Original Article

Effectiveness and Safety of Topical Combination of Tropicamide 0.8% (w/v) and Phenylephrine Hydrochloride 5% (w/v) among the Successful Postdacryocystorhinostomy Cases

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Abstract

Background: Mydriatics are essentially used in routine ophthalmoscopic examinations and before various eye surgeries. Because pupil is under the control of autonomic nervous system, a combination of parasympatholytic drug (tropicamide) and sympathomimetic agent (phenylephrine) causes greater pupillary dilatation. In postdacryocystorhinostomy (DCR) patients, the nasolacrimal passage becomes wider and shortened, so the chances of absorption of topical drugs as well as the diminished local effects such as mydriasis are higher than normal. Hence, there are more chances of systemic adverse reactions. **Materials and Methods:** Data were collected and compared between fifty patients with unilateral nasolacrimal duct obstruction scheduled for DCR. Normal eye served as the control group, whereas affected post-DCR eye was considered the study group. Local (mydriasis) and systemic effects of the combination drop of tropicamide 0.8% (w/v) and phenylephrine 5% (w/v) were assessed. **Results:** Mydriasis was lesser in the post-DCR eyes ($P < 0.001$ for both vertical and horizontal papillary diameters). There were no statistically significant changes in systemic vital parameters when measured before and after the application of the combination drop in both the groups. **Conclusions:** The combination of tropicamide and phenylephrine can be safely used in post-DCR eyes as mydriatics, although mydriasis is lesser due to rapid drainage.

Keywords: Dacryocystorhinostomy, mydriasis, nasolacrimal duct, phenylephrine, tropicamide

Introduction

The combination of tropicamide and phenylephrine hydrochloride eye drop is commonly used in routine ophthalmoscopic examinations and before cataract surgery to achieve maximal mydriasis. Phenylephrine hydrochloride is a sympathomimetic agent or more specifically alpha1-receptor agonist. It causes tachycardia and vasoconstriction of the systemic and pulmonary arteries. As a result, there may be increase in systolic as well as diastolic blood pressures and reflex bradycardia.[1,2] On the other hand, tropicamide is a parasympatholytic drug, which causes mydriasis and cycloplegia[3] and is devoid of any vasopressor effect. Individually, both the drugs cause adequate mydriasis. The combination of sympathomimetic agent and a parasympatholytic drug produces maximal mydriasis, which is resistant to intense stimulation by light.[4,5] Topical ophthalmic drops reach to the systemic circulation by absorption through the cornea and nasal mucosa via the lacrimal system. Thus it cause unwanted side effects.[6,7] Thus, systemic absorption depends on the patency of nasolacrimal duct. In postdacryocystorhinostomy (DCR) patients, the naso-lacrimal passage becomes wider and shortened. Hence, the nasal mucosa becomes more exposed when compared to the normal nasolacrimal system. As a result, the chances of absorption of topically applied drugs are higher. Thus, the systemic adverse effects including elevated blood pressure, tachycardia, reflex bradycardia, and cardiac

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arrhythmias may increase and the desired local effects may be less.[8] For the proper use of any drug through a particular route, we must have comprehensive knowledge about all the desired and adverse effects. Phenylephrine is a potentially dangerous drug for patients with cardiac ailments. Our study was intended for the assessment of drugs and to obtain clear knowledge to avoid systemic complications and adverse effects of the drugs in the background of post-DCR status.

