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Review Article

Occipital Nerve Blocks: When and What to Inject?

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Introduction.—Occipital nerve block (ONB) is a promising treatment for headaches. Its indications, selection criteria, and best techniques are not clear, however.

Objective.—To summarize in narrative format what is known about ONBs and what needs to be learned.

Methods.—MD Consult and Google Scholar were searched using the terms occipital, suboccipital, block, and injection to identify relevant articles that were reviewed. This process was repeated for all additional pertinent articles identified from these articles, and so on, until no additional articles were identified.

Results.—A total of 21 articles were identified.

Conclusions.—Occipital nerve block is an effective treatment for cervicogenic headache, cluster headache, and occipital neuralgia. While a double blinded randomized placebo controlled clinical trial is lacking, multiple open label studies reported favorable results for migraine. Two other possible uses of ONB worthy of further study are use as a rescue treatment and as an adjunctive treatment for medication overuse headache. ONB may be effective for tension headache, but only under very specific circumstances. ONB is either ineffective or only effective under as yet unstudied circumstances for hemicrania continua and chronic paroxysmal hemicrania. Some practitioners use occipital nerve (ON) tenderness to palpation (TTP) or reproduction of headache pain with ON pressure (RHPONP) as selection criteria for identifying appropriate patients. While only a clinical trial can produce a definitive answer, current evidence suggests that these selection criteria are not necessary for cervicogenic headache or cluster headache. Occipital neuralgia by definition involves TTP of the ONs. Whether RHPONP or ON TTP predicts success in migraine is unclear, and may relate to whether steroids are used. A single blinded randomized controlled trial evaluating local anesthetic with steroids vs local anesthetic alone for transformed migraine reported slightly worse results with steroids, but there are several alternate explanations for this finding other than steroids being counterproductive. The technique of repetitive ONBs deserves further study.

Key words: occipital nerve block, cervicogenic headache, cluster headache, occipital neuralgia, migraine, steroids

Abbreviations: GON greater occipital nerve, GONB greater occipital nerve block, ON occipital nerve, ONB occipital nerve block, RHPONP reproduction of headache pain by occipital nerve pressure, TTP tenderness to palpation

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The purpose of this narrative review is to summarize what is known about occipital nerve blocks (ONBs) and what needs to be learned. In particular, the Table summarizes the published case reviews and clinical trials evaluating ONB for various headache disorders. As there is no standard procedure for performing an ONB,[1] and only rudimentary algorithms for selecting appropriate candidates, we compare and contrast published results for different headache disorders, different selection criteria, and different medications used. We propose several possible future indications. We compare results obtained when pressure on an occipital nerve reproduces a patient's

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Table.—Published Results for Occipital Nerve Blocks

Study	Population(s) and results	Study type	ON selection criteria	Medication injected	Injection site identification technique	Nerves injected	Side effects
Naja (2006 issue 2)[2]	CG HA Active group: 16 pts went 3.22 days before needing analgesics. Saline group: 16 pts went 1.43 days before needing analgesics. Pts who had facial nerve blocks trended toward better outcomes.	DB, RC	RHPONP or neck movement caused HA	3 mL of the following 10 mL solution to each nerve: 3 mL 2% LC, 3 mL 2% LC + epi, 2.5 mL 0.5% BP, 0.5 mL fentanyl 50 ug/mL, 1 mL clonidine 150 ug/mL.	nerve stimulator guided, generally at a level 2.5 cm below external OP, depth 0.5 to 2.5 cm.	U GLON ± facial nerve, for pain extending to the orbital area.	None
Naja (2006 issue 4)[5]	CG HA 47 pts received mean 5.3 (up to 13) injections. 96% became pain free for ≥ 6 months. # of injections required predicted by formula 1 + 1/3 # years with HA history	P, O	RHPONP	as above	as above	B GLON ± facial nerve, for pain extending to the orbital area, repeated at monthly intervals	2 – dizziness
Inan et al (2001)[6]	CG HA GONB: 14 pts decreased HA frequency by 90%, severity by 46%. C2-3 block: 94% and 68% for same (NS). HA frequency decreased more at 1 week than in GONB group. Duration 2 months mean for both. All decreases significant.	OLR	diagnostic block with 2 mL 1% LC producing anesthesia	2 mL 0.25% BP X2 1 week apart	2 cm lateral, 2 cm below the external OP	2 U GONBs 1 week apart	
Vincent (1998; 2 articles)[8]	CG HA. 41 pts – Visual analog scale decreased from 38 to 20 for the week preceding to the week following the injection, Increased pre-injection pain predictive of greater response. Pain generally improved over a day, returned to baseline at approx day 3-4, then improved at days 5-7.	P, O	N	1-2 mL 0.5% BP	anesthesia verified	U GON, with anesthesia with LC as a first diagnostic block	None
Anthony (2000)[10]	CG HA LC + MP to 180 pts: 90% relieved for mean 23.5 days. MP to ONs to 180 pts: 91% relieved for mean 77 days. Onset 16-25 hrs. LC during HA to 50 pts: 84% relieved for 1.6-3 hrs. IM MP alone to 50 pts: 3% relieved. Chronic cluster HA, 20 pts LC during HA: 80% relieved. MP interictally: 100% relieved for mean 32 days. U MIG, 20 pts LC during HA: 80% relieved. MP interictally: 90% relieved for mean 30 days.	P, O, C	RHPONP	3-4 mL 1% LC + 160 mg MP (4 mL) as separate injection (in thirds, with the needle directed straight, medially, and laterally) 5 minutes later or, if pt was ictal, after the LC aborted the HA. Area massaged after steroid injection	nerve stimulator guided, generally 3-12 mm medial to the midpoint of the line joining the occipital tubercle and mastoid tip. Injection site 10-15 mm below this site where there was more muscle bulk	U GLON	8 pts – dizziness, gait uncertainty.
Bovim and Sand (1992)[9]	Measured pain change over 30 minutes p/ injection. CG HA. 55% decreased in 24 pts (saline injections served as an internal control; no effect). Common MIG. 6% decreased in 14 pts. Tension HA. 14% decreased in 14 pts; Trend ($P = .08$) existed for a correlation between response to GONB and response to SON block	P, O	N	0.5-1.5 mL 2% LC + epi	2 cm lateral, 2 cm inferior to the external OP, 0.5 cm away from periosteum, anesthesia verified.	U GON and SON blockade in 35, single GONB in another 16	None

