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Awareness during Anesthesia

A Closed Claims Analysis

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Background: **Awareness during general anesthesia is a frightening experience, which may result in serious emotional injury and post-traumatic stress disorder. We performed an in-depth analysis of cases from the database of the American Society of Anesthesiologists Closed Claims Project to explore the contribution of intraoperative awareness to professional liability in anesthesia.**

Methods: **The database of the Closed Claims Project is composed of closed US malpractice claims that have been collected in a standardized manner. All claims for intraoperative awareness were reviewed by the reviewers to identify patterns of causation and standard of care. Logistic regression analysis was used to identify independent patient and anesthetic factors associated with claims for recall during general anesthesia compared to other general anesthesia malpractice claims.**

Results: **Awareness claims accounted for 79 (1.9%) of 4,183 claims in the database, including 18 claims for awake paralysis, *i.e.,* the inadvertent paralysis of an awake patient, and 61 claims for recall during general anesthesia, *i.e.,* recall of events while receiving general anesthesia. The majority of awareness claims involved women (77%), younger than 60 yr of age (89%), American Society of Anesthesiologists physical class I–II (68%), who underwent elective surgery (87%). Most (94%) claims for awake paralysis represented substandard care involving errors in labeling and administration, whereas care was substandard in only 43% of the claims for recall during general anesthesia ($P < 0.001$). Claims for recall during general anesthesia were more likely to involve women (odds ratio [OR] = 3.08, 95% confidence interval [CI] = 1.58, 6.06) and anesthetic techniques using intraoperative opioids (OR = 2.12, 95% CI = 1.20, 3.74), intraoperative muscle relaxants (OR = 2.28, 95% CI = 1.22, 4.25), and no volatile anesthetic (OR = 3.20, 95% CI = 1.88, 5.46).**

Conclusions: **Deficiencies in labeling and vigilance were common causes for awake paralysis. Claims for recall during general anesthesia were more likely in women and with nitrous–narcotic–relaxant techniques. (Key words: Complications; consciousness; injuries; medicolegal; memory.)**

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AWARENESS during general anesthesia is a frightening experience, which may result in serious emotional injury and post-traumatic stress disorder.[1,2] Patients who have experienced awareness and recall during anesthesia most commonly describe auditory perceptions, the sensation of paralysis, anxiety, helplessness, and panic.[1–3] The sensation of pain occurs less frequently.[2] Up to 70% of patients who had intraoperative awareness experience unpleasant after effects, including sleep disturbances, dreams and nightmares, and flashbacks and anxiety during the day.[2] In a minority of patients, post-traumatic stress disorder develops, associated with repetitive nightmares, anxiety, irritability, and preoccupation with death.[2,3]

The incidence of awareness during general anesthesia with current anesthetic agents and techniques has been reported as 0.2–0.4% in nonobstetric and noncardiac surgery,[3,4] as 0.4% during cesarean section,[5] and as 1.5% in cardiac surgery.[6,7] The incidence during major trauma surgery is higher.[8] A predisposing factor for awareness may be small doses of general anesthetic agents.[3] Several case reports and small clinical studies have also suggested that intraoperative awareness is more likely to

occur with nitrous oxide and intravenous agents, such as opioids, propofol, benzodiazepines, and barbiturates.[9–11] Several authors report prevention of conscious recall of events by administration of relatively small concentrations of volatile anesthetics.[12–15] Isoflurane in concentrations greater than 0.6 minimum alveolar concentration (MAC) prevented conscious recall and unconscious learning of factual information and behavioral suggestions.[16]

Increased public concern of awareness during general anesthesia may increase the liability risk. Fifty-four percent of 247 patients undergoing general anesthesia feared that they would not be asleep during the operation.[17] However, attorneys may be less likely to take on malpractice litigation involving emotional injury and potentially smaller compensation for damages.[18] The medicolegal consequences of awareness remain unclear.[19,20] We therefore used the database of the American Society of Anesthesiologists (ASA) Closed Claims Project to conduct a detailed analysis of claims for awareness, defined as being paralyzed while awake or being awake while receiving a general anesthetic. The dual purpose of this study was to identify patient and anesthetic factors associated with intraoperative awareness and to describe the medicolegal ramifications of intraoperative awareness in the United States.

