

**Association between duration of general anesthesia and postoperative ocular surface complications in patients undergoing major abdominal surgery**

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Abstract

Background: Postoperative ocular surface complications are recognized complications of general anesthesia, ranging from dryness and foreign-body sensation to conjunctival congestion and corneal epithelial injury. Prolonged anesthesia may increase the risk of ocular surface damage.

Objective: To evaluate the association between the duration of general anesthesia and postoperative ocular surface complications in patients undergoing major abdominal surgery.

Materials and Methods: A prospective observational study was conducted among 80 patients undergoing major abdominal surgery at Sri Chamundeshwari

Medical College Hospital and Research Institute, Channapatna, from December 2024 to December 2025. Patients were assessed for postoperative ocular surface symptoms and clinical findings, including dryness, burning, foreign-body sensation, conjunctival congestion and corneal epithelial changes. The occurrence of complications was compared across different durations of anesthesia.

Results: Postoperative ocular surface complications were observed in 21 (26.2%) patients, while 59 (73.8%) had no complications. The frequency of complications increased with anesthesia duration, occurring in 2 (9.1%) patients with anesthesia duration ≤ 2 hours, 8 (23.5%) with duration of 2–4 hours and 11 (45.8%) with duration

>4 hours. Dryness was the most frequently observed complication.

Conclusion: Postoperative ocular surface complications were relatively frequent and showed an increasing pattern with longer duration of general anesthesia. Adequate perioperative eye protection and postoperative ocular assessment are important, particularly during prolonged anesthesia.

Keywords: General Anesthesia, Ocular Surface; Corneal Injury, Postoperative Complications; Anesthesia Duration; Abdominal Surgery.

Introduction

Perioperative ocular surface complications are recognized complications of general anesthesia in patients undergoing non-ocular surgery. These complications range from transient dryness, burning, foreign-body sensation and conjunctival congestion to corneal epithelial injury and corneal abrasion. Although most ocular surface injuries are minor and self-limiting, they can cause considerable postoperative discomfort and, in some cases, require ophthalmic evaluation and treatment¹⁻⁴.

General anesthesia can compromise normal ocular protective mechanisms. Reduction or absence of the blink reflex, decreased tear-film stability, incomplete eyelid closure and exposure of the cornea may result in drying of the ocular surface and epithelial damage. In addition, direct mechanical trauma may occur during airway manipulation, patient positioning, surgical procedures or transfer of the patient¹⁻⁴. Early studies demonstrated an association between inadequate ocular protection during general anesthesia and the development of corneal abrasions³.

The duration of anesthesia is an important potential risk factor for perioperative ocular injury. Prolonged

anesthesia may increase the period during which the ocular surface is exposed to reduced blinking, tear-film instability and environmental exposure. A case-control study reported a significantly increased risk of corneal abrasion in patients undergoing longer surgical procedures, particularly procedures lasting three hours or more⁵. A systematic review also identified longer procedures, general anesthesia and advanced age among important risk factors for perioperative corneal abrasions⁶.

Large observational studies have further demonstrated the relationship between anesthesia duration and postoperative corneal injury. Deljou et al. reported that longer anesthesia duration was independently associated with an increased risk of postoperative corneal injury⁷. Ocular complications may also be influenced by other perioperative factors, including patient positioning, airway management and postoperative recovery characteristics^{7,8}.

The spectrum of ocular surface injury is broader than clinically diagnosed corneal abrasion. Patients may experience dryness, irritation, foreign-body sensation, burning, redness and conjunctival congestion without developing a definite corneal epithelial defect. Exposure keratopathy has also been reported following general anesthesia for non-ocular surgery, with several perioperative factors contributing to its occurrence⁸. Certain surgical settings, including laparoscopic procedures, have also been associated with increased risk of postoperative corneal injury⁹.

Appropriate perioperative eye protection is therefore an important component of anesthesia care. Different methods of ocular protection have been evaluated, including eyelid closure and protective measures intended to prevent corneal exposure and mechanical

trauma^{10,11}. Previous literature emphasizes the importance of standardized eye protection, early recognition and appropriate management of perioperative ocular injury^{1,4,6}.

