Medical Sciences

Facial Temperature Changes Following Intranasal Sphenopalatine Ganglion Nerve Block

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Objectives: **To determine whether a facial temperature change occurs following lidocaine delivery to the sphenopalatine foramen via an intranasal catheter.**

Background: **Intranasal SPG blockade has received renewed interest with the advent of intranasal catheters that direct medication to the sphenopalatine foramen to achieve neural blockade. However, it is unclear whether such procedures have a measurable effect on cranial autonomic function. To date there have been no published reports of cranial autonomic nervous system effect via temperature change from intranasal SPG block procedures.**

Methods: **This was a retrospective analysis of 47 patients with a diagnosis of chronic head or facial pain who underwent intranasal sphenopalatine ganglion (SPG) blockade. Facial temperatures were monitored using skin temperature probes over the ipsilateral zygoma and recorded pre-procedure and 15 minutes post-procedure.**

Results: **47 patients were included. The average temperature change was an increase of +1.4 °C which was statistically significant ($p<0.001$) and 50% of patients had a 1 °C or higher temperature change.**

Conclusion: **This study is the first to show a statistically significant increase in temperature following intranasal SPG block. This suggests that delivery of anesthetic to the sphenopalatine foramen results in blockade of the sympathetic fiber activity possibly via the maxillary artery plexus branches surrounding the sphenopalatine foramen prior to parasympathetic activity in the SPG.**

Sphenopalatine | ganglion block | Sphenocath® | Facial temperature monitoring | chronic headache

Introduction

The sphenopalatine ganglion (SPG) is a key structure to facial pain and migraine headache (1-3). It is located in the pterygopalatine fossa lateral to the sphenopalatine foramen which is above the middle turbinate and covered by 3mm of connective tissue/mucous membrane (4). The SPG has trigeminal nerve inputs from the maxillary branch just distal to the middle meningeal nerve, which contributes to the nociception of the periorbital dura and middle cranial fossa (2).

The SPG regulates autonomic control to the skull and face, including skin temperature of the cheek (5). This includes both pre and post ganglionic parasympathetic fibers that synapse in the SPG and post ganglionic sympathetic fibers that pass through the ganglion (6). The postganglionic sympathetic fibers originate in the superior cervical ganglion and classic teaching has been that these fibers via the deep petrosal nerve will pass along with the greater petrosal nerve via the vidian nerve to the SPG (6). The sympathetic fibers are then believed to follow the sphenopalatine ganglion branches. Newer immunohistochemical studies have shown that there is a dual sympathetic pathway within the sphenopalatine fossa which includes the classic teaching through the vidian nerve, but also via the maxillary artery plexus (7). The sympathetic fibers then exit not only via the SPG branches but also via the arterial scaffolding (7). Given this dual sympathetic innervation, delivery of anesthetic to the sphenopalatine foramen may chemically block sympathetic fiber activity prior to parasympathetic fiber activity, leading to the clinical findings of parasympathetic overdrive such as tearing and temperature increase of the cheek. The objective of this study is to determine whether temperature change occurs following lidocaine delivery to the sphenopalatine foramen. Our hypothesis was that a temperature increase would occur initially demonstrating blockade of the sympathetic fiber activity most likely via the maxillary artery plexus branches surrounding the sphenopalatine foramen prior to parasympathetic activity in the SPG.

Methods

This was a retrospective chart review study conducted at the University of Michigan Back and Pain Center (Department of Anesthesiology, Division of Pain Medicine, Ann Arbor, Michigan). Institutional Review Board (University of Michigan, Ann Arbor, MI) approval was obtained before data collection and analysis (HUM00116732). A waiver of written informed consent was obtained.

Participants

The retrospective analysis included patients who underwent a sphenopalatine ganglion block using the Sphenocath® (Dolor Technologies, Scottsdale, Arizona, USA) intransal catheter between January 2012 and January 2016. Inclusion criteria were: 1) Diagnosis of chronic migraine, trigeminal neuralgia, facial pain, or trigeminal autonomic cephalgia. 2) Age $\geq$18 years old. Demographics were collected from the electronic medical record.

