

Original Research Article

The need for eye protection during general anaesthesia and the efficacy of various eye protection methods

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ABSTRACT

Background: Patients undergoing prolonged non-ocular surgery with general anaesthesia may develop ocular complications. Previous studies suggested that prophylactic ocular care should include prevention of mechanical exposure of cornea and replacement of deficient tears.

Methods: To assess the basal tear volume with various eye protection methods during general anaesthesia so as to find the need of eye protection and also to compare and assess the efficacy of lid taping with hypo allergenic adhesive surgical paper tape, paraffin based lubricant eye ointment, 2% hydroxyl propyl methyl cellulose tear substitute ointment and combinations of these ointments with lid taping as eye protection methods during general anaesthesia, the study was conducted in a tertiary care centre during the period of 1 year among 200 patients (400 eyes) undergoing general anaesthesia. After obtaining written informed consent they were subdivided into four groups of fifty patients each by randomization. A multiple cross over design with four groups each divided into two sub groups for eye protection methods was done. Corneal staining by fluorescein and basal tear volume assessment by Schirmer's test were done pre-and postoperatively. Significance is assessed at 5 % level of significance. Student t test (two tailed, dependent) has been used to find the significance of study parameters (schirmer's test score) on continuous scale within each group.

Results: The percentage of difference of schirmer's test score pre-and post-operatively were almost the same in all methods.

Conclusions: Eye protection is mandatory in all cases under general anaesthesia. There was almost equal effectiveness for all eye protection methods analysed.

Keywords: Basal tear volume, Eye protection, Fluorescein staining, Hydroxy propyl methyl cellulose eye ointment, Paraffin based eye ointment, Schirmer's test score, Taping of eye

INTRODUCTION

Ophthalmic complications following general anaesthesia are not uncommon. They could be due to injury by surgical drapes, anaesthetic or surgical equipments or inadequate lid closure.¹ The most common reported ophthalmologic complication during general anaesthesia for non-ocular surgery in literature is corneal abrasion.²⁻⁴

Other reported eye injuries are injuries from toxic chemicals allowed to contact eyes during general anaesthesia, various degrees of vision loss related to pressure on eye or optic nerve retinal ischaemia, and acute angle closure glaucoma due to atropine.^{2,5,6} Position of the patient may also play a significant role in the incidence of ophthalmological complications during anaesthesia. Published data report an incidence range of

0.17%–44%.⁷ Roth S et al studied-on eye injuries during anaesthesia in a huge number of patients and concluded that lengthier the procedures more the eye injuries.²

Most corneal abrasions are not due to trauma alone but instead due to drying of corneal epithelium probably due to the decreased basal tear production.⁸ This reduction occurs in all the patients and is not related to the inhalation agent used. The basal tear production is primarily responsible for adequate hydration and nutrition of the cornea. There could be multiple factors like absence of protective corneal reflex, absent pain perception during general anaesthesia. Generally, lid taping is done to protect the eyes from harmful effects of general anaesthesia. There are mixed reports in the literature regarding recommendation for use of gel, ointment, or eye drops to moisten eyes during anaesthesia.⁹

Aim of the study

To assess the basal tear secretion with various eye protection methods during general anaesthesia and to compare and assess the efficacy of hypo allergenic adhesive surgical paper tape, paraffin based lubricant eye ointment and 2% hydroxyl propyl methyl cellulose tear substitute ointment and combinations of these agents as eye protection methods under general anaesthesia.

METHODS

The study was conducted in a tertiary care centre during a period of 1 year. Institutional ethics review board approval was obtained for the study.

200 patients (400 eyes) undergoing general anaesthesia for more than 45 minutes for non-ophthalmological procedures were selected for the study. They were subdivided into four groups of fifty patients each using a computer-generated randomization chart after obtaining written informed consent. Each group was again divided into 2 equal subgroups for eye protection methods. Each of these sub group consisted of 25 subjects and eye protection was instituted accordingly.

Table 1: Different groups and the eye protection methods used in the eyes.

	Right	Left
A	Tape	Paraffin
B	Paraffin	Tape
C	Tape methylcellulose	Hydroxy Propyl
D	Hydroxy propyl methylcellulose	Tape
E	Tape	Tape+ Paraffin
F	Tape+ Paraffin	Tape
G	Tape Methylcellulose	Tape+HydroxyPropyl
H	Tape+HydroxyPropyl Tape methylcellulose	

Inclusion criteria

ASA1 (American Society of Anesthesiologists Physical Status classification system) and ASA 2 patients for non-ocular surgeries under general anaesthesia for more than 45 minutes during the period of 1 year between age 12 years and 60 years.

