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## Best Practice & Research Clinical Anaesthesiology

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### Closed claims' analysis

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#### Keywords:

outcomes  
outcomes research  
regional anaesthesia  
airway management  
obstetric anaesthesia  
medication therapy management  
claims analysis  
perioperative complications  
burns

The American Society of Anesthesiologists (ASA) Closed Claims database was started in 1985 to study anaesthesia injuries to improve patient safety, now containing 8954 claims with 5230 claims since 1990. Over the decades, claims for surgical anaesthesia decreased, while claims for acute and chronic pain management increased. In the 2000s, chronic pain management involved 18%, acute pain management 9% and obstetrical anaesthesia formed 8% of claims. Surgical anaesthesia claims with monitored anaesthesia care (MAC) increased in the 2000s to 10% of claims, while regional anaesthesia involved 19%. The most common complications were death (26%), nerve injury (22%) and permanent brain damage (9%). The most common damaging events due to anaesthesia in claims were regional-block-related (20%), respiratory (17%), cardiovascular (13%) and equipment-related events (10%). This review examines recent findings and clinical implications for injuries in management of the difficult airway, MAC, non-operating room locations, obstetric anaesthesia and chronic pain management.

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#### Background

In response to rapidly rising professional liability insurance premiums during the early 1980s, the American Society of Anesthesiologists (ASA) Closed Claims Project was established in 1984 to improve patient safety and prevent anaesthetic injury.<sup>1</sup> At that time, anaesthesiologists were regarded as

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especially poor malpractice insurance risks, as 11% of total dollars paid for patient injury were anaesthetic-related complications despite anaesthesiologists accounting for only 3% of total physicians insured. The ASA Closed Claims Project aimed to identify major areas of loss in anaesthesia and analyse patterns of injury to devise strategies for prevention, thereby reducing patient injuries and associated malpractice claims and consequent payments, and leading to a decrease in premiums.

Created to provide a systematic and structured evaluation of adverse anaesthetic outcomes, the Closed Claims Project reviews and analyses closed claims files of United States professional liability insurance companies. The insurance companies participating in the project include state-wide organisations that comprise both physician-owned and private companies, as well as companies insuring anaesthesiologists in multiple states.

The data collection process has been previously described in detail.<sup>1,2</sup> Briefly, the closed claim files typically consist of the hospital and medical records, narrative statements from involved health-care personnel, expert and peer reviews, deposition summaries, outcome reports and the cost of settlement or jury awards. Dental injury claims are excluded from the database, as are claims in which the sequence of events and nature of the injury cannot be reconstructed from the insurance company records. As a consequence, most (but not all) data are derived from lawsuits. Data are collected regardless of the litigation outcome; claims both with and without payment are included in the project. Claims data are collected by one or more trained practicing anaesthesiologists, who visit each insurance company office at periodic intervals to review claims filed against fellow professionals. Anaesthesiologist claims reviewers complete a standardised form for each claim with information on patient characteristics, surgical procedures, sequence and location of events, critical incidents and injuries, severity of injury, standard of care, outcome and payments. A detailed summary of the sequence of medical events is included. The current ASA Closed Claims Project database contains 8954 claims representing events that occurred from 1970 through 2007, with 5230 claims since 1990.

### Strengths and limitations of closed claims analysis

Closed claims data analysis has distinct strengths and limitations that differ from other ‘outcomes’ research. One of the strengths is the ability to study a large collection of relatively rare events. Studying insurance company closed claim files is a cost-effective approach to such research, as these files contain extensive data on injuries that occurred at many different institutions and have been gathered in a centralised location. Closed claims data can be analysed as a large collection of ‘sentinel events’ revealing relatively rare, yet important, sources of patient injury. For example, the ASA Closed Claims Project database contains detailed clinical information on large collections of difficult intubations, pulmonary aspirations, central venous catheter complications, medication errors and other relatively uncommon complications (Table 1) that would be difficult and costly to obtain from standard medical record or multi-institutional clinical investigations.

Although the use of closed claims represents a cost-effective method of studying rare anaesthetic complications, this approach includes inherent limitations that have been previously described.<sup>1–3</sup> The incidence and risk of anaesthetic-related adverse outcomes are unknown due to the absence of numerator data regarding the total number of adverse events and denominator data for the total number of anaesthetic procedures performed. Professional liability insurance companies that insure

**Table 1**  
“Sentinel Events” associated with anaesthesia.

	No. Claims
Permanent brain damage	867
Airway injury	581
Difficult intubation	466
Spinal cord injury	417
Medication errors	283
Aspiration	213
Central venous catheter injury	183

ASA Closed Claims *N* = 8954.

