Pain Physician 2020; 23:423-427 • ISSN 1533-3159

Retrospective Review

Lidocaine Versus Bupivacaine in the Treatment of Headache with Intranasal Sphenopalatine Nerve Block

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Disclaimer: There was no external funding in the preparation of this manuscript.

Conflict of interest: Each author certifies that he or she, or a member of his or her immediate family, has no commercial association (i.e., consultancies, stock ownership, equity interest, patent/licensing arrangements, etc.) that might pose a conflict of interest in connection with the submitted manuscript.

Manuscript received: 03-05-2019
Revised manuscript received: 01-26-2020
Accepted for publication: 02-03-2020

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Background: Intranasal sphenopalatine ganglion (SPG) block has been shown to be an effective treatment for headaches. Multiple therapeutic agents have been studied, although the wide availability and low cost of lidocaine and bupivacaine have made them attractive treatment options. To the authors knowledge, no study has yet demonstrated superiority of one anesthetic over the other.

Objective: To determine the efficacy of lidocaine versus bupivacaine when performing intranasal sphenopalatine ganglion (SPG) block for the treatment of headaches.

Study Design: Retrospective cohort study.

Setting: A single tertiary care academic institution

Methods: This retrospective study identified patients who underwent SPG block at a single institution from January 1, 2014 to December 20, 2017. Patients were included if they were treated with either lidocaine or bupivacaine and had both pre- and post-procedure pain scores recorded on a 0-10 scale. Patients were excluded if they were less than 18 years of age.

Results: 386 total procedures were performed. 303 (78.5%) were lidocaine delivered via the SphenoCath device, and 83 (21.5%) were bupivacaine delivered via the Tx360 device. 90.2% of treatments (n = 348) decreased the patient's pain level. Of the treatments performed with lidocaine, 89.1% (n = 270) resulted in improvement of the patient's pain level with a mean decrease in pain level of 3.1 (SD ± 2.3). Of the treatments performed with bupivacaine, 94.0% (n = 78) resulted in improvement of the patient's pain level, with a mean decrease in pain level of 3.0 (SD ± 1.9). No statistically significant difference was found between the 2 anesthetics.

Limitations: The retrospective study design may introduce selection bias. Both lidocaine and bupivacaine were administered by different devices (Sphenocath and Tx360 respectively) which may account for differences in initial treatment success. There were differences in the size of the two groups, which may also introduce error.

Conclusions: This study demonstrates similar efficacy of SPG block performed with lidocaine or bupivacaine. While no difference was found, the particular advantages and disadvantages of the intranasal delivery device may influence physician choice.

Key words: Sphenopalatine ganglion nerve block, lidocaine, bupivacaine, sphenocath, Tx360, pain intervetnio, headache, miimally invasive therapy

Pain Physician 2020: 23:423-427

Headaches are a common problem, affecting up to 11% of the population in the United States and are a common cause of disability (1,2). Acute headaches can be treated with non-steroidal anti-inflammatory drugs (NSAIDS), combination analgesics, caffeine, corticosteroids, anti-emetics, serotonin agonists, triptans and ergot alkaloids (3,4). When a patient's headaches are chronic, preventative medications can be prescribed, although place the patient at risk of medication overuse headaches. More invasive techniques are available, including botulinum toxin injections, implantable occipital nerve stimulators, and radiofrequency denervation, although these carry significant risks (4-6).

A lower risk alternative are therapies targeting the sphenopalatine ganglion (SPG). The SPG is the largest cluster of neuronal tissue outside of the calvarium, which lies just behind the middle turbinate in the pterygopalatine fossa and is thought to play a role in multiple headache and facial pain syndromes (7). This ganglion is intricately interwoven with the neural axis of the head and neck, with sensory, motor, sympathetic, and parasympathetic connections (7). While the mechanism behind the SPG block isn't completely understood, it has been found to be an effective target in treatment of migraines, cluster headaches, trigeminal neuralgia, atypical facial pain, and vasomotor rhinitis (7,8).

Several devices have been developed to treat the SPG from an intranasal route, which are advanced through the nares and apply a topical anesthetic directly to the mucosa overlying the SPG. While a number of studies have looked at the efficacy of the SPG nerve block as well as the efficacy of individual devices, to the author's knowledge, none have compared the efficacy of lidocaine versus bupivacaine. This study aimed to determine if there was greater efficacy of one topical anesthetic over the other. A secondary objective of this study was to examine additional factors to determine if there were factors predictive of treatment failure.

Methods

Institutional review board approval was obtained, and patient medical records were reviewed in compliance with Health Insurance Portability and Accountability Act guidelines. This retrospective study included all patients who underwent SPG block in the interventional radiology division at a single institution from January 1, 2014 to December 20, 2017. Patients were included if they were treated with either lidocaine or bupivacaine and were required to have both pre- and post-procedure pain scores recorded on a 0-10 scale. Patients were excluded if they were less than 18 years of age.