Materials and Methods

The study was designed to be conducted on patients with unilateral chronic nasolacrimal duct obstruction scheduled for elective DCR operation in R G Kar Medical College and Hospital, Kolkata, in the Department of Ophthalmology. Appropriate permission was taken from the Institutional Ethics Committee, R G Kar Medical College and Hospital on January 22, 2013, before the commencement of the study. The patients were recruited from the ophthalmology outpatient department, within the age group of 15–50 years irrespective of their sex and religion. Informed consent was taken from all the participants of this study. Normotensive, nondiabetic patients with gonioscopically open angle and normal intraocular pressure as measured by applanation tonometer were included in the study. On syringing with normal saline, the patients should have "hard stop" and regurgitation through the upper punctum. Hard stop occurs if the cannula touches the medial wall of the lacrimal sac and lacrimal bone. The hard stop indicates that the common canalicula of the nasolacrimal duct system remains patent. "Soft stop" is the spongy feeling as the cannula presses the common canalicula and the lateral wall against the medial wall of the sac. The "soft stop" indicates that the cannula has been prevented from entering the lacrimal sac by an obstruction in the common canalicular system. Pregnant and lactating mothers or patients with a history of any respiratory or cardiovascular disease and myasthenia gravis were also excluded from this study. The unaffected eyes were considered the "control group" and the affected eyes served as the "study group." Each patient was monitored twice during the course of the study, that is, before the scheduled DCR operation and 1½ months after the operation. Pupillary diameter (both vertical and horizontal) of the normal eye was measured by a slide caliper at the time of admission. It is considered the baseline measurement of the normal side. Both vertical and horizontal diameters of the normal side were measured again at 45 min after the baseline measurement. Within this time period, three subsequent applications of the combination drop of tropicamide 0.8% (w/v) and phenylephrine 5% (w/v) were done at a 10-min interval. Hence, 15 min after the application of the last drop, the second reading was taken. Blood pressure, pulse rate, and electrocardiographic (ECG) changes (rate, rhythm, and ST changes) were noted at the time of admission and at 45 min after the baseline measurement, that is, after the three subsequent applications of the combination drop.

One and half month after DCR operation when it was ensured that the surgical anastomosis was patent, the operated eye received the same medication in the similar manner as stated before. The aforesaid parameters were noted again as described before. Data thus collected were compared and analyzed. The analysis of all data was done using IBM SPSS statistics Version 20 New York, United States.

Results

The study was conducted on 100 eyes of 50 patients with unilateral chronic nasolacrimal duct obstruction scheduled for elective DCR operation. The demographic characteristics are depicted in Figure 1. The study parameters were normally distributed (nonparametric data) as per Kolmogorov–Smirnov test for normality. In Tables 1 and 2, the vertical and horizontal pupillary diameters were compared, respectively. There was a statistically significant mydriasis obtained before and after the application of the combination drop in both the control and study groups. The *P* value was obtained by the application of the Student's paired *t*-test. However, the pupillary dilatation as measured by both vertical and horizontal pupillary diameters had reduced statistically significantly after DCR operation of the study group when compared to the parameters of the normal side ($P < 0.001$ was obtained by the Student's unpaired *t*-test). The vital parameters showed no significant changes before and after the application of the combination drop in both the control and study groups, as depicted in Tables 3 and 4, respectively. No significant rate, rhythm, or ST-T segment changes in changes were seen in both the groups.

Discussion

Mydriatics are essentially used in routine ophthalmoscopic examinations and before various eye surgeries. All the available mydriatics are capable of causing adequate mydriasis individually. Because pupil is controlled by the autonomic nervous system, a combination of a sympathomimetic agent and a parasympatholytic drug causes greater pupillary dilatation.[9,10]

Our study shows that application of the combination drop of tropicamide 0.8% (w/v) and phenylephrine 5% (w/v) can cause statistically significant mydriasis for the normal eye (control group) as well as in the eye which had undergone

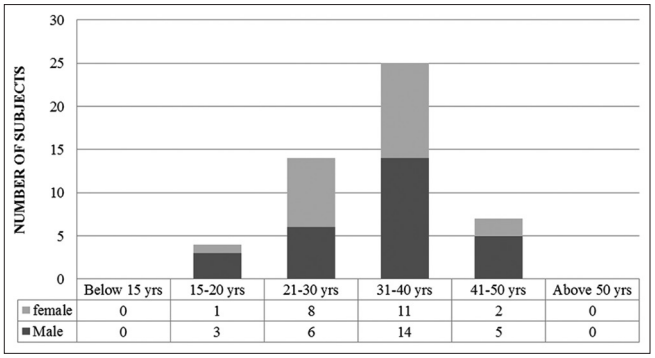

Figure 1: Bar diagram showing the demographic characteristics of the subjects in the study

Table 1: Comparison of the vertical pupillary diameter of the normal eye (control group) and affected side after dacryocystorhinostomy (study group) before and after the application of the combination eye drop

