4 days with 23.5% still reporting benefits at 1 week</td>
<td>None</td>
<td>Suboccipital until it hit the bone (aspiration negative) Injected at site in three directions</td>
<td>0.5 mL 2% lidocaine; 0.5 mL 0.5% bupivacaine (1 mL total)</td>
</tr>
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(Continued)
<table>
<thead>
<tr>
<th>First Author, Year</th>
<th>Type of Study</th>
<th>Type of Headache</th>
<th>No. of Subjects</th>
<th>Patients Receiving Benefit</th>
<th>Length of Results</th>
<th>Adverse Effects</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Lambru, 2014 (27)</td>
<td>Prospective Unilateral GONB</td>
<td>Chronic cluster headache</td>
<td>83</td>
<td>47 (57%) responded to the injection; 35 (42%) became pain-free; 12 (15%) achieved partial response</td>
<td>Median of 21 days</td>
<td>34% of the patients reported mild and self-limited tenderness at the injection site, neck stiffness, or dizziness</td>
<td>Injected in the suboccipital area at a point lying on the medial third of a line drawn between the inion and mastoid process, ipsilateral to the pain at site in three different directions</td>
<td>80 mg methylprednisolone and 2 mL of 2% lidocaine</td>
</tr>
<tr>
<td>Afridi, 2006 (9)</td>
<td>Retrospective GONB × 1+ 116 injections 101 subjects</td>
<td>Chronic daily headache (migraine 49%; cluster 19%; daily headache (14%); hemicrania continua (9%))</td>
<td>101</td>
<td>62 (53%)</td>
<td>Mean 20 days (1–420 days)</td>
<td>Small patch of alopecia at site (n = 2); vasovagal syncope (n = 1); transient dizziness (n = 3); typical headache (n = 3); worsening of symptoms (n = 2)</td>
<td>1–2 cm below the midpoint between the occipital protuberance and the mastoid process.</td>
<td>3 mL 2% lidocaine; 80 mg methylprednisolone</td>
</tr>
<tr>
<td>Hecht, 2004 (8)</td>
<td>Retrospective GONB with or without LONB Post-concussive with occipital tenderness</td>
<td>Headache reproduced or worsened with pressure on either the greater or lesser ON (symptomatic medication overuse tripled the risk of ONB failure)</td>
<td>10</td>
<td>10 (2 &lt; 24 h)</td>
<td>&gt;24 h</td>
<td>1–3 mL 0.5% bupivacaine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tobin, 2009 (28)</td>
<td>Retrospective ONB</td>
<td>Headache reproduced or worsened with pressure on either the greater or lesser ON (symptomatic medication overuse tripled the risk of ONB failure)</td>
<td>108</td>
<td>78% of injections provided improvement of 83%</td>
<td>Mean 6.6 weeks</td>
<td>Injection at area of greatest tenderness along superior nuchal line in general vicinity of target ON</td>
<td>1.5 mL 0.5% bupivacaine; 60 mg methylprednisolone</td>
<td></td>
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ADL, activities of daily living; GONB, greater occipital nerve block; LONB, lesser occipital nerve block; TPI, trigger point injection; SOB, shortness of breath.
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<tr>
<th>First Author, Year</th>
<th>Type of ONB</th>
<th>Type of Headache</th>
<th>No. of Subjects</th>
<th>Benefit Received</th>
<th>Length of Results</th>
