

Comparison of eye protection methods for corneal abrasion during general anesthesia

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Background: Corneal abrasion is one of the most common ophthalmic complications that occurs after general anesthesia. Although they can occur by direct contact with surgical drapes or masks, most occur as a result of the drying of the cornea exposed during general anesthesia due to a reduced amount of tear secretions, the loss of light reflex, or the loss of recognition of pain during the procedure. Thus, to prevent corneal abrasions during general anesthesia, proper eye protection is required.

Methods: Seventy-two patients (144 eyes) were divided into four groups as follows: 1) control group: careful manual eye closure; 2) adhesive tape group: a bandage attached over the eyelid; 3) ointment group: eye ointment placed into the eye followed by eye closure; and 4) ointment and tape group: eye ointment placed into the eye followed by a bandage attached over the eyelid, with the patient subjected to both methods for each eye. The National Eye Institute (NEI) scale, conjunctiva hyperemia scale, tear break-up time, and Schirmer test were conducted before and after operation.

Results: No statistically significant difference was noted between groups regarding the NEI scale, conjunctiva hyperemia scale, tear break-up time, or Schirmer test.

Conclusions: To prevent corneal abrasions in normal patients undergoing general anesthesia, eye taping, eye ointment application, or taping after eye ointment application will not significantly reduce the degree of corneal epithelial damage compared to manual eye closure. (*Anesth Pain Med* 2016; 11: 99-103)

Key Words: Anesthesia, Cornea, Intraoperative complications, National Eye Institute, Tears.

INTRODUCTION

The most common ophthalmic complication that occurs after general anesthesia is corneal abrasion [1,2]. Corneal abrasion can occur by direct contact with surgical drapes or masks, but most occur as a result of the drying of the cornea exposed during general anesthesia due to a reduced amount of tear sections, the loss of light reflex, or the loss of recognition of pain during the procedure [3,4]. Corneal abrasion can result in eye pain or soreness in response to bright light and may develop into inflammation or ulcers by infection of bacteria or fungi on the scar. Although corneal abrasion can improve with conservative treatment within 2–3 days, proper eye protection is required to prevent it during general anesthesia [5]. To prevent ocular complications during general anesthesia, eye-protection methods such as taping and eye ointment application have been used; however, which is more effective remains controversial [6–8].

In the present study, we compared the effect of eye-protection methods—eye taping, eye ointment application, or taping after eye ointment application—on preventing corneal abrasions during general anesthesia.

MATERIALS AND METHODS

Seventy-two patients (144 eyes) who were scheduled for elective non-ophthalmic operation, had an American Society of Anesthesiologists physical status classification I or II, and were aged 20–70 years were included in the present prospective, randomized double-blinded study. The Institutional Review Board approved the current study, and all patients provided written informed consent.

The patients underwent elective non-ocular surgery, and

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operation times longer than 60 min were included in the present study. All operation positions were supine. Exclusion criteria included the following: 1) abnormal findings in the ophthalmic examination before surgery, a corneal epithelial defect, keratitis, conjunctivitis, conjunctiva hyperemia, conjunctiva or eyelid edema; 2) a history of systemic or topical medications that affect tear production within a month before surgery; 3) a history of eye trauma or eye surgery; 4) eyelid abnormality; and 5) pregnancy.

Balanced anesthesia was conducted using propofol, desflurane, and rocuronium. The eye-protection method was performed after the induction of anesthesia until the end of anesthesia induction. The average temperature was 24°C and the average humidity was 55% in the operation room.

The patients were randomly assigned into four groups as follows: 1) control group: careful manual eye closure; 2) adhesive tape group: a bandage attached over the eyelid; 3) ointment group: eye ointment, anhydrous liquid lanolin (Duratears®; Alcon, Fort Worth, TX, USA), placed into the eye followed by eye closure; and 4) ointment and tape group: eye ointment placed into the eye followed by a bandage attached over the eyelid, with the patient subjected to both methods for each eye.

The 72 patients were divided into four groups composed of 18 patients as follows. In the first group, the left eye made up the control group, and the right eye made up the adhesive tape group. In the second group, the left eye was the control group, and the right eye was the ointment group. In the third group, the left eye was the adhesive tape group, and the right eye was the ointment and adhesive tape group. In the fourth group, the left eye was the ointment group, and the right eye was the ointment and adhesive tape group.

Measurement of corneal damage was performed using the National Eye Institute (NEI) scale, conjunctiva hyperemia scale (CHS), tear break-up time (TBUT), and Schirmer test in the

hospital ward or ophthalmology outpatient room 1 day before surgery.