Exclusion criteria were: 1) Age <18 years old. 2) Allergies to contrast dyes, or lidocaine. 3) Unstable medical or psychiatric condition.

Intervention Technique

All procedures were performed on an outpatient basis and premedication or sedatives were not used. Fluoroscopic guidance was implemented in all cases using a C-arm system (OEC 9800, General Electric Healthcare). In the holding area the patients received intranasal Xylometazoline 0.05% 2 sprays per nostril, followed by 2% lidocaine with a total of 2 mls per nostril via an atomizer. Smith Medical STS-400 temperature sensor skin probes

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(Smiths Medical, St Paul, Minnesota) were then applied over the ipsilateral zygoma and the pre-procedure temperatures were obtained. The patients were then brought back to the procedure room and placed supine on the fluoroscope table with 20 - 30 degrees Trendelenburg. The Sphenocath® was then lubricated with viscous lidocaine 2% jelly or 5% lidocaine ointment. The catheter was then primed with Omnipaque 180 or 240 dye or Gadolinium in the case of iodine allergies. Then, the catheter was inserted into the nostril to contact the soft tissue inferior to the nasal bone. Once the catheter contacted the nasal bone, it was withdrawn 5-8 mm and then the inner angled flexible catheter was deployed. Position was then confirmed on both AP and lateral fluoroscopic views to be lying above the middle turbinate and aiming towards the sphenopalatine fossa on the lateral view. Position was further confirmed by the injection of 1-2 mls of contrast dye. This was then followed by the injection of 1.5-2 mls of 4% lidocaine, and the inner catheter was retracted and then the Sphenocath® was removed. The patients were kept in the supine Trendelenburg position and transferred over to their bed in this position and maintained this way for 15 minutes during which time the temperatures were monitored continuously. After 15 minutes post procedure the final temperatures were recorded.

Outcomes

The primary outcome measure was the change in skin temperatures from pre-procedure to 15 minutes post-procedure over the ipsilateral zygoma.

Statistical analyses

Descriptive statistics were calculated for the demographic data including age, gender, and diagnosis on day of procedure. Next, average temperature changes in degrees Celsius on the side blocked were calculated for each patient. Sample t-tests were conducted to assess whether the facial temperature changes were significantly different from 0. Although the best cut-off value for the change in temperature of the skin overlying the zygoma has not been determined for predicting the success of a sphenopalatine ganglion block, based on literature looking at lumbar sympathetic blocks (8) we defined a temperature change of 1 °C at 15 minutes as being clinically significant. After calculating the percentage of patients with a temperature change of 1 °C, we then conducted binomial tests to assess whether the facial temperature changes were significantly different from 0.

Results

A total of 47 patients' data were included in the analysis. Baseline demographic data is presented in Table 1.

Post-procedure facial temperature changes are presented in Table 2. For both the overall sample, and the subset of patients who underwent a bilateral procedure, the average temperature change was an increase of +1.4 °C which was statistically significant ($p<0.001$) and 50% of patients had a 1 °C or higher temperature change.

Table 1. Demographic, diagnostic, and procedural descriptive data for the sample of 47 patients.

	n = 47
Age[a]	47.2 (14.7)
Female	30 (63.8%)
Caucasian	43 (91.5%)
Diagnosis	
Chronic Migraine	37 (78.7%)
Facial Pain	4 (8.5%)
Trigeminal Neuralgia	2 (4.3%)
Trigeminal Autonomic Cephalgia:	
-Hemicrania Continua	3 (6.4%)
-Other	1 (2.1%)
Side Of Procedure	
Bilateral	34 (72.3%)
Right	5 (10.6%)
Left	8 (17%)

a. Mean and standard deviation presented for age and average pre-procedure pain. Frequency and percentages presented for each other variable.

Table 2. Average post-procedural pain change and temperature change in Celsius for the overall sample and the subset of patients who underwent the bilateral procedure.