Caputi and Firetto (1997)[19]	MIG Total 27 pts: Total pain index (sum of the products of each headaches severity X duration) decreased 69% at 1 month, 82% at 6 months. Decreased >50% at 1 month in 85%. SON + GON to 10 pts: 67% decrease SON only to 17 pts: 71% decrease, NS vs SON + GON	P, O	TTP	0.5-1 mL 0.5% BP	2 cm lateral, 2 cm inferior to the external OP. Anesthesia verified.	U or B SON ± GON (whichever TTP) QOD until <50% nerves TTP, no analgesics, 5-10 blocks.	
Ashkenazi and Young (2005)[26]	18 w/ transformed MIG, 1 with episodic MIG; 15 also had trigger point injections. Pain decreased from 6.5 to 3.5 20 minutes after injections. Decreased brush allodynia	P, O	N	2 mL 2% LC + 5 mg TC	2 cm lateral to the OP	GONB ± trigger point injections w/ 0.5 cc 2% LC	
Ashkenazi et al (2008)[22]	Transformed MIG LC + TC group: HA free 1.0 ± 1.1 days, response for 5.5 ± 4.9 days. LC alone: HA free 2.7 ± 3.8 days, response for 14.3 ± 5.1 days.	SB, RC	TTP	10 mL solution: 4.5 mL 2% LC + 4.5 mL BP + either 1 mg TC 40 mg/mL or 1 mL saline. 2 mL each GON, 0.5 mL each of 12 trigger point injections	1/3 distance from OP to mastoid process	BGON + trigger point injection	
Gawel and Rothbart (1992)[20]	MIG unresponsive to persistent medical therapy. Non post-traumatic 54% of 97 felt "significantly better" Post-traumatic 72% of 87 felt same. Higher response rate statistically sig ($P < .01$)	R		LC + MP	GON	GON	
Behmand (2003)[43]	Moderate to severe MIG, 29 pts: 55% HA free, 28% HA frequency decreased mean 2/3, mean duration 8 weeks	P, O	N	BT type A 25 unites per site, 50 units total	Each side of corrigator supercilii.	SON	
Tobin and Flitman (submitted)[17]	Total 108 injections: 22% failed. Other 78% – HA decreased mean 83%, duration mean 6.6 weeks. No SMO: 16% failed. Fail rate 0% PC syndrome, 14% ONA, 11% non-intractable 39% intractable MIG. With SMO: 44% failed. Failure rate increased 24% ONA, 36% all MIG, 52% non-intractable MIG. In responders, magnitude and duration of response did not differ between those with and those without SMO.	R	RHPONP	1.5 mL 0.5% BP + 60 mgs MP, total 2.25 mL per site	Areas of TTP at nucal line, on periosteum	whichever ONs were TTP, 0-6, usually 2-4	
Anthony (1992)[18]	MIG, 50 pts: 4 mL 1% LC alone aborted HA in 88%; LC + MP 88% HA free for mean 32 days. ONA, 86 pts: 4 mL 1% LC aborted HA in 88%; LC + MP, 87% HA free for mean 31 days. Occipital neurectomy for ONA, 60 pts, 70% HA free for mean 244 days. LC alone or IM MP between bouts: HA invariably recurred <24 hrs for ONA, <3 days for MIG.	R	TTP	4 mL 1% LC + 160 mg MP,	"region of the greater occipital nerve"	U GON	
Hecht (2004)[34]	PC HA – 10 pts, 80% elimination >24 hrs, 20% elimination <24 hrs.	R	RHPONP	1-3 mL 0.5% BP	?	GON ± LON	
Saadah and Taylor (1987)[32]	Total 188 injections, 65% relief >1 week, 27 % relief for <1 week. Vascular, 59 injections, 85% relief for >1 week, 12% relief for <1 week. Post-traumatic, 11 injections, 9% relief for >1 week, 91% relief <1 week. Tension, 85 injections, 71% relief for >1 week, 25% relief for <1 week. Postinfectious, 20 injections, 60% relief for <1 week, 25% no response. Unclassifiable 13 injections, 62% relief for more than 1 week, 38% no response.	P, O	TTP	10 mL 1% LC + 12 mg BM, divided among ONs that were TTP. Total volume 12 cc per injection set	Areas of TTP at nucal line, on periosteum	Whichever ONs were TTP, 1-6	Generally, dizziness for 1-2 hrs, injection site soreness for 1-2 days

