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A Retrospective Review of Corneal Abrasions after Oncologic Surgery in a Tertiary Cancer Center

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Abstract

Corneal abrasions are the single most common ocular injury in the perioperative period. The exact etiology of perioperative corneal abrasions is usually unclear, and several risk factors have been described. The aim of our study was to determine the incidence of known and hypothetical risk factors for corneal abrasion in a cohort of cancer patients who had developed corneal abrasion after oncologic surgery. Our review showed a high incidence of risk factors which were similar to that reported for other heterogeneous surgical populations. Contrary to our expectations, there was a low incidence of prior chemotherapy in our study cohort.

Keywords

Corneal abrasion, Anesthesia, Perioperative, Risk factors, Incidence

Introduction

A corneal abrasion (CA) is a condition where the epithelial layer of the cornea is removed from the underlying basement membrane, leading to a defect in the corneal epithelial surface. Patients typically complain of eye pain, blurry vision, tearing, redness and a foreign body sensation in the eye [1]. Current literature review suggests that the incidence of perioperative CAs range between 0.013% and 0.15% [2,3]. An American Society of Anesthesiologists (ASA) closed-claims analysis found that perioperative CAs were the single most common ocular injury in the perioperative period [4]. Apart from the significant discomfort, perioperative CAs contribute to delays in discharge from the hospital while awaiting consultation, diagnosis and treatment. As a result, patient satisfaction and healthcare costs are significantly impacted.

The most commonly cited etiologies of perioperative CAs are corneal exposure, pressure on the globe, and direct chemical or mechanical trauma [5]. However, the perioperative factors which may be contributory to the aforementioned etiologies continue to be explored [6-8].

The objective of our study was to investigate the incidence of corneal abrasions and its associated factors in the unique cohort of cancer patients who presented for oncologic surgery at our tertiary cancer center.

Material and Methods

After institutional quality review board approval, the departmental quality improvement database was retrospectively queried for a two year period to identify cases of CA. Medical records of patients with a CA were reviewed, and the incidences of known and hypothetical factors associated with the development of CA were recorded. Clinical characteristics of interest included: demographics, surgery type and duration, patient positioning, use of preoperative chemotherapy, selected co-morbidities, use of intraoperative ophthalmic-lubricant, intraoperative blood loss, total intravenous fluid administered intraoperatively, and use of post-operative supplemental oxygen. Descriptive summary statistics were used to evaluate the percentage of patient factors that were associated with a corneal abrasion.

Results

Over the 2 year study period, 19 cases of CA were reported, representing an incidence of 0.059%. In patients with a diagnosis of CA, the factors with the highest frequency of observation included: Trendelenburg positioning (73.7%), age over 60 years old (73.7%), lack of eye lubricant application (63.2%), body mass index (BMI) greater than 25 (84.2%), urologic procedures (63.2%), robotic procedures (63.2%), and oxygen delivery by nasal cannula (73.7%). Diagnoses observed included: prostate cancer (47%), uterine cancer (11%), renal cell carcinoma (16%), melanoma (11%), parotid mass (5%), breast cancer (5%), and chondrosarcoma of the hip (5%). Other clinical characteristics and their frequency of observation are described in table 1.

Discussion

In this retrospective study of cancer patients who developed CA after undergoing oncologic surgery, there was a high incidence of

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Table 1: Clinical characteristics of patients with a corneal abrasion after oncologic surgery.

