

Liability Associated with Obstetric Anesthesia

A Closed Claims Analysis

Joanna M. Davies, F.R.C.A.,* Karen L. Posner, Ph.D.,† Lorri A. Lee, M.D.,‡ Frederick W. Cheney, M.D.,§
Karen B. Domino, M.D., M.P.H.||

Background: Obstetrics carries high medical liability risk. Maternal death and newborn death/brain damage were the most common complications in obstetric anesthesia malpractice claims before 1990. As the liability profile may have changed over the past two decades, the authors reviewed recent obstetric claims in the American Society of Anesthesiologists Closed Claims database.

Methods: Obstetric anesthesia claims for injuries from 1990 to 2003 (1990 or later claims; n = 426) were compared to obstetric claims for injuries before 1990 (n = 190). Chi-square and z tests compared categorical variables; payment amounts were compared using the Kolmogorov-Smirnov test.

Results: Compared to pre-1990 obstetric claims, the proportion of maternal death (P = 0.002) and newborn death/brain damage (P = 0.048) decreased, whereas maternal nerve injury (P < 0.001) and maternal back pain (P = 0.012) increased in 1990 or later claims. In 1990 or later claims, payment was made on behalf of the anesthesiologist in only 21% of newborn death/brain damage claims compared to 60% of maternal death/brain damage claims (P < 0.001). These payments in both groups were associated with an anesthesia contribution to the injury (P < 0.001) and substandard anesthesia care (P < 0.001). Anesthesia-related newborn death/brain damage claims had an increased proportion of delays in anesthetic care (P = 0.001) and poor communication (P = 0.007) compared to claims unrelated to anesthesia.

Conclusion: Newborn death/brain damage has decreased, yet it remains a leading cause of obstetric anesthesia malpractice claims over time. Potentially preventable anesthetic causes of newborn injury included delays in anesthesia care and poor communication between the obstetrician and anesthesiologist.

THE practice of obstetrics carries a high medicolegal risk that has reached crisis proportions during the past decade.¹⁻⁵ The 2006 American College of Obstetricians and Gynecologists survey on professional liability showed that 89% of respondents had been sued during their careers, with an average of 2.6 claims per obstetrician.[#] The majority of claims were related to newborn injury, with 31% associated with newborn brain injury and 16% related to stillbirth or neonatal death.[#] Nearly 39% of specialists in obstetrics and gynecology in Massachusetts had a professional liability payment made on their behalf between 1996 and 2005.² Sixty percent of malpractice insurance premiums paid by obstetricians are used to cover lawsuits for alleged birth-related cerebral palsy.⁶

It is unclear whether this increased liability extended to anesthesiologists involved in obstetric care. Nearly two decades ago, a review of liability associated with obstetric anesthesia using the American Society of Anesthesiologists (ASA) Closed Claims database found that, although awards to plaintiffs were higher in obstetric claims from the 1970s and 1980s, there were more claims for minor complications in obstetric compared to nonobstetric claims.⁷ The most common complications in obstetric claims were newborn death or brain damage (29%) and maternal death (22%).⁷ Over the past three decades, there have been numerous changes in the practice of anesthesiology in general⁸ and in the practice of obstetric anesthesia specifically.⁹⁻¹¹ The use of general anesthesia, particularly for elective Cesarean sections, has decreased, and the use of epidural anesthesia for labor analgesia has increased. In addition, there has been increasing recognition that only a minority of cases of newborn encephalopathy are related to intrapartum hypoxia, most of which are not preventable by actions of care givers.^{5,12-18} We therefore compared the liability profiles in obstetric anesthesia claims from injuries arising in 1990 or later to the pre-1990 claims. We specifically explored the contribution of newborn death and brain damage compared to maternal death and brain damage to obstetric anesthesia liability in 1990 or later claims.

Materials and Methods

The ASA Closed Claims Project is a structured evaluation of adverse anesthetic outcomes obtained from the closed claim files of 35 United States professional liability

This article is featured in "This Month in Anesthesiology." Please see this issue of ANESTHESIOLOGY, page 9A.

This article is accompanied by an Editorial View. Please see: Leighton BL: Why obstetric anesthesiologists get sued. ANESTHESIOLOGY 2009; 110:8-9.

* Assistant Professor, † Research Professor, ‡ Associate Professor, § Professor Emeritus, || Professor, Department of Anesthesiology, University of Washington School of Medicine.