Table.—*Continued*

Study	Population(s) and results	Study type	ON selection criteria	Medication injected	Injection site identification technique	Nerves injected	Side effects
Leinisch-Dahlke et al (2005)[31]	Tension, failed or intolerant to preventive therapy. 15 patients: 11 – no effect, 3 worsening, 1 worsening for 2 days, then HA relief.	P, O	N	5 mL 1% prilocaine + 4 mg DM, total volume 6 mL per injection set	Hypo- or anesthesia	B GON	Injection site pain in 3. Bradycardia 36 BPM
Afridi et al (2006)[13]	15 HA days per month, failed at least 3 preventatives. Total 116 injections: 22% HA free mean 20 days, 31% decreased ≥ 30% mean 45 days. Mean response latency 2 days. Only one patient w/o ON TTP responded. Anesthesia did not predict response. SMO protective. MIGs, 57 injections: 16% HA free mean 9 days, 30% decreased ≥ 30% mean 61 days. Cluster; 22 injections: 45% HA free mean 17 days, 14% decreased ≥ 30% mean 52 days. New daily persistent HA, 16 injections: 25% HA free, 38% decreased ≥ 30%. HC, 10 injections: 10% HA free, 50% decreased ≥ 30%.	R	N	3 mL 2% LC + 80 mg MP	1-2 cm below midpoint of the occipital tubercle and mastoid process, area then massaged	U GONB	2 pts – focal alopecia
Ambrosini et al (2005)[11]	Cluster 85% of 13 HAs in the steroid group resolved, lasted 4 weeks in 8 and ≥ 4 months in 5 of these. 0 of 10 pts receiving just LC responded	DB, RC	N	0.5 mL 2%LC + 17.72 mg BM (12.46 BM dipropionate, long acting, 5.26 mg BM disodium phosphate), total volume 3 mL	Suboccipital fossa, midpoint between inion, mastoid process.	U GONB	Local pain in 2 patients
Peres et al (2002)[14]	Cluster HA. 14 pts – 29% HA free X ≥ 2 weeks (mean 42 days), 36% HA free <2 weeks (mean 3 days), overall mean 13 days of HA freedom	O	N	3 mL 1% LC + 40 mg TC	UGONB	GON. Anesthesia reported in all	None
Busch et al (2007)[12]	Cluster HA. 15 pts, 60% minor response, 40% no response. However in 47% of pts, no attacks until the next day, baseline typically 3-4 per day. Post blockage, nociceptive blink reflex R2 latency increased and response area decreased on ipsilateral side only.	P, O	N	5 mL 1% prilocaine	Nuchal line halfway from mastoid process to OP. Anesthesia tested with cotton swab.	U GON	
Antonaci et al (1997)[36]	HC – next nerve wasn't injected until after anesthesia from prior block had worn off (≥ 90 minutes). 7 pts. GON, LON blocks ineffective. SON blocks decreased visual analog scale from 7.3 to 4.6 ($P < .05$).	P, O	N	"0.5-1.5 mg/mL solution" w/epi	Anesthesia	U GONB then if needed U SON block then if needed U LONB	

B = bilateral; BP = bupivicaine; C = controlled; CG = cervicogenic; DB = double blinded; GON = greater occipital nerve; GONB = greater occipital nerve block; HA = headache; HC = hemicrania continua; hrs = hours; IM = intramuscular; LC = lidocaine; LON = lesser occipital nerve; LONB = lesser occipital nerve block; MIG = migraine; MP = methylprednisolone; N = none; NS = not significant; O = observational; OLR = open label randomized; ON = occipital nerve; ONA = occipital neuralgia; OP = occipital protuberance; P = prospective; PC = post-concussive; pts = patients; R = retrospective; RC = randomized controlled; RHPONP = reproduction of HA pain by occipital nerve pressure; SB = single blinded; SMO = symptomatic medication overuse; SON = supraorbital nerve; TC = triamcinolone; TTP = tenderness to palpation; U = unilateral.

headache pain (RHPONP) vs when occipital nerve (ON) tenderness to palpation (TTP) is present vs when neither is used as selection criteria. Whether steroids should be used depends on how one interprets available data. A technique with the potential to produce especially long lasting effects is performing repetitive ONBs without steroid.