Age	Number	Percentage
> 60 years old	14	73.70%
< 60 years old	5	26.30%
Sex		
Male	11	57.90%
Female	8	42.10%
BMI		
> 30	8	42.10%
25-30	8	42.10%
< 25	3	15.80%
Eye lubrication		
No	12	63.20%
Yes	7	36.80%
Duration of Surgery		
> 3 hours	10	52.60%
< 3 hours	9	47.40%
Type of Surgery		
Robotic Prostatectomy	9	47.40%
Robotic Nephrectomy	3	15.80%
Wide local excision of skin	2	10.50%
Laparoscopic Hysterectomy	1	5.30%
Open Hysterectomy	1	5.30%
Breast Tissue Expander	1	5.30%
Hip Arthroplasty	1	5.30%
Parotidectomy	1	5.30%
Positioning		
Steep Trendelenburg	11	57.90%
Sloppy Lateral/ Trendelenburg	3	15.80%
Lateral	3	15.80%
Supine	2	10.50%
Prone	0	0.00%
Chemotherapy		
No	13	68.40%
Yes	6	31.60%
Hypertension		
Yes	10	52.60%
No	9	47.40%
Diabetes		
No	16	84.20%
Yes	3	15.20%
ASA Status		
Three	18	94.70%
Two	1	5.30%
Estimated Blood Loss		
< 199	11	57.90%
≥ 200	8	42.10%
Intra-Op IV Fluids		
Intra-Op IV Fluids (total)		
< 1500cc	8	42.10%
> 1500cc	11	57.90%
Crystalloids only	12	63.16%
Crystalloids and colloids	7	36.84%
Post-op O2		
Nasal Cannula	14	73.70%
Face Mask	3	15.70%
Unknown	2	10.50%

several factors previously shown to be associated with perioperative CAs in other surgical populations. Factors with a high incidence in our cohort included Trendelenburg positioning, advanced patient age, lack of eye lubricant application, robotic procedures and oxygen delivery by nasal cannula. On the other hand, only 31.6 % of patients with a CA had a prior history of chemotherapy.

Trendelenburg positioning, which is widely used during robotic and laparoscopic procedures, has been cited by other authors as a risk factor for the development of corneal abrasions [6,7]. Although the exact mechanism by which this position contributes to the development of CA is unclear, its impact on ocular perfusion pressure may play a role. Contrary to the long standing view that cerebral and ophthalmic circulatory autoregulation prevents elevated compartment pressures and reductions in perfusion, Molloy *et al.* [9] in their study examining the effects of patient positioning on ocular perfusion pressure (OOP), suggested a relationship between prolonged steep Trendelenburg and reduced OPP. Other authors have also demonstrated increases in intraocular pressure measurements during steep Trendelenburg positioning [10,11]. Thus, altered intraocular pressures may possibly contribute to an increased propensity for the development of CA in the Trendelenburg position.

Increases in intraocular pressure (IOP) produced by pneumoperitoneum may further compromise OPP of patients in the Trendelenburg position. In their study investigating changes in IOP with patient positioning, Hwang *et al.* [12] noted that depending on the type of anesthetic being administered, the addition of pneumoperitoneum to the Trendelenburg position was associated with a further increase in IOP. Interestingly, in patients receiving propofol, IOP values were similar to preoperative values during the whole period of pneumoperitoneum (18 ± 3 mm Hg, $P < 0.001$ versus desflurane). However, in patients receiving desflurane, IOP during the pneumoperitoneum significantly exceeded the preoperative value ($P < 0.001$) and kept increasing with time ($P < 0.01$). The average IOP value after 20 minutes of pneumoperitoneum under desflurane anesthesia was over the normal range (22 ± 4 mm Hg). Upon further review of our cohort, we discovered that all 14 patients who developed a CA after procedures involving Trendelenburg and pneumoperitoneum did indeed receive desflurane. Seventeen out of our entire cohort of 19 patients (89%) received desflurane. The other 2 received sevoflurane. However, desflurane is widely used in our practice and further research is necessary to ascertain if this increase in IOP during desflurane anesthesia is associated with the development of CAs.

There was a high representation of patients with a BMI of greater than 25 in our study cohort (84.2%). Although the mechanisms for this association are unclear, it is possible that an increased BMI further contributes to some of the ocular physiologic changes that have been described for Trendelenburg positioning. For example, in a study evaluating the relationship between metabolic syndrome, BMI and elevated intraocular pressure, a statistically significant positive correlation was found between males with a high BMI and elevated IOP ($r = 0.11677$, $P < 0.0001$) [13]. Furthermore, a study examining the relationship between elevated BMI and complications in diabetic patients concluded that ocular complications occurred at higher BMI levels than other complication types in both men and women [14].