<th>Adverse Effects</th>
<th>Technique</th>
<th>Medication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baron, 2010 (28)</td>
<td>Unilateral GONB</td>
<td>Basilar-type migraine with aura</td>
<td>1</td>
<td>Complete resolution in several minutes of all symptoms; decreased severity of symptoms noted over the next month</td>
<td>1 month</td>
<td>None</td>
<td>GONB in the right occipital region (ipsilateral to the cluster headache), over the neuroma site</td>
<td>3 mL 0.25% bupivacaine; 40 mg triamcinolone</td>
</tr>
<tr>
<td>DiStani, 2008 (34)</td>
<td>Unilateral GONB</td>
<td>Atypical cluster headache with trigeminal symptoms</td>
<td>1</td>
<td>Pain-free within minutes</td>
<td>6 months</td>
<td>None</td>
<td></td>
<td>5 mL 2% lidocaine, 4 mg betamethasone</td>
</tr>
<tr>
<td>Rozen, 2007 (29)</td>
<td>Bilateral GONB (performed × 2 with same results)</td>
<td>Migraine with hemiparesis, aphasia, and hemisensory disturbances</td>
<td>1</td>
<td>At 5 min, ptosis and aphasia resolved and pain improved; complete resolution at 1 h</td>
<td>2 weeks</td>
<td>None</td>
<td></td>
<td>5 mL 1% lidocaine; 40 mg triamcinolone on each side</td>
</tr>
<tr>
<td>Scattoni, 2006 (30)</td>
<td>Unilateral GONB (in Emergency Department)</td>
<td>Episodic cluster headache</td>
<td>1</td>
<td>Complete pain relief within a few minutes</td>
<td>1 year</td>
<td>None</td>
<td></td>
<td>5 mL 2% lidocaine; 2 mg betamethasone</td>
</tr>
<tr>
<td>Tobin, 2011 (31)</td>
<td>LONB × 5; GONB × 1</td>
<td>Migraine</td>
<td>1</td>
<td>#1 (60 mg) complete resolution at 18 h for 21 days #2 (80 mg) increased headaches/pain at site #3 (60 mg) relief × 14 days #4 (50 mg-GON) resolution at 5 days lasting 21 days #5 (40 mg) no relief #6 (50 mg) relief × 14 days then 3–4 headaches/month × 3</td>
<td>3 months</td>
<td>Injection site pain</td>
<td>GON 2 cm below nuchal line and 1/3 the distance from the occipital protuberance to the mastoid process; LON 2/3 distance and 2 cm below</td>
<td>Various doses of methylprednisolone</td>
</tr>
<tr>
<td>Young, 2004 (32)</td>
<td>Unilateral GONB with TPI</td>
<td>Menstrual migraine with left occipital pain</td>
<td>1</td>
<td>Alldynia relieved after 1 min; complete resolution at 5 min</td>
<td></td>
<td></td>
<td></td>
<td>5 mL 2% lidocaine and 10 mg triamcinolone between all sites</td>
</tr>
<tr>
<td>Young, 2008 (33)</td>
<td>Unilateral GONB, supraorbital, and supratrochlear blocks</td>
<td>Migraine with photophobia and alldynia</td>
<td>1</td>
<td>Relief within 30 s of last injection</td>
<td>2 weeks</td>
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GONB, greater occipital nerve block; LONB, lesser occipital nerve block; TPI, trigger point injection.
authors also felt that ONBs may be of use with medication-overuse headaches and specific cases of tension headache. Ashkenazi et al. also completed a systematic review highlighting evidence supporting a functional continuum between the GON and the trigeminal system (4). This evidence supports the use of ONBs in the treatment of headache disorders, even when pain is not centered over the occipital area.