Patients were identified using Picture Archiving and Communications System (PACS)-integrated data mining software (Illuminate Insight; Softek, Kansas City, Kansas), and intervention characteristics were obtained through the electronic medical record (EMR). Patients were categorized based on whether they received lidocaine or bupivacaine. A total of 217 patients met inclusion criteria during the study period, 168 females (77.4%) and 49 males (22.6%), with a mean age of 43.8 years (SD ± 14.3 years, Table 1). Headaches were classified by the International Classification of Headache Disorders, 3rd edition (9). Patients were followed through the EMR to the conclusion of the study.

SPG block was first performed at the author's institution in 2014 using lidocaine applied through the SphenoCath device (SphenoCath Applicator; Dolor Technologies, Scottsdale, Arizona). In late 2016, treatment transitioned to use bupivacaine applied through the Tx360 device (Tx360 Nasal Applicator; Tian Medical, Grayslake, Illinois), as it could be performed without fluoroscopic guidance. All patients undergoing SPG block were treated by one of 6 fellowship-trained interventional radiologists with an average of 9 years of experience (range = 5-14 years).

SPG block with the SphenoCath began by recording the patient's baseline pain level on a scale of 1-10 prior to the procedure. The patient was placed in the lateral decubitus position and the paranasal sinuses were located via fluoroscopy. The catheter was advanced into one nostril and positioned just above the middle turbinate. Contrast was injected to confirm catheter position just anterior to the sphenopalatine fossa. A solution of lidocaine was slowly dripped onto the mucosa overlying the sphenopalatine ganglion. The catheter was removed, and the procedure repeated in the contralateral nasal cavity. Ten minutes following the procedure, the patient's pain level was recorded.

SPG block with the Tx360 began by recording the patient's baseline pain level on a scale of 1-10 prior to the procedure. The patient remained in the upright position, the catheter was advanced into one nostril and rotated slightly towards the ipsilateral ear. A solution of bupivacaine was then sprayed onto the mucosa overlying the sphenopalatine ganglion. The catheter was removed, and the procedure repeated in the contralateral nasal cavity. Ten minutes following the procedure, the patient's pain level was recorded.

Table 1. *Patient demographics*.

Characteristic	All Patients	Lidocaine	Bupivacaine	*P*-Value
Gender, n (column %)				0.1261
Female	168 (77.4)	135 (75.4)	33 (86.8)	
Male	49 (22.6)	44 (24.6)	5 (13.2)	
Mean age, years (SD)	43.8 (14.3)	44.0 (14.5)	42.9 (13.8)	0.6673
Race, n (column %)				0.8186*
White	194 (89.4)	160 (89.4)	34 (89.5)	
Black	13 (6.0)	10 (5.6)	3 (7.9)	
Other	10 (4.6)	9 (5.0)	1 (2.6)	
Headache etiology, n (column %)				0.3414
Primary headache	169 (77.6)	136 (76.0)	33 (86.8)	
Secondary headache	38 (17.5)	34 (19.0)	4 (10.5)	
Painful cranial neuropathies, other facial pains, and other headaches	10 (4.6)	9 (5.0)	1 (2.6)	
Number of Patients Requiring a Single Treatment for Effective Pain Relief, n (%)	152 (70.0)	129 (84.9)	23 (15.1)	0.1584
Number of Patients Requiring More Than One Treatment for Effective Pain Relief, n (%)	65 (30.0)	50 (76.9)	15 (23.1)	

*Fisher's Exact Test used, as the expected counts in some cells less than 5.

Statistical analyses were performed using SAS software (SAS Institute, Cary, North Carolina) and Stata (StataCorp, College Station, Texas) and a *P*-value of < 0.05 was considered statistically significant. Initial treatment success was defined as a decrease in the patient's reported pain level 10 minutes following the procedure by greater than or equal to 1. Treatment failure was defined as no change or worsening in the patient's reported pain level 10 minutes after the procedure. Patients who did not experience sustained pain relief after SPG block could return for further treatments. A Sign test was used to determine if SPG block lowered pain. A multivariable mixed effects REML regression model was used to examine the effect of selected covariates on pain change.

Results

A total of 217 patients were included in this study, comprising 386 total procedures. Of these procedures, 303 (78.5%) were lidocaine delivered via the SphenoCath device, and 83 (21.5%) were bupivacaine delivered via the Tx360 device (Table 2). Out of all treatments performed, regardless of the topical anesthetic used, 90.2% (n = 348) resulted in improvement in the patient's pain level, and 9.8% (n = 38) resulted in no change or worsening pain following the procedure. The average pre-treatment pain score was 6.1/10 (SD ± 2.3), and the average post-treatment pain score was 2.9/10 (SD ± 2.4). The mean decrease in pain per treatment was 3.1 (SD ± 2.2). 70% (n = 152) of patients required a single treatment for headache relief and did not return for repeat SPG block during the study timeframe. 30% (n = 65) of patients underwent multiple treatments to achieve sustained pain relief.