	Mean±SEM		*P*+
	Baseline (mm)	After the application of the combination drop	
Pupillary diameter (normal side) (*n*=50)	3.09±0.0634	7.84±0.076	0.002**
Pupillary diameter (affected side after DCR) (*n*=50)	3.08±0.061	6.51±0.075	<0.001**
P#	0.910	<0.001**	

+Obtained by using Student's paired *t*-test, #Obtained by using Student's paired *t*-test, ***P*<0.05 considered statistically significant. DCR: Dacryocystorhinostomy, SEM: Standard error of mean

Table 2: Comparison of the horizontal pupillary diameter of the normal eye (control group) and affected side after dacryocystorhinostomy (study group) before and after the application of the combination eye drop

	Mean±SEM		*P*+
	Baseline (mm)	After the application of the combination drop	
Pupillary diameter (normal side) (*n*=50)	3.07±0.0589	7.87±0.0726	<0.001
Pupillary diameter (affected side after DCR) (*n*=50)	3.07±0.059	6.47±0.080	0.001
P#	1	<0.001**	

+Obtained by using Student's paired *t*-test, #Obtained by using Student's paired *t*-test, ***P*<0.05 considered statistically significant. DCR: Dacryocystorhinostomy, SEM: Standard error of mean

Table 3: Comparison of the vital statistics before and after the application of combination eye drop in the normal eye (control group)

Systemic parameters	Mean±SEM		*P*
	Baseline measurement	Measurement after the application of the combination drop	
Pulse per minute (*n*=50)	77.40±1.152	76.96±0.988	0.432
Systolic BP in mmHg (*n*=50)	120.78±0.893	120.28±0.865	0.121
Diastolic BP in mmHg (*n*=50)	72.64±1.001	71.42±0.791	0.119

P: Obtained by using Student's paired *t*-test. SEM: Standard error of mean, BP: Blood pressure

Table 4: Comparison of the vital statistics before and after the application of combination eye drop in the affected side after dacryocystorhinostomy (study group)

Systemic parameters	Mean±SEM		*P*
	Baseline measurement	Measurement after the application of the combination drop	
Pulse per minute (*n*=50)	77.02±1.190	76.82±1.066	0.594
Systolic BP in mmHg (*n*=50)	118.48±0.961	117.58±0.752	0.124
Diastolic BP in mmHg (*n*=50)	69.82±0.834	70.66±0.766	0.125

P: Obtained by using Student's paired *t*-test. SEM: Standard error of mean, BP: Blood pressure

DCR operation. However, the post-DCR eye exhibited lesser dilatation compared to the normal eye, which is statistically significant. This can be explained by the fact that the nasolacrimal passage becomes wider and shortened after the DCR operation, so the chances of drainage of topically applied drugs are quicker when compared with normal eye. Hence, the local action of topically applied drugs is less. The study depicts no statistically significant change in the systemic vital parameters before and after the application of the combination drops in either situation. This can be explained as follows: One standard eye drop measures between 26 and 35.4 µl by volume.[11-13] Therefore, one drop of 5% (w/v) phenylephrine solution contains approximately 0.13 to 0.18 mg of phenylephrine. That was given thrice before the second measurement of pupillary diameter and other systemic vital parameters. Hence, a total of 0.39 –0.54 mg of phenylephrine was administered in one eye. In an average adult, the lowest amount of phenylephrine required to produce any systemic effect is 0.4 mg intravenously and 2 mg subcutaneously.[5,14] Moreover, phenylephrine causes local vasoconstriction. Hence, it is possible that a relatively small portion of commercially available phenylephrine and tropicamide was able to reach the systemic circulation. The drugs were rapidly transported from the eye via the nasolacrimal duct and absorbed into the

vascular system after DCR operation. Hence, even with the widened passage and exposed nasolacrimal mucosa, the drugs in the systemic circulation were not adequate to change the systemic vital parameters.

Conclusions

This study reveals that the combination eye drop of tropicamide 0.8% (w/v) and phenylephrine 5% (w/v) causes statistically significant pupillary dilatation both in normal eyes and post-DCR eyes. There is no statistically significant change in systemic vital parameters in normal and post-DCR eyes. It is safe to use the combination eye drop of tropicamide 0.8% (w/v) and phenylephrine 5% (w/v) in post-DCR patients.

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Conflicts of interest

There are no conflicts of interest.

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