Acute Ocular Effects of Sphenopalatine Ganglion Nerve Block

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ABSTRACT

Aim and objective: The goal of this study was to measure acute ocular effects in patients undergoing routine sphenopalatine ganglion (SPG) nerve block for headache. Projections from the SPG influence blood flow to the eye which may influence intraocular pressure (IOP). There are limited animal and human studies investigating the relationship between the SPG and its effect on the eye.

Materials and methods: This was a single-site, investigator-initiated, single-visit, prospective study. Participants were aged 18–85 years old who had consented to SPG nerve block for headache. The primary outcome measures were change in near visual acuity (NVA) and IOP pre-procedure to immediately post-procedure. Additional data collected included pupil diameter and presence of any ocular or visual complaints.

Results: A total of 13 patients were enrolled in the study. Average pre-procedure IOP was 14.2 mm Hg (standard deviation (SD) 3.8) in the right eye and 13.7 mm Hg (SD 3.2) in the left eye. Average post-procedure IOP was 14.8 mm Hg (SD 3.8) in the right eye and 14.2 mm Hg (SD 2.9) in the left eye. Neither the right nor left eye experienced a statistically significant change in IOP after SPG block. There were no statistically significant changes in average NVA or pupil diameter in either eye. There were no adverse events.

Conclusion and clinical significance: This pilot study suggests no significant acute changes in IOP or other ocular parameters after SPG block for headache disorders and supports the fact that the procedure is safe as it relates to ocular health. The ocular effects of SPG blockade merit further study in a larger cohort of patients.

Keywords: Headache, Intraocular pressure, Nerve block, Sphenopalatine ganglion.

How to cite this article: Siegel DT, Ertel MK, Patnaik JL, et al. Acute Ocular Effects of Sphenopalatine Ganglion Nerve Block. J Curr Glaucoma Pract 2020;14(2):57–60.

INTRODUCTION

The sphenopalatine ganglion (SPG), also called the pterygopalatine ganglion, is located in the pterygopalatine fossa just beneath the maxillary nerve and is the main parasympathetic ganglion of the upper jaw and related structures.1 It features complex anatomy and innervates blood vessels and glands of the nasal cavity, palate, lacrimal gland, eye, and cerebral circulation.1 Because of its anatomical connections and its role in the trigeminal-autonomic reflex, the SPG has been implicated in certain headache disorders and considered a therapeutic site for intervention.2 Sphenopalatine ganglion block is routinely performed by neurologists primarily for cluster headache and chronic migraine headache.3

Evidence suggests that projections from the SPG influence blood flow to the eye which can then influence intraocular pressure (IOP).4 Neurons from the SPG project to the ciliary body vasculature of the eye and contain nitric oxide synthase (NOS) and vasoactive intestinal peptide (VIP), which mediate vasodilation and increase blood flow.1 Activation of preganglionic input to the SPG via facial nerve stimulation has been shown to increase blood flow to the ciliary body; this effect can be blocked by a nicotinic acetylcholine receptor antagonist, hexamethonium.5

Animal models also show that NOS inhibition substantially reduces (~50%) ciliary blood flow.6 These animal models suggest a high parasympathetic resting tone that produces a tonic vasodilation of the ciliary body vasculature. Thus, decreasing parasympathetic innervation via this pathway may reduce blood flow and aqueous humor production and therefore lower IOP.4

There are limited animal and human studies investigating the relationship between parasympathetic input from the SPG and its effect on IOP. One study found long-lasting reduction in ocular effects in patients undergoing routine SPG nerve block for headache. We hypothesize that blood flow to the eye may be influenced by this procedure which, in turn, can influence IOP.

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Materials and Methods
This was a single-site, investigator-initiated, single-visit, prospective study to assess therapy-related changes in patients undergoing SPG block. The study adhered to the tenets of the Declaration of Helsinki and Institutional Review Board/Ethics Committee approval was obtained through the Colorado Multiple Institutional Review Board (COMIRB). Patients with a confirmed diagnosis of cluster headache or chronic migraine were recruited at their standard-of-care neurology exam visits. Inclusion criteria were individuals 18–85 years of age who underwent SPG nerve block for cluster headache or chronic migraine and had consented to the procedure. Exclusion criteria included: (1) Inability to complete the ocular examinations required for this study and (2) Multiple nerve blocks being performed at the same session.

