

forms in the first six years of life; beyond this age exotropia predominates until the teenage years when the three forms have a similar but decreased incidence.

THIS STUDY WAS SUPPORTED IN PART BY AN UNRESTRICTED Grant from Research to Prevent Blindness, Inc, New York, New York. The authors indicate no financial conflict of interest. Involved in design and conduct of study (B.G.M.); collection (B.G.M., A.E.G.); management (B.G.M.); analysis and interpretation of the data (B.G.M., N.N.D.); preparation of the manuscript (B.G.M.); and review and approval of the manuscript (B.G.M., A.E.G., N.N.D.). Institutional Review Board approval was obtained for this study, and only patients who provided research authorization were included. Mayo Clinic institutional review board approval and HIPAA compliance were appropriately followed for this study.

REFERENCES

1. Frandsen AD. Occurrence of squint: a clinical-statistical study on the prevalence of squint and associated signs in different groups and ages of the Danish population. *Acta Ophthalmol Suppl* 1960;62:9-157.
2. Nordlow W. Squint—the frequency of onset at different ages, and the incidence of some associated defects in a Swedish population. *Acta Ophthalmol* 1964;42:1015-1037.
3. Graham PA. Epidemiology of strabismus. *Br J Ophthalmol* 1974;58:224-231.
4. Friedman MC, Neumann E, Hyams SW, et al. Ophthalmic screening of 38,000 children, age 1 to 2 1/2 years, in child welfare clinics. *J Pediatr Ophthalmol Strabismus* 1980;17:261-267.
5. Matsuo T, Matsuo C. The prevalence of strabismus and amblyopia in Japanese elementary school children. *Ophthalmic Epidemiol* 2005;12:31-36.
6. Yu CB, Fan DS, Wong VW, et al. Changing patterns of strabismus: a decade of experience in Hong Kong. *Br J Ophthalmol* 2002;86:854-856.

Effect of Prophylactic Brimonidine Instillation on Bleeding During Strabismus Surgery in Adults

Samin Hong, Chan Yun Kim, Gong Je Seong, and Sueng-Han Han

PURPOSE: To investigate the effects of preoperative brimonidine-purite 0.15% instillation on intraoperative bleeding and postoperative subconjunctival hemorrhage during strabismus surgery in adult patients.

DESIGN: Randomized comparative interventional case series.

METHODS: One hundred and eighteen eyes of 90 consecutive adult patients were instilled with either a single

drop of brimonidine-purite 0.15% (42 eyes), phenylephrine 1% (38 eyes), or sodium hyaluronate 0.1% (38 eyes) 15 minutes prior to strabismus surgery. Intraoperative bleeding and postoperative subconjunctival hemorrhage were graded on a scale of one to three. The scores were compared among the study groups.

RESULTS: Scores of the intraoperative bleeding and the postoperative subconjunctival hemorrhage of the treatment groups were significantly less than that of the control group ($P < .001$). The scores of the brimonidine group were similar to those of the phenylephrine group (intraoperative bleeding score, $P = .405$; subconjunctival hemorrhage score, $P = .722$).

CONCLUSIONS: Topical brimonidine administration before strabismus surgery may reduce intraoperative bleeding and postoperative subconjunctival hemorrhage in adult patients. (*Am J Ophthalmol* 2007;144:469-470. © 2007 by Elsevier Inc. All rights reserved.)

VASOCONSTRICTING AGENTS SUCH AS PHENYLEPHRINE have been used prior to strabismus surgery to reduce hemorrhage during the procedure. Attack of acute angle-closure glaucoma and other systemic complications after topical phenylephrine are rare.¹ However, these systemic adverse reactions include very serious cardiovascular problems such as marked hypertension, syncope, myocardial infarction, arrhythmia, subarachnoid hemorrhage, and even death.^{2,3}

Brimonidine-purite 0.15% is a selective α 2-adrenergic agonist that has been widely used to lower intraocular pressure in glaucoma patients.⁴ It is also considered to have a vasoconstrictive property. There are some reports that the preoperative use of topical brimonidine can help reduce bleeding-related problems during laser in situ keratomileusis (LASIK) and cataract surgery.^{5,6} We determined whether the preoperative use of topical brimonidine reduces intraoperative bleeding and postoperative subconjunctival hemorrhage during strabismus surgery in adult patients, and compared its effect with the well-known strong vasoconstrictor phenylephrine.