approximately one-third of all practicing anaesthesiologists in the United States participate in the Closed Claims Project. These companies are located predominantly in the Northeast, Southeast, upper Midwest and West Coast; hence, geographic variations in anaesthesia practice may influence the frequency and type of adverse events found in the Closed Claims database. In addition, malpractice claims represent only a small subset of adverse outcomes, as some injured patients do not file claims, whereas others file claims without any apparent injury.<sup>4,5</sup> Professional liability companies also do not maintain records on the total number of anaesthetics administered by insured physicians. The Closed Claims database does not offer any control groups for comparison. Another limitation of the claims is that they are biased towards more severe and costly injuries, which may result in higher financial compensation and a higher proportion of deaths. Furthermore, ambiguities in the judgement of the appropriateness of care also exist among reviewers, resulting in poor inter-rater reliability<sup>6</sup> and outcome bias.<sup>7</sup> Finally, the retrospective, non-randomised collection of data from participating insurers may contain conflicting or missing accounts of the adverse event from different sources, and thus cannot be used to test hypotheses or establish cause-and-effect relationships of previous events. Nevertheless, analysis of large numbers of adverse events can reveal patterns of injury and identify risk factors that should be addressed to improve patient safety.<sup>1</sup>

## Recent trends and findings in closed claims

### Trends in anaesthesia malpractice claims

Early anaesthesia claims collected by the ASA Closed Claims Project reflected mainly surgical anaesthesia care. This pattern has changed considerably over the decades. In the 1980s, for example, surgical anaesthesia represented more than 80% of all claims, while claims associated with acute and chronic pain care were relatively rare. This profile of claims changed in the 1990s, with surgical anaesthesia claims declining to 72% of all claims and chronic pain (11%) becoming as common as obstetric anaesthesia claims (12%, Fig. 1). Chronic pain management has continued to increase as a source of claims, representing 18% of all claims from 2000 to 2007 (Fig. 1). Acute pain also increased, representing 9% of claims since 2000, similar to obstetric anaesthesia claims at 8% of claims since 2000. By contrast, surgical anaesthesia declined to 65% of anaesthesia malpractice claims since 2000.

### Most common complications: 1990–2007

Complications leading to anaesthesia malpractice claims have changed considerably since the 1970s. With introduction of modern respiratory monitoring in the mid-1980s, and adoption of new

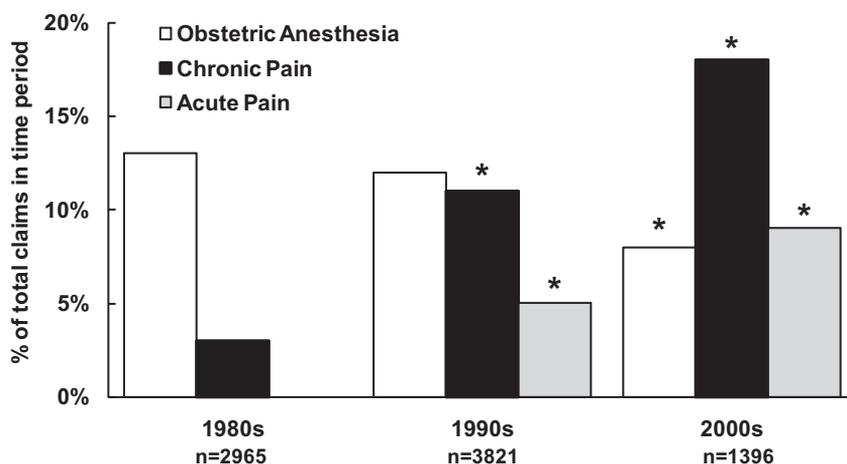


Fig. 1. Proportion of obstetric, chronic pain, and acute pain claims by decade. Claims for surgical anaesthesia not shown. \* $p < 0.01$  compared to 1980s by z test.

standards of care for patient monitoring as well as practice guidelines for management of the difficult airway in 1993,<sup>8</sup> death and brain damage have declined significantly.<sup>9</sup> A look at the injury profile in claims for events since 1990 reflects current anaesthesia malpractice injury trends in the U.S.

Death was still the leading outcome in anaesthesia claims in 1990–2007 (Fig. 2). Permanent brain damage represented 9% of claims, while nerve injury accounted for 22% of claims. While most nerve injury claims were temporary or non-disabling injuries, 23% were permanent and disabling, including loss of limb function, or paraplegia or quadriplegia. The fourth most common injury in claims was airway injury, accounting for 7% of claims (Fig. 2). The remainder of injuries in claims each accounted for 5% or fewer claims in the database. Emotional distress was fairly common, cited in 5% of claims. Eye injuries including blindness from optic nerve damage, globe perforation during blocks or retinal haemorrhage accounted for 4% of claims. Other complications included pneumothorax from peripheral blocks, headache or back pain usually associated with labour epidurals, newborn injury, stroke and myocardial infarction. Awareness during general anaesthesia was cited in only 2% of claims in 1990–2007.

