

# Eye Injuries Associated with Anesthesia

## A Closed Claims Analysis

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Claims against anesthesiologists for eye injuries were analyzed as part of the ASA Closed Claims Project. Eye injury occurred in 3% of all claims in the database (71 of 2,046). The payment frequency for eye injury claims was higher than that for non-eye injury claims (70% vs. 56%;  $P \leq 0.05$ ). The median cost of eye injury claims was less than that for other claims (\$24,000 vs. \$95,000;  $P \leq 0.01$ ). Two distinct subsets were identified. The first was characterized by corneal abrasion during general anesthesia (25 of 71 claims; 35%). Claims for corneal abrasion were characterized by low incidence of permanent injury (16%) and low median payment (\$3,000). Reviewers were able to identify a mechanism of injury in only 20% of claims for corneal abrasion. The second subset of eye injury was characterized by patient movement during ophthalmologic surgery (21 of 71; 30%). Blindness was the outcome in all cases. Sixteen of the claims involving movement occurred during general anesthesia, and 5 occurred during monitored anesthesia care. The median payment for claims involving movement was 10 times greater than for non-movement claims (\$90,000 vs. \$9,000;  $P \leq 0.01$ ). Anesthesiologist reviewers deemed the care rendered in the general anesthesia "movement" claims as meeting standards in only 19% of claims. From the perspective of patient safety, as well as risk management, these data suggest two specific needs: research directed at better understanding of the etiology of corneal abrasion and clinical strategies designed to assure patient immobility during ophthalmic surgery. (Key words: Complications, eye injury: corneal; vitreous. Medico-legal: professional liability.)

PREVENTION of anesthesia-related injuries to the eye assumes a high priority because the eye is one of the major sense organs. The eye may be damaged secondary to anesthesia for nonophthalmic surgeries or during ophthalmic surgery. The American Society of Anesthesiologists' Closed Claim Project, ongoing since 1985, provides an opportunity for a structured analysis of eye injury malpractice claims against anesthesiologists. This analysis includes severity of outcome, cost, the role of substandard care, and identification of recurrent patterns of liability.

## Materials and Methods

This report uses the total database of 2,046 cases accrued as of October 1990. Ninety-five percent of the incidents leading to claims occurred between 1974 and 1987. Cases were collected from 23 participating professional liability insurance companies throughout the contiguous United States. Details of the methods of data retrieval have been reported elsewhere<sup>1</sup> but are summarized here.

To collect data, 1 or more of the 31 participating anesthesiologist-reviewers visited each insurance company office to review the files of all closed claims (*i.e.*, claims on which no further action was expected because of final settlement, adjudication, or lapse of time) against insured anesthesiologists. Typically, files contained copies of the hospital and anesthesia record; transcripts of both fact and opinion depositions by both parties and their expert witnesses; narrative statements of involved health care personnel; outcome reports; and the cost of settlement or jury awards, where applicable. Claims for dental injury were excluded from review. A standardized data collection form was completed for those claims in which there was sufficient information to reconstruct the sequence of events and the nature of the injury.

The data collection forms completed by the reviewer contained general patient demographic data such as age, gender, physical status, and weight, as well as the date of incident, surgical procedure, personnel involved, anesthetic and monitoring techniques, damaging events noted (if any), clinical clues, complications (outcome), whether a law suit was filed, and the amount of settlement or judgment.

Each claim was assigned a severity-of-injury score by the on-site reviewer using the insurance industry's ten-point scale.<sup>2</sup> Reviewers also wrote a brief narrative summary of each case, outlining the sequence of events and providing additional relevant information.

In addition to recording summary data for each claim, the reviewers assessed the standard of care rendered to the patient. Care was rated by the on-site reviewer as standard (appropriate), substandard (inappropriate), or impossible to judge, based on reasonable and prudent practices at the time of the event.

The completed data collection forms were returned to Seattle, Washington where the Closed Claims Project

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Committee (comprising three practicing anesthesiologists) reviewed the on-site reviewers' assessments of the standard of care and other judgmental questions. Reviewers' judgments were overruled by the Committee in 3% of the cases.