After informed consent from the patients was obtained, a total of 118 eyes of 90 consecutive adult patients (49 males and 41 females) who underwent strabismus surgery were included in the study. Mean age was 36.22 ± 14.76 years. Seventy-four eyes received the extraocular muscle recession surgery and 27 eyes received the resection surgery (including 11 eyes which received both the recession and resection surgery). The patients who received prior ocular surgery were excluded.

A drop of brimonidine-purite 0.15% (42 eyes), phenylephrine 1% (38 eyes), or sodium hyaluronate 0.1% (38 eyes) was applied randomly to the eye(s) of each patient 15 minutes prior to strabismus surgery. All procedures were performed by the same surgeon (S.H.H.). During the surgery, the severity of bleeding was detected by the same observer (S.H.) in a double-blind manner and classified as

Accepted for publication Apr 17, 2007.

From the Institute of Vision Research, Department of Ophthalmology, Yonsei University College of Medicine, Seoul, Korea.

Inquiries to Sueng-Han Han, Institute of Vision Research, Department of Ophthalmology, Yongdong Severance Hospital, Yonsei University College of Medicine, 146-92 Dogok-dong, Kangnam-gu, Seoul, 135-720 Korea; e-mail: shhan222@yumc.yonsei.ac.kr

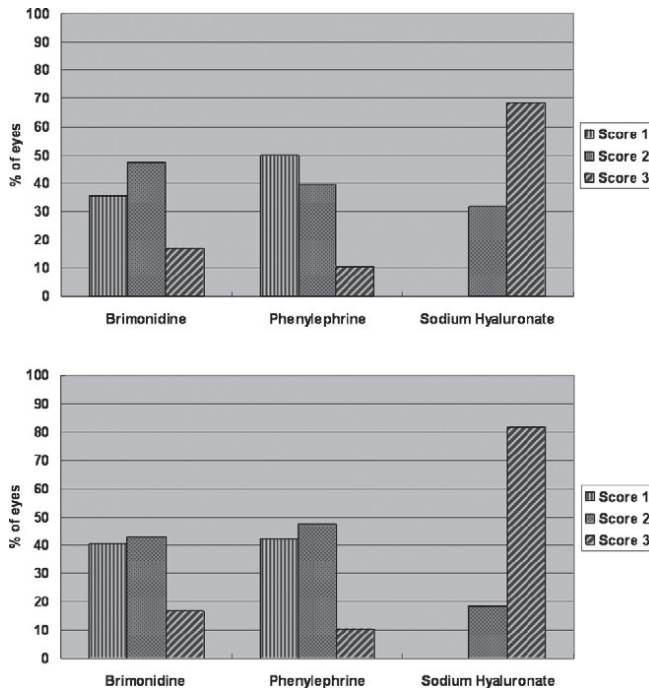


FIGURE. Intraoperative bleeding score (Top) and postoperative subconjunctival hemorrhage score (Bottom) in eyes receiving strabismus surgery, with and without prophylactic brimonidine or phenylephrine.

follows: grade 1, mild; grade 2, moderate; and grade 3, severe. The size of the subconjunctival hemorrhage was classified by slit-lamp examination as follows: grade 1, < 3 mm; grade 2, between 3 and 5 mm; and grade 3, > 5 mm after four hours. Statistical analysis was performed using the Chi-square test of Pearson and $P < .05$ was considered statistically significant.