### Trends in anaesthesia technique and associated complications

While the ASA Closed Claims Project database lacks a denominator of the total anaesthetics from which the claims arose, trends in malpractice claims data appear to correspond to trends in anaesthesia practice. For example, just as claims for chronic and acute claim management have increased from the 1980s to the 1990s and 2000s, claims for monitored anaesthesia care (MAC) have also shown an increase over the decades (Fig. 3). MAC was the primary anaesthetic technique in only 2% of claims for injuries in the 1980s, increasing to 5% in the 1990s and to a full 10% of claims in 2000 and later (Fig. 3). Regional anaesthesia has continued to represent nearly 20–25% of claims in each decade.

An analysis of surgical anaesthesia claims for events from 1990 to 2007 shows a profile of injuries related to MAC that is distinct from general and regional anaesthesia claims. Death was the most common outcome in claims associated with MAC, representing 38% of surgical anaesthesia claims associated with MAC in 1990–2007 (Fig. 4). Death was significantly more common in claims associated with MAC than in claims associated with general anaesthesia or regional anaesthesia during this time period (Fig. 4). Permanent brain damage represented 8–10% of surgical anaesthesia claims regardless of primary anaesthetic technique. Permanent nerve injury, on the other hand, was more commonly associated with regional anaesthesia (15%) and general anaesthesia (5%, Fig. 4).

### Most common damaging events leading to anaesthesia claims 1990–2007

Analysis of the most common injuries in claims may help focus patient safety efforts on the most common and severe injuries. However, analysis of the events that lead to these injuries is critical in identifying causes of complications and suggesting preventive strategies.

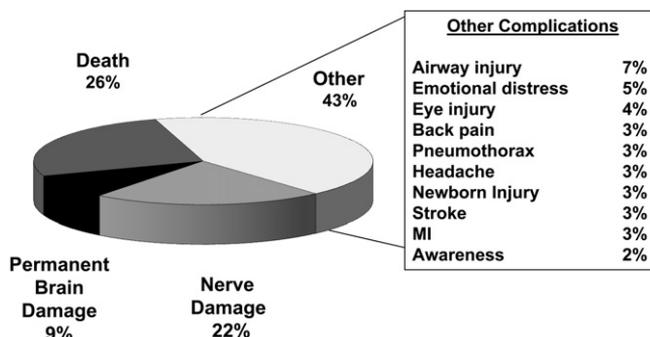
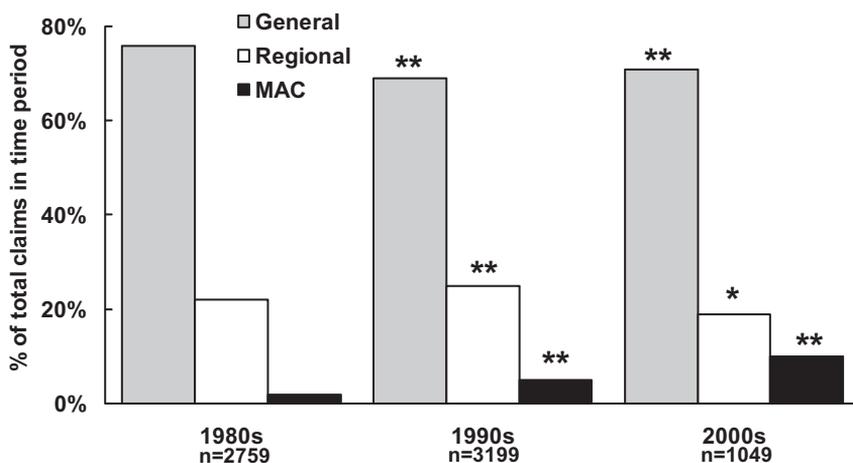


Fig. 2. Most common complications 1990 or later ( $n = 5230$ ).

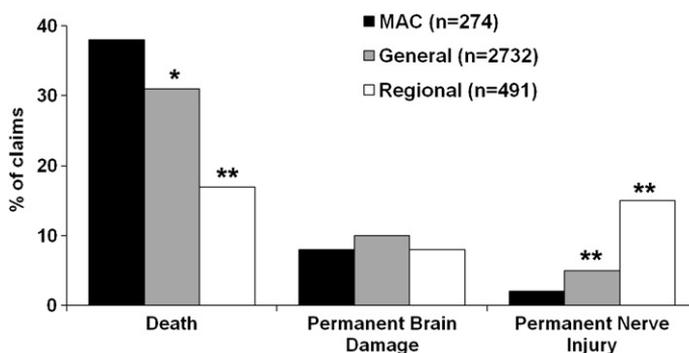


**Fig. 3.** Proportion of general, regional and MAC claims by decade. MAC = monitored anaesthesia care. Claims for chronic pain management ( $n = 1697$ ) excluded. Claims with no anaesthetic or combined general anaesthetic + regional anaesthetic excluded. \* $p < 0.05$  compared to 1980s; \*\* $p < 0.01$  compared to 1980s.