Of the treatments performed with lidocaine, 89.1% (n = 270) resulted in improvement of the patient's pain level, and 10.9% (n = 33) resulted in no change or worsening of pain following the procedure. The average pre-treatment pain score was 6.1/10 (SD ± 2.3), and the average post-treatment pain score was 3.0/10 (SD ± 2.5). The mean decrease in pain per treatment was 3.1 (SD ± 2.3). No complications were reported in those treated with lidocaine.

Of the treatments performed with bupivacaine, 94.0% (n = 78) resulted in improvement of the patient's pain level, and 6.0% (n = 5) resulted in no change or worsening of pain following the procedure. The average pre-treatment pain score was 5.9/10 (SD ± 2.2), and the average post-treatment pain score was 2.9/10 (SD ± 2.3). The mean decrease in pain per treatment was 3.0 (SD ± 1.9). No complications were reported in those who were treated with bupivacaine.

Additional covariates were analyzed to explore if any had a significant outcome on pain relief with SPG

Table 2. *Treatment characteristics*.

Characteristic	All	Lidocaine	Bupivacaine	*P*-Value
Treatments Performed, n (%)	386	303 (78.5)	83 (21.5)	
Pre-Treatment Pain Level, mean (SD)	6.1 (2.3)	6.1 (2.3)	5.9 (2.2)	0.4992
Post-Treatment Pain Level, mean (SD)	2.9 (2.4)	3.0 (2.5)	2.9 (2.3)	0.7403
Change in Pain Level from Pre- to Post-Treatment, mean (SD)	-3.1 (2.2)	-3.1 (2.3)	-3.0 (1.9)	0.7130

block. This included gender, race, age at first treatment, indication, headache etiology, and the drug administered (lidocaine versus bupivacaine). None of the covariates analyzed were found to be statistically significant.

Discussion

Studies on the efficacy of intranasal SPG block have shown that 36-80% of patients who underwent the procedure experienced a decrease in pain, usually within 10 - 30 minutes (8). However, long term relief has been mixed, with headache relapse reported in 20-42% of patients, usually within 24 hours (8). Multiple drugs have been studied, including cocaine, triamcinolone, onabotilinumtoxin A, and ketorolac, as well as a number of topical anesthetics, including lidocaine, bupivacaine, and mepivacaine. Currently, no study has demonstrated superiority of any of these medications. However, the wide availability and low cost of lidocaine and bupivacaine have made them attractive treatment options.

The earliest studies investigated the use of intranasal lidocaine and reported successful reduction of pain in 36-78% of patients (8,10-12). A randomized controlled trial in 2014 also showed a benefit to intranasal lidocaine for headache relief (13). The use of bupivacaine delivered via the Tx360 device has also been investigated, with 68% of patients experiencing a decrease in headache pain (14,15). A follow-up study on this group reported decreased number of headache days, average headache pain, and decreased medication use in the 6 months following SPG block, suggesting there may be a disease-modifying component to this treatment (16). However, several studies have found no difference between intranasal lidocaine and bupivacaine and saline (17,18).

This study demonstrated similar efficacy of SPG block to that reported in the literature. 90.2% of procedures performed resulted in a decrease in pain. Pain relief in both groups showed a 53.7% reduction in headache pain, with an average decrease in the reported pain scale by 3. However, there was no statistically significant difference in pain relief when comparing lidocaine and bupivacaine ($P = 0.838$). Initial treatment success between lidocaine and bupivacaine were slightly different. While lidocaine showed decreased pain in 89% of patients immediately following treatment, bupivacaine was 94%. However, this difference was not statistically significant, and therefore no definite conclusion can be drawn.

Although no statistically significant difference was found, differences in the devices may influence physician choice. Both SphenoCath and Tx360 appear efficacious in their delivery of topical anesthetic to the SPG. However, as the SphenoCath device drips lidocaine onto the SPG fossa, patients are required to be recumbent and fluoroscopic guidance is often required for accurate medication delivery. Tx360 allows patients to remain in the sitting position, and fluoroscopic guidance is not needed for accurate drug delivery, allowing the procedure to be performed in the clinic setting.

There were a number of limitations to this study. The retrospective study design may have introduced selection bias, as the patient populations were determined by a change in the authors' practice, rather than true randomization. While no significant differences were found between lidocaine and bupivacaine, the differences in technical success may be confounded by the use of two different devices. The SphenoCath and Tx360 devices have differences in the administration of the topical anesthetic, and technical success may be secondary to these differences, rather than the anesthetic used. The differences in size of the 2 treatment groups may be a source of error.

Conclusion

SPG block is an effective treatment for the treatment of headache, although long-term durability is unclear. In those who respond to SPG block but experience multiple recurrences, more permanent treatments directed at the SPG may be helpful. Future studies may benefit this population by identifying patient characteristics predictive of treatment failure, testing the efficacy of additional therapeutic agents, and further studying the long-term durability of SPG block.

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