The primary outcome measures were change in near visual acuity (NVA) and IOP pre-procedure to immediately post-procedure. Additional data collected included pupil diameter and presence of any oculal or visual complaints. Study measurements were obtained immediately prior to the SPG block procedure and 15 minutes after the procedures were performed as outlined below:

- Near visual acuity: Near visual acuity was measured monocularly using the patient’s current spectacle correction. A standard Rosenbaum Pocket Vision Screener card was held 14 inches from the eye in standard room lighting. Near visual acuity was recorded in Snellen equivalent for the smallest line of letters where the majority of numbers were read correctly.
- Pupil diameter: Measurement was obtained using the Oasis Colvard Pupillometer (Glendora, California, USA). This measurement was obtained by the examiner looking through the eyepiece to visualize the iris and pupil of the patient. The device has a reticule which superimposes a millimeter ruler over the image of the iris and pupil allowing for easy measurement of the pupil diameter.
- Tonometry: Measurement was performed using an FDA approved rebound tonometer (Icare ic100, Icare USA, Raleigh, North Carolina, USA). The IOP is obtained by a small probe which instantaneously rebounds off the corneal surface 6 times per eye in rapid succession. Rebound tonometry is used routinely in everyday ophthalmological examinations for IOP measurement.
- Assessment of visual and ocular complaints: Patients were asked to spontaneously report any observations pertaining to their vision as well as any general observations on ocular comfort. Responses were recorded verbatim.

Sphenopalatine ganglion blocks were planned for bilateral treatment according to standard of care. The procedure was performed under local anesthetic by dosing each nostril with 0.5 mL of 2% preservative-free lidocaine gel. Then, a lubricated spheno-catheter was placed in the nostril, parallel to the septum and above the middle turbinate, and advanced toward the apex of the nose approximately 5 cm posteriorly. Once resistance was felt, the catheter tip was deployed, delivering approximately 1.5 mL of 1% or 2% preservative-free lidocaine.

Following administration of the anesthetic, patients were maintained in a supine position for approximately 5 minutes and then repositioned upright. After 10 minutes in the seated position, the ocular measurements were repeated. Following the post-procedure measurements, the patients were managed by their neurology provider according to standard of care.

Results of the study were summarized using a combination of simple statistics (mean, standard deviation (SD), median, and range). Paired t-tests were used to examine changes in ocular parameters before and after treatment for right and left eyes separately. The signed-rank test was also used to assess change before and after treatment for logMAR since it was not normally distributed. In addition, all right and left eyes were combined and analyzed using linear modeling with generalized estimating equations with a working unstructured correlation structure. These models account for the correlation of patients having two eyes and two time points included in the analysis. A *p* value < 0.05 was considered statistically significant.

Results
A total of 13 patients were enrolled in the study. Ten patients were Caucasian (non-Hispanic/Latino), two patients were Hispanic/Latino, and one patient was Native American (Table 1). Twelve patients were female, and one patient was male. The age range was 23–71 years of age with a median of 32.5 years. Two patients had a history of photorefractive keratectomy previously. One patient had a history of non-exudative age-related macular degeneration. None of the patients had history of glaucoma, ocular hypertension, or ocular surgery within 6 months of testing and none were on IOP lowering medications. Twelve patients underwent bilateral SPG block. One patient underwent SPG block only on the right side due to a deviated septum preventing treatment on the contralateral side. This eye was excluded from ocular measurement data.

Ocular measures are presented in Table 2. Average NVA in the right eye prior to the SPG block was logMAR 0.07 (SD 0.15). After the procedure, the average NVA was logMAR 0.11 (SD 0.22). Average decline in vision for right eyes was logMAR 0.04 (SD 0.15), which was not significant (paired t-test *p* = 0.41). Mean NVA in the left eye prior to the SPG block was logMAR 0.04 (SD 0.09) and these summary measures remained exactly the same for left eyes after the procedure; in fact, there was absolutely no individual change in vision for the 12 left eyes in the study. *p* values for signed-rank test were also not significant (*p* = 1.0 for each eye). When all eyes were combined into one model, the change in logMAR remained not significant (*p* = 0.45).

