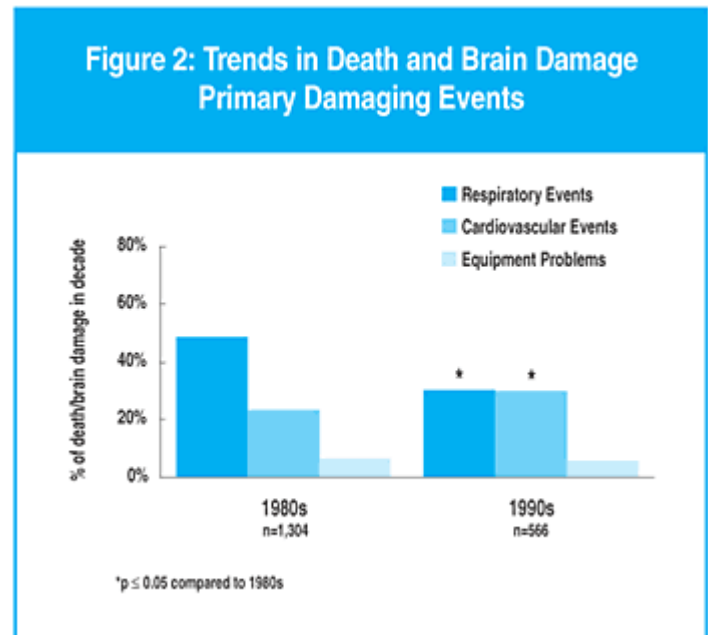
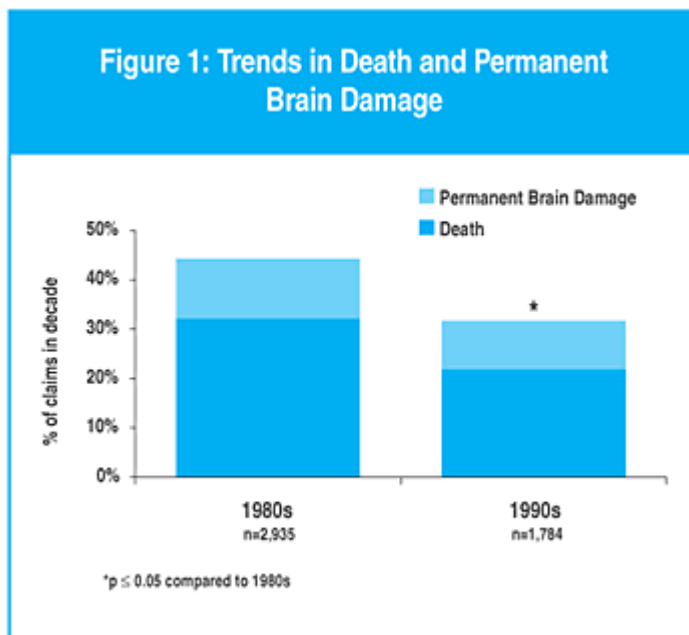


## Full Text

Analysis of the most recent data from the ASA Committee on Professional Liability Closed Claims Project indicates that severe anesthesia-related injuries such as death and permanent brain damage are becoming less frequent among injuries reported to insurance carriers. This standardized collection of case summaries of adverse anesthesia-related outcomes has been ongoing since 1985 and now contains 5,480 claims or potential claims from 35 insurance organizations that insure approximately 14,500 anesthesiologists. This analysis consists of 1,870 claims for death or permanent brain damage occurring in the 1980s and 1990s.