Materials and Methods

The ASA Closed Claims Project is a structured evaluation of adverse anesthetic outcomes obtained from the closed-claim files of 35 US professional liability insurance companies. Claims for dental damage are not included in the database. The current study was based on a total of 4,183 claims for adverse outcomes that occurred between 1961 and 1995. Sixty-eight percent of the claims occurred between 1980 and 1990.

The data collection process was described previously in detail.[21] Briefly, a closed-claim file, typically consisting of relevant hospital and medical records; narrative statements from involved healthcare personnel; expert and peer reviews; summaries of depositions from plaintiffs, defendants, and expert witnesses; outcome reports; and the cost of settlement or jury award, is reviewed by a practicing anesthesiologist. The reviewer uses standardized instructions to fill out a standardized form that records information regarding patient characteristics, surgical procedures, sequence and location of events, critical incidents, clinical manifestations of injury, standard of care, and outcome.[21]

Each claim was assigned a severity of injury score that was designated by the on-site reviewer using the insurance industry's 10-point scale. This ordinal scale rates severity of injury from 0 (no injury) to 9 (death).[21] Values of 1 represent temporary emotional injury, 2–4 reflect temporary physical injuries, 5 reflects permanent, nondisabling emotional and physical injuries, and 6–8 reflect permanent and disabling emotional and physical injuries. For the purpose of analysis, injuries were grouped into two categories: temporary/nondisabling (0–5) and disabling/permanent/death (6–9). The reliability of reviewer judgements previously was found to be acceptable.[22]

In the current study, claims for *awareness,* defined as being paralyzed while awake or awake while receiving a general anesthetic, were reviewed. These claims were further divided into two categories: *awake paralysis*, *i.e.,* the inadvertent paralysis of an awake patient, and *recall during general anesthesia*, *i.e.,* patient recalled events while receiving general anesthesia. Each claim file was examined for anesthetic agents, patient characteristics, and quality of care that were associated with intraoperative awareness.

Differences between proportions were evaluated using the chi-square test.[23] The distribution of occurrence date for awareness claims *versus* other claims was compared by the chi-square test for trend. Payments for settlement and jury award were expressed in original dollar amounts, without adjustment for inflation. Because payments did not exhibit a normal distribution, the median and range were used for descriptive purposes. Statistical comparisons of payment distributions were made using the Kolgomorov-Smirnov test. The influence of gender on the severity of injury for all claims in the database, both including and excluding obstetric claims, was assessed using the chi-square test.

To identify patient variables associated with recall during general anesthesia compared to other general anesthesia claims, 61 recall claims and 2,882 other general anesthesia claims were compared using logistic regression analysis.[23] The association of specific anesthetic agents with recall claims was evaluated using 58 recall claims and 2,416 other general anesthesia claims that had recorded sufficient detail concerning anesthetic agents. The claim was coded as "no volatile anesthetic" if a volatile anesthetic was not administered during the anesthetic or if it was not administered at the specific time that recall occurred during the maintenance phase. For example, if the patient recalled the preparation and positioning, during which only a nitrous oxide and a

Table 1. Low Frequency Outcomes

Outcome	Number of Claims	% of All Claims (n = 4,183)
Airway/intubation trauma	245	5.9
Pneumothorax	152	3.6
Eye damage	148	3.5
Injury/death of newborn	146	3.5
Headache	135	3.2
Stroke	120	2.9
Back pain	108	2.6
Respiratory distress syndrome	102	2.4
Aspiration pneumonia	100	2.4
Awareness	79	1.9
Awake paralysis	18	0.4
Recall during general anesthesia	61	1.5
Burn (thermal)	79	1.9
Myocardial infarction	68	1.6
Hepatic dysfunction/failure	56	1.3
Skin reaction (nonthermal)	55	1.3
Renal dysfunction/failure	47	1.1
Prolonged arrhythmia	26	0.6
Localized vascular insufficiency	19	0.5

muscle relaxant were administered, this was coded as no volatile anesthetic, even if a volatile anesthetic was started later in the anesthetic.

Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated. To identify independent risk factors for recall claims, we used a forward-selection multiple logistic regression analysis. Based on accepted statistical practice recognizing the total number of recall claims,[23] only the five variables (gender, surgical procedure, intraoperative opioids, intraoperative muscle relaxants, or no volatile anesthetic) most significantly associated with recall claims on the univariate analysis were included in the multiple logistic regression analysis. $P < 0.05$ was deemed statistically significant.

Results

Awareness accounted for 79 of 4,183 claims (1.9%) in the ASA Closed Claims Project database, a similar proportion in the database to burns, aspiration pneumonia, and myocardial infarction (table 1). Compared to all other claims, awareness claims more often involved women (77% of awareness claims *versus* 59% of all other claims, $P = 0.002$), patients younger than 60 yr of age (89% for awareness claims *versus* 79% for all other claims, $P = 0.019$), and patients undergoing elective surgery (87% of awareness claims *versus* 72% for all other claims, $P = 0.016$, table 2). The severity of injury in claims for awareness during anesthesia was lower than the severity in the other claims, with more than 95% involving temporary injury (score = 0–5) in contrast to 32% of other claims resulting in temporary injuries ($P < 0.001$).

In the entire database (n = 4,183 claims), a greater proportion of claims by women involved temporary injuries. The trend for claims by women to involve a lower severity of injury was evident whether obstetric claims were included or excluded. Forty-eight percent of claims by women were for a temporary or nondisabling injury (score = 0–5, n = 1,180), compared to 42% of claims by men (n = 702, $P < 0.001$).

Awareness claims were subdivided into 18 claims for awake paralysis (0.4% of all claims) and 61 claims for recall during general anesthesia (1.5% of all claims) for in-depth analysis presented in the subsequent results. The distribution of awareness claims by decade was different from the temporal distribution of all other claims ($P = 0.023$, fig. 1). A smaller proportion of awareness claims originated in the 1970s and a greater proportion originated in the 1990s. Eighty percent (n = 49) of claims for recall during general anesthesia and 61% (n = 11) of claims for awake paralysis involved women.

Awake Paralysis

Most claims for awake paralysis were related to intravenous infusion errors or syringe swaps. Infusion errors

Table 2. Demographic Characteristics of Patients Filing Claims for Awareness

	Awareness Claims (n = 79) [n (%)]	All Other Claims (n = 4,104) [n (%)]
Gender		
Female	60 (77)	2,412 (59)*
Male	18 (23)	1,656 (41)*
ASA status		
1–2	32 (68)	1,789 (70)
3–5	15 (32)	761 (30)
Age		
<60 yr	62 (89)	3,039 (79)*
≥60 yr	8 (11)	810 (21)*
Emergency surgery		
Yes	7 (13)	782 (28)*
No	47 (87)	2,041 (72)*
Procedure		
Inpatient	45 (82)	1,900 (78)
Outpatient	10 (18)	521 (22)
Surgery		
Obstetrics-gynecology	29 (37)	951 (23)*
Other	50 (63)	3,153 (77)*

* $P < 0.05$ *versus* awareness claims by chi-square test.

