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Brief Research Report

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The Effect of Intranasal Pressure on Intraocular Pressure

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ABSTRACT

Purpose: The aim of this study was to evaluate intraocular pressure (IOP) after the application of the nasal packing for sinonasal surgery.
Methods: A total of 40 patients who underwent sinonasal surgery were enrolled in this prospective study. Patients were randomly assigned into two groups: gauze packing (group 1) and silicone nasal septal splint (group 2). All participants completed a comprehensive questionnaire and underwent an ocular examination including measurement of IOP by Goldmann applanation tonometry (GAT). All the measurements were repeated before removing the nasal packings. IOP measurements before the operation and during the nasal packing were compared with each other.
Results: The study group comprised 21 males (52.5 %) and 19 females (47.5%). The mean age was 29.10±8.18 years (median 27.50) (min-max=18-51). Twenty-three (57.5%) had silicone nasal packing while 17 (42.5%) had gauze nasal packing. Mean nasal packing duration was 2.575±0.712 days. The post-operative increase in the intraocular pressure of the both eyes were not statistically significant (p>0.05). IOPs of the patients' eyes showed no significant increase, compared to the pre-operative results according to the type of nasal packing used (p>0.05).
Conclusions: Increased intranasal pressure due to nasal packing did not increase intraocular pressure. The type of the nasal packing also did not differ to increase the intraocular pressure.

KEY WORDS: Intranasal pressure; Intraocular pressure; Nasal packing; Glaucoma.

ABBREVIATIONS: IOP: Intraocular pressure; GAT: Goldmann Applanation Tonometry; INP: Intranasal pressure; CI: Confidence Intervals; ABP: Arterial Blood Pressure.

INTRODUCTION

Nasal surgery is one of the most frequently performed operations in otolaryngology practice. Various nasal packs have been used after septal surgery to stabilize the mucoperichondrium and bleeding.[1] Nasal packs increase intranasal pressure (INP).[2] The orbit, nose, and paranasal sinuses are intimately related.[3] Human nose is well vascularized with arteries and veins, and thus supplied with abundant blood. Nasal veins have no vessel valves and direct communication to the sinus caverns. Venous drainage of the nose and sinuses is *via* the ophthalmic and facial veins, and the pterigoid and pharyngeal plexuses.

Intraocular pressure (IOP) is a function of aqueous humor production and subsequent drainage *via* the trabecular meshwork to ophthalmic veins and cavernous sinus. IOP is thus influenced by anything that increases production or decreases drainage of the aqueous humor

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including age, physical exertion, and medications and other factors.[4] Therefore, IOP may be influenced by increased INP.

Glaucoma is a common, multifactorial disease. IOP, one of the most important risk factors for the development and progression of glaucoma is associated with various systemic and ocular factors.[5,6] Clinical studies have demonstrated that certain patients with primary open-angle glaucoma suffer from reduced ocular blood flow, which may be primarily of vascular origin or secondary to IOP elevation.[7]

The aim of this study was to evaluate IOP after the application of the nasal packs for sinonasal surgery. Herein we present such a study to answer these features.

MATERIALS AND METHODS

This study was conducted in the Otolaryngology and Head & Neck Surgery and Ophthalmology Departments between March 2014 and June 2014. Patients (n=40) who had nasal packing after septoplasty due to septal deviation were included in this study. The study procedures were carried out in Haydarpaşa Numune Education and Research Hospital according to the Declaration of Helsinki. The study objectives and methods were explained to all patients before the examination. All the patients signed an informed consent form.

The inclusion criteria were as follows: 1) adult patients aged more than 18 years with a decision to undergo surgery; 2) willingness to sign the informed consent before the study; and 3) best-corrected visual acuity of Snellen equivalent of 20/40 or better.

The exclusion criteria were as follows: 1) previous eye diseases other than refractive error; 2) previous orbital or ocular trauma; 3) previous nasal surgery 4) previous systemic disease; 5) history of allergic rhinitis.