Received from the Department of Anesthesiology, University of Washington School of Medicine, Seattle, Washington. Submitted for publication June 16, 2008. Accepted for publication September 26, 2008. Supported by the American Society of Anesthesiologists, Park Ridge, Illinois. All opinions expressed are those of the authors and do not reflect the policy of the American Society of Anesthesiologists.

Address correspondence to Dr. Davies: Department of Anesthesiology, Box 356540, University of Washington School of Medicine, Seattle, Washington 98195. jodavies@u.washington.edu. This article may be accessed for personal use at no charge through the Journal Web site, www.anesthesiology.org.

Wilson N, Strunk AL: Overview of the 2006 survey on professional liability - American College of Obstetricians and Gynecologists. Available at www.acog.org/departments/professionalliability/2006surveyNatl.pdf. Accessed May 21, 2008.

insurance companies. Claims for dental damage are not included in the database.

The data collection process has been previously described in detail.^{19,20} Briefly, a closed claim file was reviewed at the professional liability insurance company by a practicing anesthesiologist. The file typically consisted 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. The reviewer completed a standardized form and narrative summary that recorded information about patient characteristics, surgical procedures, sequence and location of events, critical incidents, clinical manifestations of injury, standard of care, and outcome. Forms and summaries completed by the on-site anesthesiologist reviewer were subsequently reviewed by a physician member of the central Closed Claims Committee before incorporation in the database.

The physical or psychological injury for which the patient was seeking compensation was recorded in each claim. There was no apparent injury in some claims, and some claims had multiple injuries. In the case of brain damage followed by death, death was considered the complication. The patient and newborn in each claim were assigned a severity of injury score that was designated by the on-site reviewer using the insurance industry's 10-point scale that rates severity of injury from 0 (no injury) to 9 (death). For the purposes of analysis, injuries were grouped into temporary/nondisabling (score = 0-5) *versus* permanent/disabling (score = 6-8) *versus* death (score = 9). The damaging event that caused the injury was determined by the on-site anesthesiologist reviewer and confirmed by the Closed Claims Committee. Appropriateness of anesthesia care was rated as appropriate (standard), substandard, or impossible to judge on the basis of reasonable or prudent practice at the time of the event by the on-site reviewer. A previously published study found reliability of reviewer judgments to be acceptable.²¹

From the ASA Closed Claims Project database of 7328 cases, those associated with obstetric procedures that occurred from 1990 to 2003 (*1990 or later*) were included for the current study. These claims were reviewed again in detail by two of the authors (JMD, KBD). These claims (1990 or later) were then compared to obstetric claims for procedures that occurred before 1990 (n = 190) and were reported previously by Chadwick *et al.*⁷ (*pre-1990*). Most of these claims (92%) reported by Chadwick *et al.* involved procedures that occurred between 1975 and 1985.⁷ Obstetric claims

were classified as associated with vaginal delivery or Cesarean section on the basis of the delivery mode that occurred. Planned vaginal delivery that was changed to Cesarean section was classified as Cesarean section. If both regional and general anesthesia were administered, the claim was classified according to the technique associated with the injury in the claim.

Claims from 1990 or later for maternal and newborn death or permanent brain damage were independently classified as anesthesia-related by two of the authors (JMD, KBD) if there was a possible anesthesia contribution to the injury. Two claims for newborn permanent brain damage were excluded from this analysis because the alleged newborn brain damage was not substantiated. In claims in which there was disagreement about anesthesia-related injury, classification was resolved after discussion. Specific maternal, obstetric, and newborn factors associated with maternal and newborn death/brain damage were abstracted from the narrative summaries of these claims. The presence of anesthesia factors such as alleged anesthesia delay, neonatal resuscitation by the anesthesiologist, and poor communication between the anesthesiologist and the obstetrician (usually concerning the urgency of the Cesarean section) were also abstracted from the summaries of claims for newborn death/brain damage.

Payments were adjusted to 2007 dollar amounts using the Consumer Price Index.^{**} In a subset of claims in which adequate information was available on the datasheet (for claims collected after 2000 due to a revision of the datasheet) or narrative summary, payments were separated into payments on behalf of the anesthesiologist (*i.e.*, on behalf of an anesthesiologist, anesthesiology group, resident, or certified registered nurse anesthetist) and total payments by all parties.