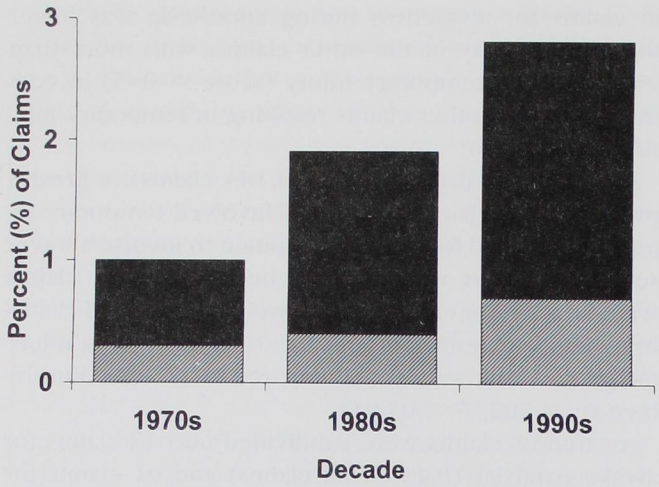

Fig. 1. Proportion of claims as percent of total claims in each decade for recall during general anesthesia (solid bar) and awake paralysis (hatched bar). The proportion of other claims is not shown. A smaller proportion of awareness claims originated in the 1970s and a greater proportion originated in the 1990s ($P = 0.023$).

involved succinylcholine drips in 10 claims (56% of awake paralysis claims) caused by unlabeled succinylcholine bags (2 cases), mislabeled succinylcholine bags (2 cases), and failure to check the label on unintended succinylcholine drips (6 cases). Syringe swaps occurred with mislabeled drugs (2 cases) and failure to check the label on a properly labeled syringe (6 cases). No syringe swaps occurred with unlabeled syringes. In several of the cases, the practitioner injected a benzodiazepine after the muscle relaxant in an unsuccessful attempt to achieve retrograde amnesia. The periods of highest vulnerability were in the preinduction (n = 8) and induction periods (n = 5), when a muscle relaxant was administered instead of a sedative or hypnotic agent. The damaging event in awake paralysis was coded as wrong dose/drug in 94% of awake paralysis claims (n = 17 of 18 claims) compared with 3% of claims (n = 145 of 4,183 claims) in the entire database.

Reviewers considered most cases of awake paralysis to be examples of substandard anesthesia care, although the paralysis was promptly recognized and appropriately managed. Ninety-four percent of awake paralysis claims (n = 17) were judged to represent substandard care, in contrast to 40% of all other claims (n = 1,645, $P < 0.001$, table 3). The one case for which the care by the anesthesiologist was judged to be appropriate involved mislabeling of a syringe in the pharmacy. Follow-up care was described as adequate in 12 claims (67%), inadequate in 1 claim (6%), and not rated in 5 claims (28%). Payments were made in a greater proportion of awake paralysis claims (n = 14; 78%), compared to all other claims (n = 2,271; 55%; $P < 0.001$; table 3). However, payments for awake paralysis claims were less than for all other claims ($P < 0.001$, table 3).

Recall during General Anesthesia

The highest frequency of recall during general anesthesia was during the maintenance phase of anesthesia. Recall was described during the maintenance of anesthesia alone in 80% (n = 49 of 61 recall claims) and in 5% (n = 3) of cases during induction and maintenance of anesthesia. Recall occurred in seven (12%) cases during induction alone and during emergence in one case (1.6%).

Patient recollections of intraoperative events and emotional sequence are listed in table 4. Thirty percent (n = 18) described recollection of conversations and sounds in the operating room, including comments about their body habitus (n = 3). Feeling surgery without pain (n = 15), pain (n = 13), paralysis (n = 12), tracheal intubation (n = 9), and severe panic (n = 7) were also described. Eighty-four percent (n = 51) sustained temporary emotional distress, whereas in 10% (n = 6) posttraumatic stress disorder developed (table 4). Recurrent nightmares were described in 16% of the claims and need for psychotherapy was described in 13% of the claims (table 4). The anesthetic care was judged to be substandard in 43% of the recall cases (n = 26) and appropriate in 33% of the cases (n = 20, table 3). The judgement of appropriateness of care for all other claims in the database was similar (table 3). Follow-up care by the anesthesiologist was described as being adequate in 40 claims (66%), inadequate in 4 claims (6%), and not rated in 17 claims (28%). Three claim files described a lack of concern and attention by the anesthesiologist.