Exclusion criteria

The following groups of patients were excluded from the study

- Patients with known dry eye syndrome
- Patients with corneal diseases
- Patients on ocular medications
- Patients with connective tissue disorders
- Patients with thyroid ophthalmopathy
- Patients in prone or lateral positions
- Patients with cranial nerve palsies
- Patients with horner's syndrome
- Pregnant patients
- Patients who not willing to give consent.

Cornea was examined with vital staining with fluorescein and any prior lesions were ruled out. Jone's modification of Schirmer's test was performed prior to induction of general anaesthesia for assessment of basal tear production.¹⁰ The study was conducted in a double blinded fashion such that the patient and the anaesthesiologist were unaware of the the groups. Hypoallergenic adhesive surgical paper tape 25.4mm wide was applied over the tarsal plate to firmly close the eye. If ointment was applied, lids were separated to instill the ointments either paraffin based or hydroxy propyl methyl cellulose 2%, into the conjunctival cul de sac. Then additional taping of lids was done in allocated groups. General anaesthesia was instituted according to institutional protocol. Post operatively Schirmer's test was repeated 30 minutes after the end of general anaesthesia by an observer blinded to the study. Post-operative basal tear production was assessed with Schirmer's test. Vital staining with fluorescein was also done in the post-operative period, to assess any corneal abnormalities. If any abnormalities were detected the patient were to be sent for a detailed ophthalmological evaluation and management.

Study design

A multiple cross over design with four groups each was divided into two sub groups. Subjects were allotted in the cross over design to study the efficacy of various eye protection methods and basal tear production under general anaesthesia. Basal tear volume of all subjects was assessed in all groups. Efficacy of eye protection methods was assessed based on the ocular findings, fluorescein staining pattern of the cornea and basal tear volume that

was assessed by Schirmer's test which was done pre-operatively and post operatively.

Statistical methods

Descriptive statistical analysis has been carried out in this study. Results on continuous measurements are presented on Mean±SD (Min-Max) and results on categorical measurements are presented in Number (%). Significance is assessed at 5% level of significance. Student t test (two tailed, dependent) has been used to find the significance of study parameters (Schirmer test score) on continuous scale within each group. Student t test has been used to find the homogeneity of parameters on continuous scale and Chi-square /Fisher exact test has been used to find the homogeneity of samples on categorical scale.

Chi-square test

$$\chi^2 = \frac{\sum (O_i - E_i)^2}{E_i}$$

Where O_i is Observed frequency and E_i is Expected frequency.

Fisher exact test

	Class 1	Class 2	Total
Sample 1	A	B	a+b
Sample 2	C	D	c+d
Total	a+c	b+d	N

2x2.Fisher exact test statistic=

$$\sum p = \frac{(a+b)!(c+d)!(a+c)!(b+d)!}{n!} \frac{1}{\sum a!b!c!d!}$$

Student t-test for paired comparisons

Objective: To investigate the significance of the difference between single population means. No assumption is made about the population variances.

$$t = \frac{(\bar{x}_1 - \bar{x}_2)}{s / \sqrt{n}}$$

where $s = \sqrt{\sum (d_i - \bar{d})^2 / n - 1}$

and d_i is the difference formed for each pair of observations

Significant figures

* Moderately significant (P value:0.01<P≤0.05)

** Strongly significant (P value: P≤0.01)

Statistical software: The Statistical software namely SPSS 15.0, Stata 8.0, MedCalc 9.0.1 and Systat 11.0 were used for the analysis of the data and Microsoft word and Excel have been used to generate graphs, tables etc.

RESULTS

Among the 200 patients in the study group 105 were males, with maximum number of patients in the age group of 21-30 years as in Figure 1. The median age for the study group was found to be 37 years.

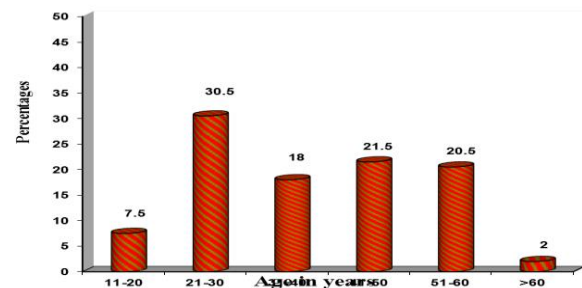


Figure 1: Percentage of study population and the age group.

Effect of different eye protection methods during general anaesthesia on the basal tear volume were assessed by Schirmer's test which was done preoperatively and post operatively.

Schirmer's test score results in various eye protection agents

Comparison of tape against paraffin based eye ointment

In our study of comparison of tape against paraffin based ointment with Schirmer's test, post-operatively Schirmer's value decreased to 10.12±1.57mm in taped group while the post-operative Schirmer's reduced to 9.72±1.01 mm in the group with paraffin based ointment applied, which is shown in Table 1. The percentage of change of basal tear volume is almost the same in both groups.

Table 2: Effect of tape against paraffin based on Schirmer test score.