	Overall (n = 47)		Bilateral (n = 34)	
	Mean (SD)	p value (two-tailed)	Mean (SD)	p value (two-tailed)
Average temperature change (both sides)[a]	1.4 (1.1)	<0.001	1.4 (1.1)	<0.001
Average temperature change (right side)	1.3 (1.5)	<0.001	1.3 (1.5)	<0.001
Average temperature change (left side)	1.4 (1.2)	<0.001	1.4 (1.3)	<0.001
% with 1 or higher temp change (both sides)	50.0%	<0.001	50.0%	<0.001
% with 1 or higher temp change (right side)	64.1%	<0.001	64.7%	<0.001
% with 1 or higher temp change (left side)	57.1%	<0.001	58.8%	<0.001

a. Note that for the overall sample, temperature change for both sides was calculated for bilateral procedures only. Temperature change for right side was calculated for bilateral or right side procedures only. Temperature change for left side was calculated for bilateral or left-side only procedures.

Discussion

Autonomic symptoms are common in headache syndromes, with more than 80% of patients with chronic migraine reporting at least one cranial autonomic symptom (9). SPG block is currently indicated in the management of medically resistant cluster headaches, migraine, other trigeminal autonomic cephalalgias as well as intractable orofacial pain syndromes (10). Intranasal SPG blockade has received renewed interest with the advent of intranasal catheters that direct medication to the sphenopalatine foramen to achieve neural blockade. However, it is unclear whether such procedures have a measurable effect on cranial autonomic function. To date there have been no published reports of cranial autonomic nervous system effect via temperature change from intranasal SPG block procedures. The primary objective of this study was to determine if a temperature change occurred following lidocaine delivery to the sphenopalatine foramen using a directional intranasal catheter. We found that there was a statistically significant increase in temperature on average of 1.4 °C and that an increase of $\geq$ 1 °C occurred in 50% of the patients undergoing injection. It has been shown that sympathetic input to the sphenopalatine fossa occurs both from the internal carotid plexus via the vidian nerve and the external carotid plexus via the maxillary artery plexus (7). Our findings of a statistically significant temperature increase following intranasal SPG via directional catheter supports our theory that delivery of anesthetic to the sphenopalatine foramen may chemically block sympathetic fiber activity due to the collection of sympathetic fibers from the plexus of the maxillary artery that populate the sphenopalatine foramen region prior to parasympathetic fiber activity in the SPG.

Limitations

There are a number of limitations to our study. The most significant is that the sample size is small with only 47 patients overall. This was a retrospective observational study with no control group and thus carries all the limitations associated with this type of study. Another limitation is that there were different operators performing the procedure which could result in interoperator variability. We did not control for the number of parasympathetic features a patient had however what effect this might have on temperature elevation is not known. Ambient room temperature can affect skin temperature monitoring and was not specifically controlled for in this study although the ambient room temperature was not adjusted between the pre and post block measurements. We did not assess the relationship between temperature rise which represents the sympathetic blockade to pain relief since our primary focus was on temperature change. Some component of pain relief is believed to be attributed to the parasympathetic blockade (11). However pain relief has also been attributed to sympathetic blockade for cluster headaches (12) as well as helpful in other chronic pain syndromes such as CRPS (13). Future studies examining the relationship of temperature change to analgesic response particularly 24 hours and further out from the procedure are needed.

Conclusion

This study is the first to show a statistically significant increase in temperature following intranasal SPG block via a directional catheter. Our findings support our theory that delivery of anesthetic to the sphenopalatine foramen may chemically block sympathetic fiber activity due to the collection of sympathetic fibers from the plexus of the maxillary artery that populate the sphenopalatine foramen region prior to parasympathetic fiber activity in the SPG.

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Conflicts of Interest Statement

Dr. Wasserman, Dr. Schack, and Dr. Moser have no conflict of interest. Dr. Cooper is a consultant and shareholder for Dolor Technologies (Scottsdale, AZ). Dr. Brummett receives research funding from Neuros Medical, Inc. (Willoughby Hills, OH) and is a consultant for Tonix Pharmaceuticals (New York, NY). Neither of these affiliations has any bearing on the current research.

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