Our systematic review had some similarities, as well as differences, to these two reviews. We utilized some of the same articles—12 of the 43 (28%) referenced in Tobin and Flitman and 12 of the 34 (35%) referenced by Ashkenazi et al.—who also used PubMed to perform their literature searches (4,26). The differences between our review and the 2009 review by Tobin and Flitman included the fact that they searched MD Consult and Google Scholar, not PubMed, used additional search terms (suboccipital, injection), and only included case reports and clinical trials (26). Ashkenazi et al. searched for the terms peripheral nerve block and trigger point injection, in addition to occipital nerve block, also looked through textbooks for information, and did not limit their search to a specific time period (4).

DISCUSSION

The RCTs that have been conducted on this topic have all included ≤70 subjects. Even so, each of the studies demonstrated statistical significance in comparing the results of the treatment group with those in the placebo group. Available observational studies also show strong evidence that ONBs are effective in providing pain relief for patients, especially considering that occipital blocks were utilized after other treatment options had failed. Recognizing the significant disability and impact on quality of life for patients with headache disorders, further exploration of additional treatment options is warranted. This is especially true if the procedure can be performed by providers in primary and emergency care settings, with minimal risks, and at a reasonable cost. Utilizing the U.S. Preventive Services Task Force grading of evidence definitions and information from Peres et al., Table 4 was created to show the grades that can be provided, based on available research, for the use of ONBs in the treatment of various types of headaches (22,36).

Performing Occipital Nerve Blocks

The Interventional Procedures Special Interest Section of the American Headache Society has established the long-term goal of developing a consistent, evidence-based approach to the use of ONBs in the management of headache (2,37). A survey was conducted among American Headache Society members regarding the use of ONBs and TPIs in the treatment of headaches. Providers reported that injections were generally well tolerated by patients, however, pain and numbness at the injection site was commonly reported, along with some reports of transient lightheadedness or syncope. Most did not give PNBs to patients under the age of 18 due to limited research evidence, concerns regarding liability, and poor patient tolerance and cooperation. Response was generally measured in months, and most provided repeated injections at intervals of 1 to 8 weeks with local anesthetics and 2 to 12 weeks with steroids. Of note, reimbursement problems were rarely reported. The survey concluded that both ONBs and TPIs were commonly used by providers who specialized in the management of headaches, and the procedures appear to be well tolerated and safe.

Technique

The majority of studies and summary articles utilize palpable physical landmarks in identifying the location of injection (Figure 2). However, the recommended location for injection varied. Most frequently, an imaginary line is drawn between the occipital protuberance and the mastoid process as a reference point (4). Some authors suggest injecting at both one third the distance and at midpoint along this line, as well as 1 to 2 cm inferior to midpoint. Levin suggests palpating along this line for the occipital artery and injecting just medial to this point (5). Hecht recommends injecting just inferior to the point

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<th>Research Topic</th>
<th>Grade</th>
<th>Level of Certainty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use of occipital nerve blocks in the treatment of: Cluster headache</td>
<td>B</td>
<td>Moderate</td>
</tr>
<tr>
<td>Cervicogenic headache</td>
<td>B</td>
<td>Moderate</td>
</tr>
<tr>
<td>Migraine headache</td>
<td>C</td>
<td>Low</td>
</tr>
<tr>
<td>Tension-type headache</td>
<td>I (insufficient evidence)</td>
<td>Low</td>
</tr>
<tr>
<td>Hemicrania continua</td>
<td>I (insufficient evidence)</td>
<td>Low</td>
</tr>
<tr>
<td>Chronic daily headache</td>
<td>C</td>
<td>Low</td>
</tr>
</tbody>
</table>

Created using the U.S. Preventative Services Task Force Grading of Evidence definitions (36) and information from Peres et al. (22).
that is most tender with palpation along this line (8). The superior and inferior nuchal lines are also referenced to mark the point of injection. Naja et al. suggested using a nerve stimulator to more precisely locate the nerve to better identify the point of injection (15). Several authors also indicate that inserting the needle until a bony end point is met and then withdrawing minimally will prevent the solution from being inadvertently injected into the cranial vault. Some authors advocate for a single point of infiltration, while others suggest that it is beneficial to direct the needle in three directions from the point of insertion to further distribute the solution.

A study looking at anatomical variations in the course of the occipital nerves and whether anatomical landmarks could accurately identify the location of these nerves was completed by Ducic et al. (38). They noted that the course of the occipital nerves varied from classic anatomy texts by utilizing 112 live interoperative measurements and 13 cadaver specimens. They also measured the nerves diameter and the distance of the nerves from the occipital protuberance. In just less than half of the 125 patients studied, there were anatomical differences in the course of the nerves when comparing the left to the right side. They concluded that attempts to specifically target individual nerves based on anatomic landmarks may not be accurate based on anatomic variants. However, they noted that injections targeted to areas of tenderness, presumed to be nerve trigger tenderness, tend to consistently demonstrate success. Considering that local anesthetics penetrate tissue fairly easily, it is difficult to clearly discern what area affected is contributing to an improvement in symptoms, particularly when larger volumes are infused (33). Therefore, it might not be necessary to directly target the nerve in order to obtain a block, or make it necessary to inject in more than one direction at the insertion site to obtain symptom relief.