The most common events leading to injury in anaesthesia claims were regional-block-related, accounting for 20% of claims in 1990–2007 (Fig. 5). Respiratory system management issues accounted for 17% of claims and cardiovascular events for 13% of claims. The injury was attributed to the surgical procedure or patient condition in 11% of claims, and to equipment problems in 10% of claims. Other anaesthetic events were the source of 9% of claims, and medication issues were related to 8% of claims in this time period. In another 10% of claims, no event occurred. Claims with no event are most commonly nerve injuries in which no anaesthesia management factors leading to injury could be identified. The following section will focus further on the specific mechanisms of injury in anaesthesia claims (e.g., surgical, obstetric and acute pain claims), excluding those for chronic pain management, as the treatment modalities and injury causation differ substantially from anaesthesia claims.

#### Specific damaging events in anaesthesia injury

The most common respiratory system events leading to anaesthesia claims since 1990 were difficult intubation, inadequate oxygenation or ventilation, and pulmonary aspiration (Table 2).



**Fig. 4.** Injuries by type of anaesthesia in surgical claims 1990 or later. Acute pain, chronic pain and obstetric anaesthesia claims excluded. Claims with no anaesthetic or general anaesthetic + regional anaesthetic excluded. \* $p < 0.05$  compared to MAC; \*\* $p < 0.01$  compared to MAC.

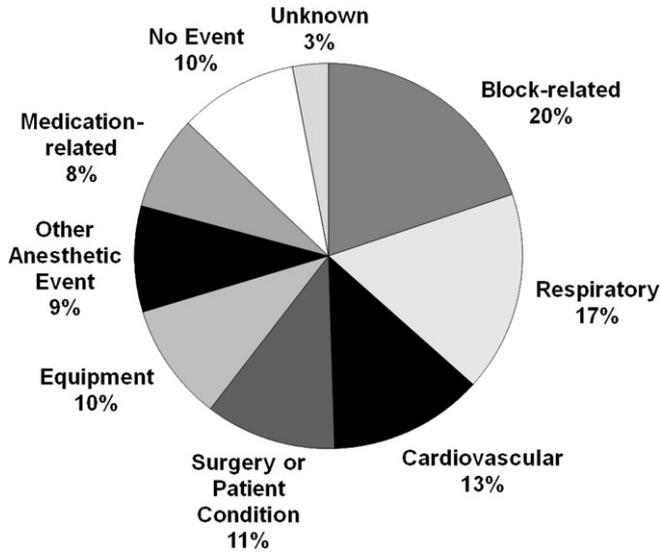


Fig. 5. Most common damaging events 1990 or later ( $n = 5230$ ).

Since the 1970s to the 1980s, oesophageal intubation has nearly disappeared with adoption of end-tidal capnography (Fig. 6).<sup>10</sup> Inadequate oxygenation or ventilation has also declined with the adoption of pulse oximetry as a standard of intra-operative monitoring (Fig. 6).<sup>9</sup> However, inadequate oxygenation/ventilation has more recently arisen as a problem during MAC and non-operating room locations, often associated with oversedation and inadequate monitoring of ventilation,<sup>11,12</sup> as described later in this article. Difficult intubation remains a concern, representing 27% of adverse respiratory events in 1990–2007 (Fig. 6). Pulmonary aspiration of gastric contents is the third most common respiratory event leading to anaesthesia malpractice claims in 1990–2007 (Fig. 6).

Regional-block-management problems occurred in 15% of anaesthesia claims in 1990–2007 (Table 2). Most regional-block-management claims were associated with surgical anaesthesia care (45%), but a significant number were associated with obstetric anaesthesia (37%) and acute pain management (18%). Most (74%) events associated with regional-block technique involved neuraxial blocks. The other regional-block-related claims were associated with peripheral nerve blocks (15%, most commonly interscalene and axillary techniques) and eye blocks (8%). There were no specific events that emerged as prominent in the cause of block-related claims, and nerve injury was the most common outcome (57% of block-related claims). Death occurred in 9% of regional-block-related claims and permanent brain damage in 9%. Injuries associated with regional blocks have been recently reviewed in detail.<sup>13,14</sup>

Cardiovascular events were observed to increase as a cause of death and brain damage in closed claims.<sup>9</sup> Cardiovascular events were associated with 15% of all anaesthesia claims in 1990–2007. The most common specific cardiovascular events in these claims were haemorrhage or blood replacement (3%), electrolyte imbalance or fluid management (2%) and stroke (2%). In 3% of claims, a cardiovascular event was evident, but could not be more specifically characterised. Most cardiovascular damaging events resulted in death (64%) or permanent brain damage (21%).

