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David D. Kim
Henry Ford Health System, Dkim1@hfhs.org

Nabil Sibai
Henry Ford Health System, nsibai1@hfhs.org

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ORIGINAL RESEARCH

Prolongation of greater occipital neural blockade with 10% lidocaine neurolysis: a case series of a new technique

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David Daewhan Kim
Nabil Sibai

Department of Anesthesiology/Pain Medicine Division, Henry Ford Hospital, Detroit, MI, USA

Introduction: Greater occipital nerve blocks (GONB) have been used for headache but their benefit may be short. Ready et al performed intrathecal injections on rabbits and reported neurologic/histologic changes that required concentrations of at least 8%. Our study tests the hypothesis that the neurolytic effects of GONB with 10% lidocaine can prolong relief.

Methods: After an approval from Henry Ford Hospital Institutional Review Board, a chart review was performed for patients who had GONB with 10% lidocaine. Patients received 10% lidocaine after short response (<1 month / >50% relief) to GONB with 1 cc of a solution containing 9 mL 0.5 % bupivacaine and 40 mg methylprednisolone. They received a block with 10% lidocaine with volume given at <80% of the maximum dose of 4 mg/kg. Injections were performed under fluoroscopic guidance after injection of 0.1 cc of contrast (isovue or magnevist). All patients had intravenous access and were given fentanyl and midazolam. The visual analog scale (VAS) scores were recorded on follow-up, and the duration of response was noted. VAS changes with 10% lidocaine and comparison of duration with methylprednisolone were performed using paired *t*-test.

Results: Thirteen patients were reviewed; 12 were female and the mean age was 47. Ten were diagnosed with migraine, and three with occipital neuralgia; 12 had bilateral symptoms. Baseline VAS prior to 10% lidocaine averaged 86.92 mm. The mean volume injected per nerve was 1.096 mL. There was significant decrease in mean% VAS with 10% lidocaine at 60.4% (mean: −52.69 mm) (P=0.001). The mean duration of relief was significantly higher with 10% lidocaine at 148.05 days ([standard deviation]=98.87) versus methylprednisolone at 6.33 days (standard deviation=5.01) (P=0.001). No complications or side effects were reported.

Conclusion: Ten percent lidocaine may be a useful neurolytic agent in prolonging the duration of GONB.

Keywords: pain relief, migraines, occipital neuralgia, intractable headaches, injections

Introduction

Chronic migraine and occipital neuralgia are common causes of intractable headache with prevalence of (1.4%–2.2%) for migraine and (0.4%–4%) for occipital neuralgia.[1,2] Medication management has traditionally been limited in efficacy, tolerability, and compliance.[3] Greater occipital nerve blocks (GONB) have been used to treat various headache syndromes such as migraine, greater occipital nerve (GON), cluster headache, cervicogenic headache, and even dural puncture headache that are refractory to other treatments.[3–7] The mechanism of action has been speculated to be due to the convergence of sensory afferents from C2 and the trigeminal nerve.[8,9] The duration of pain relief obtained from GONB has been shown to be quite variable and short

Correspondence: David Daewhan Kim
Department of Anesthesiology/Pain Medicine Division, Henry Ford Hospital (I-3 Pain Clinic), 2799 W Grand Blvd, Detroit, MI 48208, USA
Tel +1 248 344 8000
Email Dkim1@hfhs.org

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in duration. Lambru et al in a prospective open-label study of cluster headache patients reported a mean duration of 21 days.[6] Siddiqui and Caplinger evaluated the efficacy of occipital nerve blocks for chronic migraine with and without bupivacaine, and reported mean duration of either 23.7 and 22.6 days, respectively, with a range of 1–90 days.[10] Afridi et al performed GONB for various primary headache syndromes and reported a mean duration of partial response of 61 days.[11] Due to the short duration of relief with GONB, radiofrequency ablation (RFA) using pulsed, cooled, and continuous ablation has been used to prolong relief.[12–16] However, these are not without complications, especially with continuous RFA, which can cause post-denervation neuralgia.[12–16] Due to the current fiscal environment in the US, alternatives such as cooled and pulsed RFA may not be reimbursed by insurance. The use of chemical neurolysis with phenol and alcohol in the thin tissue of the GON may be problematic given the risk of anesthesia dolorosa and necrosis of surrounding soft tissue.[17–19] Lidocaine has been demonstrated to be neurotoxic in multiple animal and cell culture studies.[20–34] Ready et al in 1985 performed intrathecal injections of 2%–32% lidocaine on rabbits and followed neurologic function for 7 days prior to harvesting the spinal cords for histology.[24] They reported persistent neurologic deficit and major histologic changes starting at 8% concentration. The reports of clinical use of higher concentration lidocaine for chronic pain were highly limited. Choi and Liu reported three cases of patients who had months of relief with peripheral nerve blocks of 5% lidocaine with 7.5 dextrose.[35] Only one of the cases was a GONB for post-herpetic neuralgia, which lasted 8 months. Their study was problematic given the small number and the concentration used by Choi was less than the 8% concentration threshold for neurolysis seen in animal study by Ready et al. Also Hempl et al demonstrated that the addition of dextrose and lower concentration lidocaine did not show consistent neurolytic symptoms in the context of increased transient neurologic symptoms (TNS) in spinal anesthesia.[36] Kim et al demonstrated that 10% lidocaine caused rapid neurolytic changes in the sciatic nerve in a canine.[37] Therefore, this study tests the hypothesis that lidocaine >8% concentration can be an alternative neurolytic agent in the prolongation of headache relief with GONB in a retrospective chart review.