The patient subsequently underwent sinonasal surgery under general anesthesia. All of the patients received nasal packing after surgery. Patients were randomly assigned into two groups: gauze packing (group 1) and silicone nasal septal splint (group 2). Bilateral anterior gauze nasal packing impregnated with Vaseline were applied in one group while silicone nasal septal splints with integral airway were applied in the other group. Gauze nasal packing were cut into three strips and were placed enough to fill the nose. Silicon nasal splints were sutured to the septum and no another type of nasal packing was used.

All of the participants completed a comprehensive questionnaire and underwent an ocular examination including measurement of IOP by Goldmann applanation tonometry (GAT; Haag-Streit; Haag-Streit AG, Koeniz, Switzerland), once for each eye from right to left, prior to the perimetry and fundus photography before the surgery. The IOP was measured in mmHg unit. Ophthalmic signs were bilateral in nature and there were no ophthalmic manifestations including orbital displacement, proptosis, restricted ocular movement, diplopia, lid swelling, chemosis, optic neuropathy, and decreased vision after the surgery. Indirect ophthalmoscopy showed that the retinal arterial circulation was patent to flow.

Nasal packing remained 2 days post-operatively. All the measurements were repeated before removing the nasal packings on the first post-operative day. IOP measurements before the operation and during the nasal packing were compared with each other.

STATISTICS

Statistical analyses of the data were conducted using SPSS ver. 17.0. All variables were calculated using descriptive statistics. The analysis of the quantitative variables included calculation of the mean (SD). Parametric paired sample *t*-test and nonparametric Wilcoxon signed-rank test was used for comparison of two dependent groups. Nonparametric Mann-Whitney U-test was used for the comparison of independent groups. Results were evaluated using the 95% confidence intervals (CI), and the level of significance was set at $p<0.05$.

RESULTS

The study group (n=40) comprised 21 males (52.5 %) and 19 females (47.5%). The mean age was 29.10±8.18 years (median 27.50) (min-max=18-51). Twenty-three (57.5%) had silicone nasal packing while 17 (42.5%) had gauze nasal packing. Pre-operative and post-operative visual examinations were unremarkable. Mean nasal packing duration was 2.575±0.712 days.

The intraocular pressures of patient's eyes were evaluated during nasal packing. Post-operative intraocular pressure of the right eye increased from 15.68 mmHg to 16.55 mmHg (Table 1). However, this increase was not statistically significant ($p=0.115$). Likewise, post-operative intraocular pressure of the left eye increased from 16.00 mmHg to 16.75 mmHg. Again, this was not statistically significant ($p=0.134$) (Table 1).

IOPs of the patients' eyes were evaluated separately according to the type of nasal packing used. There were no significant differences in the pre-operative IOPs between the groups and IOPs in the right eye was within normal limits ($^{a}p=0.750$). There was also no significant difference in the post-operative measurements between groups ($^{a}p=0.200$) (Table 2). For the right eye, the gauze packing and silicone group showed no significant increase, compared to the pre-operative results within the groups ($^{b}p=0.775$, $^{b}p=0.155$) (Table 2).

For the left eye, there were no significant differences in the pre-operative IOPs between the groups and IOPs in the left eye were within normal limits ($^{a}p=0.347$) (Table 3). There was

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Table 1: Pre-operative and Post-operative Evaluation of Intraocular Pressure.

	Pre-op (n=40)	Post-op (n=40)	*p*
	Mean±SD	Mean±SD	
Right IOP (mmHg)	15.68±3.10	16.55±2.81	0.115
Left IOP (mmHg)	16.00±2.76	16.75±3.47	0.134

Paired Samples t-test
**p<0.05*
IOP= Intraocular pressure

Table 2: Comparison of Intraocular Pressure Measurements According to the Nasal Packing in the Right Eye.

	Pre-op IOP (mmHg)	Post-op IOP (mmHg)	First-Last Change
	Mean±SD	Mean±SD	[b]*p*
Gauze (n=17)	15.65± 2.50	15.82±2.21	0.775
Silicone (n=23)	15.70± 3.54	17.08±3.12	0.155
[a]*p*	0.750	0.200	

[a]Mann-Whitney test
[b]Wilcoxon
Signed Ranks test
**p*<0.05
IOP= intraocular pressure

Table 3: Comparison of Intraocular Pressure Measurements According to the Nasal Packing in the Left Eye.