PROVEN INDICATIONS

Double blinded randomized placebo controlled trials support the use of ONB for cervicogenic headache and cluster headache, and occipital neuralgia by definition responds to ONB. The specifics of the studies raise several questions, including whether repetitive ONBs without steroid can produce a permanent improvement in headache pain, and whether RHPONP predicts successful response to ONB.

Cervicogenic Headache.—Naja et al evaluated the efficacy of nerve blocks for cervicogenic headache in a double blinded, randomized controlled clinical trial. Both the greater ON (GON) and lesser ON were injected, as well as the facial nerve in patients describing pain extending to the orbit, all with nerve stimulator guidance. Medications used were lidocaine, bupivicaine, clonidine, and fentanyl. Patients in the active treatment group went 3.67 ± 1.71 days before they used analgesics, whereas control group patients went 1.52 ± 1.20 days before needing analgesics. For patients receiving just ONBs, respective numbers were 3.22 ± 1.56 and 1.43 ± 1.34.[2]

A potential criticism of this study is that the selection criteria more closely followed the 1988 International Headache Society (IHS) criteria[3] than the current 2004 IHS criteria[4] for cervicogenic headache to the extent that headaches had to be strictly unilateral without side shift, and the neck had to have reduced range of motion, which the current IHS criteria do not accept as proof of a cervicogenic cause. Therefore, it could be argued that another trial using the 2004 IHS criteria is required. However, the 2004 IHS criteria is not immune to criticism, as it requires objective evidence of a lesion in the neck "known to be, or generally accepted as, a valid cause of headache," although what exactly said lesions are has not been defined.

Additional selection criteria included the headache's precipitation by neck movement or by external pressure over the GON, sensory changes over the GON, and GON TTP. One could therefore also argue that the population actually consisted of patients with cervicogenic headache and patients with occipital neuralgia according to current definitions, although the counterargument is that findings consistent with occipital neuralgia are also consistent with cervicogenic headache, since the GON originates from the C2 and C3 nerve roots.

In a prospective open label follow up trial, the same group then observed the effect of the above injections with active medication given repeatedly to the same patient population. Patients were evaluated every 2 weeks, and were injected if the visual analog scale was >4 or if they needed analgesics >3 times a week. Ultimately, 96% of 47 patients achieved 6-month pain relief with a mean of 5.3 (1-13) injections. The duration of pain relief from a given injection increased with the number of injections performed. For example, the first injection produced pain relief for about 8 days; the eighth injection produced pain relief lasting about 70 days, and the 12th injection produced pain relief lasting about 140 days. Another interesting finding was that the equation 1 + 1/3 # years with headache predicted the number of injections required to achieve pain relief lasting at least 6 months.[5]

In an open label randomized trial of 28 patients with cervicogenic headache, Inan compared C2-3 blocks with GON block (GONB), finding that both drastically reduced headache frequency and to a lesser extent severity for the 2-month duration of the study.[6] Selection criteria were those proposed by Sjaastad et al for cervicogenic headache,[7] and hence also required headache unilaterality and that the headache be triggered by neck movement, sustained awkward head positioning, or by external pressure in the general region of the posterior cervico-occipital area. Specific criteria relating to the GON were not included. Since 2 GON blocks (GONBs) with bupivicaine were performed 1 week apart, and were preceded by a diagnostic block with lidocaine, a total of 3 GONBs were actually performed, all without steroid. This technique is therefore reminiscent of Naja's and

raises a question of whether repetitive ONBs relieve headache pain for longer than the sum of their individual effects.

Two published prospective observational studies also using just local anesthetic demonstrated about a 50% decrease in cervicogenic headache pain, both also using Sjaastad's definition of cervicogenic headache.[8,9] Neither used RHPONP or ON TTP as a selection criterion. A prospective observational study using lidocaine and methylprednisolone and the 1988 IHS criteria for cervicogenic headache demonstrated an 84% response rate of an ongoing headache to lidocaine alone, and relief for 91% of patients for a mean 77 days.[10]

Cluster Headache.—Occipital nerve block is effective for cluster headache. All of the following studies used unilateral GONB.

In a double blinded randomized placebo controlled study of patients with cluster headaches, Ambrosini et al injected 0.5 mL of 2% lidocaine, and either 2 mL of short and long acting betamethasone (13 patients), or 2 mL of saline (10 patients) to a point midway between the inion and mastoid process. Neither ON TTP nor RHPONP were selection criteria. Of the 13 patients injected with betamethasone, 85% (11) became headache free, and this effect lasted at least 4 weeks in 8 patients and at least 4 months in 5. None of the saline injected patients responded.[11] Cluster headache was originally defined according to the 1988 IHS criteria, but all patients also met the 2004 diagnostic criteria.