Statistical Analysis

Differences in categorical variables in patient characteristics, injuries, and liability between pre-1990 and 1990 or later claims were compared using the Chi-square tests and Fisher exact test, with specific comparisons made using the z test if the overall Chi-square test was statistically significant. Age in years was compared in the two groups using Student *t* test. Payment amounts (excluding \$0 and missing data) were compared in the two groups using the Kolmogorov-Smirnov test. Kappa statistics were calculated between two raters (JMD, KBD) on the independent classification of anesthesia-related *versus* nonanesthesia-related for maternal and neonatal death/brain damage claims in the 1990 or later time period. The relationship between anesthesia-related claims and other factors such as anesthesia delay, poor communication, substandard care, and payment on behalf of the anesthesiologist (and anesthesia care team or anesthesia group) in these claims was determined using Fisher exact test. All statistical analysis was conducted

^{**} Consumer Price Index Inflation Calculator. U.S. Department of Labor, Bureau of Labor Statistics. Available at <http://www.bls.gov/data/home.htm>, Accessed May 30, 2008.

Table 1. Characteristics of Obstetric Anesthesia Claims Pre-1990 and 1990 or Later

	Pre-1990*	1990 or Later	P Value
Proportion of perioperative claims†	190 (12%)	426 (13%)	NS
Mean age, yr (SD)	28 (5)	29 (6)	0.044
Mode of delivery			
Cesarean section	127 (67%)	246 (58%)	0.029
Vaginal delivery	63 (33%)	180 (42%)	0.029
Primary anesthetic			
Regional anesthesia	124 (65%)	342 (80%)	< 0.001
General anesthesia	62 (33%)	73 (17%)	< 0.001
Other or unknown	4 (2%)	11 (3%)	NS
Respiratory damaging event	46 (24%)	17 (4%)	< 0.001
Aspiration of gastric contents	8 (4%)	2 (< 1%)	0.012
Difficult intubation	10 (5%)	11 (3%)	NS
Esophageal intubation	7 (4%)	0 (0%)	0.007
Inadequate oxygenation/ventilation	10 (5%)	3 (1%)	0.006
Standard of care			
Substandard care	74 (39%)	92 (22%)	< 0.001
Appropriate	87 (46%)	293 (69%)	< 0.001
Impossible to judge	29 (15%)	41 (10%)	NS
Payment made‡	100 (58%)	164 (42%)	< 0.001
Adjusted total payment in 2007 dollars			
Median	\$455,000	\$222,000	NS
Range	\$1,539–\$19,656,000	\$1,196–\$18,400,000	

* Data from pre-1990 previously published and used with permission of author and publisher.⁷ † Claims for chronic pain management excluded from 1990 and later. ‡ Missing data excluded.

P values obtained by *t* test (age), *z* test (proportions), and Kolmogorov-Smirnov test (payment amounts).

NS = not statistically significant ($P > 0.05$); SD = standard deviation.

with SPSS 12.0.1 for Windows (SPSS Inc, Chicago, IL). Confidence intervals for proportions were calculated as equal-tailed Jeffreys prior intervals according to SPSS Resolution Number 37680. Statistical significance was accepted at $P < 0.05$. For multiple comparisons of payments with newborn death/brain damage, maternal nerve injury, and maternal minor injuries compared to maternal death/brain damage, a Bonferroni correction was used.

Results

Comparison of 1990 or Later Claims versus Pre-1990 Claims

There were 426 claims associated with obstetric anesthesia from 1990 or later (246 [58%] Cesarean section and 180 [42%] vaginal delivery). Compared to pre-1990 claims ($n = 190$), the proportion of obstetric claims from 1990 or later associated with Cesarean section decreased ($P = 0.029$) and the proportion of claims associated with general anesthesia decreased ($P < 0.001$; table 1).

The pattern of injuries in the claims also changed over time. Compared to pre-1990 claims, the proportion of obstetric claims from 1990 or later associated with maternal death ($P = 0.002$) and newborn death or brain damage ($P = 0.048$) decreased (fig. 1). In contrast, the proportion of obstetric claims from 1990 or later associated with maternal nerve injury ($P < 0.001$) and back pain ($P = 0.012$) increased (fig. 1). Respiratory causes of injuries decreased in claims from 1990 or later (24% in

pre-1990 claims vs. 4% in 1990 or later claims, $P < 0.001$; table 1). Claims related to inadequate oxygenation/ventilation ($P = 0.006$), aspiration of gastric contents ($P = 0.012$), and esophageal intubation ($P = 0.007$) decreased in 1990 or later claims, whereas claims related to difficult intubation did not change (table 1).