Equipment problems were notable for the role of central and peripheral venous catheters in claims. While early closed claims analysis identified anaesthesia-gas-delivery systems (gas supplies, anaesthesia machines, ventilators and breathing circuits) as a source of patient injury,<sup>15</sup> these problems now account for only 1% of claims. Central venous catheters accounted for 3% of claims in 1990–2007, while peripheral catheters accounted for 2% of all claims. Central venous catheter claims had a high proportion of deaths, and problems were most commonly associated with access rather than use of catheters.<sup>16</sup> The most common complications associated with central venous catheters were wire/catheter embolus, cardiac tamponade, carotid artery puncture/cannulation, haemothorax and

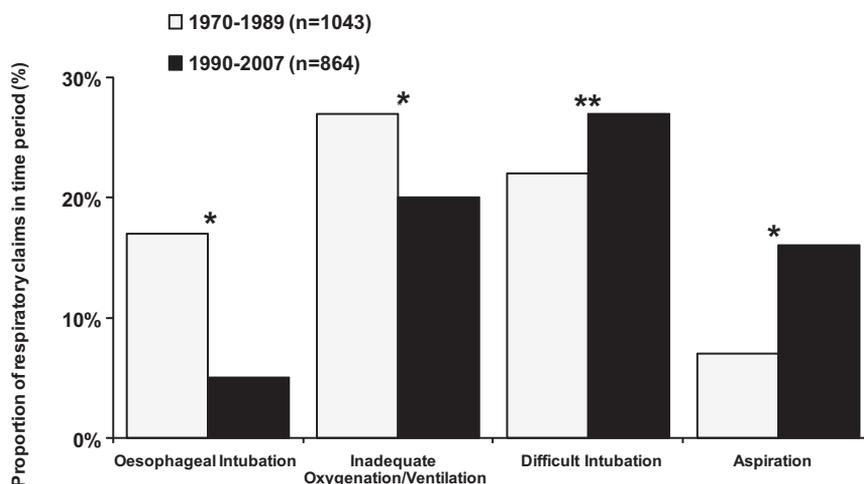
**Table 2**

Most common damaging events in anaesthesia claims 1990 or later.

	% of 4549
<b>Respiratory Events (n = 865)</b>	
Difficult intubation	5%
Inadequate oxygenation/ventilation	4%
Aspiration	3%
Premature extubation	2%
Airway obstruction	2%
<b>Regional Block (n = 681)</b>	
Dural puncture	1%
High block	1%
Unexplained block complication	1%
Neuraxial cardiac arrest	1%
Inadequate analgesia from block	1%
Block needle trauma	1%
Retained catheter	1%
<b>Cardiovascular Events (n = 665)</b>	
Unexplained cardiovascular event	3%
Hemorrhage/blood replacement	3%
Electrolyte imbalance/fluid management	2%
Stroke	2%
<b>Equipment (n = 506)</b>	
Central venous catheters	3%
Peripheral catheters	2%
Cautery burns or fires	2%
Anaesthesia-gas-delivery equipment	1%
Patient warming devices	1%
Hot bottle burns	1%
<b>Medication (n = 338)</b>	
Adverse drug reaction	3%
Wrong drug or dose	3%
Inadequate analgesia from MAC or GA	2%

MAC = monitored anaesthesia care; GA = general anaesthesia.

Most common events in anaesthesia claims that occurred in 1990 or later (n = 4549). Claims for chronic pain (n = 681) excluded. Claims for miscellaneous events in each major category not shown. Percentages may sum to greater than overall category percentages due to rounding.



**Fig. 6.** Changes in respiratory events over time. \* $p < 0.001$ , 1970–89 vs 1990–07; \*\* $p < 0.05$ , 1970–89 vs 1990–07. Excerpted from Ref.<sup>10</sup> New trends in adverse respiratory events, ASA Newsletter 2011; 75(2):28–29 of the American Society of Anesthesiologists. A copy of the full text can be obtained from ASA, 520 N. Northwest Highway, Park Ridge, Illinois 60058-2573.

pneumothorax. Pressure waveform monitoring, use of ultrasound guidance for difficult catheterisation, and checking and acting on a chest radiograph after vascular catheter insertion were noted as potential actions to reduce patient injury associated with central venous catheters.<sup>16</sup>

Peripheral I.V. and arterial vascular cannulation complications were most commonly associated with cardiac surgery procedures with tucked arms, preventing visual checking for proper catheter position and function.<sup>17</sup> Half of I.V. claims resulted from extravasation of drugs or fluids, sometimes causing severe tissue damage. There were remarkably few claims associated with radial artery cannulation.<sup>17</sup>

Other equipment problems included cautery burns or fires (2%) and burns from patient warming devices (1%) or hot bottles used to warm or position patients (1%). Warming device claims were often associated with misuse of equipment, such as separating a hose from a forced-air warming device. Claims associated with hot bottles used to warm or position patients<sup>18</sup> appeared to decline with the introduction of forced-air warming devices, although sporadic injuries continue to occur. Fires associated with cautery use during MAC represented 2% of claims in 1990–2007 and will be discussed in more detail later.