There were a variety of factors associated with recall during general anesthesia (table 5). A lack of volatile anesthetic associated with a planned nitrous–narcotic–relaxant technique (11 cases) and associated with hypotension requiring discontinuation of anesthetic agents (11 cases) were common factors. The standard of care was evaluated as appropriate in more than half of these cases. Recall during general anesthesia caused by inadequate doses of drugs for no obvious reason, as judged by the on-site reviewer (eight cases), and during difficult tracheal intubation (five cases) were predominantly judged as representing substandard care. Recall associated with failure to increase drug doses in morbidly obese patients (eight cases) was judged as a mixed stan-

Table 3. Standard of Care and Claim Payment for Awake Paralysis, Recall during General Anesthesia, and All Other Claims

Type of Claim	Standard of Care* [no. (%)]		Payment		
	Standard	Substandard	Yes [no. (%)]	Median Amount ($)	Minimum–Maximum Amount ($)
Awake paralysis (n = 18)	1 (6)†	17 (94)†	14 (78)†‡	9,500‡	1,000–75,000
Recall during general anesthesia (n = 61)	20 (33)	26 (43)	30 (49)	18,000‡	1,700–600,000
All other claims (n = 4,104)	1,882 (46)	1,645 (40)	2,271 (55)	100,000	15–23,200,000

* These data represent claims where standard of care could be judged. The remainder were impossible to judge.

† $P < 0.001$ *versus* recall during general anesthesia claims.

‡ $P < 0.001$ *versus* all other claims.

dard of care. Recall during general anesthesia associated with vaporizer leaks (five cases) or failure to turn on a vaporizer (three cases) were causes that predominantly represented substandard care. No obvious factor was present in 16% (n = 10) of the claims for recall during general anesthesia. The standard of care in most of these cases was evaluated as impossible to judge.

The classic cues for light anesthesia were absent in most cases. Hypertension was noted as a clinical cue in 15% (n = 9) of recall cases, tachycardia was described in 7% (n = 4) of recall cases, and patient movement occurred in one case (most patients received muscle relaxants). Hypertension was treated with an additional narcotic in two cases, with hydralazine in one case, with no supplementation in three cases, and treatment was not described in three cases. One claim alleged recall despite use of an intraoperative electroencephalograph.

A similar proportion of recall during general anesthesia claims resulted in a law suit (82%, n = 50), a settlement before court (67%, n = 41), and payment (49%, n = 30), as for all other claims in the database. However, the amount of payment was similar to awake paralysis claims and less than the amount for all other claims ($P < 0.001$, table 3). The median payment was $18,000 compared to a median payment of $100,000 for all other claims.

Five factors were significantly associated with claims for recall during general anesthesia compared to other general anesthesia claims: no volatile anesthetic agent, female gender, obstetric or gynecologic procedure, intraoperative opioid, and intraoperative muscle relaxant (table 6). The relative frequency of an awareness claim compared to other general anesthesia malpractice claims was increased with female gender (OR = 3.21) and with anesthetic techniques without a volatile anesthetic (OR = 3.33). The use of intraoperative opioids (sufentanil in eight cases) (OR = 2.48), intraoperative muscle relaxants (OR = 2.47), and an obstetric or gynecologic surgical procedure (OR = 2.66) increased the relative frequency of a recall claim compared to other general anesthesia claims (table 6). Age, ASA status, anesthesia personnel, standard of care, and use of benzodiazepines, barbiturates, and nitrous oxide were not associated with claims for recall during general anesthesia.

After adjusting for the other risk factors using multiple logistic regression analysis, female gender and anesthetic techniques using intraoperative opioid and muscle relaxants without a volatile anesthetic increased the relative frequency of claims for recall during general anesthesia when compared to all claims during general anesthesia (table 6). Obstetric or gynecologic procedures alone did not independently increase the risk of a claim for recall.

Table 4. Patient Recollections and Emotional Sequelae of Recall during General Anesthesia

	n	%*
Intraoperative events		
Sounds	18	30
Feeling surgery without pain	15	25
Pain	13	21
Paralysis	12	20
Intubation	9	15
Panic	7	11
Postoperative sequelae		
Temporary emotional distress	51	84
Recurrent nightmares	10	16
Psychotherapy	8	13
Post-traumatic stress disorder	6	10

* Percent of recall during general anesthesia claims; n = 61 claims.

