Retrospective Study

Sphenopalatine Ganglion Nerve Block for the Treatment of Migraine Headaches in the Pediatric Population

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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: 03-15-2020
Revised manuscript received: 05-05-2020
Accepted for publication: 05-21-2020

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Background: Persistent headaches and migraines are common in pediatrics with various treatment options. The sphenopalatine ganglion (SPG) has been identified as communicating with the parasympathetic autonomic nervous system and pain receptors. In adults, SPG block is an established treatment but there is no published literature in pediatrics.

Objectives: The purpose of this study is to analyze the SPG block in pediatrics.

Study Design: Retrospective, single-center study.

Setting: This study was conducted at Phoenix Children's Hospital in Phoenix, Arizona.

Methods: A comprehensive review of patient charts from 2015–2018 of all pediatric SPG blockades performed by interventional radiology were included in the analysis. Utilizing fluoroscopic guidance, a SphenoCath was inserted into each nostril and after confirming position, and 4% lidocaine injected. Pre- and postprocedural pain was assessed using the Visual Analog Scale (VAS). Immediate and acute complications were documented.

Results: A total of 489 SPG blocks were performed in patients between ages 6 and 26 years who were diagnosed with migraine or status migrainosus. One hundred percent technical success was achieved with mean reduction of pain scores of 2.4, which was statistically significant ($P < 0.0001$). There were no immediate or acute complications.

Limitations: Results of this study were based on retrospective study. The use of VAS may be subjective, and the need of a prospective study may be necessary.

Conclusions: With 100% technical success, statistically significant pain reduction, and no complications, we support SPG block in the pediatric population as a simple, efficacious, and safe treatment option for refractory headaches. It is routinely performed in less than 10 minutes and commonly negates the need for inpatient headache pain management. Given its minimal invasivity, we support the use of SPG blockade as a therapeutic treatment in refractory pediatric migraines as it reduces the need for intravenous medications, prolonged pain control, or hospital admission.

Key words: Chronic, migraine, minimally invasive, nerve block, pediatric, sphenopalatine

Pain Physician 2021: 24:E111-E116

Persistent headaches and migraines are common in the pediatric population, occurring in 3% to 8% of 3-year-old children, increasing to 57% to 82% in 8- to 15-year-olds. The prevalence in boys is higher than in girls prepuberty, but the trend reverses postpuberty (1,2). With headaches being the most common cause of pain in pediatrics, chronic pain has been shown to decrease quality of life through decreased participation in school and social activities (3,4). Treatment of pediatric headaches can

be very diverse depending on the etiology, including oxygen, triptans, nonsteroidal anti-inflammatory drugs, verapamil, steroids, and antiepileptics. Chronic, persistent headaches prove to be difficult to treat due to recurrence and long-term usage of medication. Common prophylactic treatment of chronic headaches consists of amitriptyline, propranolol, topiramate, and valproic acid.

The sphenopalatine ganglion (SPG) has been identified in adult patients as a site that communicates with the parasympathetic autonomic nervous system and pain receptors. A blockade of SPG prevents activation of the trigeminal-autonomic reflex, blocking vasodilating peptides and the resultant neurogenic inflammation. The role of the SPG block has come into the limelight in recent years. The process involves a small flexible catheter that is advanced deeply into each nostril under fluoroscopic guidance, after which local anesthetic is administered. The SPG block is a minimally invasive, effective method for the alleviation of chronic headaches and migraines in adults. Evidence is also emerging on the success of SPG blocks in acute migraine attacks (5). The SPG block has even been utilized for less common types of headaches, including postdural lumbar puncture headaches, and intranasal contact point headaches (6,7).

The SPG block has traditionally only been used in adult patients with great success, however, there has been no published literature on the utility and effect on migraine headaches in the pediatric population. We first reported the use of SPG block in the pediatric population in 2017, detailing its utility and safety in treating migraine headaches in 200 children ranging in age from 8 to 26 years. This group demonstrated a significant decrease in headache pain level, suggesting that the SPG block was a simple, effective, and timely alternative to traditional therapies (8). The purpose of this study was to analyze the use of the SPG block in a large pediatric population with refractory migraine headaches to demonstrate its safety and efficacy. Treatment of other headache types were not the focus of this article.