For evaluation using the NEI scale, the eye is divided into five zones after staining the cornea with fluorescein, and the extent of damage to the cornea is quantified by assigning a numerical grade (0, 1, 2, 3) to each zone out of a total of 15 using slit-lamp biomicroscopy as follows: grade 0: no staining; grade 1: scattered micropunctate staining (dots are discrete and countable); grade 2: areas of clustered micropunctate staining of one macropunctate stain; grade 3: areas of confluent micropunctate staining or two or more macropunctate stains or filaments. The CHS observes the conjunctiva by slit-lamp biomicroscopy and is graded as follows: grade 0: none: normal, few vessels of the palpebral or bulbar conjunctiva easily observed; grade 1: mild: reddening of the palpebral or bulbar conjunctiva; grade 2: moderate: bright reddening of the palpebral or bulbar conjunctiva; grade 3: severe: deep, bright, and diffuse reddening of the palpebral or bulbar conjunctiva. The TBUT measures tear film stability by observing the conjunctiva by slip lamp biomicroscopy after administration of sodium fluorescein dye to the eye followed by measurement of the time for the appearance of tears after blinking; a TBUT longer than 10 s is normal, whereas 5 s or less is low. The Schirmer test measures tear secretion from the lacrimal gland by placing a piece of paper 3 cm in length under the lower eyelid for 5 min, and then the soaked length is measured; a soak length of 5 mm or less indicates reduced tear secretion. In addition, the NEI scale, CHS, TBUT, and Schirmer test were conducted in a hospital ward or ophthalmology outpatient room during the afternoon on the day of surgery.

Similar to that reported in other literature, the manual eye closure group showed an incidence of corneal damage of 27% [9]. We believed that the incidence of corneal abrasion is reduced by 25% with the application of eye protection methods. An alpha level of $0.05/3 = 0.0167$ and a beta level

Table 1. Demographic Data

	Control (n = 34)	Adhesive tape (n = 36)	Eye ointment (n = 37)	Tape & Ointment (n = 37)	P value
Age (yr)	48 ± 13	46 ± 11	48 ± 12	48 ± 10	0.996
Gender (M/F)	16 / 18	16 / 20	14 / 23	14 / 23	0.809
ASA I / II	22 / 12	25 / 11	17 / 20	18 / 19	0.112
Time (min)	137.35 ± 50.77	158.33 ± 36	145.95 ± 60.92	168 ± 81.19	0.246
Allergy history	2	1	3	2	0.802

Values are presented as mean ± SD or the number of patients, Time: anesthesia time.

of 0.8 determined that the sample size was 34 eyes per group. Because the dropout rate is expected to be 5%, 36 eyes per group were calculated.

Regarding statistical analysis, continuous data were analyzed using analysis of variance with post-hoc Bonferroni test correction, and categorical data were analyzed by chi-squared test. P values less than 0.05 were deemed to be statistically significant.

RESULTS

A total of 144 eyes from 72 patients were evaluated. Each patient was subdivided according to age, gender, American Society of Anesthesiologist physical status classification, anesthesia duration, and previous allergy history (Table 1). Each group showed no significant differences in demographic characteristics.

The incidence of corneal abrasion after general anesthesia did not differ among the control, adhesive tape, eye ointment, and eye ointment and adhesive tape groups (Fig. 1). The incidence of corneal abrasion was 23.5% in the control group, 16.7% in the adhesive tape group, 21.6% in the eye ointment group, and 16.2% in the eye ointment and adhesive tape group.

Table 2 shows a comparison of results regarding the NEI scale, CHS, TBUT, and Schirmer test before and after general anesthesia. No statistically significant difference was found among the groups according to the NEI scale, CHS, TBUT, and Schirmer test. In the eye ointment group, the CHS was 0.51 ± 0.69 after general anesthesia, significantly low compared to 0.70 ± 0.57 before general anesthesia. In the eye ointment and adhesive tape group, the CHS was 0.46 ± 0.55

after general anesthesia, significantly low compared to 0.62 ± 0.54 before general anesthesia. In addition, in the eye ointment group, the Schirmer test revealed a value of 7.00 ± 0.46 mm after general anesthesia, significantly low compared to 9.08 ± 4.74 mm before general anesthesia.

DISCUSSION

Several studies have considered how to prevent ocular complications after general anesthesia [5,9-11]. Direct damage to the eye or a reduction in the amount of tears during general anesthesia can cause ocular damage during surgery [12]. Cross and Krupin [13] suggested that tear production is

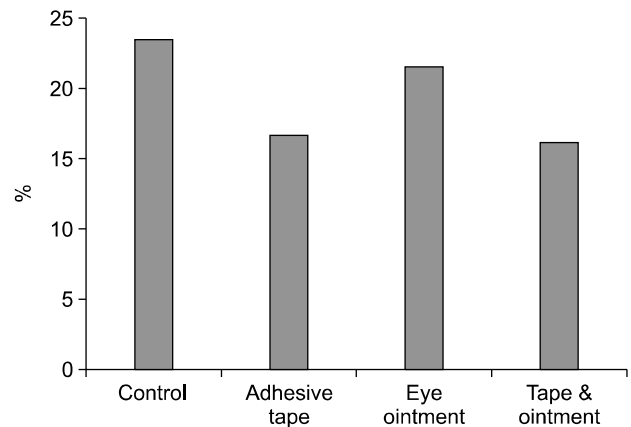


Fig. 1. Comparison of the incidence of corneal abrasion. The incidence of corneal abrasion was 23.5% in the control group, 16.7% in the adhesive tape group, 21.6% in the eye ointment group, and 16.2% in the eye ointment and adhesive tape group. The incidence of corneal abrasion after general anesthesia did not differ among the control, adhesive tape, eye ointment, and eye ointment and adhesive tape groups ($P = 0.826$).