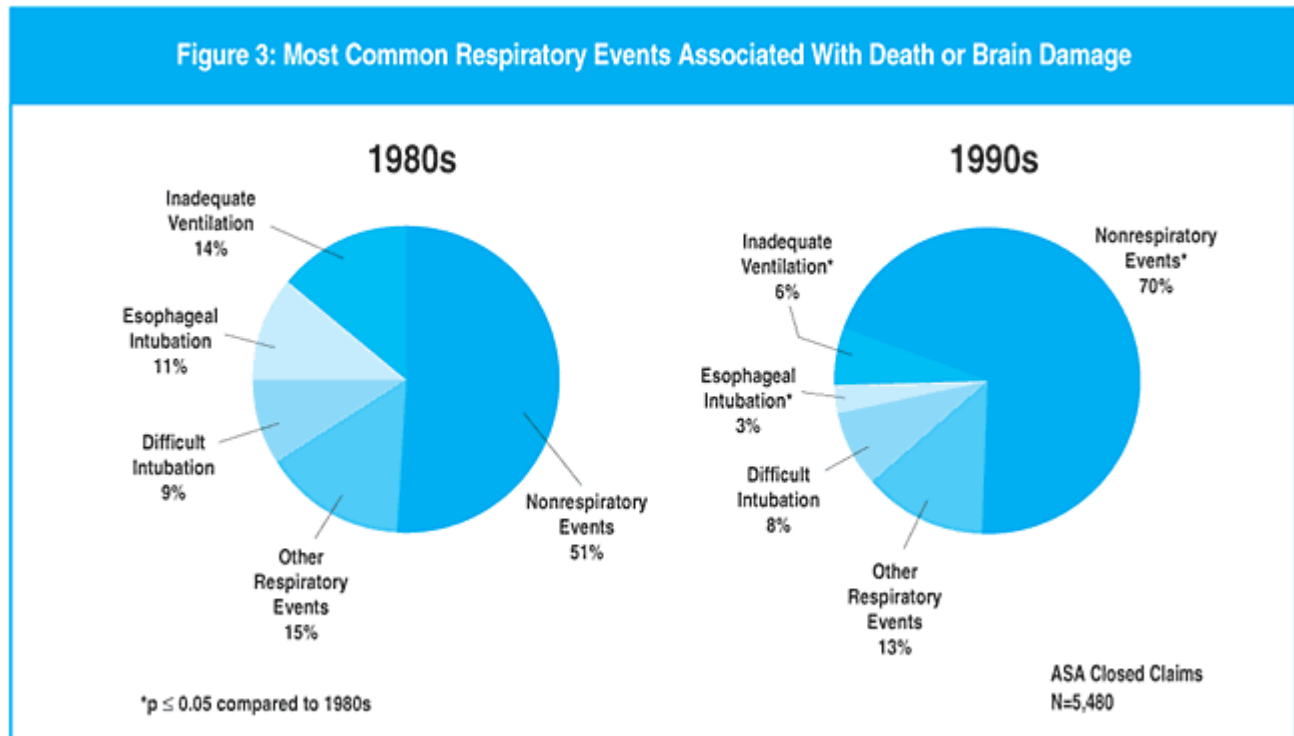
In the 1980s, 42 percent of claims involved death or permanent brain damage compared to 32 percent in the 1990s ( $p < 0.05$ ) [Figure 1]. This decrease was predominately due to a decrease in claims for death (32 percent versus 22 percent) in the 1980s versus the 1990s. In the 1980s, respiratory-related damaging events were more common (48 percent) than cardiovascular-related damaging events (23 percent) [Figure 2]. In the 1990s, cardiovascular and respiratory damaging events were responsible for the same percent of claims involving death or brain damage [Figure 2]. The third most common damaging event, equipment failure or misuse, showed little change between the decades.



## Trends in Respiratory Events

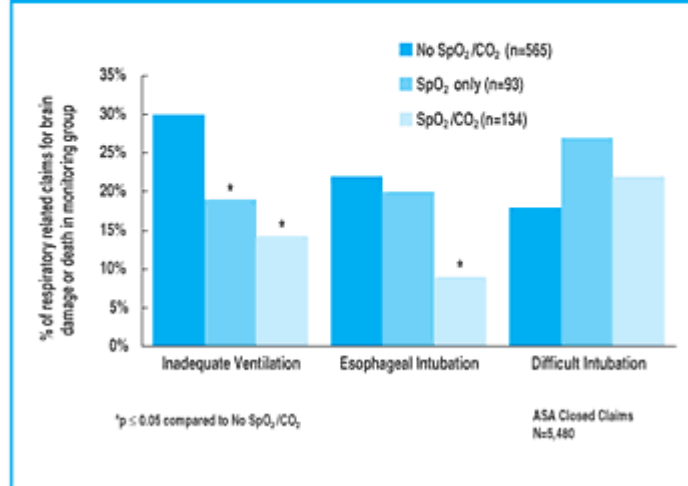
The most common respiratory damaging events causing death or permanent brain damage in the 1980s and 1990s were inadequate ventilation, esophageal intubation and difficult intubation [Figure 3]. Claims

for inadequate ventilation and esophageal intubation decreased significantly in the 1990s as compared to the 1980s. These two events combined accounted for 25 percent of claims for death and brain damage in the 1980s, decreasing to 9 percent in the 1990s. As Figure 3 shows, reductions in these two events account for nearly the entire decrease in respiratory-related death and brain damage claims between the 1980s and 1990s. The proportion of claims for difficult intubation and other respiratory events leading to death or brain damage stayed relatively stable between the 1980s and 1990s [Figure 3].