Compared to pre-1990 claims,⁷ the proportion of claims with substandard care decreased, and appropriate care increased in 1990 or later claims ($P < 0.001$; table 1). The proportion of claims with payment to the plaintiff decreased from 58% in pre-1990 claims to 42% in 1990 or later ($P < 0.001$; table 1). Although median payments tended to be higher in pre-1990 claims, the

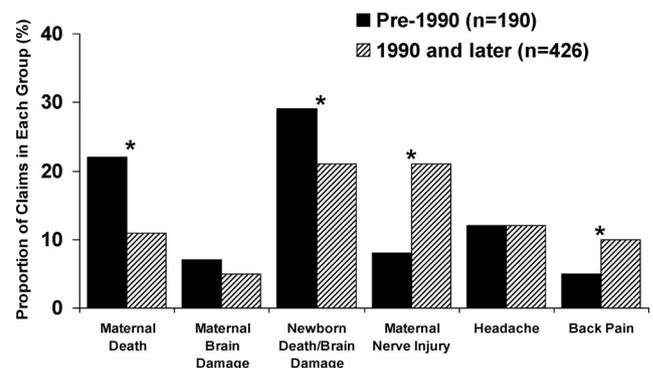


Fig. 1. Comparison of injuries in obstetric anesthesia claims before and after 1990. Data from pre-1990 previously published and used with permission of author and publisher.⁷ * $P < 0.05$ comparing the two time periods by *z* test.

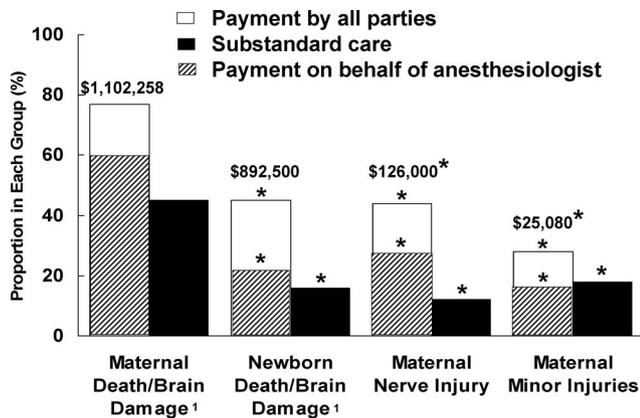


Fig. 2. Liability associated with injuries in 1990 and later obstetric claims ($n = 426$). White bars = proportion of payment by all parties. Hatched bars = proportion of payment on behalf of anesthesiologist. Black bars = proportion of substandard care. Median payment by all parties is shown in 2007 dollars above bars showing payments. Missing data are excluded from payment proportions and amounts¹. Claims with maternal and newborn injury ($n = 7$) were excluded from statistical comparisons between these groups. * $P < 0.001$ compared to same dependent variable in maternal death/brain damage group. Bonferroni correction was used for multiple comparisons. Proportions compared by z test; payment amounts compared by Kolmogorov-Smirnov test.

ranges of payments were very broad and were not significantly different between the two time periods (table 1).

Detailed Review of Obstetric Claims from 1990 or Later

Overview of Injuries and Liability. The most common injuries leading to obstetric claims in 1990 or later were newborn death/brain damage (21%) and maternal nerve injury (21%; fig. 1). Claims for maternal minor injuries (e.g., headache, back pain, pain during surgery, and emotional distress) made up a large proportion (28%) of obstetric claims.

Liability characteristics for selected maternal and newborn injury claims are shown in figure 2. A payment was made on behalf of the anesthesiologist in only 21% of claims for newborn death/brain damage (fig. 2). A payment was made on behalf of the anesthesiologist more frequently in claims for maternal death/brain damage than for newborn death/brain damage ($P < 0.001$, fig. 2). Payment amounts for newborn and maternal death/brain damage were similar. Payment amounts for maternal nerve injury and minor injuries were reduced compared to maternal death/brain damage ($P < 0.001$).

Major Complications.

Newborn Death/Brain Damage. Most (71%) claims for newborn death/brain damage ($n = 91$) were associated with a nonreassuring fetal heart tracing and urgent or emergent Cesarean section (table 2). Anesthesia care was judged as having a possible contribution in only 22% of newborn death/brain damage claims ($\kappa = 0.84$; $P < 0.001$). Other factors observed in newborn death/brain damage claims included a variety of maternal and

Table 2. Factors in Newborn Death/Permanent Brain Damage ($n = 91$) 1990 or Later

Factor	n	%
Nonreassuring fetal heart tracing*	65	71%
Urgent/emergency Cesarean section*	65	71%
Possible anesthesia contribution	20	22%
Maternal coexisting conditions	14	15%
Umbilical cord problems	11	12%
Uterine rupture†	8	9%
Abnormal placenta	8	9%
Chorioamnionitis or maternal fever	7	8%
Fetal congenital abnormality	7	8%
Meconium aspiration	6	7%
Breech presentation	6	7%
Less than 34 wk gestation	4	4%

* Fifty-five cases (60%) included both factors. † Six of eight associated with attempted vaginal birth after Cesarean section (VBAC).

fetal conditions known to be associated with newborn encephalopathy (table 2).