Table 2. Comparison of the Effect of Eye Protection

	Control (n = 34)	Adhesive tape (n = 36)	Eye ointment (n = 37)	Tape & Ointment (n = 37)	ANOVA
Pre_NEI	0.68 ± 0.95	0.58 ± 0.90	0.57 ± 1.23	0.43 ± 0.89	0.839
Post_NEI	0.79 ± 1.04	0.50 ± 0.84	0.68 ± 1.08	0.57 ± 1.04	
Pre_CHS	0.59 ± 0.61	0.53 ± 0.56	0.70 ± 0.57	0.62 ± 0.54	0.499
Post_CHS	0.53 ± 0.71	0.47 ± 0.60	$0.51 \pm 0.69^*$	$0.46 \pm 0.55^*$	
Pre_TBUT	5.91 ± 3.48	5.33 ± 0.45	5.30 ± 2.34	5.51 ± 2.57	0.730
Post_TBUT	5.88 ± 2.80	5.19 ± 2.25	5.59 ± 2.47	5.27 ± 2.19	
Pre_Sch	8.79 ± 5.21	8.89 ± 4.79	9.08 ± 4.74	7.86 ± 4.82	0.615
post_Sch	7.26 ± 3.88	7.97 ± 4.21	$7.00 \pm 0.46^*$	7.32 ± 3.96	

Pre: Preoperation, Post: Postoperation, NEI: Corneal Staining scale, CHS: Conjunctival hyperemia scale, TBUT: Tear break-up time, Sch: Schirmer test. ANOVA: analysis of variance. * $P < 0.05$ for comparison with each preoperation value.

reduced during general anesthesia.

In anesthetized patients, ocular damage is caused by two factors: suppression of the normal eyelid reflex and insensitivity to pain when debris splashes into the eyes, both of which can lead to corneal abrasion [14].

General anesthesia reduces the contraction of the orbicularis oculi muscle, and the incidence of lagophthalmos is up to 59%. If the anesthesiologist does not notice that the eye is not completely closed, the incidence of keratoconjunctivitis is up to 27-44%. General anesthesia suppresses Bell's phenomenon, which protects the cornea by causing the upward movement of the eyeball during sleep, reducing the amount of tear production and tear film stability. This effect can lead to drying of corneal epithelial cells. Most corneal abrasions are caused by lagophthalmos due to corneal exposure and dryness during the peri-operative period [5,11].

According to Batra and Bali [6], if there is no manual eye closure, the incidence of lower-third corneal epithelial cell damage is up to 44%, so the eyes must be protected with tape or Vaseline gauze. When using eye ointment, the incidence of corneal abrasion is 2.1% in the study of Schmidt and Boggild-Madsen [15]. And in the more recent study, Grover et al. [9] reported the incidence of corneal abrasion is 1%. The duration of anesthesia time during which corneal damage can occur most is 90-150 min [6].

Grover et al. [9] reported that the total incidence of corneal epithelial cell damage after surgery is 10%. They studied the relationship between the surgery position and corneal damage. The dependent eye can be damaged easily in the lateral decubitus position. In our study, to exclude position errors, all surgeries were performed in the supine position. This study only included surgeries performed in the supine position. However, in the operation room, various positions can be used, including prone, lateral decubitus, and sitting positions, and additional studies are needed to determine the best eye-protection method for each posture.

In our study, no patient reported serious ocular complications. White and Crosse [5] did not recommend the routine use of water-soluble drugs, as a gel or ointment, because the drugs do not provide a benefit to prevent corneal damage, and ointments can be a cause of serious ocular disease.

Ocular damage can occur at any time during the peri-operative period. Ocular damage during induction of anesthesia can occur because of an ill-fitting facial mask, the laryngoscope, the anesthesiologist's finger, the watchstrap, the

patient tag, or the stethoscope. Ocular damage after induction of anesthesia can occur because of surgical drapes, surgical instruments, and the patient's position. Ocular damage in the post-anesthesia care unit after surgery can occur because of a patient's finger, pulse oximetry, the pillow, the oxygen mask, and manual removal of the adhesive tape [2].

In previous studies, the incidence of corneal epithelial damage in control groups was 27% compared to 23.5% in the present study, showing the lack of a significant difference [9].

Although the mean general anesthesia time in this study was over 2 h, each group showed no significant difference in the incidence of corneal abrasion compared to the control group, suggesting that performing manual eye closure during general anesthesia is an effective method economically and timely.

In conclusion, for patients receiving non-ocular surgery under general anesthesia in the supine position, all eye protection methods including eye taping, eye ointment application, or eye taping after eye ointment application did not reduced corneal abrasions compared to the manual eye closure.

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