Discussion

We found that deficiencies of labeling and vigilance were common causes for awake paralysis, whereas recall during general anesthesia represented a more diverse group. Claims for recall during general anesthesia were more likely in women and with nitrous–narcotic–relaxant techniques.

Table 5. Factors and Standard of Care Associated with Recall during General Anesthesia

Factor	Total		Standard of Care [no. (%)]†		
	n	%*	Standard	Substandard	Impossible to Judge
Nitrous-narcotic-relaxant technique	11	18	8 (73)	2 (18)	1 (9)
Hypotension	11	18	6 (55)	4 (36)	1 (9)
Inadequate doses of drugs	8	13	0 (0)	8 (100)	0 (0)
Obesity	8	13	3 (38)	3 (38)	2 (25)
Difficult intubation	5	8	0 (0)	4 (80)	1 (20)
Vaporizer leaks	5	8	2 (40)	3 (60)	0 (0)
Failure to turn on vaporizer	3	5	0 (0)	2 (67)	1 (33)
No obvious factor	10	16	1 (10)	0 (0)	9 (90)

* Percent of recall during general anesthesia claims; n = 61 claims.

† Percent of each factor.

Methodologic Issues

Before interpreting the data, it should be emphasized that closed-claims analysis has numerous previously described weaknesses.[21] These limitations include the inability to provide numerical estimates of risk because of the lack of denominator data, the absence of rigorous comparison groups, a probable bias toward adverse outcomes, and partial reliance on data from direct participants rather than from impartial observers. The retrospective case review studies included in the database were also selected in a nonrandom fashion, without control of geographic balance. They spanned a period of time during which anesthetic agents and practice patterns changed. Because the claims were anonymous, patients were not interviewed to provide additional information concerning the emotional sequelae of awareness.

The analysis also only examined the information in the database that was transcribed to the data sheet by the reviewers, who depended on the information contained in the insurance company file. Specific information regarding drug doses, premedication, and vital signs is generally lacking on the data sheet, and details regarding patient perceptions may be incomplete. In addition, transcription of data by the reviewer may introduce bias in the current study, which evaluated the relation of the claim with anesthetic agents. Anesthetic agents were documented in a greater proportion (95%) of claims for recall during general anesthesia (n = 58 of 61 claims) compared to 84% of all other general anesthesia claims (n = 2,416 of 2,882 claims, $P = 0.018$). This may have occurred because anesthetic agents may not have been specified in the claim file for injuries such as burns, peripheral neuropathy, or postoperative complications. However, this amount of differential reporting is unlikely to significantly alter the essential results of the study.

The logistic regression analysis compared patient and anesthetic variables associated with claims for recall during general anesthesia to other general anesthesia claims. The usual investigation of risk factors compares patients in whom the adverse outcome develops (*e.g.*, recall during general anesthesia) to patients in whom the outcome does not develop. Because the closed-claims project only involves a select group of patients who file malpractice claims, the risk factors reported represent a risk for a claim for intraoperative recall rather than for

Table 6. Risk Factors for Malpractice Claims for Recall during General Anesthesia

Factor	Univariate Logistic Regression		Multivariate Logistic Regression	
	OR	(95% CI)	OR	(95% CI)
No volatile anesthetic	3.33*	(1.97, 5.63)	3.20*	(1.88, 5.46)
Female gender	3.21*	(1.89, 6.05)	3.08*	(1.58, 6.06)
Obstetrical/gynecological procedure	2.66*	(1.57, 4.50)	—	
Intraoperative opioid	2.48*	(1.42, 4.32)	2.12†	(1.20, 3.74)
Intraoperative muscle relaxant	2.47*	(1.35, 4.53)	2.28†	(1.22, 4.25)

OR = odds ratio; 95% CI = 95% confidence interval.

* $P < 0.001$.

† $P < 0.01$.

another type of claim. The risk factors, therefore, are not necessarily risk factors important in the cause of recall during anesthesia.