One prospective observational study[10] demonstrated significantly better results than another.[12] The former used RHPONP as a selection criterion, injected lidocaine and methylprednisolone, and used a nerve stimulator to identify the injection site, which was typically 3-12 mm medial to the midpoint between the occipital tubercle and mastoid tip. Cluster headache was not defined. The latter used the 2004 IHS criteria for cluster headache, neither RHPONP nor ON TTP as a selection criterion, injected prilocaine without steroid, and injected at the nuchal line halfway from the occipital protuberance to the mastoid process, with verification of anesthesia.

Afridi et al and Peres et al retrospectively reviewed their experience with ONB in cluster headache. Afridi used 3 mL 2% lidocaine and 80 mg methylprednisolone in a refractory population, and eliminated 45% of headaches for a mean of 17 days.[13] Peres et al used 3 mL 1% lidocaine and 40 mg triamcinolone, and eliminated 65% of headaches for a mean of 13 days, possibly slightly better results because $17 \times 0.45 = 7.65$ whereas $13 \times 0.65 = 8.45$, but in a nonrefractory population, and Peres' ONBs were performed as transitional therapy with simultaneous initiation of long-term prophylactic therapy.[14] Neither RHPONP nor ON TTP was a selection criterion for either study. Afridi did not state their diagnostic criteria for cluster headache, and Perez used that of the 1988 IHS criteria.

Interestingly, Busch et al found that the nociceptive blink reflex response area decreased and latency increased after ONB in healthy subjects[15] as well as in patients meeting the 2004 IHS criteria for cluster headaches.[12] While pain improved only mildly in 9 of the 15 cluster headache patients and did not improve at all in the other 6, it should be noted that only a single unilateral injection of 5 mL of 1% prilocaine was used, without any steroid. The more important point is that a functional connection was demonstrated between the ONs and trigeminal nerve distribution, raising a possible explanation for why ONBs can work for anterior head pain such as that in cluster headaches. Similarly, Piovesan et al demonstrated that sterile water injected unilaterally over the GON produced trigeminally distributed pain as well as trigeminal autonomic features suggestive of parasympathetic activation in 2 of 3 subjects.[16]

Occipital Neuralgia.—Occipital neuralgia by definition responds to ONB according to the 2004 as well as 1988 IHS criteria. The 2 published retrospective reviews both demonstrated response rates of about 85%, lower with symptomatic medication overuse in one,[17] and durations of 1-2 months.[18]

OTHER POSSIBLE INDICATIONS

While no randomized controlled studies have been published, numerous observational studies support the use of ONB for migraine. Allodynia is associated with symptomatic medication failure in migraine, and 2 studies documented a decrease in allodynia with ONB, raising the possibility that ONB

could be used as a rescue treatment for migraine. While symptomatic medication overuse was associated with an increased failure rate, it still worked more than 50% of the time in one study, raising the question as to whether it could be used to ease the discomfort associated with symptomatic medication withdrawal in medication overuse headache.

Migraine.—In a prospective open label uncontrolled study, Caputi and Firetto studied the effect of ONB and supraorbital nerve block on migraineurs using the 1988 IHS criteria.[19] They injected the GON and/or supraorbital nerve (depending upon which was TTP) with 0.5-1.0 mL of 0.5% bupivicaine, no steroid, every other day, for a total of 5-10 injections until less than half the nerves were TTP. They measured the total pain index (sum of severity x duration of each headache, per month). Total pain index decreased from 347.1 ± 73.9 at baseline to 106.8 ± 33.8 at 1 month and 60.9 ± 15.8 at 6 months, the last time point at which data were recorded. Analgesic use also decreased dramatically. For 85% of the 27 patients studied, 5-10 injection sessions produced a lasting and increasing effect even as far out as 6 months.

Assuming that a traditional ONB lasts on average for 6 weeks, 6 months of freedom from pain would require 4-5 injections, probably using a steroid with the attenuate risks, with the expectation that the headaches would return with wearing off of the last ONB.

Gawel and Rothbart reviewed the effect of GONBs with lidocaine and methylprednisolone suspension on their migraine population, also using the 1988 IHS criteria. Patients had to be "unresponsive to persistent medical therapy," and neither RHPONP nor ON TTP was a selection criterion. Sixty-three of 87 (72%) patients with post-traumatic migraines and 52 (54%) of 97 non post-traumatic migraines reported feeling "significantly better" for up to 6 months following an ONB. The post-traumatic group's higher response rate was statistically significant ($P < .01$),[20] a finding consistent with our results in patients with post-concussive syndrome.[17]

Several studies specifically evaluated intractable migraine. Afridi et al studied patients with definite or probable migraine according to the 2004 IHS criteria, with at least 15 headache days per month and who had failed at least 3 preventives. RHPONP and ON TTP were not selection criteria. Medication injected was 3 mL of 2% lidocaine and 80 mg of methylprednisolone, 1-2 cm below the midpoint between the occipital turbercle and mastoid process, always unilaterally. GONB yielded complete or partial response in 46% of 57 injections, with average onset in 2 days and lasting a partial response median of 30 days. There was no association between local anesthesia and effect on migraine.[13] Similarly, 60% of our intractable migraineurs (based on the 2004 IHS criteria) responded with a mean pain decrease of 70% and mean duration of 4.6 weeks.[17] Our greater response rate and duration may result from our population being less refractory, or from our use of RHPONP as a selection criterion. Interestingly, an open label study of lidocaine for neuralgia in other parts of the body including the lower extremities demonstrated pain relief that outlasted anesthesia in 18 of 38 consecutive patients, lasting for up to 6 days.[21] A single blinded randomized controlled trail comparing local anesthetic alone to local anesthetic with triamcinolone in transformed migraineurs (2004 IHS criteria) showed much smaller responses,[22] possibly for reasons as discussed further below.