When compared to newborn death/brain damage claims with no anesthesia contribution, anesthesia delay ($P = 0.001$), poor communication ($P = 0.007$), and substandard anesthesia care ($P < 0.001$) occurred more frequently when anesthesia care may have contributed to the newborn outcome (fig. 3). The anesthesia delays in the 11 newborn death/brain damage claims ranged from 10 to 70 min, with a mean delay of 40 min (SD = 22 min). Delay due to anesthesia care was a factor in 11 (55%) of 20 anesthesia-related newborn death/brain damage claims (fig. 3). The anesthesiologist was not in the hospital for approximately half ($n = 6$) of these cases. Poor choice of anesthesia technique, with inappropriate prolonged attempts to administer regional rather than general anesthesia, probably contributed to some of the delays ($n = 3$). Poor communication between the obstetrician and anesthesiologist, primarily regarding the urgency of the Cesarean section, also contributed to nearly two thirds of the anesthesia delays ($n = 7$). Other anesthesia contributions to newborn

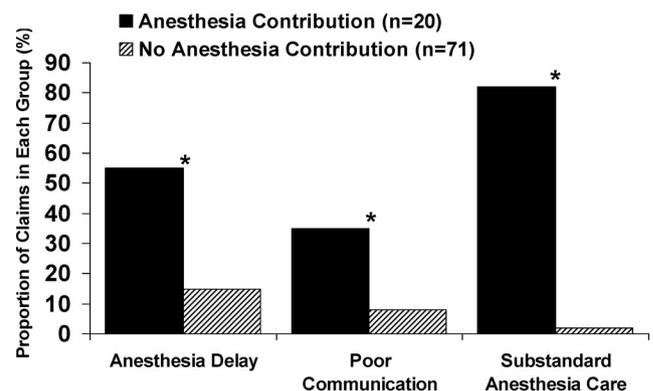


Fig. 3. Factors associated with anesthesia contribution to newborn death/brain damage. Anesthesia delay, poor communication between obstetrician and anesthesiologist, and substandard anesthesia care were associated with anesthesia contribution. * $P < 0.01$ by z test.

Table 3. Factors Associated with Anesthesia Payments for Newborn Death/Permanent Brain Damage 1990 or Later

	Anesthesia Payment (n = 17)	95% CI	No Payment (n = 63)	95% CI	P Value
Anesthesia contribution to injury	10 (59%)	(36–79%)	3 (5%)	(1–12%)	< 0.001
Appropriateness of care					
Substandard	9 (53%)	(30–75%)	3 (5%)	(1–12%)	< 0.001
Appropriate	7 (41%)	(21–64%)	52 (83%)	(72–90%)	0.001
Impossible to judge	1 (6%)	(1–24%)	8 (13%)	(6–23%)	NS
Alleged anesthesia delay	7 (41%)	(21–64%)	12 (19%)	(11–30%)	NS
Communication problems	5 (29%)	(12–53%)	6 (10%)	(4–19%)	NS
Newborn resuscitation by anesthesiologist	4 (24%)	(9–47%)	9 (14%)	(7–24%)	NS

Total n = 91. Table excludes 11 claims with unknown anesthesia payments. Table includes 3 claims that also had maternal death (2 paid, 1 not paid).

CI = confidence interval; NS = not statistically significant ($P > 0.05$); P values obtained by z test.

death/brain damage included difficult intubation resulting in maternal hypoxia (n = 4) and profound hypotension after neuraxial block (n = 4). Care was judged to be substandard in 82% of claims in which anesthesia care may have contributed to newborn death/brain damage (fig. 3).

There was a significant association of payment by the anesthesiologist with possible anesthesia contribution to the newborn injury ($P < 0.001$; table 3). Payment on behalf of the anesthesiologist was also associated with the judgment of substandard anesthesia care ($P < 0.001$; table 3). A payment was made on behalf of the anesthesiologist in only 7 claims (10%) in which anesthesia care was judged as not contributing to the newborn death/brain damage.