Awake Paralysis

Errors in labeling or vigilance, or both, responsible for awake paralysis were most likely to occur in the preinduction and induction periods. The errors involved confusion of succinylcholine drips in more than half the cases. Because the use of succinylcholine infusions is uncommon in current anesthetic practice, an important systematic source of error and potential liability has been eliminated. However, syringe swaps of muscle relaxants with sedative or hypnotic agents remain an important potential source of error in the practice of anesthesia.

Errors in drug administration play a prominent role in critical incidents during anesthesia.[24–27] Syringe swaps, drug ampule swaps, and wrong intravenous lines used together comprised 16% of critical incidents reported by Cooper *et al.*[24] (83 of 507 incidents) and Kumar *et al.*[25] (21 of 129 incidents) and 6% of incidents reported by Webb *et al.*[26] (113 of 2,000 incidents). In contrast, claims for wrong drug or dose accounted for 3% (145 of 4,183 claims) of the ASA Closed Claims database. The difference is likely to result from the fact that most of the closed claims (97%) involved an identifiable injury, whereas critical incidents may have only the potential to cause injury. Thus, many critical incidents are detected and remedied before an identifiable injury occurs. A claim is usually not initiated unless the error results in a significant injury. Some of the observed differences may also represent a willingness of the practitioner to volunteer reports about certain types of critical incidents.

The high frequency of payment in the awake paralysis claims (78%) is consistent with the judgment that most represented substandard care. In an earlier ASA Closed Claims publication, the frequency of payment was shown to be related to appropriateness of care, but not to the severity of injury.[21] Payment was received in 80% of cases when the care was substandard, in contrast to 40% of the cases when the standard of care was met.[21] The low median payment for awake paralysis claims ($9,500) is also consistent with previous observation that the magnitude of the payment is linked to both the severity of injury and the standard of care.[21]

Recall during General Anesthesia

Claims for recall during general anesthesia accounted for only 1.5% (61 of 4,183 claims) of the ASA Closed Claims database. This proportion is lower than would be expected based on reports of the incidence of recall during general anesthesia.[3–7] Although the incidence of recall has been reported to be as high as 11–43% in major trauma cases in the early 1980s,[8] none of the claims for recall in the closed-claim database occurred during major trauma surgery. Most claims for recall during general anesthesia in the current study involved patients undergoing elective surgery (87%, table 2). This suggests that patients undergoing emergency surgery are unlikely to file malpractice claims for recall during general anesthesia.

The liability risk of intraoperative recall is unclear. Published studies from the United Kingdom[19,28] and Finland[20] have provided few details about the medicolegal consequences of intraoperative awareness. Personal accounts of awareness during anesthesia are vivid and frightening.[1–3] Serious emotional injury may result in post-traumatic stress disorder and an inability to work.[1,2] Physician–patient communication and patient support is especially important in medical malpractice claims.[18] Because claims represent only a small fraction of adverse outcomes,[29] it is possible that fewer claims are filed for an emotional injury than for a physical injury. The relatively low median payment ($18,000) for intraoperative recall may deter plaintiffs' attorneys from pursuing these cases on behalf of someone who has had the problem. Huycke and Huycke[18] reported that plaintiffs' attorneys are reluctant to pursue cases with an estimated financial recovery for damage of less than $50,000.

Payments for awareness claims show some interesting variability from one country to another. Although sizable financial settlements for intraoperative awareness have been described in the United Kingdom,[19,28] the number of claims and compensation for awareness were surprisingly low in Finland.[20] This suggests that there may be social or cultural factors that have an impact on this aspect of liability. In the United States, the Closed Claims database suggests that the frequency of payment in claims for recall during general anesthesia is similar for other general anesthesia claims; however, the amount of compensation is less (table 3). The lower median payment is consistent with a lower severity of injury and is similar to compensation for awake paralysis, back pain, and emotional distress. The marked variability in range of compensation (table 3) reflects differences in the geographic distribution, severity of injury, standard of care, and presence of additional injuries (*e.g.*, aspiration pneumonia with substandard care). Higher payments have been reported for more severe injuries in which care was substandard.[11]

The trend for an increase in claims for recall during general anesthesia in the 1990s, compared to the 1970s, may represent an increase in public awareness for intraoperative recall[1–3] rather than an increase in incidence. In fact, the incidence in intraoperative awareness has been decreasing because of changes in anesthetic techinques.[3–7] It may also reflect an improvement in anesthetic safety, because a decrease in severe adverse outcomes would result in a proportional increase in claims for less severe outcomes, such as awareness. In addition, the delay to closure of a claim may be shorter in awareness claims than in claims for more severe injury, so a relatively greater proportion of awareness claims than other claims from the 1990s would be in the database.