Despite increasing recognition of perioperative ocular complications, limited information is available regarding the relationship between the duration of general anesthesia and the broader spectrum of postoperative ocular surface complications in patients undergoing major abdominal surgery. Therefore, the present study was undertaken to evaluate the association between the duration of general anesthesia and postoperative ocular surface complications in patients undergoing major abdominal surgery.

Materials and Methods

Study Design and Setting

A prospective observational study was conducted in Sri Chamundeshwari Medical College Hospital and Research Institute, Channapatna, over a period of one year from December 2024 to December 2025. The study included patients undergoing major abdominal surgery under general anaesthesia.

Study Population and Sample Size

A total of 80 patients scheduled for major abdominal surgery under general anaesthesia were included in the study. Patients were selected according to the predefined eligibility criteria.

Inclusion Criteria

- Patients aged ≥ 18 years.
- Patients undergoing major abdominal surgery under general anaesthesia.
- Patients willing to participate in the study.
- Patients with no pre-existing significant ocular surface disease.

Exclusion Criteria

- Patients with pre-existing ocular surface disorders.
- Patients with previous ocular surgery or significant ocular trauma.
- Patients with severe systemic illness affecting the ocular surface.
- Patients undergoing emergency surgery.
- Patients who received prolonged mechanical ventilation postoperatively.

Preoperative Assessment

All patients underwent a detailed preoperative evaluation, including demographic details, medical history, systemic examination, and assessment of relevant ocular history. Baseline ocular surface status was assessed before surgery.

Anaesthetic Management

General anaesthesia was administered according to standard institutional protocols. Anaesthetic technique, airway management, intraoperative monitoring, duration of anaesthesia, and perioperative medications were documented. The duration of general anaesthesia was recorded from induction of anaesthesia to completion of anaesthetic administration and was expressed in minutes.

Assessment of Postoperative Ocular Surface

Patients were assessed for postoperative ocular surface complications following surgery. Assessment included symptoms such as ocular discomfort, foreign-body sensation, dryness, burning, redness, photophobia, and visual discomfort. Clinical examination was performed to identify ocular surface abnormalities, including conjunctival congestion and corneal epithelial changes. The ocular surface was evaluated preoperatively and postoperatively using the same assessment protocol. The occurrence of postoperative ocular surface complications

was documented during the postoperative assessment period.

Study Variables

The primary study variable was the duration of general anaesthesia. The primary outcome was the occurrence of postoperative ocular surface complications. Other variables recorded included age, sex, type and duration of surgery, intraoperative factors, and postoperative ocular findings.

Statistical Analysis

Data collected from the 80 patients were entered into a structured database and analyzed using appropriate statistical methods. Continuous variables were expressed as mean $\pm$ standard deviation, while categorical variables were presented as frequencies and percentages. The association between duration of general anaesthesia and postoperative ocular surface complications was assessed using appropriate statistical tests. A p-value <0.05 was considered statistically significant.

Results and Observations

A total of **80 patients** undergoing major abdominal surgery under general anaesthesia were included in the study. The occurrence of postoperative ocular surface complications was evaluated and its association with the duration of general anaesthesia was assessed.

Table 1: Distribution of patients according to age group

Age group (years)	Number of patients	Percentage
18–30	12	15.0
31–40	18	22.5
41–50	21	26.3
51–60	17	21.2
>60	12	15.0
Total	80	100.0

The majority of patients belonged to the 41–50-year age group.

Table 2: Distribution of patients according to sex

Sex	Number of patients	Percentage
Male	46	57.5
Female	34	42.5
Total	80	100.0

Male patients constituted 57.5% of the study population, while females constituted 42.5%.

Table 3: Distribution according to duration of general anaesthesia

Duration of general anaesthesia	Number of patients	Percentage
≤ 2 hours	22	27.5
2–4 hours	34	42.5
>4 hours	24	30.0
Total	80	100.0

The largest proportion of patients underwent general anaesthesia for 2–4 hours.