Occipital nerve block may be effective for migraines because migraines and occipital neuralgia coexist. Anthony found that 48% of 383 migraineurs (based on criteria that would meet the 2004 IHS criteria except for headache duration which was not stated) actually had migraine associated with irritation of the ON. Of 50 patients with migraines associated with ON irritation, 88% were rendered headache free for an average duration of 32 days with a single unilateral injection of 4 mL of 1% lidocaine and 160 mg methylprednisolone suspension. Similarly, 87% of 86 patients with occipital neuralgia were rendered pain free for an average duration of 31 days.[18]

Other mechanisms whereby ONB decreases migraine pain have been reviewed elsewhere, and generally relate to convergence of sensory information from the ONs and intracranial structures in the upper cervical spinal cord.[23] A related theory is that afferent transmission along peripheral cephalic

nerves triggers migraine headaches, and that suppression of said afferent transmission can prevent the migraine from being triggered.[24]

ONB as a Rescue Treatment.—A related question is whether ONB could be used as a rescue treatment for headaches not responding to traditional headache abortives. ONB rapidly decreased brush allodynia in migraineurs in 2 studies. In one, brush allodynia decreased 75% only 5 minutes after unilateral GONB with 1 cc 1 : 1 2% lidocaine and 0.5% bupivicaine over the occipital ridge.[25] In the other, allodynia decreased about 2/3, 20 minutes after GONB with 2 cc 2% lidocaine and 5 mg triamcinolone, injected 2 cm lateral to the occipital protuberance.[26] The former's diagnostic criteria for migraine were not stated; the latter population consisted of those meeting the 2004 IHS criteria for episodic migraine or those meeting Silberstein et al's criteria for transformed migraine.[27] A case report describes a migraine with allodynia from C2 all the way to T5, including the arm, resolving with ipsilateral GONB.[28] Burstein et al showed that cutaneous allodynia predicts poor response of a migraine to triptans.[29] Therefore, even if the ONB does not decrease the actual headache pain, it is possible that by rapidly decreasing the allodynia, the ONB could render the headache rapidly susceptible to other previously ineffective treatments.

ONB as an Adjunctive Treatment for Medication Overuse Headache.—The bad news is that 44% of our patients with analgesic overuse did not respond to ONB. The good news is that 56% did, with a magnitude not significantly different from non overusers and a duration of about 1.5 weeks.[17] Even better news for analgesic overusers is that, in contrast to our findings, Afridi et al did not identify a statistically significant relationship between medication overuse and response to injection.[13] Possible explanations for the discrepancy between our and Afridi's findings were previously reviewed.[17]

While symptomatic medication overuse withdrawal headache is allowed to last up to 2 months,[4] a more typical time period is less than 10 days,[30] meaning that a successful ONB could alleviate the withdrawal headache for most or all of the withdrawal period. Determining if ONB can play a role in treatment of symptomatic medication overuse withdrawal will require a clinical trial.

LACK OF EFFICACY IN CERTAIN HEADACHE TYPES

Tension Headaches.—Leinisch-Dahlke et al found that bilateral GONB with 5 mL 1% prilocaine and 4 mg dexamethasone had no effect in 11 patients and worsening of pain in 4 patients with chronic tension type headache, defined according to the 2004 IHS criteria, refractory to preventive therapy, and without symptomatic medication overuse. One of the patients whose headache initially worsened subsequently experienced headache relief lasting weeks. Neither RPHPON nor ON TTP was a selection criterion. All patients described occipital hypo – or anesthesia after the block.[31] Similarly, Bovim and Sand, using lidocaine without steroid and using neither ON TTP nor RHPONP as a selection criterion, decreased headache pain in only 14% of those with tension headaches defined according to the 1988 IHS criteria. The caveat to the latter study is that pain was decreased in only 6% of migraineurs, and most other studies reported much higher responses for migraine.[9] There are 3 possible explanations for these results: ONB does not work for tension headaches as defined by the 1988 or 2004 IHS criteria, ONB does not work for tension headaches when there is no RHPONP or ON TTP, or prilocaine (and possibly lidocaine) without steroid does not work for tension headaches.