Most claims for recall during general anesthesia occurred during the maintenance phase of the anesthetic. Only one claim resulted from recall during emergence, although awareness may commonly occur during emergence.[3] The frequent description of auditory perceptions and sensation of surgery without pain are consistent with studies in which patients with intraoperative awareness were interviewed.[1–3] The sequelae of awareness in the closed-claims population may be more severe than is commonly reported,[1–3] with post-traumatic stress disorder occurring in 10% of the cases. This is probably because of the bias for severe outcomes in malpractice claims. A patient with transient emotional distress is less likely to file a malpractice claim.[18]

Regardless of the standard of care, anesthetic techniques using opioids, muscle relaxants, and no or low concentrations of volatile anesthetic agents increased the relative frequency of a claim for recall during general anesthesia by 2 or 3 times, compared to other general anesthesia claims. An obstetric or gynecologic procedure was not independently associated with an increased relative frequency of recall after consideration of female gender and anesthetic technique. The association of claims for recall during general anesthesia with anesthetic techniques using opioids, muscle relaxants, and little or no volatile anesthetic is consistent with the known increased incidence of intraoperative awareness with these light-anesthetic techniques.[9–11] Ranta *et al.*[3] recently reported that the doses of isoflurane and propofol were smaller in patients with intraoperative awareness, suggesting that recall during anesthesia is associated with small doses of anesthesia. Several authors report prevention of conscious recall of events by relatively small concentrations of volatile anesthetics.[12–15] Isoflurane in concentrations of 0.6 MAC prevented conscious recall and unconscious learning of factual information and behavioral suggestions.[16] However, the minimal concentration to guarantee lack of recall is unknown, as is the effect of adding intravenous anesthetics, such as benzodiazepines, propofol, and opioids, to inhalation anesthetics.[30]

In contrast to the logical association of recall with light-anesthetic techniques, it is unclear why female gender was associated with a three times higher rate of a recall claim than other types of claims. This may represent a gender-related increase in propensity for recall during general anesthesia or a greater likelihood to file a claim for recall. Although many reports of intraoperative awareness involve a preponderance of women,[1–5] this is most likely secondary to light-anesthetic techniques,[3] especially for cesarean section.[31] However, gender-related differences in the requirements for intravenous anesthetics have also been reported.[32,33] Women wake up faster from propofol/alfentanil anesthesia.[32] Plasma remifentanil levels, titrated to ensure the lack of a hemodynamic response to a surgical stimulus, were almost twice as high in women than in men.[33]

Women may also file claims for temporary injuries more often than men. Claims for women in the Closed Claims database involved a lower severity of injury than those for men. These data suggest that women may be more likely than men to file a claim for recall during general anesthesia.

Interestingly, the classic clinical signs of hypertension and tachycardia were absent in most of the cases of recall during general anesthesia in the database. Patient movement was also noted in only one patient, because most patients received muscle relaxants. The lack of clinical signs of light anesthesia has been previously described in other case reports of intraoperative awareness.[2,6] Experienced anesthesiologists were unable to reliably distinguish awareness cases from matched controls by review of the anesthetic record.[2,6] Our study does not address the effectiveness of neurophysiologic monitoring in the prevention of intraoperative awareness.

In summary, errors in labeling and vigilance were common causes for awake paralysis. Claims for recall during general anesthesia were more likely in women and with nitrous–narcotic–relaxant techniques in the ASA Closed Claims database. Claims for awareness resulted in relatively low compensation to the plaintiff, consistent with the low severity of injury.

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