Limitations of the ASA Closed Claims Project have been described previously.<sup>1</sup> These include the retrospective nature of the study, lack of geographic balance in the source of the claims, and the issue of interrater reliability in judging the standard of care.

All cases involving injury to the eye, its surrounding structures (eyelid and conjunctiva), blood supply, and optic nerve were deemed "eye injury" cases for the purposes of this study. Injuries to nerves enervating extraocular muscles and to the occipital lobe of the brain were excluded from the set of eye injury claims. Data from these and other non-eye injury claims is presented for purposes of comparison of eye injury claims to other claims in the database.

Patient ages are reported as means  $\pm$  standard deviations. Student's *t* test was used to compare mean patient age between eye injury claims and claims for other injuries. Differences between proportions of eye injury claims and other claims resulting in payments to the patient were evaluated by the Z statistic.<sup>3</sup> The Kolmogorov-Smirnov test was used to compare the distribution of payments between eye injury and other claims. The median test was used to compare median payments between subsets of eye injury claims. Two-tailed tests were used throughout, with  $P \leq 0.05$  considered to be statistically significant.

### Results

Eye injury occurred in 71 patients, representing 3% of the total database of 2,046 claims. Injuries occurred to the anterior chamber of the eye (including the cornea and conjunctiva) in 34 cases (48%) and to the posterior chamber and its blood vessel in 37 cases (52%). The single most common type of injury was corneal abrasion (25 claims), followed by vitreous loss or hemorrhage (21 claims). Patient movement was alleged to be the mechanism of injury in the latter 21 claims and was the most common single mechanism of injury cited in the files (table 1). Other mechanisms of eye injury included chemical injury to the cornea or conjunctiva from cleaning materials on the mask or spillage of prep solutions onto the cornea or conjunctiva (9 claims, 13% of total eye cases) and direct trauma to the eye (6 claims, 8% of total eye claims) from the operating room table padding (patient's head dragged across the padding during repositioning), from the needle used in retrobulbar block (2 cases), from the anesthetic mask (2 cases), and from a laryngoscope accidentally falling into patient's eye. Two claims involved pressure on the globe as the mechanism, one involving

TABLE 1. Mechanism of Eye Injury

Mechanism of Injury	Eye Injury (Total) (n = 71)	Corneal Abrasions (n = 25)
Patient movement	21 (30%)	0 —
Chemical injury	9 (13%)	1 (4%)
Direct trauma	6 (8%)	4 (16%)
Pressure on eye	2 (3%)	0 —
Other	3 (4%)	0 —
Unknown	30 (42%)	20 (80%)

an anesthetic mask and the other direct pressure in the prone position. Other known mechanisms of injury included two cases of increased intraocular pressure, as well as hypoxemia following cardiac arrest. A mechanism of injury was not apparent in the files of 30 of the 71 claims (42%, table 1).

The mean age of patients in the eye injury group ( $52 \pm 21$  yr) differed significantly from that of the rest of the database ( $39 \pm 20$  years). Forty-two percent of patients in both groups were ASA physical status 1 or 2.

Fifty-five percent of the eye injuries (39 claims) occurred in the setting of surgery unrelated to the eye or surrounding tissues, whereas 37% (26 claims) occurred during eye surgery itself. The remainder (6 claims, 8% of total eye claims) occurred in surgery on areas in close physical proximity to the eye itself (e.g., ear or face).

General anesthesia was the primary anesthetic technique used in 59 cases (83%), and monitored anesthesia care was used in 8 cases (11%). Major conduction anesthesia (for nonophthalmic surgery) was used in 3 cases, and in the remaining 1 case the anesthetic technique used was not apparent from the file.

The majority (61%) of eye injuries were permanent (fig. 1). Although most nonophthalmic claims in the database also resulted in permanent injury, the eye injury group differed in that it contained no deaths or brain damage.

The standard of care was judged to have been met in 29 (41%) of the eye injury claims, whereas care was less than appropriate in 31 (44%). These proportions are similar to judgments in the non-eye injury claims in the database as a whole (fig. 2).