Methods

After Institutional Review Board at Henry Ford Hospital (Detroit MI) approval, a retrospective chart review was performed on all patients who received GONB with 10% preservative-free lidocaine for headache from January 2014 to June 2015 after referral for occipital nerve block from neurology service. Ten percent preservative-free lidocaine was compounded by Health Dimensions Compounding Pharmacy (Farmington, MI, USA). Those patients who received 10% lidocaine had to have ≥50% relief on visual analog scale (VAS) for <1 month with GONB using bupivacaine/methylprednisolone (BM). Demographic information including age, sex, laterality, diagnosis, and baseline VAS prior to 10% lidocaine GONB was recorded. As per routine in our clinic, patients were asked to follow-up once they felt the headaches had return to baseline. On follow-up, the VAS during the period of relief and duration of relief as reported by patients was recorded. Duration of relief with initial GONB with BM was noted. All GONB were performed by the same provider. GONB with BM were performed at the bedside. After written informed consent was obtained for the whole study as per standard practice of care, GONB with 10% lidocaine was performed with the patients in prone position in a cervical headrest under fluoroscopic guidance to exclude vascular uptake with sedation of intravenous fentanyl and midazolam. The volume of 10% lidocaine used was up to 80% max dose of lidocaine based on 4 mg/kg body weight, and 0.1 cc isovue or magnevist contrast was injected prior to exclude vascular uptake to reduce the risk of lidocaine toxicity. Of note, patients who received bilateral GONB received a smaller dose/volume of 10% lidocaine due to the dose limit of 4 mg/kg. Statistical analysis was performed using paired *t*-test.

Results

A total of 13 patients were reviewed. All but one patient was female, and the average age was 47 years (standard deviation [SD]=15.42) (Table 1). Ten were diagnosed with migraine and three with occipital neuralgia. Eleven had bilateral symptoms (Table 1). Baseline VAS prior to GONB with 10% lidocaine averaged 86.92 mm (SD=11.82) (Table 2). The mean volume of 10% lidocaine injected per nerve was 1.096 mL (SD=0.38) (Table 1). There was significant decrease in mean % change VAS with 10% lidocaine at 60.4% (mean: −52.69 mm) (P=0.001) (Table 2). The mean duration of relief was significantly higher with 10% lidocaine at 148.05 days (SD=98.87) versus BM at 6.33 days (SD=5.01) (P=0.001) (Table 3). No complications or side effects were reported.

Discussion

Relationship of concentration of lidocaine and neurolysis

Most animal studies have used concentrations of 5% or less to study neurotoxicity since this is the most common concentration used clinically. Previous studies used direct intraneural or intrathecal injections, desheathed nerves, and cell cultures. Only one paper by Kalichman et al mentions

Table 1 Patient demographics and dose of 10% lidocaine used

Diagnosis	Male=1	Female=1	Age	Bilateral=1	Dose (mL) per site 10% lidocaine
Migraine	0	1	19	0	1.5
Migraine	0	1	38	1	1
Migraine	0	1	45	1	1
Migraine	0	1	67	1	1
Migraine	0	1	48	1	1
Migraine	0	1	52	1	1
Migraine	0	1	65	1	1
Occipital	0	1	69	1	0.75
Migraine	0	1	57	1	1
Migraine	1	0	36	1	1.5
Occipital	0	1	35	0	2
Migraine	0	1	28	1	1
Occipital	0	1	52	1	0.5
Migraine (N=10) Occipital (N=3)	Male=1	12	Mean=47	Bilateral=11	Mean=1.096154

Table 2 VAS baseline and post 10% lidocaine

Diagnosis	Base VAS before 10% lidocaine (mm)	Post-VAS after 10% lidocaine (mm)	Change VAS (mm)	% change VAS
Migraine	80	20	60	75
Migraine	90	22.5	67.5	75
Migraine	100	62.5	38.5	38.5
Migraine	100	60	40	40
Migraine	70	40	30	40.4
Migraine	90	50	40	44.4
Migraine	70	30	40	57.14
Occipital	80	30	50	62.5
Migraine	90	22.5	67.5	75
Migraine	90	22.5	67.5	75
Occipital	100	25	75	75
Migraine	70	30	40	57.2
Occipital	100	30	70	70
Mean	86.9230769	34.2307692	50.25	60.39538462 (*P*=0.0001)
SD	11.82	14.48	15.56	15.10

Abbreviations: SD, standard deviation; VAS, visual analog scale.