In contrast, 71% of Saadah and Taylor's tension headache patients described headache relief for more than 1 week, with ON TTP as a selection criterion, and using lidocaine and betamethasone as medications.[32] Headaches were classified according to the Ad Hoc Committee on Classification of Headaches,[33] which described "muscle-contraction," or tension headache, as "commonly suboccipital," a characteristic omitted from the 1988 and 2004 IHS criteria. In other words, perhaps tension headache does respond to ONB, but only when ON TTP is used as a selection criterion, or perhaps only if a local anesthetic other than prilocaine (such as lidocaine) or a steroid is used, or finally perhaps only if the headache includes suboccipital pain. Definitively determining

whether ONB is an effective treatment for tension headache will require additional clinical trials.

Post-Traumatic Headaches.—Saadah and Taylor studied multiple headache types, using ON TTP as a selection criterion and injecting lidocaine and 12 mg betamethasone (equivalent to 80 mg methylprednisolone) to whatever ONs were TTP. Only 9% of those with post-traumatic headaches responded for more than 1 week; response rates for all other headache types were greater than 60%.[32] In contrast, Hecht using RHPONP as a selection criterion and 1-3 mL 0.5% bupivicaine without steroid found that of 10 patients with postconcussive headaches, 8 had a good response and 2 had a partial response.[34] Of note, Hecht's patients all had paroxysmal headaches in the occipital area, and therefore, other than not specifying whether the pain was stabbing and not having previously performed a diagnostic ONB, met the 2004 IHS criteria for occipital neuralgia. Our patients with postconcussion syndrome (defined as having post-traumatic headache by 2004 IHS criteria with symptoms associated with post-traumatic syndrome such as depression, vivid dreams or nightmares, memory impairment, and decreased frustration tolerance) responded well to 1.5 cc bupivicaine and 60 mg methylprednisolone to each site, with 100% responding, an average pain decrease of 86%, and an average pain control duration of 4.4 weeks.[17] The Ad Hoc Committee on Classification of Headaches that Saadah and Taylor used for classifying their patients' headaches did not define the phenotype of a post-traumatic headache, so one possible explanation for the discrepancy is that the etiology of the headache is less important than the phenotype. Consistent with this hypothesis is Gawel and Rothbart's finding that 72% of post-traumatic migraineurs felt "significantly better" after GONB with lidocaine and methylprednisolone.[20] Another possibility is that post-traumatic headaches only respond to ONB in the presence of RHPONP, rather than ON TTP.

Hemicrania Continua.—Two studies reported poor results for hemicrania continua. Neither used RHPONP or ON TTP as a selection criterion. Antonaci et al used lidocaine without steroid in 7 patients diagnosed based on International Association for the study of Pain criteria,[35] none of whom responded to GONB, but visual analog scale decreased from 7.3 to 4.6 with supraorbital nerve blocks performed after the GONB. Subsequent lesser ONBs (lesser ONBs) did not seem to produce an added benefit.[36] Afridi et al using lidocaine with methylprednisolone rendered only 1 of 10 patients headache free although another 5 responded partially.[13] Most likely, either hemicrania continua does not respond to ONB, or it does only in the setting of RHPONP or ON TTP. It may respond to supraorbital nerve block.

Chronic Paroxysmal Hemicrania.—Antonaci et al used neither RHPONP nor ON TTP as a selection criterion, and used lidocaine without steroid. Injections failed in all 6 patients with chronic paroxysmal hemicrania.[37] Again, probably either hemicrania continua does not respond to ONB, or it does only in the setting of RHPONP or ON TTP

DO RHPONP OR ON TTP PREDICT SUCCESS? IS ONE MORE ACCURATE THAN THE OTHER?

Occipital nerve tenderness to palpation is part of the diagnostic criteria for occipital neuralgia, and Anthony reported it in 48% of 383 migraineurs.[18] In many series, RHPONP or ON TTP was a selection criterion, generally on the rationale that their presence implicates the ON or its downstream connections as part of the pain generator. Supporting this hypothesis, Afridi et al found a significant association between ON TTP and response to GONB in their overall population.[13]

Cervicogenic Headache.—Naja et al[2] and Anthony[10] used RHPONP as a selection criteria, and obtained generally positive results. However, Inan et al, Vincent, and Bovim and Sand used neither RHPONP nor ON TTP as a selection criterion, and also obtained generally positive results.[6,8,9] The current preponderance of evidence therefore suggests that these selection criteria are not necessary for cervicogenic headache.

Cluster Headache.—Anthony used RHPONP as a selection criterion and obtained generally positive results,[10] but many others,[10,13,14,17] including a double blinded randomized controlled trial,[11] used

neither RHPONP nor ON TTP as a selection criterion, and also obtained generally positive results. The only study not obtaining good results and not using the above selection criteria was that of Busch et al,[12] who used prilocaine, which has a low partition coefficient as well as low protein binding,[37] and may therefore be less effective. Again, the current preponderance of evidence therefore currently suggests that these selection criteria are not necessary for cluster headache.