The patient received payment in 70% of the eye injury claims. This payment rate is significantly greater than the 56% rate of payment in non-eye injury claims ( $P \leq 0.05$ ; table 2A). Payments for eye injury ranged from \$25,000 to \$1,000,000. The distribution of payments in claims for eye injury (median \$24,000) differed from that of non-eye injury claims (median \$95,000,  $P \leq 0.01$ ; table 2A).

Of the 21 claims for injury caused by patient movement during ophthalmic surgery, 16 occurred during general anesthesia and 5 during monitored anesthesia care (table 2B). Of the 16 claims emanating from movement under

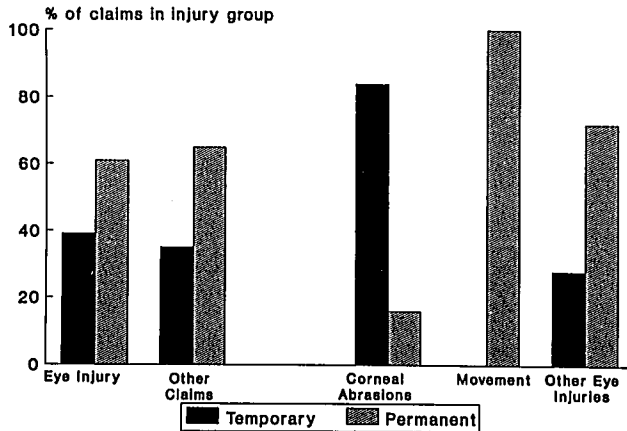


FIG. 1. Severity of injury. Distribution of temporary and permanent injuries in eye injury claims compared to claims for other injury. Permanent injuries in non-eye injury claims include 36% deaths and 28% other permanent injury. There were no deaths in the eye injury claims.

general anesthesia, 15 involved surgery on the anterior segment of the eye (cataract extractions). Movement was characterized as resulting from either coughing or "bucking" in the claims involving general anesthesia and was not specified beyond "restlessness/movement" in all but one (specified as coughing) of the claims involving monitored anesthesia care. It was not clear from the claim files whether respiration was controlled or spontaneous in the general anesthesia movement claims. Neuromuscular blockers were used in only 7 of the 16 general anesthesia cases, and, when used, the patients were not monitored with nerve stimulators. All of the movement-related claims were for permanent injuries (fig. 1). Reviewers judged the care rendered in the general anesthesia group as meeting standards in only 3 of the claims (19%). By

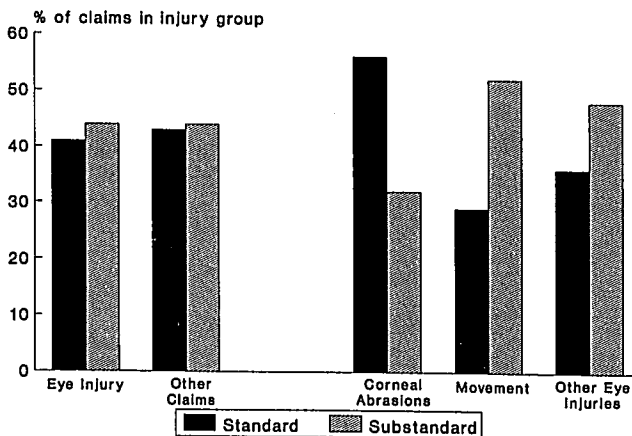


FIG. 2. Standard of anesthesia care. Distribution of standard of care determinations in eye injury claims compared to claims for other injuries. Claims in which a determination could not be made are not shown.

TABLE 2A. Incidence and Amount of Payment: Eye Injury versus Other Claims

Type of Claim	Number of Claims with Payment	Median Payment (\$ × 1,000)	Range of Payments (\$ × 1,000)
Eye injury (n = 71)	50 (70%)*	24†	0.025–1,000
Other claims (n = 1975)	1,110 (56%)*	95†	0.015–6,000

\*  $P \leq 0.05$  between proportion of eye injury and other claims resulting in payments.