Average pupil diameter prior to the procedure in the right and left eye was 4.8 mm (SD 1.1) and 4.9 (SD 1.0), respectively. After the procedure, the mean pupil diameter was 4.7 mm (SD 1.1) and 4.8 (SD 1.0) in the right and left eyes, respectively. Average change in

Table 1: Participant characteristics

| Age, median | 32.5 years (range 23–71) |
| Sex | |
| - Female | 12 (92.3%) |
| - Male | 1 (7.7%) |
| Race | |
| - Caucasian, not Hispanic | 10 (76.9%) |
| - Hispanic | 2 (15.4%) |
| - Native American | 1 (7.7%) |
| Ocular history | |
| - Photorefractive keratectomy | 2 (15.4%) |
| - Non-exudative macular degeneration | 1 (7.7%) |
The study adhered to the tenets of the Declaration of Helsinki and Institutional Review Board/Ethics Committee approval was obtained through the Colorado Multiple Institutional Review Board (COMIRB).
REFERENCES
1. Gibbins I. Chapter 5 – peripheral autonomic pathways. Hum Nerv Syst 2012. 141–185.
2. Robbins MS, Robertson CE, Kaplan E, et al. The sphenopalatine ganglion: anatomy, pathophysiology, and therapeutic targeting in headache. Headache J Head Face Pain 2016;56(2):240–258. DOI: 10.1111/head.12729.
3. Mojica J, Mo B, Ng A. Sphenopalatine ganglion block in the management of chronic headaches. Curr Pain Headache Rep 2017;21(6):1–8. DOI: 10.1007/s11916-017-0626-8.
4. McDougal DH, Gamlin PD. Autonomic control of the eye. Compr Physiol 2015;5(1):439–473.
5. Nilsson SFE, Linder J, Bill A. Characteristics of uveal vasodilation produced by facial nerve stimulation in monkeys, cats and rabbits. Exp Eye Res 1985;40(6):841–852. DOI: 10.1016/0014-4835(85)90129-0.
6. Ruskell GL. An ocular parasympathetic nerve pathway of facial nerve origin and its influence on intraocular pressure. Exp Eye Res 1970;10(2):319–330. DOI: 10.1016/S0014-4835(70)80044-6.
7. Golding-Wood PH. The ocular effects of autonomic surgery. Proc R Soc Med 1964;57(6):494–497.
8. Schuurmans R, Strebel P. Die beeinflussung des augeninnendrucks durch koagulation des nervus vidianus. Klin Monbl Augenheilkd 1980;177(10):459–462. DOI: 10.1055/s-2008-1057669.
9. Biankina IN, Katin VI. Use of pterygopalatine ganglionic block in the treatment of malignant glaucoma. Vestn Oftalmol 2006;122(2):35–36.
10. Binfalah M, Alghawi E, Shosha E, et al. Sphenopalatine ganglion block for the treatment of acute migraine headache. Pain Res Treat 2018;2018:2516953. DOI: 10.1155/2018/2516953.
11. Slade SG, Linberg JV, Immediata AR. Control of lacrimal secretion after sphenopalatine ganglion block. Ophthal Plast Reconstr Surg 1986;2(2):65–70. DOI: 10.1097/00002341-198601050-00002.
12. Burch RC, Loder S, Loder E, et al. The prevalence and burden of migraine and severe headache in the United States: updated statistics from government health surveillance studies. Headache 2015;55(1):21–34. DOI: 10.1111/head.12482.
13. Manzoni GC, Stovner LJ. Epidemiology of headache. Handb Clin Neurol 2010;97:3–22.
14. Cursiefen C, Wisse M, Cursiefen S, et al. Migraine and tension headache in high-pressure and normal-pressure glaucoma. Am J Ophthalmol 2000;129(1):102–104. DOI: 10.1016/S0002-9394(99)00289-5.