Schirmer test score	Tape	Paraffin	P value
Pre-op	15.66±2.15	14.96±2.25	0.092
Post-op	10.12±1.57	9.72±1.01	0.074
% Change	35.40%	35.02%	-
Significance	t=17.612; P<0.001**	t=17.850; P<0.001**	-

Comparison of tape with hydroxyl propyl methyl cellulose based eye ointment

In the comparison of tape with hydroxyl propyl methyl cellulose based ointment the assessment of basal tear volume was done and it was found that pre-operative basal tear volume was 16.38±1.75mm for tape as compared to 9.96±1.32mm post operatively. Pre-

operative basal tear volume assessed with Schirmer's test for group with eye protection with hydroxyl propyl methyl cellulose based ointment was found to be 15.62 ± 1.54 while postoperatively it decreased to 10.04 ± 1.51 as shown in Table 3. The percentage of change between pre-and post-operative group among the tape and HPMC is also shown there.

Table 3: Effect of tape against HPMC on Schirmer test score.

Schirmer test score	Tape	HPMC	P value
Pre-op	16.38 ± 1.75 (12-19)	15.62 ± 1.54 (12-19)	0.027*
Post-op	9.96 ± 1.32 (7-12)	10.04 ± 1.51 (7-14)	0.779
% Change	39.19%	35.72%	-
Significance	t=20.766; P<0.001**	t=17.392; P<0.001**	-

Comparison of Schirmer test score in tape and tape + paraffin group

Preoperative Schirmer's was found to be 15.94 ± 1.33 mms. in the group which had tape alone as eye protection while it reduced to 10.56 ± 1.01 mms. postoperatively in the same group. Schirmer's test score was found to be 16.60 ± 1.25 mms. preoperatively in the group which had tape with paraffin as eye protection method. The basal tear volume reduced post operatively to 10.58 ± 1.14 mms. in this group as shown in Table 4.

Table 4: The effect of tape versus tape and paraffin.

Schirmer test score	Tape	Tape +paraffin	P value
Pre-op	15.94 ± 1.33 (13-19)	16.60 ± 1.25 (13-19)	0.005**
Post-op	10.56 ± 1.01 (8-13)	10.58 ± 1.14 (8-13)	0.925
% Change	33.75%	36.26%	-
Significance	t=22.055; P<0.001**	t=24.413; P<0.001**	-

Comparison of Schirmer test score in Tape and Tape + HPMC group

Table 5: Comparison of Schirmer test score in tape and tape + HPMC group.

Schirmer test score	Tape	Tape +HPMC	P value
Pre-op	15.64 ± 1.21 (13-18)	16.30 ± 1.59 (12-19)	0.022*
Post-op	10.62 ± 1.35 (8-15)	10.68 ± 1.09 (8-13)	0.726
% Change	32.09%	34.48%	-
Significance	t=20.495; P<0.001**	t=20.632; P<0.001**	-

Results are presented as Mean \pm SD (Min-Max). Basal tear volume in patients protected with tape alone in pre-operative period was 15.64 ± 1.21 while post operatively it reduced to 10.62 ± 1.35 . In patients who had their eyes protected with tape and hydroxyl propyl methyl cellulose preoperative basal tear volume was found to be 16.30 ± 1.59 while post operatively it reduced to 10.68 ± 1.09 as in Table 5.

Comparison of fluorescein test-to check for corneal abrasion

The patients were checked pre-and postoperatively for corneal abrasions with fluorescein staining in all the groups. None of the patients in the study developed corneal abrasion postoperatively.

DISCUSSION

The results of present randomised controlled trial showed that eye protection method is essential to prevent ocular complications since the basal tear volume was reduced during general anaesthesia. Any one technique, use of hypoallergic tape alone or paraffin based ocular lubricant or hydroxyl propyl methyl cellulose or combinations are sufficient, with minimal superiority for tape with hydroxy propyl methyl cellulose eye ointment. Draw backs of study would be a less sample size of 100 eyes in each group and observer variability.

Corneal abrasion has been mentioned as the most frequent complication, which can be detected by fluorescein staining. The Schirmer's test is simple, inexpensive, readily available, easily performed test and without side effects to detect the aqueous tear production. It measures the volume of tears during a fixed period.¹⁰

Generally, the prophylaxis against corneal abrasion occurring due to general anaesthesia is to keep the eyelids closed during operative procedure. Taping the eye lids closed to prevent exposure may not be sufficient because of marked depression of tear production. Krupin et al suggested that prophylactic eye care should include both replacement of tears and prevention of mechanical exposure.¹ White soft paraffin is a semisolid mixture of hydrocarbons obtained from petroleum and then bleached, used in the management of dry eye, to prevent evaporative dryness. Hydroxypropyl methyl cellulose is an isotonic, non-pyrogenic viscoelastic solution with a high molecular weight (>80,000 Daltons). It is used as a tear substitute in aqueous deficiency. Both are used to prevent and treat trauma to corneal epithelium. So combinations of taping the lids and use of either of the drugs, white soft paraffin or hydroxyl propyl methyl cellulose were tried.