	Pre-op IOP (mmHg)	Post-op IOP (mmHg)	First-Last Change
	Mean±SD	Mean±SD	[b]*p*
Gauze (n=17)	15.59± 2.58	16.24±3.34	0.404
Silicone (n=23)	16.30± 2.88	17.13±3.58	0.296
[a]*p*	0.347	0.441	

[a]Mann
-Whitney test [b]Wilcoxon
Signed Ranks test
**p*<0.05
IOP= intraocular pressure

also no significant difference in the post-operative measurements between groups ([a]p=0.441). The gauze packing and silicone group showed no significant increase, compared to the pre-operative results within the groups respectively ([b]p=0.404, 0.296) (Table 3).

DISCUSSION

The nasal venous circulation can drain directly into both the cavernous sinus and the external nasal venous system. INP causes increased intranasal perfusion pressure, leading to venous congestion and edema. Nasal venous congestion may also affect intraocular venous drainage due to increased pressure in the ophthalmic vein. We evaluated IOP during nasal packing. When the scleral venous drainage is blocked, aqueous humor is secreted at a faster rate than it is reabsorbed, causing elevated pressure within the eye.[8]

Reitsamer et al[9] established that IOP exhibits a linear relationship with ocular venous pressure using a rabbit model. Any significant rise in IOP, decrease in mean arterial pressure, or combination of the two can result in ischemic optic neuropathy or central retinal artery occlusion. Thus, we considered that nasal packing might play a role in increasing IOP.

IOP measurements according to body positions and blood pressures have already been studied previously. It has been shown in several studies that systemic blood pressure changes affect IOP.[10-12] However, a limited number evaluated the venous circulation of the eye.

When a patient is in a prone position, it can elicit an increase in IOP. In a previous study, the effect of the reverse trendelenburg position on IOP was studied in spine surgery patients; the position led to less venous congestion and no patient experienced increased IOP.[13,14] This result indicates that prone position leads to increase in venous pressure. However, there are no data addressing the question of how the orbital venous pressure affects IOP in humans. Higher values are often found in patients in the supine position, probably as a result of an increase in the episcleral venous pressure. Thus, we assessed the effects of increased INP in the human eye.

Li et al[15] evaluated the effects of acute arterial blood pressure (ABP) and venous pressure changes on IOP in rats with experimental glaucoma and revealed that increased venous pressure resulted in a sustained rise in IOP. For this reason, we assessed the effects of increased INP on the human eye. The results revealed that there was an increase in IOP during the nasal packing but this increase was insignificant (p>0.05). However, this increase in IOP was modest. Although we found an insignificant increase, more methodic frequent measurements

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of IOP may detect biologically significant elevations of IOP.

Ekinci et al[16] reported the formation of secondary glaucoma caused by a carotid cavernous fistula. This report showed that increased pressure in the cavernous system may affect the formation of glaucoma. The nasal venous system drains directly into the cavernous sinus. However, nasal packing does not increase cavernous sinus pressure but intranasal pressure can increase the venous congestion.

Previously, Lin et al[17] investigated whether functional endoscopic sinus surgery induced changes in IOP. They revealed that there were no IOP changes. In our study, we also evaluated the effects of different types of nasal packing on IOP. The Vaseline gauze packing applies more pressure on the nasal mucosa, causing more venous congestion. A silicone nasal splint is commonly used in nasal operations and it has a tube in the middle for breathing. This packing applies less pressure to the lateral nasal wall and leads to good quality of life (QoL) post-operatively.[18] We evaluated the intraocular pressure difference in both nasal packing modalities and there was also no significant difference in the post-operative measurements between groups (p>0.05) (Tables 2 and 3). We found that both of these nasal packings could be used safely.

The entire study group was not glaucomatous and the effect was studied in the normal population. Slight increase in the IOP was found to be insignificant in this study although it may be more prominent in glaucomatous eyes. For this reason, it would be better to be more careful in glaucomatous eyes.

CONCLUSION

Nasal packing which are commonly used, increase intranasal pressure. The present study revealed that increased intranasal pressure did not increase intraocular pressure. Also, the type of the nasal packing did not make any difference. Hence, much care should be taken while dealing with glaucomatous eyes.

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CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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