Table 4: Distribution according to postoperative ocular surface complications

Ocular surface complication	Number of patients	Percentage
No complication	59	73.8
Ocular dryness	9	11.2
Conjunctival congestion	6	7.5
Foreign-body sensation	3	3.8
Corneal epithelial changes	2	2.5
Burning/discomfort	1	1.2
Total	80	100.0

Postoperative ocular surface complications were observed in 21 patients (26.2%), with ocular dryness being the most frequently observed complication.

Table 5: Association between duration of general anaesthesia and postoperative ocular surface complications

Duration of anaesthesia	Complications present, n (%)	No complication, n (%)	Total
≤2 hours	2 (9.1)	20 (90.9)	22
2–4 hours	8 (23.5)	26 (76.5)	34
>4 hours	11 (45.8)	13 (54.2)	24
Total	21 (26.2)	59 (73.8)	80

The frequency of postoperative ocular surface complications increased with increasing duration of general anaesthesia, from 9.1% in patients receiving anaesthesia for ≤2 hours to 45.8% in those receiving anaesthesia for >4 hours.

Table 6: Mean duration of general anaesthesia according to occurrence of ocular complications

Group	Number of patients	Mean duration of anaesthesia (hours)	SD
Complications present	21	4.3	1.1
No complications	59	2.9	1.0

Patients who developed postoperative ocular surface complications had a higher mean duration of general anaesthesia than those without complications.

Table 7: Distribution of ocular complications according to duration of general anaesthesia

Ocular complication	≤2 hours	2–4 hours	>4 hours	Total
Ocular dryness	1	3	5	9
Conjunctival congestion	1	2	3	6
Foreign-body	0	2	1	3

sensation				
Corneal epithelial changes	0	1	1	2
Burning/discomfort	0	0	1	1
Total	2	8	11	21

Ocular dryness was the most frequently observed complication across the anaesthesia-duration groups.

Table 8: Overall postoperative ocular surface outcome

Outcome	Number of patients	Percentage
Ocular surface complication present	21	26.2
No ocular surface complication	59	73.8
Total	80	100.0

Overall, postoperative ocular surface complications were observed in 26.2% of the study participants.

Discussion

The present study evaluated the association between the duration of general anaesthesia and postoperative ocular surface complications among 80 patients undergoing major abdominal surgery. In the present study, postoperative ocular surface complications were observed in 21 patients (26.2%), whereas 59 patients (73.8%) did not develop an identifiable ocular surface complication. The recorded manifestations included dryness, conjunctival congestion, foreign-body sensation, corneal epithelial changes and burning or ocular discomfort.

The occurrence of postoperative ocular surface complications can be explained by the effects of general anaesthesia on normal ocular protective mechanisms. During anaesthesia, the blink reflex is reduced or absent, tear-film stability may decrease and incomplete eyelid closure may expose the corneal surface. These changes

can result in ocular surface desiccation and epithelial injury¹⁻⁴. Batra and Bali demonstrated the relationship between corneal exposure during general anesthesia and postoperative corneal abrasion, highlighting the importance of maintaining adequate ocular protection³.

A major finding of the present study was the increasing frequency of ocular surface complications with increasing duration of anesthesia. Complications were observed in 9.1% of patients with anesthesia duration of ≤ 2 hours, 23.5% of patients with duration of 2–4 hours and 45.8% of patients with duration of >4 hours. Thus, the proportion of patients developing ocular surface complications increased progressively across the anesthesia-duration categories.

This observation is consistent with previous studies demonstrating a relationship between prolonged anesthesia or surgery and postoperative ocular injury. Carniciu et al. reported that the risk of corneal abrasion was significantly higher in patients undergoing procedures lasting three hours or longer⁵. Their findings support the concept that increasing duration of exposure during anesthesia may contribute to ocular surface injury.

The findings are also consistent with the systematic review by Papp et al., which identified longer procedures as an important risk factor for perioperative corneal abrasions⁶. The review also emphasized that reported incidence varies substantially between studies because of differences in patient populations, definitions of ocular injury, methods of detection and perioperative practices. Therefore, the frequency observed in the present study should be interpreted in the context of its broader definition of ocular surface complications rather than being directly compared with studies reporting only clinically confirmed corneal abrasions.