Table 3 Comparison duration of maintenance of pain relief of bupivacaine/methylprednisolone test block with 10% lidocaine

Diagnosis	Duration from test block (days)	Duration from 10% lidocaine (days)	Change in duration (days)
Migraine	14	210	+196
Migraine	0.333	365	+364.667
Migraine	2	220	+218
Migraine	1	71	+70
Migraine	7	24	+17
Migraine	14	287	+273
Migraine	4	60	+56
Occipital	7	123	+116
Migraine	7	120	+113
Migraine	7	90	+83
Occipital	4	221	+217
Migraine	1	96	+95
Occipital	14	120	+106
Mean	6.333307692	154.3846154	+149.05
SD	5.01	98.87	(*P*-value=0.0001)

Abbreviation: SD, standard deviation.

lidocaine being injected perineurally by piercing the connective tissue separating the neural tissue from overlying muscle rat sciatic nerves.[22] They measured nerve conduction post-injection and performed histologic analysis at 48 hours. They reported endoneurial edema, collapsed myelin sheaths, and axonal degeneration. This study, however, used a lower concentration than seen in previous studies at 3% lidocaine. Although animal models have shown evidence of neurotoxicity at clinically used concentrations of 5% or less, evidence of neurotoxicity in humans at these concentrations appeared to be much less than expected. This has been well documented in the use of intrathecal lidocaine for spinal anesthesia and the phenomenon of TNS. Schneider et al reported four cases of TNS using 5% lidocaine.[34] Keld et al compared 5% lidocaine versus 0.5% bupivacaine and found that lidocaine caused TNS in 26% of patients versus 3% in bupivacaine.[38] Several prospective studies noted TNS incidence of 4%–33% with lidocaine.[30,31] This may be explained by the study of Ready

et al who reported prolonged neurologic deficit and profound histological changes after intrathecal injection in rabbits occurred only at lidocaine concentrations ≥8%, which was compatible with the previously mentioned clinical experience in humans. In our study, 10% lidocaine allowed local concentrations ≥8% despite the requirement to inject contrast beforehand to exclude vascular uptake.

Extraneural local toxicity of lidocaine

Our study did not find gross acute changes to the surrounding soft tissue after injection. Phenol and alcohol have been well known to cause significant necrosis in tissue other than neural tissue. Besides the obvious cardiac and central nervous system toxicity with lidocaine, which was controlled in our study by dose and image guidance, review of literature does not indicate significant soft tissue injury with lidocaine. Only two case reports or series have been published in the ophthalmology literature with cases of ptosis and diplopia after lidocaine injection for retro-orbital nerve blocks causing what is presumed to be due to ocular muscle necrosis but not proven by biopsy.[32,33] Sahai-Srivastava and Subhani reviewed the side effects of different concentrations of lidocaine in their retrospective analysis of 89 patients who received GONB with 1% (N=69), 2% (N=18), and GONB with 5% lidocaine.[39] They reported adverse effects such as dizziness, hypertension, blurry vision, slurred speech, and pseudo-seizure in 9% of patients with four patients in the 5% group and three in the 1% group. They reported no statistically significant correlation between lidocaine dose and occurrence of adverse effects, though there was a slight trend toward more adverse effects in the lidocaine 5% group (P=0.072) compared to the lidocaine 1% group. Their study was limited since it did not mention the total mg of lidocaine used or volume. In our study, the risk of inadvertent vascular was decreased by using contrast and fluoroscopy. The total dose of lidocaine was kept below the recommended dosage limits, and the patients received midazolam and fentanyl to raise seizure threshold and decrease anxiety, which may contribute to the hypertension seen in the previous study.

Comparison of lidocaine to RFA

Gabrhelík et al in a pilot study compared the efficacy of pulsed RFA of the greater occipital nerve versus GONB with a mixture of local anesthetic and steroid in the management of refractory cervicogenic headache.[12] They reported that pain remained reduced even after 9 months. Navani et al described a case of pulsed RFA of the GON obtaining 4 months' pain relief.[13] Hamer and Purath performed continuous RFA of the C2 dorsal root ganglion with or without third occipital nerve in an observational study of 40 patients with cervicogenic headache and occipital neuralgia.[16] They reported a mean duration of pain relief at 22.35 weeks; however, 12.5% of the study patients reported hyperesthesia along the GON and lesser occipital nerve on the side treated. This lasted between 1 and 6 months at the time of follow-up. The use of cooled RFA was limited to a single case report and only the acute response was measured.[15] The duration of GONB with 10% lidocaine at 148 days appeared to be at least comparable in duration to pulsed RFA and continuous RFA without the side effects. No dysesthesia was reported by any of the 10% lidocaine GONB patients.

Conclusion

In this case series, 10% lidocaine does appear to prolong the relief of headache and may have neurolytic action without side effects. The study was limited by its retrospective nature, small number of patients, and nonstandardized time for follow-up requiring self-report by patients. Given that, further investigation with a randomized controlled trial is warranted to confirm results. Also, further studies are needed to see if 10% lidocaine is a viable alternative to RFA of the occipital nerve in the treatment of headache.

Disclosure

The authors report no conflicts of interest in this work.

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