Medication problems represented 7% of anaesthesia claims in 1990–2007. These claims were fairly equally distributed between adverse drug reactions and medication errors. Medication management for chronic pain was an important patient safety issue in more recent claims, and will be presented in detail later on. The most common medication errors during surgical and obstetric anaesthesia care were incorrect dosage and drug substitution errors.<sup>19</sup> Drug substitution errors included both syringe swaps and infusion swaps. Vasopressors and muscle relaxants were the most common medications involved in medication error claims. Most medication errors were considered preventable, and they resulted in a high proportion of brain injury to patients.

## Clinical lessons learned

### *Adverse events and injuries associated with management of the difficult airway*

An analysis of closed claims in the management of the difficult airway revealed that difficult airways arose throughout the perioperative period: 67% on induction, 15% during surgery, 12% on extubation and 5% during recovery.<sup>20</sup> During airway emergencies, persistent intubation attempts were associated with death or permanent brain damage.<sup>20</sup> The laryngeal mask airway (LMA) was not an effective rescue technique in some claims in which multiple prolonged attempts at conventional intubation were made. The Closed Claims data emphasise that the LMA cannot be considered a fail-safe for the difficult airway, particularly when there is infraglottic obstruction or swelling/trauma of the airway with persistent intubation attempts. The Closed Claims data suggest that a surgical airway should be instituted early in the management of a difficult airway. Death and permanent brain damage from difficult intubation at induction of anaesthesia have declined since adoption of the ASA practice guidelines for management of the difficult airway.<sup>20</sup> However, management of the difficult airway at extubation and other phases of anaesthesia care remains a significant anaesthesia patient safety issue. This finding suggests that new strategies that focus upon extubation of the difficult airway are necessary.

### Practice points

- Difficult airways can be encountered throughout anaesthesia care, not just on induction of anaesthesia.
- Persistent intubation attempts in airway emergencies were associated with poor outcomes. Limit conventional attempts to three before using other strategies.
- The LMA is not a fail-safe in the rescue of a difficult airway in the presence of infraglottic obstruction or persistent intubation attempts.
- A surgical airway should be instituted early in the management of the difficult airway.
- Development of additional management strategies for difficult airways encountered during maintenance, emergence or recovery may improve patient safety.

### Adverse events and injuries associated with MAC

As pointed out earlier, claims associated with MAC practice signify a growing area of liability for the anaesthesiologist. An analysis of the Closed Claims database by Bhananker et al.<sup>11</sup> sheds light on the causes and mechanisms of injury encountered during MAC.

#### Respiratory events

Respiratory depression as a direct consequence of anaesthetic overdose was the most specific mechanism of injury and accounted for 21% of MAC claims.<sup>11</sup> Drug combinations (propofol plus benzodiazepines or opioids) were involved in over half of the cases of oversedation. Many of the patients involved were elderly, ASA physical status 3–5 and/or obese. The care was judged substandard in the majority of cases and preventable with better monitoring, including pulse oximetry, end-tidal capnography or both.

#### Practice points

- MAC can impose a challenge to the anaesthesiologist, particularly in vulnerable patients.
- Inadequate oxygenation/ventilation related to sedative/analgesic overdose contributes to the majority of untoward events.
- Continuous monitoring of ventilation and oxygenation, and vigilance in recognising imminent respiratory adverse events are mandatory during MAC cases. Use of end-tidal capnography to monitor ventilation is particularly important, as oxygen saturation is slow to decrease in the presence of supplemental oxygen.

#### Burn injuries

On-the-patient operating-room fires accounted for nearly a fifth of MAC claims, but only 1% of general anaesthesia and less than 1% of regional anaesthesia claims.<sup>11</sup> MAC claims associated with fire almost always occurred in the setting of surgery on the head, face and neck. In all cases, an electrocautery and supplemental oxygen were used. It is important to understand the fire triad: ignition source (cautery), oxidiser (supplemental oxygen) and fuel (drapes and/or alcohol prep) (Fig. 7).<sup>1</sup> Supplemental oxygen is under anaesthesia control, and greatly contributes to a dramatic and rapid fire.

The ASA developed a practice advisory for the prevention and management of operating-room fires.<sup>21</sup> The recommendations emphasise the importance of communication between the surgeon and the anaesthesia team regarding the timing of use of the electrocautery. The surgeon must give adequate notice for use to allow the anaesthesia team to stop delivery of oxygen and wait several minutes before

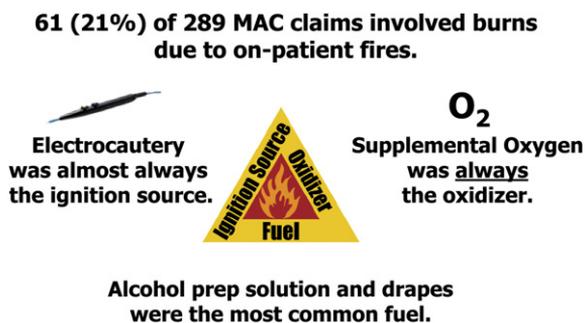


Fig. 7. On-patient fires during monitored anaesthesia care.

cauterisation. The drapes should be open to the room to avoid accumulation of high concentrations of oxygen under them. If moderate or deep sedation is required, general anaesthesia with a sealed delivery device (e.g., LMA or endotracheal tube) should be considered.