Methods

This retrospective, single-center study was approved by the Phoenix Children's Hospital institutional review board (PCH IRB 15-085).

From February 2015 through July 2018, all SPG blockades performed in interventional radiology (IR) by 4 attending pediatric interventional radiologists and 3 pediatric IR fellows were included in the analysis. The 4 attending pediatric interventionalists had 38, 26, 12, and 3 years of experience, respectively. Data were collected from the medical records of patients and included patient demographics, procedural indications, and inpatient versus outpatient status. All patients were referred to IR with the diagnosis of refractory acute and/or chronic migraine headaches. In addition, all children who were referred to IR for an SPG block had failed medical therapy.

In this series, all patients were referred to IR with the diagnosis of status migrainosus. The referring physicians were generally pediatric neurologists or pediatric hospitalists. All studies were performed using the same protocol and equipment and graded using the Visual Analog Scale (VAS). After obtaining verbal and written consent for the procedure, patients were placed on the IR suite table in supine position with the neck hyperextended. Fluoroscopic image-guidance was performed with a Philips Imaging System (AlluraClarity FD Angiography System; Philips Healthcare, Andover, MA). Procedures were predominantly performed with only local anesthesia or with light procedural sedation (i.e., intravenous or oral midazolam), with a minority performed under general anesthesia due to conjoint procedures (i.e., peripherally inserted central catheter placement, lumbar puncture).

Pre- and 10-minute postprocedural pain was assessed using the VAS from 1 to 10 (Fig. 1). Immediate and acute complications were recorded, including minor nasal bleeding. Both pain assessment and complications were recorded as per the operating physician.

Technique

Our team modified the procedure so that it could be utilized in children without the use of general anesthesia. Local anesthesia using 1.5 mL of aerosolized 4% lidocaine is administered into each nostril via a 5-mL syringe. After 1 to 3 minutes, 1 mL of 2% lidocaine gel is administered into the orifice of each nostril with 1-mL syringes (Fig. 2). Immediately following, a cotton swab saturated with 2% lidocaine gel is inserted into each nostril to the level of the nasal bridge and allowed to remain for 5 minutes prior to commencing the procedure. The purpose for these 3 steps is to allow for numbing of the nasal mucosa prior to delivery of the SphenoCath (Dolor Technologies, LLC, Clearfield, UT). Given the challenges of the pediatric population with regard to anxiety and

nervousness, these steps help ease patient tension prior to catheter delivery and improve patient comfort. The phased local anesthesia is easier for the child to adjust to. This greatly enhances the technical success of delivering the SphenoCath into the nostril without the patient becoming uncooperative or unable to proceed with the procedure. Anesthetizing via the SphenoCath is generally unsuccessful because it makes the child cry before local anesthesia can be achieved.