The question arises as to the cause of the reduction in the relative proportion of anesthesia-related deaths or permanent brain damage as compared to other anesthesia-related injuries. The use of pulse oximetry (SPO2) and end-tidal carbon dioxide (ETCO2) monitors, which came into use in the mid- to late-1980s and became ASA standards in the early 1990s, would seem to be the most likely cause. When the claims are grouped by monitors used (or not used) during anesthesia, a clearer picture emerges. Figure 4 shows the most common respiratory events leading to death or brain damage as a proportion of respiratory events (rather than all claims). Inadequate ventilation decreased significantly when either SPO2 alone or ETCO2 also was monitored. On the other hand, SPO2 monitoring did not affect the proportion of claims for esophageal intubation unless ETCO2 also was monitored [Figure 4]. SPO2 only gives information about an end-stage symptom (hypoxemia) of an esophageal intubation and does not make a primary diagnosis of this condition as does ETCO2. The proportion of respiratory-related claims for difficult intubation was unaffected by the presence of SPO2 and ETCO2 monitoring [Figure 4]. If anything, the proportion of respiratory-related claims for death or permanent brain damage due to difficult intubation was greater when SPO2 and ETCO2 were utilized. This is not surprising, as placement of an endotracheal tube is a technical act whose success may not be influenced by monitoring. Thus the overall reduction in respiratory-related damaging events seems to be related to two injuries (inadequate ventilation and esophageal intubation) most affected by SPO2 and ETCO2 monitoring.

**Figure 4: Most Common Respiratory Damaging Events Associated With Death or Brain Damage by Monitoring Group**



## Trends in Cardiovascular Events

The cause of the increase in the proportion of cardiovascular-related damaging events as a mechanism of death or permanent brain damage in the 1990s is not readily apparent [Figure 2]. When the specific cardiovascular damaging events are analyzed according to decade, no significant pattern emerges. The largest cardiovascular-related category is the "unexplained/other," which includes pulmonary embolism, stroke, myocardial infarction, arrhythmia and undiagnosed (preoperative) conditions such as myocardial fibrosis or cardiomyopathy identified post mortem. These events account for 11 percent of death and brain damage claims in the 1980s and 17 percent in the 1990s ( $p < 0.05$ ). Likewise, the occurrence of death or permanent brain damage due to cardiac arrest associated with neuraxial block (4 percent in the 1980s and 1990s), inadequate fluid replacement (2 percent in the 1980s; 3 percent in the 1990s) and excessive blood loss (3 percent in the 1980s; 2 percent in the 1990s) did not show any change with time. When the cardiovascular damaging event data are analyzed by monitoring group, no clear picture emerges.

## Implications for Further Reductions in Death and Brain Damage

Do the current findings have any implications for further improvement in decreasing the occurrence of anesthesia-related death or permanent brain damage? Any interpretation of closed claims data for predictive purposes has to be done with an understanding of its drawbacks, including lack of denominator data and a three- to five-year time lag between the date of injury and closure of a claim. The database represents claims, not all patient injuries, so it is possible (but unlikely) that plaintiff attorneys are not pursuing claims for anesthesia-related death and permanent brain damage as frequently in the 1990s as in the 1980s.

With the aforementioned in mind, the data seem to indicate that there is a decrease in the proportion of anesthesia-related claims for death and permanent brain damage in the 1990s. This seems to be related to the use of SPO2 and ETCO2 monitoring, as evidenced by the fact that the damaging events most affected are inadequate ventilation and esophageal intubation. Within the respiratory damaging events group, further opportunities for a reduction in severe injury would seem to lie in utilization of the ASA

"Practice Guidelines for Management of the Difficult Airway."<sup>1</sup> The Closed Claims Project Subcommittee has been collecting data evaluating the role of this guideline (first published in 1993) in claims where the injury was due to difficult intubation. Analysis of these data should, in time, give information as to the impact of the guideline on the occurrence of the injury due to difficult intubation.

The relative increase in the proportion of cardiovascular damaging events in the 1990s deserves comment. This increase may be due to the fact that injuries related to the onset of bradycardia and hypotension, which were previously attributed to inadequate ventilation/oxygenation in the absence of SPO2/ETCO2 monitoring, are now more appropriately attributed to primary cardiovascular damaging events. There is no clear pattern of injury in the more frequently occurring cardiovascular damaging events category (unexplained/other). The only cardiovascular category where there is a recurring pattern is that of cardiac arrest associated with neuraxial block. In this case, early recognition of the phenomenon with prompt pharmacologic therapy and thump-pacing or chest compression offer the most opportunity for prevention of the injury.

In summary, Closed Claims Project data indicate a downward trend in the occurrence of claims for severe patient injury. This seems to be primarily due to injuries that are amenable to prevention by SPO2 and ETCO2 such as inadequate ventilation/oxygenation and esophageal intubation. If the downward trend is entirely due to injuries preventable by monitoring, then future strategies to prevent severe injuries should be directed to cardiovascular events and respiratory-related damaging events not amenable to prevention by SPO2 and ETCO2 monitoring.

## Reference

1. Caplan RA, Benumof JL, Berry FA, et al. Practice guidelines for management of the difficult airway: A report by the American Society of Anesthesiologists Task Force on Management of the Difficult Airway. *Anesthesiology*. 1993; 78:597-602.

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