#### Practice points

- Aim for light sedation to avoid need for supplemental oxygen for head and neck procedures.
- Consider a sealed delivery device (LMA or endotracheal tube), if moderate or deep sedation is required.
- The surgeon should give adequate notice for use of the cautery. The anaesthesia team should stop delivery of oxygen and wait for several minutes.
- Avoid delivery of oxygen under drapes.

#### *Adverse events and injuries associated with anaesthesia at remote locations*

Anaesthesia outside the traditional operating-room setting continues to represent a challenging field and a growing area of liability for the anaesthesiologist. A recent closed claims study<sup>12</sup> examined patterns of injury and liability related to 87 claims encountered in remote locations and compared them to those of operating-room claims. Most remote location claims occurred in the gastroenterology suite, cardiac lab or emergency department and involved a high percentage of elderly and medically complex patients.

Adverse respiratory events were the leading cause of bad outcomes, including death and permanent brain damage, and occurred twice as often in remote locations compared with the operating room. Inadequate oxygenation/ventilation was the most common damaging event, followed by equipment failure/malfunction and cardiovascular events. MAC was performed in one-half of the procedures. Respiratory depression secondary to oversedation during MAC accounted for over 30% of remote location claims. Polypharmacy and substandard monitoring of oxygenation and ventilation showed similar patterns, as described previously. Disturbingly, in 15% of the cases, monitoring with pulse oximetry was absent and capnography was used in only four patients.<sup>12</sup> Reviewers judged care in remote location claims as being substandard in 54% and preventable with better monitoring in 32% of cases.<sup>12</sup>

#### Practice points

- The risks associated with anaesthesia at remote locations cannot be underscored enough.
- As compared with general operating-room anaesthesia claims, remote location claims are associated with more severe injuries, with death and brain damage common.
- Adherence to uniform standards in respiratory monitoring is critical. Use of end-tidal capnography is especially recommended to monitor ventilation.

#### *Adverse events and injuries associated with obstetric anaesthesia*

An analysis of closed claims in obstetric anaesthesia by Chadwick et al. in 1991 identified severe injuries, such as maternal death and newborn death/brain damage as contributing to the largest number of claims.<sup>22</sup> In a more recent review, newborn death/brain damage still constituted a large number of claims (21%), but maternal nerve injuries (21%), which were largely temporary and non-disabling, emerged as a significant source of malpractice claims.<sup>23</sup> All but one of the nerve injuries in

the more recent claims review occurred in association with regional anaesthesia, and reflects the trend of increased use of regional anaesthesia for both labour analgesia and caesarean section over the time periods in these reviews. In many cases, nerve injury from obstetric causes (e.g., pregnancy, vaginal delivery, foetal position and maternal position during second stage of labour) could not be differentiated from nerve injury due to regional anaesthesia. However, severe disabling spinal cord injuries occurred in 10% of nerve injury claims due to direct cord injury, epidural haematoma or abscess or anterior spinal artery syndrome.

The proportionate decrease in claims for maternal death and permanent brain damage may be encouraging, but their continued occurrence demands review and attention. The most common anaesthetic causes of maternal death and brain damage in obstetric general anaesthesia claims were difficult intubation and maternal haemorrhage, while for regional anaesthetics, it was high neuraxial block. The problems of delayed recognition of high neuraxial block and lack of immediately available resuscitation equipment were frequently associated with these catastrophic claims.<sup>23</sup> Difficult intubation claims were only observed in claims with injuries from 1991 to 1998, largely predating widespread use of the LMA. Maternal haemorrhage was associated with the failure of the anaesthesiologist to keep up with the blood loss despite best efforts, or with inadequate fluid resuscitation.

Obstetric rather than anaesthetic factors were far more common in peripartum hypoxic brain injury in the newborn. However, the occurrence of claims for newborn death/brain damage associated with anaesthetic care draws attention to the associated problems of poor communication between obstetricians and anaesthesiologists and anaesthetic delays around emergent deliveries.

### Practice points

- Claims for transient nerve injury and maternal back pain were surprisingly common. Many of these claims may be avoided by improved physician–patient communication, informed consent, and patient follow-up.
- Anaesthesia-related claims for newborn death or brain damage involved anaesthetic delays, communication failures between obstetrician and anaesthesiologists regarding the urgency of caesarean section, and/or substandard anaesthesia care in response to difficult intubation or block-related hypotension. Patient safety may be improved by adherence to practice guidelines regarding the decision to incision interval for urgent caesarean section and methods to improve communication.
- Delays in diagnosis and treatment of high neuraxial block were preventable causes of maternal death/brain damage.
- Improved treatment of maternal disease (e.g., haemorrhage) are needed to reduce maternal mortality.