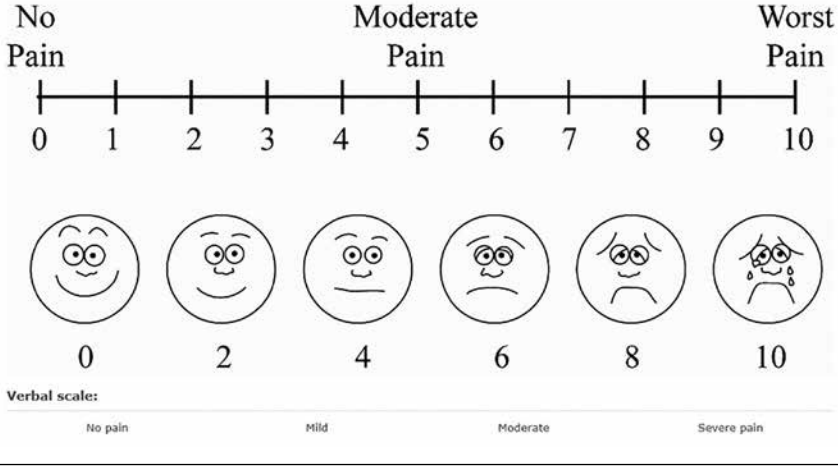

Fig. 1. *The VAS.*

All procedures were performed using fluoroscopic guidance. Using intermittent cross-table lateral fluoroscopy, a SphenoCath (Fig. 3) is inserted into a single nostril and advanced to the anterosuperior nasal cavity, below the floor of the frontal sinus. The inner curved catheter is then deployed above the middle nasal turbinate and 1 mL of Isovue-300 is injected to confirm transit of contrast medium toward the pterygopalatine fossa where it pools as aided by neck flexion, located 1.0 to 1.5 mm deep to the posterior nasal mucosa (Fig. 4) and not into the middle turbinate. Two milliliters of 4% lidocaine is slowly injected via the SphenoCath, and the catheter is removed. This is repeated for the contralateral nostril. The lights in the procedural room are then dimmed and the patient maintained supine with the neck extended for 10 minutes following completion of the procedure to allow contact and absorption of the 4% lidocaine through the mucosa overlying the SPG. The primary outcome measure that was assessed was headache intensity because comorbidities are not common in children.

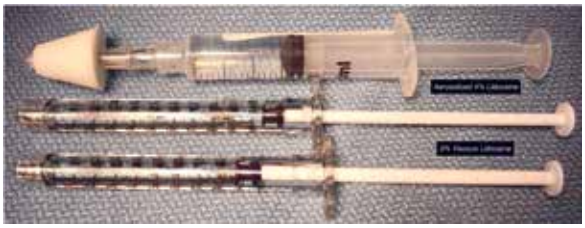

Fig. 2. *Three milliliters of aerosolized 4% lidocaine in a 5-mL syringe and 1 mL of 2% lidocaine in gel in 2 1-mL syringes.*

Fig. 3. *Sphenocatheter.*

Results

A total of 489 SPG blocks were performed in pediatric patients (404 female, 85 male) between the ages of 6 and 26 years who were diagnosed with migraine or status migrainosus. Of these patients, 9 were 19 years or older, all young adults with pediatric conditions. One hundred percent technical success, defined as delivery of 4% lidocaine to the pterygopalatine fossa, was achieved in all 489 SPG blocks.

The mean and standard deviation (SD) of pre- and postprocedure pain scores, respectively, were 5.7 (SD = 2.5) and 3.3 (SD = 2.7) using the paired t-test, which was statistically significant ($P < 0.0001$) (Table 1). There was a mean reduction of pain scores of 2.4 (SD = 2.2).

Of the 489 procedures, 243 were completed with local anesthetic only, 206 completed with procedural sedation, and 40 completed under general anesthesia of which 31 were with conjoint procedures. When procedural sedation was utilized, intravenous midazolam