In 2010, Greher et al. suggested that the use of ultrasound may assist in improving accuracy and more precisely targeting specific nerves (39). They argued that current techniques based on anatomic landmarks often result in a nonselective blockade and that more accurate identification of the target nerve will reduce the volume of medication needed for injection, thereby reducing the risks of potentially adverse reactions. A recent case report utilizing ultrasound-guided blocks of the GON and a volume of 1 mL combining methylprednisolone and bupivacaine reported nearly complete pain relief in a patient suffering from post-concussive occipital headaches (40).

Most researchers felt that pain reproducible with palpation over the occipital nerve was a good indication that an ONB could be of use in providing pain relief (35). However, studies that did not utilize this criterion still demonstrated success. Weibelt et al. did not find a correlation between occipital tenderness and a positive response to treatment and felt that neither the physical examination nor the duration of headaches could be used to predict positive outcomes (24). Still, the practice is a reasonable measure that providers should choose to consider.

In considering what medications and volumes to utilize for injection, the studies reviewed did not provide a clear consensus. Regarding local anesthetics, the use of amides, including lidocaine, bupivacaine, and prilocaine, was promoted, as these medications tend to be more hypoallergenic and well tolerated (5). Lidocaine and prilocaine have a similar potency, with an onset of action between 4 and 8 min and duration of 1–2 h (5). Bupivacaine is four times more potent than lidocaine, with an onset of 8–12 min and duration of 4–8 h. However, it is more cardiotoxic than the other amide anesthetics (5).

The majority of adverse reactions associated with local anesthetics occur when they are given systemically. Most can be avoided by ensuring that the needle is not placed intravascularly by pulling back on the plunger to check for blood return. In order to ensure the accuracy of this technique, providers should avoid using 30-
gauge or smaller needles and should not apply back pressure too forcefully. However, caution is still advised, as all medications are eventually absorbed systemically. Another consideration is that local anesthetics are metabolized by the cytochrome P450 system, specifically 3A. Use of other medications competing for this same enzyme may result in increased systemic levels and lead to more adverse effects.

Studies evaluated volumes between 0.5 and 10 mL injected at a single site, with the most common volume being 3 mL. Of the studies included in this review, 11 used lidocaine (3 used 3–5 mL 1%; 8 used 0.5–5 mL of 2%) and 2 studies used prilocaine. Nine studies used bupivacaine, most using between 0.5 and 4.5 mL of 0.5%, one using 4–6 mL 0.325%, one using 3 mL 0.25%, and one using 10 mL without specifying the concentration. Three studies used a combination of lidocaine and bupivacaine. Current recommendations limit the dose of local anesthetic per treatment to 300 mg lidocaine or 175 mg bupivacaine, and a volume ratio of 1:1 to 1:3 (2). Five studies used only a local anesthetic, and 13 used a local anesthetic in combination with a steroid. Two studies used steroid alone.

The steroid most commonly used was triamcinolone in dosages from 5 to 40 mg. Other steroids used were methylprednisolone (40–80 mg), dexamethasone (4 mg), and betamethasone (2–12 mg). None of the studies provide a clear consensus about optimum dosing. The only comparison of dosages was a case study by Tobin and Flitman using methylprednisolone (31). The authors found that a 40-mg dose provided no relief, while relief was obtained with doses of 50–60 mg. An increase in headache symptoms was noted with a dose of 80 mg in a single patient. With the higher dosage, the patient reported increased injection-site pain that could have been associated with the higher medication dosage or the larger volume of medication delivered, either of which may have contributed to treatment failure.