†  $P \leq 0.01$  between distribution of payments for eye injury versus other claims. Claims with no payment were excluded from calculations.

contrast, the care was deemed appropriate in 3 of the 5 (60%) local cases where movement was involved.

Payment was made in 88% of the claims for injury from movement under general anesthesia and in only 40% of the claims for injury from movement during local block (table 2B). Whereas median payment in the movement cases as a whole was \$90,000, payments in the two cases involving movement during local block were only \$5,000 and \$65,000, respectively.

## Discussion

Patient movement during anesthesia on the eye was found to be the single most frequently identified mechanism of injury in this review, and corneal abrasions sustained during general anesthesia constituted the most frequent injury. Data analysis of both of these groups raises pertinent liability and clinical issues.

Sixteen of the 21 "movement" claims involved general anesthesia; in the five other claims monitored anesthesia care was used. Clinical outcome in all 21 claims was uniformly poor, with blindness as the end result. Of the 16 claims involving patient movement under general anesthesia, 15 involved surgery on the anterior chamber of the eye (cataract extractions) and could conceivably have been performed under local anesthesia. Choice of anesthetic technique (general vs. local) for cataract surgery involves numerous competing factors. Patient and surgeon preference need to be taken into account, and risk to the patient (who is frequently old and infirm) from the anesthetic technique itself, as well as risk to the anesthetist from a liability perspective, constitute additional variables.

Although not statistically significant, trends in the data suggest liability implications associated with both choice and conduct of anesthesia for ophthalmic surgery. The standard of care was found to be appropriate by the reviewers in 60% of the local cases involving movement, but care was considered to have met standards in only 19% of the claims for injury from movement under general anesthesia. Although the issue of interrater reliability is of importance, and although Caplan *et al.* demonstrated the influence of outcome on standard of care determi-

TABLE 2B. Incidence and Amount of Payment Eye Injury

Type of Claim	Number of Claims with Payment	Median Payment (\$ × 1,000)	Range of Payments (\$ × 1,000)
All movement claims (n = 21)	16 (76%)	90*	5-275
During general anesthesia (n = 16)	14 (88%)	108	20-275
During MAC (n = 5)	2 (40%)	35	5-65
Nonmovement (n = 50)	34 (68%)	9	0.025-1,000
All corneal abrasions (n = 25)	16 (64%)	3†	0.025-25
Nonabrasion (n = 46)	34 (74%)	83	1-1,000
All other claims (n = 25)	18 (72%)	75	1-1,000

Note: Claims with no payment (\$0) are excluded from calculation of all statistics.

\*  $P \leq 0.01$  between median payment for eye injuries caused by

movement versus other eye injury claims.

†  $P \leq 0.01$  between median payment for corneal abrasions versus other eye injuries.

nations,<sup>4</sup> we believe that the uniformity of outcome (blindness) in the patient movement group nullifies any potential for bias in the present study group. Trends in payment data likewise suggest differences between the two anesthetic modalities; 88% of the claims involving movement under general anesthesia generated payment to the patient, whereas only 40% of those with local anesthesia did (table 2B). Neuromuscular blockers were used in fewer than half the general anesthesia "movement" cases and, when used, their effects were not monitored by peripheral nerve stimulators. Median payment in the movement cases as a whole was \$90,000 and was greater still (\$107,500) for the general anesthesia movement claims.

These figures underscore the seriousness of the liability problem encountered in the movement cases generally, especially when compared with median cost of the non-movement claims (\$9,000). The data indicate that patient movement during general anesthesia for ophthalmic surgery is viewed by both peer-group reviewers and the liability industry as legally indefensible, creating, in effect, a presumption of negligence. However, we do not wish to imply the existence of a current standard of care or a preference for one anesthetic technique over another. Because we lack incidence data and information on the reasoning behind the practitioners' choice of specific technique as well as the basis of the reviewers' judgment, we lack the foundation for explicit recommendations regarding anesthetic options in ophthalmic surgery.