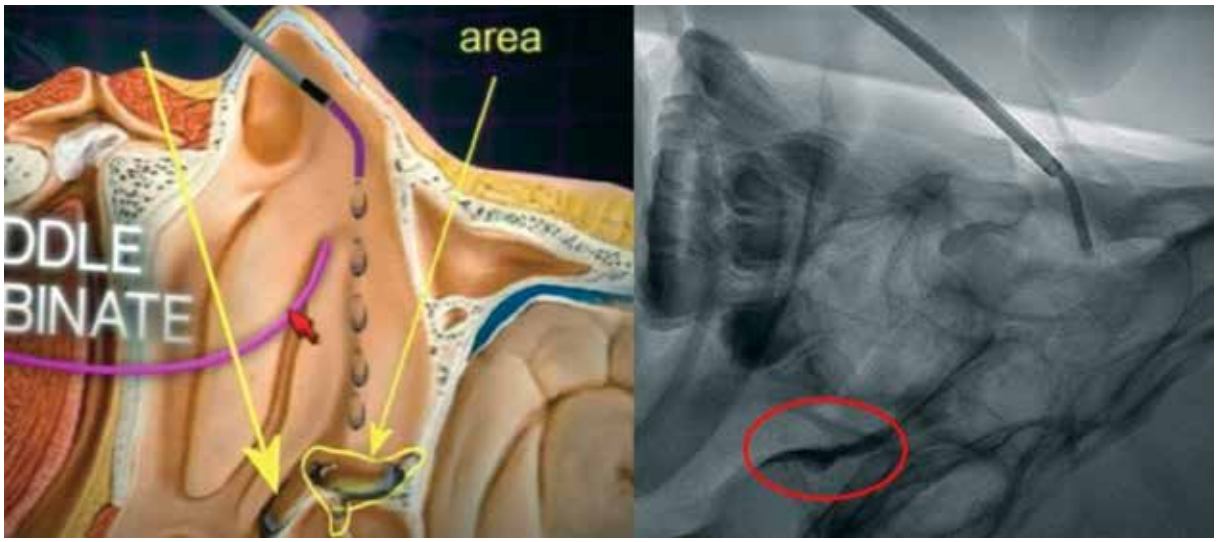

Fig. 4. *(A) Pictorial diagram demonstrating sphenocatheter deployed above the middle nasal turbinate with local anesthetic administration to the SPG (yellow circle) and low yellow below localizing the posterior nasopharynx. (B) Cross-table lateral fluoroscopic image of proper catheter position and pooling at the SPG (red circle).*

Table 1. *Patient demographic and outcomes of SPG blockade in pediatric migraine patients.*

SPG Patient Demographics and Statistical Outcomes				
	Female	**Male**	**Total**	***P* value**
Patient #	404 (82.6%)	85 (17.4%)	489	
Age				< 0.0001
Mean (SD)	14.9 (2.4)	12.7 (2.7)	14.5 (2.6)	
Median	15	13	15	
Range	(8-26)	(6-18)	(6-26)	
Diagnosis/Indication				0.0004
Headache	120 (29.7%)	42 (49.4%)	162 (33.1%)	
Migraine	284 (70.3%)	43 (50.6%)	327 (66.9%)	
Preprocedure pain				0.6792
Mean (SD)	5.7 (2.5)	5.9 (2.4)	5.7 (2.5)	
Median	6	6	6	
Postprocedure pain				0.5326
Mean (SD)	2.4 (2.1)	2.6 (3.0)	2.4 (2.2)	
Median	2	2	2	

was given in 200 patients, oral midazolam in 3 patients, intranasal midazolam in 2 patients, and 1 child received intravenous diphenhydramine. When comparing procedures performed with no sedation to either those performed with sedation or general anesthesia, the pain reduction scale was not statistically significant (P = 0.3245) with pain reduction scores of 2.5 (SD = 2.4), 2.2 (SD = 2.1), and 2.2 (SD = 1.6) using the χ^2 test.

Pain reduction scores were compared for girls and boys. In girls the mean pain reduction was 2.4 (SD = 2.1) and boys 2.6 (SD = 3.0). We did not observe statistically significant gender differences for pain scores with a P value of 0.4836.

There were no immediate or acute complications.

Discussion

In our study, we found statistically significant pain reduction in the 489 treated patients with a mean reduction of pain of 2.4 (P < 0.00001), without experiencing a single immediate or short-term complication. With 100% technical success, we support the utility of the SPG block in the pediatric population as a simple, safe, and efficacious treatment option for refractory headaches. The procedure is routinely performed in less than 10 minutes and commonly negates the need for inpatient admission for pain management of headache.

With regard to the type of anesthetic required for the procedure, our data does not support a preferred method as no statistically significant pain reduction differences were noted (P = 0.3245). However, our suggested approach is with the use of local anesthetic only. Administering procedural sedation or a general anesthetic may contribute to more unreliable or skewed

interpretations of the VAS, used to assess the reporting of pain pre- and post-SPG block. Therefore we only recommend a general anesthetic or procedural sedation if a concurrent surgical procedure requiring these measures is requested.

Assessing the influence of the SPG block on boys versus girls, the data does not support its effectiveness in one over the other. However, pain scores significantly improved in both subgroups independently. Interestingly, the female prevalence in this series is striking with a 4.75:1 girl to boy ratio. Kristjansdottir et al (1) report that the prevalence of headaches is more in boys before puberty; whereas girls are significantly more affected in teens. This high frequency in teenage girls is thought to be multifactorial, the result of hormonal changes, peer group pressures, and school stressors. With the majority of our patients being of the adolescent age, our results support this hypothesis for a higher prevalence of refractory migraines in teenage girls.