None of the eyes were left unprotected since Grover et al and Batra and Bali found that eye protection is mandatory under general anaesthesia.^{11,12} So surgical tape was applied in one eye of the patient and another type of an

eye protection method in the other eye. In present study, basal tear volume assessment by Schirmer's test score was compared pre-operatively and postoperatively after standardized general anaesthesia technique in all eyes with different eye protection methods-taping alone, paraffin eye ointment, hydroxy propyl methyl cellulose eye ointment, tape with paraffin eye ointment, and tape with hydroxyl propyl methyl cellulose eye ointment. It was found that basal tear volume was reduced post operatively with all eye protection methods. Basal tear volume was found to be reduced in all groups with maximum reduction under tape alone group, 39.19% reduction. This correlates with the previous studies that general anaesthesia reduces the tear production.^{2,13} Hence there is a need of eye protection in all cases of general anaesthesia.

The percentage of change in schirmer's score pre-operatively and postoperatively among the Tape versus Paraffin alone, Tape versus HPMC alone, Tape versus Tape and Paraffin and Tape versus Tape and HPMC are given in the Table 6 below.

Table 6: The protective agent and the percentage of difference in the pre-and postoperative Schirmer test score.

Protective agent	% of difference in the Schirmer's score pre and postoperatively in the agent applied other than Tape
Paraffin	35.02
HPMC	35.72
Tape+ Paraffin	36.26
Tape +HPMC	34.48

Lesser the percentage of change between pre and post-operative Schirmer score in a group better the adopted protection of the method. All the methods adopted appeared to be almost equally effective, with minimal superiority for Tape with Hydroxy propyl methyl cellulose eye ointment probably because of their aqueous component tear substitution capacity.

Batra YK et al conducted a study on the eyes of 200 healthy adult patients undergoing general anaesthesia.¹² They suggested that covering of eyes are necessary in all cases undergoing general anaesthesia to avoid the complications of anaesthesia. Grover et al compared the efficacy of eye ointment and adhesive tape for protection of eyes under general anesthetic.¹¹ They found that the overall incidence of corneal epithelial defect was 10% of which 90% occurred in control groups, 6.6% in tape 3.3% ointment group. According to them the incidence of corneal epithelial defects did not alter with increase in duration of surgery. They concluded that during general anaesthesia, eyes need protection either by tape or ointment as incidence of corneal injury is greater in unprotected eyes. Since in the present study, all our eyes were protected with either tape, paraffin based eye

ointment, 2% hydroxyl propyl methyl cellulose eye ointment, tape with paraffin or tape with 2% hydroxyl propyl methyl cellulose, we never had any corneal injury. Bogglid et al worked-on patient using paraffin and 4% methylcellulose based ointment as prophylaxis against eye injury.¹⁴ They noticed less periocular edema with methyl cellulose ointment. We had used 2% hydroxyl propyl methyl cellulose. Instead of 4% as in India, 2% hydroxyl propyl methyl cellulose is readily available as ocular lubricant.

According to Bogglid et al and Manecke GR Jr et al eyes treated with paraffin based ointments in halothane induction appeared very much red.^{14,15} None of these findings were noticed in our study. According to Bogglid et al there was no difference in the symptoms or drug interaction in the patients who received neurolept analgesia and in those who had thiopentone anaesthesia. They suggested that the water-based methylcellulose four per cent offers better protection of the eyes during general anaesthesia than the paraffin-based ointment. The most important advantage is that it keeps the eyelids firmly closed by gluing. Methylcellulose, supplement the volume of tears that is otherwise decreased because of the anaesthesia itself and has been used several times daily without problems in patients with decreased tear production. According to them, hydroxyl propyl methyl cellulose causes a firm gluing of the eye lid with the result that eye is protected mechanically and is better than paraffin.¹⁴ Orlin et al prospectively analysed taping of lids and use of bland lubricants for prophylaxis of corneal injury with no significant difference.^{15,16}

CONCLUSION

Eye protection is mandatory in all cases under general anaesthesia. Basal tear volume was found to be reduced in all groups with maximum reduction under tape alone group. Eye protection methods including taping of eye with hypo allergenic tape, instilling paraffin based ocular lubricants or instilling hydroxy propyl methyl cellulose based tear substitutes are equally efficacious in protecting the eye from untoward ophthalmological injuries as none of our patients had corneal injury following prolonged general anaesthesia. Minimal superiority was found in eyes protected with combination of hydroxyl propyl methyl cellulose eye ointment instillation and taping of eyes with hypo allergenic adhesive surgical paper tape.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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