Deljou et al. evaluated postoperative corneal injuries following non-ocular surgery and found that increasing anesthesia duration was associated with increased risk of postoperative corneal injury⁷. This supports the dose-duration relationship observed in the present study, in which patients exposed to longer anesthesia durations showed a higher frequency of postoperative ocular surface complications.

The mean duration of anesthesia was also higher among patients who developed postoperative ocular complications than among those without complications in the present study. This difference further supports the observed association between prolonged anesthesia exposure and postoperative ocular surface morbidity. However, duration of anesthesia should not be considered the sole determinant because perioperative ocular injury is multifactorial.

Exposure keratopathy represents another important mechanism of postoperative ocular surface injury. Amini et al. reported a high frequency of exposure keratopathy among patients undergoing general anesthesia for non-ocular surgery and identified several perioperative factors associated with its occurrence⁸. Their findings demonstrate that ocular surface injury may occur even in the absence of clinically apparent corneal abrasion and support the inclusion of broader ocular surface manifestations in perioperative assessment.

Previous studies have also demonstrated that the type and characteristics of surgery may influence ocular injury. Kim et al. reported an increased risk of postoperative corneal injury in patients undergoing laparoscopic gynecological surgery⁹. In major abdominal surgery, prolonged operative time and anesthesia exposure may therefore contribute to ocular surface stress. Nevertheless, the present study specifically

focused on anesthesia duration, and other surgical or intraoperative variables should be interpreted as potential contributing factors rather than established independent causes.

The clinical manifestations observed in the present study were predominantly mild ocular surface symptoms. Dryness was the most frequent manifestation, followed by conjunctival congestion and foreign-body sensation. These symptoms may reflect disruption of the ocular surface and tear film during anesthesia. Moos and Lind emphasized the importance of recognizing perioperative corneal abrasions because patients may present with ocular discomfort, foreign-body sensation, redness or visual symptoms during the postoperative period⁴.

Corneal epithelial changes were observed in a smaller proportion of patients in the present study. Although less frequent than subjective symptoms, epithelial changes are clinically important because they indicate objective ocular surface damage. Previous literature has consistently identified corneal abrasion as one of the principal ocular injuries associated with anesthesia^{1,2,6}. Gild et al., in an analysis of anesthesia-related closed claims, also documented ocular injuries associated with anesthesia and highlighted the clinical importance of perioperative eye protection².

Prevention of perioperative ocular injury remains an important component of anesthesia practice. Adequate eyelid closure and appropriate eye protection can reduce exposure-related injury. Different perioperative eye-protection techniques have been studied, and their effectiveness may vary according to the surgical position and clinical circumstances^{10,11}. The systematic review by Papp et al. further emphasized the importance of standardized eye protection, reporting and education in reducing perioperative corneal injury⁶.

The findings of the present study suggest that patients undergoing prolonged general anesthesia may require particular attention to perioperative ocular protection and postoperative assessment. Careful protection of the eyes throughout anesthesia, together with recognition of postoperative ocular symptoms, may help reduce the clinical burden of perioperative ocular surface complications.

The present study has certain limitations. It was conducted at a single institution with a relatively small sample size of 80 patients. In addition, the study evaluated a broad range of postoperative ocular surface manifestations rather than restricting the outcome to ophthalmologically confirmed corneal abrasion. Differences in surgical procedures, patient characteristics and other perioperative factors may also contribute to ocular complications. Future larger, multicentre studies using standardized ophthalmological assessment and clearly defined diagnostic criteria may provide further information regarding the independent contribution of anesthesia duration.

Overall, the present study demonstrates an increasing frequency of postoperative ocular surface complications with increasing duration of general anesthesia among patients undergoing major abdominal surgery. The findings emphasize the importance of adequate perioperative eye protection and postoperative ocular surveillance, particularly in patients undergoing prolonged anesthesia.

Conclusion

Postoperative ocular surface complications were observed in a substantial proportion of patients undergoing major abdominal surgery under general anesthesia. Their frequency increased with longer anesthesia duration, indicating a possible association

between prolonged anesthesia and ocular surface morbidity. Adequate perioperative eye protection and postoperative ocular assessment are therefore important, particularly during prolonged procedures.

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