Nerve Injury. Nerve injury (n = 89) was the leading maternal injury in obstetric claims from 1990 or later, most of which was temporary or nondisabling (80%). All but one nerve injury was associated with regional anesthesia, and nerve injury was more commonly associated with vaginal delivery than with Cesarean section ($P = 0.001$). Most cases of nerve injury (63%) could have been caused by the administration of regional anesthesia as evaluated by the on-site anesthesiologist reviewer, but no specific event leading to nerve injury could be identified in 18 claims (20%), and 12 (13%) were related to patient condition or delivery. Radiculopathy of a lumbar or sacral root accounted for the majority of injuries (table 4). Spinal cord injury resulted in paraplegia in 10 nerve injury claims (11%). When known, the etiology for spinal cord injuries was epidural hematoma (n = 4, only 1 of which had a coagulopathy), epidural abscess (n = 4), direct injection into the cord (n = 2), and anterior spinal artery syndrome (n = 1). The majority of nerve injury claims were judged to have appropriate care, and payment was made by the anesthesia providers in fewer than one third of claims for nerve injury (fig. 2).

Maternal Death/Brain Damage. Causes of maternal death (n = 47) and permanent brain damage (n = 22) with general (n = 28) or regional (n = 41) anesthesia are shown in table 5. The most common anesthetic causes of maternal death/brain damage in claims associated with general anesthesia were difficult intubation and

maternal hemorrhage (table 5). The seven difficult intubation injuries occurred between 1991 and 1998, mostly upon induction (six of seven cases). These claims involved multiple intubation attempts leading to progressive difficulty with ventilation. In two of the claims, tracheal intubation was assessed preoperatively as being possibly difficult, with a backup plan to awaken the patient and perform fiberoptic intubation. However, progressive airway difficulties occurred while attempting to awaken the patient. In two claims, general anesthesia was induced after failed regional block.

Maternal hemorrhage was associated with an inability of the anesthesiologist to keep up with blood loss despite best efforts (n = 10) and with inadequate fluid replacement in which it should have been possible to resuscitate during surgical bleeding (n = 1). Causes of maternal hemorrhage included subcapsular hepatic bleeding in a preeclamptic patient, placenta previa (n = 2), placenta accreta/placenta percreta (n = 2), and uterine rupture (n = 1).

The most common anesthetic cause of maternal death/brain damage in regional anesthesia claims was high neuraxial block (n = 15; table 5). Twelve claims involved epidural anesthesia (ten accidental intrathecal injections, two high epidural blocks), and three claims

Table 4. Nerve Injury Associated with Obstetric Anesthesia (n = 89) 1990 or Later

	Overall (n = 89), %	Vaginal Delivery (n = 52), %	Cesarean Section (n = 37), %
Location of nerve injury			
Radiculopathy of lumbar or sacral nerve root	48 (54)	24 (46)	24 (65)
Spinal cord injury	16 (18)	11 (21)	5 (14)
Paraplegia	10 (11)	9 (17)	1 (3)
No paraplegia	6 (7)	2 (4)	4 (11)
Femoral nerve	9 (10)	7 (13)	2 (5)
Sciatic nerve	8 (9)	5 (10)	3 (8)
Cauda equina syndrome	3 (3)	0 (0)	3 (8)
Long thoracic nerve	1 (1)	0 (0)	1 (3)
Brachial plexopathy	1 (1)	0 (0)	1 (3)
Nonspecific nerve injury	6 (7)	6 (12)	0 (0)

Percentages may not add to 100% due to rounding errors and multiple nerve injuries in some claims.

Table 5. Causes of Maternal Death/Permanent Brain Damage (n = 69) 1990 or Later

	Overall (n = 69), %	General Anesthesia (n = 28), %	Regional Anesthesia (n = 41), %
High neuraxial block	15 (22)	0 (0)	15 (37)
Maternal hemorrhage	11 (16)	8 (29)	3 (7)
Embolic events	8 (12)	2 (7)	6 (15)
Difficult intubation	7 (10)	7 (25)	0 (0)
Preeclampsia/HELLP syndrome	5 (7)	3 (11)	2 (5)
Medication	5 (7)	0 (0)	5 (12)
Inadequate oxygenation/ventilation	3 (4)	1 (4)	2 (5)
Aspiration of gastric contents	2 (3)	1 (4)	1 (2)
Neuraxial cardiac arrest	2 (3)	0 (0)	2 (5)
Hypertensive intracranial hemorrhage	2 (3)	1 (4)	1 (2)
Central venous catheter	1 (1)	1 (4)	0 (0)
Chorioamnionitis/ARDS	1 (1)	1 (4)	0 (0)
Airway obstruction	1 (1)	1 (4)	0 (0)
Other/unknown	6 (9)	2 (7)	4 (10)

Percentages do not sum to 100% due to rounding error.