Frequent use or large doses of steroids adversely impact collagen synthesis or the strength of connective tissue, potentially causing tissue necrosis, muscle wasting, and increasing the risk of tendon rupture (41). In reducing inflammation, steroids also reduce immune response and can impair healing of soft tissues at the site of injection. Steroids such as betamethasone are highly soluble and rapidly absorbed. As a result, they pose less risk for connective tissue injury, but also have a shorter duration of action. Less soluble steroids have the potential to provide longer lasting relief of pain, but they also sit at the site longer, increasing the risk of tissue injury.

The injection of steroids appears to increase the risk of adverse reactions, while the benefit remains unclear. However, for patients who achieve successful results with local anesthetics but do not maintain relief beyond a few days, utilization of a steroid should be considered. If the focus of treatment is abortive therapy, then the use of local anesthetics alone should be sufficient to induce relief and break the pain cycle. If occipital blocks are being considered for longer-term management of primary headaches, then the use of a steroid may provide longer-lasting relief. Young et al. recommended that this concern could be addressed, in part, by using a local anesthetic for injection and then following up with a course of oral steroids to assist in improving the length of response (33). Additional research will be needed to define the optimal amount of steroid that should be used with patients. Careful documentation of the use of steroids in any care setting is recommended to assist in better defining optimal dosages and tracking quality outcomes.

**Frequency**

Additional research is needed to clarify the potential risks with repeated nerve block injections, and to outline recommended treatment and dosage schedules. The current recommended frequency of anesthetic injections is once every 2–4 weeks, with injections of steroids performed less frequently (approximately once every 3 months), with timing dependent on the response of the individual patients (2). However, in their research, Caputi and Firetto did 5 to 10 ONBs using a local anesthetic on alternating days in patients with migraines and did not report any adverse effects out to 6 months (20). Leinisch-Dahlke et al. performed a series of three injections 48–72 h apart with a steroid on patients with chronic tension headache and did not report any systemic effects (21). Rothbart et al. reported that they have been routinely performing ONBs on a weekly, biweekly, or monthly basis in patients who were appropriate for, and benefitted from, this treatment for 5–8+ years (23). No long-term side effects or skin damage at the site of injection were reported.

**Potential Adverse Effects**

Overall, the risks and potential adverse effects associated with ONBs in the studies reviewed were relatively mild and transient. Anaphylactic reactions have been associated with local anesthetics, although reactions are less common with amide anesthetics, such as lidocaine and bupivacaine, than with ester anesthetics (4). Localized adverse effects can include hematoma and local pain. Shields et al. reported on two patients who developed small patches of alopecia with cutaneous atrophy at the injection sites, although these effects resolved in 7–24 months (42). As with any injection, there is a risk of infection at the injection site, nerve damage, and local injury to adjacent structures (5).
Systemic toxicity can occur with local anesthetics when large amounts are used, when the medication is inadvertently injected intravascularly, or when other medications contribute to increased systemic levels of the medication (4). Cases of methemoglobinemia, although rare, have been reported with injection of local anesthetics, predominantly lidocaine. Central nervous system symptoms related to systemic toxicity can include dizziness, lightheadedness, metallic taste, periorbital numbness, blurred vision, tinnitus, and more serious symptoms, such as muscle twitching, coma, convulsions, and cardiovascular or respiratory depression or arrest. Cardiovascular symptoms associated with toxicity can include chest discomfort or pain, palpitations or dysrhythmias, hypotension, shortness of breath, and syncope. These adverse effects are rare and can usually be avoided by use of proper injection technique. In balancing out treatment decisions, Ashkenazi et al. noted, “adverse effects are usually mild and transient, and head pain relief may be prompt and dramatic” (4).