Although the Closed Claims Project is, by definition, not an incidence study, our results lend support to the impression of other authors<sup>5-7</sup> that corneal abrasions constitute the single largest ophthalmic complication following general anesthesia. The mechanism involved in the genesis of this complication is generally unknown, but it is believed to be related to drying of the exposed cornea or careless technique on the part of the anesthesia-provider leading to direct trauma from surgical drapes, anesthesia mask, or other equipment.<sup>7</sup> The present group of corneal abrasion claims is likewise characterized by a lack

of evidence relating to the mechanism of injury. In fact, in only 5 of the 25 claims (20%) were the reviewers able to reconstruct a mechanism of injury. This contrasts with the other eye injuries in the study, in which the mechanism of injury was discernible in 78% of the claim files. In the Closed Claims analysis of nerve injuries, Kroll *et al.*<sup>8</sup> found a similar lack of data regarding mechanism of injury in the ulnar nerve injury group (mechanism apparent in 6% of claims). A significant component of closed claims analysis is the reconstruction of the mechanism of injury in patient claims for damages in an attempt to identify patterns and trends that may aid in developing risk management strategies. A dual opportunity for improving patient safety and minimizing professional liability could be subserved through further research into mechanisms of injury in both corneal and ulnar nerve injuries.

Corneal abrasions produced fewer permanent injuries (16% of claims) than either patient-movement-related injuries (100%) or "other" eye injury claims (72%, fig. 1). Of equal importance, and probably related, is that median payment for the corneal abrasions (\$3,000) was significantly less than that for other eye injuries (\$83,000,  $P \leq 0.01$ ). Given the high cost of defending nonmeritorious claims, it is conceivable that the liability carriers viewed payment without challenge on these relatively low-cost claims as the most cost-effective way of doing business.<sup>9</sup> However, since initiation of the National Practitioner Data Bank in September 1990, payments of any amount made on behalf of a physician generate entry of that physician's name in the Data Bank.<sup>10</sup> Thus, while unchallenged payments on small claims may represent economic sense for the liability carriers, this may not be in the best interest of the individual physician because of the possible adverse effects on licensing and credentialing.

In conclusion, this analysis identifies two distinctive groups of claims for eye injuries occurring during general anesthesia. The first group arises from patient movement

<sup>10</sup> Health-Care Quality Improvement Act of 1986 (Act) (Title IV of Pub.L. 99-660, as amended by Pub.L. 100-177).

during ophthalmic surgery and is characterized by a high severity of injury, a high incidence of unfavorable determinations of standard of care, and relatively high levels of patient compensation. The second group comprises corneal abrasions occurring during nonophthalmic surgery and is characterized by low severity of injury, low levels of compensation, and uncertainty regarding the mechanism of injury. Risk-management strategies directed at prevention of patient movement during anesthesia ought to reduce the incidence of the more serious eye injuries.

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## References

1. Cheney FW, Posner K, Caplan RA, Ward RJ: Standard of care and anesthesia liability. *JAMA* 261:1599-1603, 1989
2. Brunner EA: The national association of insurance commissioners' closed claim study. *Int Anesthesiol Clin* 22:17-30, 1984
3. Zar JH: *Biostatistical Analysis*. Englewood Cliffs, Prentice Hall, 1984, p 396
4. Caplan RA, Posner KL, Cheney FW: Effect of outcome on physician judgments of appropriateness of care. *JAMA* 265:1957-1960, 1991
5. Batra YK, Bali IM: Corneal abrasions during general anesthesia. *Anesth Analg* 56:363, 1977
6. Snow JC, Kripke BJ, Norton ML, Chandra P, Woodcome HA: Corneal injuries during general anesthesia. *Anesth Analg* 54:465, 1975
7. Terry HR, Kearns TP, Love JG, Orwoll G: Untoward ophthalmic and neurologic events of anesthesia. *Surg Clin N Am* 45:927-937, 1965
8. Kroll DA, Caplan RA, Posner KL, Ward RJ, Cheney FW: Nerve injury associated with anesthesia. *ANESTHESIOLOGY* 73:202-207, 1990
9. Johnson ID: Reports to the national practitioner data bank. *JAMA* 265:407-411, 1991