Similar to the findings of a large study of 60,965 patients [15], 73.7% of patients with a CA in our study cohort were over 60 years of age. Although the exact mechanism for this age related increase in incidence is unclear, age related changes in the epithelial basement membrane zone [16,17] may explain the increased susceptibility of older patients to perioperative CAs.

Our results also demonstrated a higher representation of CA in patients who received more than 1500 ml of fluids (57.9%, versus 42.1% in those who received less 1500 ml). The majority of patients received only crystalloids (63.16%). The others received a combination of crystalloid and colloid. Similar to what has been described in previous studies, periorbital edema from increased fluid administration in the Trendelenburg position may play a role in the development of CAs [18].

Over 63% of the patients with corneal abrasions in our study cohort were not pretreated with ophthalmic lubrication, suggesting that eye lubricant application may have been protective in this population. However, there is currently a lack of studies demonstrating a clear benefit of prophylactic ocular lubrication in the prevention of perioperative CA. Cucchiara *et al.* [19] prospectively evaluated the role of ocular lubricant application in 4652 patients undergoing neurosurgical procedures. The authors reported equal numbers of patients with CA in the eye-lubricant and non-eye-lubricant groups, but there was a low incidence of CA (4 patients in each group).The study therefore failed to address the value of ocular lubrication in the prevention of CA.

In our study cohort, supplemental oxygen delivery by nasal cannula was associated with a higher incidence of CA than oxygen delivery by face mask (82.4 % versus, 17.6 %). The direct stream of oxygen flow towards the eyes may be a possible explanation for this association.

Our data is equally interesting in the correlations that it did not reveal. In their study on the evaluation and treatment of perioperative corneal abrasions, Segal *et al.* [6] determined that a higher average estimated blood loss (EBL) was a statistically significant risk factor for CA ($p < 0.001$). However, in our study cohort, there was a lower incidence of CA in patients with an EBL greater than 200 ml (42.1 %, versus 57.9 % of those with an EBL of less than 200 ml). Although this difference is difficult to explain, it is worth noting that in a study investigating the incidence of CA during pelvic reconstructive surgery, Antosh *et al.* [20] found a lower EBL in patients who developed CA. Furthermore, the average EBL of patients with a CA in the Segal study was 191 ml which is similar to our cutoff of 200 ml. Further studies may therefore be necessary to fully determine the significance of EBL in the development of CA.

Our cohort of patients also demonstrated an important negative correlation. While certain chemotherapeutic agents, including bleomycin, dactinomycin, doxorubicin and mitomycin, are known to concentrate in tears and cause irritation of the conjunctiva and cornea [21] we did not find an association between the use of chemotherapy and a higher incidence of CA. To the contrary, there were a lower number of patients who had received chemotherapy as compared to those who had (31.6% versus 68.4%). On the other hand, it has also been shown that patients on doxorubicin may have increased lacrimation [21], perhaps providing a protective effect against CAs. Given that our overall incidence of CA was low, this may be an area that deserves further investigation.

The limitations of our study include the use of retrospective data, lack of rigorous statistical analysis, and a small number of cases over the two year study period. We also do not have a way to ensure that all CAs were reported to our departmental quality improvement database, which would have led to an overall reduction in the incidence of CAs. Further investigations to study our preliminary data would include a trial randomizing patients to various interventions aimed at preventing CAs, such as different methods of eye protection, or even temporarily taking the patient out of steep Trendelenburg for longer surgeries. Another possible study wound entail measuring intraoperative IOP with BMI stratification while in steep Trendelenburg position.

In conclusion, in this retrospective study of cancer patients who developed CA after undergoing oncologic surgery, there was a high incidence of factors that have previously been shown to be associated with the development of perioperative CAs in other heterogeneous surgical populations. Special precautions should be undertaken to prevent corneal abrasions in patients undergoing surgery in the Trendelenburg position, as well as those with a higher BMI. Older patients may also deserve special attention to eye protection.

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