Adverse reactions associated with steroid use can include agitation, dizziness, facial flushing, insomnia, and alopecia or changes in skin pigmentation at the site of the injection (41). Approximately 10% of patients may experience a steroid flare causing an increase in the intensity of pain at the injection site lasting 24–48 h. This occurs less frequently with more soluble steroid solutions. There was one report of a patient developing symptoms of Cushing syndrome associated with steroid injections, and the Cushing syndrome symptoms began to resolve on their own after the injections were discontinued (43). As this is the only identified case of Cushing syndrome associated with ONB injections of steroids, the authors proposed that this particular patient may have had an impaired metabolism of corticosteroids that left her more vulnerable with repeated injections during a 3-month time period.

Improving Safety

Baykal reported that puncture of the occipital artery is not uncommon and can result in hematoma (44). Applying pressure to the site after injection can address this complication. Using a small needle, advancing the tip slowly, and aiming for the tissue surrounding the occipital nerve is advised (5). A 25- to 27-gauge needle is recommended, as a 30-gauge or smaller needle can impair the provider’s ability to use aspiration in checking for intravascular placement. If the needle hits the nerve directly, the patient will report severe pain, at which point the needle should be slightly withdrawn and redirected. Irritation of the nerve during the procedure can usually be addressed by the application of a cold pack to the site to reduce local inflammation. Levin also advocates that multiple injection sites around the nerve are usually not necessary, as the local anesthetic diffuses well throughout surrounding tissue (5). However, some providers recommend injecting in three directions from the needle point of entry without complete withdrawal (33).

In identifying point of injection, most authors recommended drawing an imaginary line between the occipital protuberance and the mastoid process and then selecting a point approximately one third of the distance to the mastoid process. Providers may be able to palpate the occipital artery at this location and use this as a guide, injecting just medially (36). Hecht advocated that the risk of inadvertently injecting into the cranial vault or subarachnoid space can be minimized by advancing the needle until bony resistance is met and then retreating slightly (8). Consensus was the less volume utilized, the less risk for systemic absorption, with most providers using 1–3 mL total volume. Young et al. elected to use only local anesthetics for ONBs, as the injection of steroids poses potential risks, and the evidence supporting their effectiveness is not clear (33). Maintaining pressure over the site after the needle is withdrawn should help to both disseminate the local anesthetic and achieve hemostasis, and patients should be observed for at least 15 min, watching for any adverse reactions (45). In the majority of the studies reviewed, ONBs were performed as an outpatient procedure within a clinical office setting.

Na et al. examined the use of ultrasonic Doppler flow meter guided ONBs compared to the use of anatomical landmarks (46). Although the sensory blockade was more complete in the Doppler group, as measured by numbness along the nerve dermatome, there was no difference in pain relief between the two groups. Some studies do seem to indicate that a more precise blockade may potentially produce more significant and longer-lasting results (47). However, many studies, particularly those utilizing tenderness in helping to direct the site of injection, demonstrated high rates of success without ultrasound. Therefore, the extra cost of using an ultrasound-guided approach would need to be examined and compared with the potential for improved results. Even with precise techniques, swift distribution of local anesthetics through surrounding tissues makes it difficult to identify what injected area produced pain relief and to measure the benefits of precise placement vs. near placement (12).

Selecting Candidates

In selecting candidates appropriate for ONBs, it is important to consider a number of factors. Other causes of headache, such as vertebral artery dissection, must be ruled out before utilizing ONBs (48). Any new onset headache
or change in the quality, location, or characteristics of a headache from baseline should be investigated further to rule out other causes. Available research suggests that ONBs do not provide a long-term solution for pain. ONBs should be utilized only as an adjunct to a pain management plan that focuses on prevention. Nonpharmacological measures, such as stress reduction and cognitive behavioral therapy; prophylactic treatment with medications, such as propranolol and verapamil; and the use of early abortive medications, such as triptans, should continue to be first-line therapy to prevent and treat headaches. When these preventative measures fail, ONBs can play a role in the management of acute pain episodes in outpatient and emergency care settings, serving as a viable alternative to the use of opioids.