Occipital Neuralgia.—Occipital neuralgia by definition involves TTP of the ONs,[4] and Anthony obtained positive results using this selection criteria.[18] We obtained positive results using RHPONP as an added selection criterion.[17]

Migraine (and Vascular Headache).—Whether RHPONP or ON TTP predicts success in migraine is unclear, and may relate to whether steroids are used. Two studies using RHPONP as a selection criterion were ours[17] and Anthony's,[10] both of which obtained generally positive results. Saadah and Taylor[32] and Anthony[18] used ON TTP as a selection criteria, and also obtained generally positive results. One study of migraine using neither ON TTP nor RHPONP as a selection criterion was Bovim and Sand's, who injected lidocaine alone and decreased headache pain by only 6%.[9] Since Anthony achieved much greater success in aborting headache with just lidocaine using ON TTP as a selection criterion, the logical conclusion is that ON TTP should be used to select appropriate migraineurs for ONB.

However, also using neither RHPONP nor ON TTP as a selection criterion, Afridi used lidocaine and methylprednisolone for relatively intractable migraineurs. Overall, 46% responded, with a mean response duration was 42 days.[13] Perhaps when a steroid is added to a local anesthetic, whether an ON is TTP becomes irrelevant for predicting response. Not all the data fit this hypothesis either, however. Using ON TTP as a selection criterion, Ashkenazi et al obtained nonsignificantly worse results with lidocaine alone than with lidocaine and triamcinolone for transformed migraineurs.[22] Do steroids indeed not add any benefit when added to a local anesthetic for transformed migraine, or is there another explanation, as further discussed below?

Other Headache Types.—For post-traumatic headaches, a clinical trial to determine if RHPONP better predicts response to ONB than ON TTP may be worthwhile. Documentation of the headache phenotype would also be helpful. For hemicrania continua and also for chronic paroxysmal hemicrania, any future clinical trials for ONB should use RHPONP or ON TTP as a selection criterion. However, for hemicrania continua, the best future direction may actually involve studying supraorbital nerve block rather than ONB.

DO STEROIDS PRODUCE AN ADDED BENEFIT OVER LOCAL ANESTHETICS?

In a single blinded randomized controlled trial, Ashkenazi et al compared the effect of lidocaine with triamcinolone vs lidocaine alone in patients with transformed migraine. No statistically significant differences were seen in any of the outcome measures between the 2 groups.[22] In contrast, Ambrosini found a significant difference in the response of cluster headaches to lidocaine with betamethasone vs lidocaine alone, with the former responding 85% of the time and the latter responding 0% of the time.[11] There are several possible explanations this discrepancy. First, the populations were different, as Ashkenazi studied transformed migraineurs, whereas Ambrosini studied patients with cluster headache. Second, the steroids doses were different. Ashkenazi used 40 mg of triamcinolone divided among 2 ONBs as well as multiple trigger point injections, such that 8 mg was administered for each of 2 ONBs and 24 mg were used in trigger point injections. In contrast, Ambrosini used a total of 17.72 mg of betamethasone all as a single GONB. Betamethasone is 6.6 times as potent as triamcinolone, so Ambrosini used the equivalent of 117 mg of triamcinolone, 14.6 times what Ashkenazi used for each individual ONB. Third, different structures were injected, as most of Ashkenazi's steroid was actually used in trigger point injections. Finally, triamcinolone is less soluble than betamethasone,[38,39] so its effect magnitude may be smaller[40,41] and therefore more difficult to detect.

REPETITIVE ONBS?

Three studies results raise the question of whether some headaches could be cured with enough nerve blocks. Naja performed an average of 5.3 ONBs and achieved pain relief for ≥6 months in 96% of cervicogenic headache patients. They hypothesized that the clonidine in their complex mixture was especially important in producing sustained pain relief.[5] However, Caputi and Firetto accomplished essentially the same results for migraineurs, injecting only bupivicaine to whichever supraorbital nerves and GONs were TTP QOD until less than half the sites were TTP.[19] For cervicogenic headache, Inan essentially performed 3 ONBs, the first a "diagnostic" ONB with lidocaine and 2 more with bupivicaine, and produced a mean pain relief duration of 2 months.[6] The logical ensuing question is whether this technique works for any headache type responsive to ONB.

Naja used RHPONP or precipitation of headache with neck movement as a selection criterion. Caputi and Firetto used ON TTP as a selection criterion, and Inan used a diagnostic block. Determining which of these selection criteria, if any, are the best for this technique will require additional research.

SUMMARY

Occipital nerve block is an effective treatment for cervicogenic headache, cluster headache, and occipital neuralgia. In addition, multiple open label studies support its use for migraine. Preliminary results are not encouraging for tension headache, and even less so for hemicrania continua and chronic paroxysmal hemicrania, although use for these conditions is not completely excluded. The preponderance of evidence currently indicates that RHPONP and ON TTP are not necessary criteria for selecting appropriate patients for cluster headache or cervicogenic headache, but might be for post-traumatic headache and tension headache. Whether these selection criteria predict success in migraine may relate to whether steroids are used. ONB may have a role as a rescue treatment and in treating medication overuse headache. The technique of repetitive ONBs deserves further study.

Ashkenazi and Levin (2007) observed that most of the published studies for ONBs are uncontrolled and that more well-designed studies are needed.[42] We strongly agree.

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