The results are summarized in the Figure and in Tables 1 and 2. The intraoperative bleeding scores of the treatment groups were significantly less than that of the control group ($P < .001$). However, there was no significant difference between the intraoperative bleeding scores of two treatment groups ($P = .405$). Concerning the subconjunctival hemorrhage, the scores of the treatment groups were significantly less than that of the control group ($P < .001$). However, no significant difference was noted between the postoperative subconjunctival hemorrhage scores of two treatment groups ($P = .722$). No patient experienced angle-closure glaucoma or other systemic complications, including cardiovascular problems.

In conclusion, topical brimonidine administration before strabismus surgery reduced intraoperative bleeding and postoperative subconjunctival hemorrhage in adult patients, and is as effective and as powerful as the well-known vasoconstrictor phenylephrine.

The use of brimonidine is not suitable in pediatric patients because it can pass through the blood-brain barrier.⁷ However, its preoperative use can reduce the

TABLE 1. Intraoperative Bleeding Scores in Eyes Receiving Strabismus Surgery, With and Without Prophylactic Brimonidine or Phenylephrine

Score	Treatment Group		
	Brimonidine 0.15% (n = 42)	Phenylephrine 1% (n = 38)	Sodium Hyaluronate 0.1% (n = 38)
1	15 (35.71%)	19 (50.00%)	0 (0.00%)
2	20 (47.62%)	15 (39.47%)	12 (31.58%)
3	7 (16.67%)	26 (68.42%)	26 (68.42%)

TABLE 2. Postoperative Subconjunctival Hemorrhage Scores in Eyes Receiving Strabismus Surgery, With and Without Prophylactic Brimonidine or Phenylephrine

Score	Treatment Group		
	Brimonidine 0.15% (n = 42)	Phenylephrine 1% (n = 38)	Sodium Hyaluronate 0.1% (n = 38)
1	17 (40.48%)	16 (42.11%)	0 (0.00%)
2	18 (42.86%)	18 (47.37%)	7 (18.42%)
3	7 (16.67%)	4 (10.53%)	31 (81.58%)

bleeding-related problems of strabismus procedures without the risk of serious adverse reactions in adult patients.

THE AUTHORS INDICATE NO FINANCIAL SUPPORT OR CONFLICT OF INTEREST. All of the authors were involved in the design and conduct of study; collection, management, analysis and interpretation of the data; and preparation, review or approval of the manuscript. The proper informed consent was taken from the participants, and this study adherence to Declaration of Helsinki and all federal laws. The ISRCTN number is ISRCTN31792393.

REFERENCES

1. Wolfs RC, Grobbee DE, Hofman A, de Jong PT. Risk of acute angle-closure glaucoma after diagnostic mydriasis in nonselected subjects: the Rotterdam Study. *Invest Ophthalmol Vis Sci* 1997;38:2683-2687.
2. Meyer SM, Fraunfelder FT. 3. Phenylephrine hydrochloride. *Ophthalmology* 1980;87:1177-1180.
3. Fraunfelder FW, Fraunfelder FT, Jensvold B. Adverse systemic effects from pledgets of topical ocular phenylephrine 10%. *Am J Ophthalmol* 2002;134:624-625.
4. Katz LJ. Twelve-month evaluation of brimonidine-purite versus brimonidine in patients with glaucoma or ocular hypertension. *J Glaucoma* 2002;11:119-126.
5. Norden RA. Effect of prophylactic brimonidine on bleeding complications and flap adherence after laser in situ keratomileusis. *J Refract Surg* 2002;18:468-471.
6. Desco MC, Navea A, Ferrer E, Menezo JL. Effect of prophylactic brimonidine on bleeding complications after cataract surgery. *Eur J Ophthalmol* 2005;15:228-232.
7. Enyedi LB, Freedman SF. Safety and efficacy of brimonidine in children with glaucoma. *J AAPOS* 2001;5:281-284.