The strength of this study is that it is a first-of-kind study of the safety and efficacy of the SPG block in a large pediatric population. With this study highlighting almost 500 successful, uncomplicated procedures, we support the SPG block as a minimally invasive and effective method in alleviating refractory migraines when drug therapy has failed.

There are several weaknesses of this study that may be addressed in future studies. The VAS is used to assess the effectiveness of the outcome of the SPG block. However, this scale is subjective and may be influenced by outside factors, such as physician suggestions, patient anxiety and bias, and individual sensitivity to painful stimuli. Also, a comparative, prospective study differentiating between SPG block alone, drug therapy alone, and a combination of drug therapy and SPG block would provide stronger and more precise recommendations to optimize therapy for refractory migraines. In addition, a study highlighting different indications for therapy similar to in the adult population, such as use for postlumbar puncture headaches, cluster headaches, and trigeminal neuralgia, to name a few.

Limitations of this study may also include the protocol implementing only short-term follow-up. Duration of pain relief was assessed up to 10 minutes postprocedure without further follow-up. Our basis for this decision-making was owing to the immediate relief of the medication and its short duration, which limits its use as a prophylactic migraine treatment. Also, our technique implemented several additional steps not commonly practiced in the adult population. These additional steps included aerosolized, topical (gel), and cotton-tip application of lidocaine into the nasal passageway to specifically ease pediatric patients as to maintain their cooperativeness and ability to proceed with the procedure.

This retrospective study shows that in this large, single-institution study, SPG block is a safe and effective therapy with an extremely low rate of complications. Currently at our institution, SPG block is a rescue therapy and offered after failed attempts of pharmaceutical therapy. The effectiveness of the study and ease of administration raises the possibility of using this approach both earlier in treatment protocols, possibly as a primary treatment, and with other causes of cephalgia.

Conclusions

The SPG blockade is a safe, effective treatment option for the management of children with headaches/migraines. Our extensive initial experience has shown it to be effective in alleviating head/neck pain and routinely takes less than 10 minutes, reducing the need for intravenous medications, prolonged pain control, or hospital admission. Given its minimal invasivity generally requiring only local anesthesia, we support its utility as an effective therapeutic treatment for refractory pediatric migraine unable to be controlled by pharmacologic measures.

Acknowledgments

All authors contributed to this manuscript in a significant manner not limited to data collection, data analyses, composition of manuscript, and revision.

References

1. Kristjansdottir G, Wahlberg V. Sociodemographic differences in the prevalence of self-reported headache in Icelandic school-children. Headache 1993; 33:376-380.
2. Sillanpää M. Prevalence of headache in prepuberty. Headache 1983; 23:10-14.
3. Abu-Arafeh I, Razak S, Sivaraman B, et al. Prevalence of headache and migraine in children and adolescents: A systematic review of population-based studies. Dev Med Child Neurol 2010; 52:1088-1097.
4. Gold JI, Mahrer NE, Yee J, et al. Pain, fatigue and health-related quality of life in children and adolescents with chronic pain. Clin J Pain 2009; 25:407-412.
5. Binfalah M, Alghawi E, Shosha E, Alhilly A, Bakhiet M. Sphenopalatine ganglion block for the treatment of acute migraine headache. Pain Res Treat 2018; 2018:2516953.
6. Cohen S, Levin D, Mellender S, et al. Topical sphenopalatine ganglion block compared with epidural blood patch for postdural puncture headache management in postpartum patients: A retrospective review. Reg Anesth Pain Med 2018; 43:880-884.
7. Lee SH, Kim Y, Lim TY. Efficacy of sphenopalatine ganglion block in nasal mucosal headache presenting as facial pain. Cranio 2020; 38:128-130.
8. Dance L, Aria D, Schaefer C, Kaye R, Yonker M, Towbin, R. Safety and efficacy of sphenopalatine ganglion blockade in children: Initial experience. *J Vasc Interv Radiol* 2017; 28:2(Supplement S8)?