ARDS = adult respiratory distress syndrome; HELLP = hemolysis, elevated liver enzymes, low platelet count.

involved subarachnoid blocks. Half (53%) were placed for vaginal delivery, and half (47%) were placed for Cesarean section. Most high blocks associated with epidural anesthesia occurred with dosing of the epidural after negative aspiration for cerebrospinal fluid and an uneventful test dose (generally involving a test dose of 45–80 mg of lidocaine). In two claims, epidurals were repeated at a different interspace due to a wet tap. A high subarachnoid block occurred in two patients despite usual doses of local anesthetic. In most (80%) of the cases of high neuraxial block, there was a delay in recognizing and/or treating the sequelae of the high block (n = 12). In two of these cases, inadequate monitoring contributed to the delay, and four of these patients had to be transferred to the operating room for resuscitation due to inadequate emergency airway equipment or drugs in the labor room. Care was judged as substandard in most (73%) of the claims involving high neuraxial block.

Neuraxial cardiac arrest (defined as the sudden onset of severe bradycardia or cardiac arrest during neuraxial block in the absence of a high block with relatively stable hemodynamics preceding the event)²² occurred in two claims. Of note, there were no claims for maternal death/brain damage due to intravascular injection of local anesthetic. Other causes of maternal death/brain damage included maternal conditions, as shown in table 5.

Claims for maternal death/brain damage were judged as having a possible anesthesia contribution in 64% of claims (kappa = 0.85; $P < 0.001$). There was a significant association of payment by the anesthesiologist with possible anesthesia contribution ($P < 0.001$) and substandard anesthesia care ($P < 0.007$). However, in five claims, payment was made on behalf of the anesthesiologist despite the lack of possible anesthesia contribution to the injury. Factors cited as contributory to payment in these claims included illegible, inaccurate, and incomplete anesthetic records (such as a 30-min gap in the

record at the time of the critical events), anesthesiologist with poor English language skills or who failed boards multiple times, and damaging comments from the obstetrician concerning the anesthesia care.

Discussion

The major finding of this closed claims review is that, compared to pre-1990 obstetric claims, the proportion of maternal death and newborn death/brain damage decreased in obstetric claims from 1990 or later, whereas the proportion of claims for maternal nerve injury increased. Claims for newborn death/brain damage resulted in a lower frequency of payments on behalf of anesthesiologists (21%) than maternal death/brain damage claims (60%). Anesthesia-related claims for newborn death/brain damage were associated with anesthesia delay, poor communication, and substandard anesthesia care.

Limitations of the ASA Closed Claims Database

Analysis of data collected from the ASA Closed Claims project has a number of limitations that have been previously described.^{19,20,23} The database does not contain claims on all adverse anesthetic events, and it lacks denominator data on the number of anesthetics performed annually. Only claims from participating liability insurance organizations are included. Consequently, risk for specific injuries and populations cannot be estimated. Due to the large number of variables examined, false positive findings may result. Other limitations include only modest interobserver agreement regarding appropriateness of care²¹ and outcome bias in the judgment of standard of care.²⁴ Although the long statute of limitations for newborn injury may result in incomplete claims data for newborn brain damage, the year of injury is similar in maternal and newborn claims in this study.

For the purposes of this analysis, we combined claims for death and brain damage because they represent a continuum of severity of injury with similar damaging events. In contrast, other analyses of patterns of injury have focused primarily upon maternal death and newborn brain injury. Despite these deficiencies, the database provides useful information on large numbers of rare adverse events and a snapshot of liability in the practice of anesthesiology.

Comparison of Liability Pre-1990 and Post-1990

Our finding of a decrease in proportion of claims for maternal death and increase in the proportion of nerve injury in the 1990 or later claims compared to earlier claims⁷ may reflect changes in anesthesia practice in general⁸ and in obstetric anesthesia practice specifically over the last three decades.⁹⁻¹¹ These surveys have shown a steady decrease in use of general anesthesia for elective Cesarean sections, along with an increase in use of epidural anesthesia for labor analgesia.⁹⁻¹¹ In addition, the decrease in the proportion of claims for maternal death mirrors those in the closed claims database at large,²⁵ and it may reflect changes in drugs, training, an emphasis on safety, changes in legal strategies, or other events. Decreases in respiratory events in the 1990 or later obstetric claims are probably associated with the use of respiratory system monitors in modern anesthesia practice,⁸ the decrease in the use of general anesthesia in obstetric practice, and the enhanced awareness of the risk of aspiration of gastric contents in the obstetric patient.²⁶ Although claims for newborn death and brain damage still remain a frequent (21%) claim against anesthesiologists, the reduction in these claims over time is probably related to the recognition beginning in the mid-1980s that most cases of newborn brain injury are not related to birth asphyxia.^{5,12-18} Current evidence suggests most cases of newborn brain damage are due to antenatal factors, and only a minority are related to intrapartum hypoxia, most of which are not preventable.^{5,12-18} Increasing public awareness of these antenatal factors may further reduce anesthesiologists' liability for these claims in the future.