In evaluating the evidence, both cluster and cervicogenic headaches have at least one RCT supporting the effectiveness of ONBs as a treatment option. Research on ONBs for migraine also has demonstrated favorable results, particularly in patients with occipital tenderness. However, a history of medication overuse and rebound headaches appears to decrease the success rate of ONBs in these patients. Currently, there is no evidence that clearly supports the use of ONBs for management of tension-type headaches. With other types of headaches, such as post-concussive, headaches after lumbar puncture, chronic daily headache, and hemicrania continua, there is some research supporting the use of ONBs. Even without clear evidence, utilization of ONBs should be considered in appropriate patients when other headache treatment options have failed, or when other medications are contraindicated. Reducing disability and maximizing productivity and quality of life should be an ongoing focus of treatment decisions in any patient care setting.

Caution is advised with the use of ONBs in patients currently utilizing blood thinners, due to the potential risk of a bleed. This is true with any trigger point, nerve block, or joint injection. It should be verified that individuals are not allergic to either local anesthetics or steroids, if indicated. A review of the patient’s current medications also should consider the use of other substrates of the cytochrome P450 enzyme CYP3A4, especially if ONBs utilize high doses of local anesthetics or are given on a frequent basis. Competition for metabolism could result in higher systemic levels and place the patient at greater risk for adverse effects.

At this point, the use of ONBs in minors is still somewhat controversial. Although there is no direct contraindication to using ONBs in this population, there is also no research demonstrating either safety or effectiveness. Caution should also be used in patients with cranial abnormalities, a history of cranial surgery, or head trauma, as there is an increased risk of local anesthetics being inadvertently injected into the cranial vault. In these patients, mapping of the occipital nerve, or further imaging to detail cranial defects, is warranted to ensure safety (4).

Limitations to this Review

It must be noted that the literature search for this systematic review was mainly conducted by the lead author (C. L. Voigt) with input from the coauthor (M. O. Murphy). There is a possibility of bias in the process of determining the inclusion criteria and the selection of the articles used.

CONCLUSIONS

Studies advocate that ONBs are a simple procedure that can be performed by any properly trained provider, and state that when they work, they provide dramatic and immediate relief (2,22). Advantages to utilizing ONBs in the management of headaches in primary and emergency care settings include ease with which the procedure may be performed, relative safety, potential to eliminate the need for daily prophylactic therapy, reduced utilization of opioids, and low cost of treatment (24). Treatment is localized, often with no systemic effects, and the onset of pain relief is usually within minutes, providing results that can last for weeks (26).

In comparing ONBs with other current abortive treatment options available, the risk-to-benefit ratio for ONBs is at least similar to, if not more favorable than, other options. Caution must be used, but caution is also warranted in the use of other treatment options for headache disorders. The fact that ONBs provide a localized treatment option for pain is an important consideration that could minimize adverse effects and decrease the amount of disability caused by the treatment itself. Equipment such as ultrasound, Doppler, and nerve stimulation may be used to more accurately target occipital nerves, but evidence does not support that pain relief or results are improved by employing these tools. Although additional research is needed, current evidence supports that ONBs can be delivered safely and used to effectively treat acute headache episodes in outpatient settings. ONBs can assist providers in reducing the disability associated with headaches and headache treatment options when other abortive and preventative measures fail. Extending this useful tool into emergency care settings can provide health care providers with an effective, non-narcotic option in the treatment of acute headaches.

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REFERENCES


ARTICLE SUMMARY

1. Why is this topic important?
   Occipital blocks offer a safe and effective alternative to the use of narcotics in acute headache management.

2. What does this review attempt to show?
   Occipital blocks can be performed safely in primary, as well as emergency, care settings, and can be a very effective treatment option in the management of acute headaches.

3. What are the key findings?
   Occipital blocks may be useful in the treatment of occipital neuralgia, migraines, trigeminal neuralgia, cervicogenic headaches, and cluster headaches. Occipital blocks often provide longer-lasting relief and work as well if not better than other treatments currently available.

4. How is patient care impacted?
   Occipital blocks provide faster relief with less disability than other treatment options. They are also at least as safe if not safer than other available options.