### *Adverse events and injuries associated with medication management for chronic pain*

Malpractice claims associated with medication management for chronic pain show an increasing trend in recent years. This concerning fact prompted Fitzgibbon et al.<sup>24</sup> to perform an in-depth analysis of 51 claims that occurred between 2000 and 2006 and which were related to medication management by pain-management physicians of patients with chronic non-cancer pain. They found that malpractice claims for medication involved mostly young men suffering from chronic back pain (53%), who were treated primarily with opioid analgesics (94%). Fatal outcome was highly prevalent, accounting for nearly 60% of claims. Use of long-acting opioids, such as oxycodone and methadone, alone or in conjunction with other psychoactive medications, was considered the primary cause of death in over 60% of claims. Psychiatric co-morbidity, often present among patients with chronic pain, was suspected to increase the likelihood of death. Notably, this analysis revealed two intertwined major factors that contributed to 82% of claims: patient non-compliance with the treatment and/or substandard care provided by the

physician. The former included obtaining prescriptions from multiple providers, procuring additional medications without the anaesthesiologist's knowledge, alcohol and illicit drug abuse, and other forms of drug-seeking behaviour. The latter was correlated with failure by the prescribing physician to communicate a care plan with the primary care physician, inadequate monitoring and documentation of care, inappropriately high prescribed doses of opioids, or unethical or illegal clinical practices.

### Practice points

- Claims related to medication management of long-lasting opioids in chronic pain continue to increase.
- Death is a frequent outcome and is largely linked to the use of long-acting opioids.
- Patient non-compliance with care and improper medication management by physicians were contributory factors in the majority of claims.
- The increase in claims is most probably related to the increased availability of prescription opioids for the treatment of chronic pain. Caution is urged in the prescribing and monitoring of effectiveness of long-lasting opioids.

### *Injury and liability associated with cervical procedures for chronic pain*

Injuries related to cervical procedures were recently examined.<sup>25</sup> Over a fifth of claims were related to cervical invasive interventions. Fifty-nine percent of cervical procedure patients experienced spinal cord damage compared with 11% of other chronic pain patients, with direct needle trauma as the predominant cause. Accidental intra-arterial injection of particulate steroid was the next most-frequent cause of spinal cord injury. General anaesthesia or sedation was more often used in cervical procedure claims with spinal cord injuries than in cervical procedure claims without spinal cord injury. The patients were more often judged as non-responsive in the cervical procedure claims with spinal cord injury. Appropriate use of radiographic guidance was judged to possibly prevent the injury in nearly half of the claims with spinal cord injury. These findings point to the need for further study of the indications for these interventions and to establish techniques to prevent devastating injuries.

### Practice points

- Invasive cervical chronic pain treatments have resulted in severe spinal cord injuries, with direct needle trauma as the most common aetiology.
- Traumatic injury was more common in patients who received sedation or general anaesthesia, as well as in those who were unresponsive at the time the procedure was conducted.
- Appropriate use of radiographic guidance may prevent injury.

In summary, closed malpractice claims are a rich source of clinical details of rare severe adverse events. The ASA Closed Claims Project findings have provided the impetus for further hypothesis-testing study and have been instrumental in changes in practice. Claims from surgical anaesthesia have declined, with a quarter of claims since 2000 now related to acute or chronic pain management. Since 2000, claims associated with regional anaesthesia represent 20% and claims associated with MAC represent 10% of surgical anaesthesia claims. The most common complications are death (29%), nerve injury (22%) and permanent brain damage (9%). The profile of injuries vary with type of anaesthesia: compared with general anaesthesia, regional anaesthesia is associated with more claims for nerve injury and MAC has more claims for death.

Recent ASA Closed Claims studies focussed upon management of the difficult airway, safety concerns during MAC and outside of the operating room, obstetric anaesthesia care, and the management of chronic pain. These reviews point to several areas for improvement in anaesthesia safety: management of the difficult airway particularly at extubation, oversedation during MAC with failure to recognise and treat respiratory depression in a timely fashion, hazards of anaesthesia in non-operating-room locations, prevention of cautery-induced burns, early recognition and treatment of high neuraxial blocks in obstetric anaesthesia, and opioid-medication management and invasive cervical procedures in the treatment of chronic pain. Analysis of these rare events can improve practice and patient safety.

### Research agenda

- Optimal strategies and techniques for extubation in the presence of a difficult airway.
- Aetiology and prevention of nerve and spinal cord injury during regional anaesthesia.
- Improved safety of sedation practices during MAC and in non-operating room locations.
- Early detection and treatment of respiratory depression in acute pain management.
- Best practices for management of medications in the treatment of chronic pain.
- Indications for use of cervical invasive interventions and types of techniques to reduce risk of spinal cord injury.

### Conflict of interest

None.

### Role of funding source

The Closed Claims Project is supported by the American Society of Anesthesiologists (Park Ridge, IL, USA). The opinions expressed herein are those of the authors and do not represent the policy of the American Society of Anesthesiologists.

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