Newborn Death and Brain Damage

Anesthesiologist exposure to newborn injury claims may occur because the anesthesiologist serves as a "deep pocket" (especially in the case of an underinsured obstetrician). Although anesthesiologists may be named on

a lawsuit, our study found that anesthesiologist liability (e.g., payments) for newborn death/brain damage was limited, most likely because the obstetrician is primarily responsible for fetal wellbeing.

Obstetric, not anesthetic, causes are more common for peripartum hypoxic brain injury.²⁷ Therefore, working with obstetricians to decrease the incidence of this newborn death and brain damage is probably the best way to reduce anesthesiologists' liability. We found that anesthetic events were rare; other than an intraoperative catastrophe (e.g., difficult intubation, high block, severe hypotension), more than half of anesthesia-related events involved an anesthesia delay that resulted from being away from the hospital or from a poor choice of anesthesia technique. A decision to start of Cesarean delivery interval for emergency Cesarean section within 30 min is the international standard for fetal compromise.^{8,††} Although the scientific evidence to support the standard is weak,^{29,30} failure to meet this target time may be part of the judgment of the substandard care.²⁸ The anesthesia care team should therefore ensure that the patient is ready for surgical incision within 30 min of the decision for Cesarean section; if exceeded, thorough documentation of the reason for delay in the medical record is essential.

Newborn outcome may be improved by better communication between obstetrician and anesthesiologist, particularly concerning the urgency of Cesarean section. In our review, more than a third of anesthesia-related newborn death and brain damage had poor communication between the obstetrician and anesthesiologist. In a 2004 Joint Commission Sentinel Event Alert,^{§§} the leading preventable cause of neonatal death and brain damage in 47 cases was miscommunication between care providers. In many practices, anesthesiologists are on-call for obstetrics from home. This practice may be acceptable in low-risk cases; however, in high-risk patients (e.g., patients desiring vaginal birth after Cesarean section who are at higher risk of uterine rupture), a delay in time to get to the hospital can prove fatal to both mother and baby. Failure to communicate the urgency of a Cesarean section may compound this issue and result in an inappropriate choice of anesthesia technique. Emphasis on improved communication between all providers caring for individual patients, especially those at high risk, may therefore help avoid poor outcomes.³¹

Maternal Death and Brain Damage

The most common anesthetic causes of maternal death or permanent brain damage in the claims included difficult intubation, maternal hemorrhage, and high neuraxial block, consistent with anesthetic causes of death in published reports.³²⁻³⁵ There were no claims related to intravascular injection of local anesthetics, consistent with changes in clinical practice in the mid-1980s with the withdrawal of 0.75% bupivacaine in ob-

†† American Society of Anesthesiologists (ASA) Standards, Guidelines and Statements: Optimal Goals for Anesthesia Care in Obstetrics. Available at <http://www.asahq.org/publicationsAndServices/standards/24.html>, Accessed June 2, 2008.

§§ The Joint Commission Sentinel Event Alert: Preventing infant death and injury during delivery. Issue 30, July 21, 2004. Available at http://www.jointcommission.org/SentinelEvents/SentinelEventAlert/sea_30.htm, Accessed July 16, 2008.

stetrics and increased use of test doses and fractionated administration of local anesthetics.²⁶ The use of a test dose and incremental dosing of epidural catheters is recommended for early detection of accidental intrathecal injection and prevention of high neuraxial block.³⁶ However, delays in recognizing and treating cardiorespiratory collapse secondary to a high block as well as inadequate resuscitation equipment continue to result in maternal injury. Even more cautious incremental dosing of epidurals may aid in early detection of an accidental intrathecal injection and prevent a high block. In the event of a high neuraxial block, all staff should be familiar with the location of the code cart equipped with appropriate equipment and drugs. All epidural carts should include airway equipment and emergency drugs to allow for immediate resuscitation.

Although Mhyre *et al.*³⁵ did not find any cases of anesthesia-related death on induction of general anesthesia in their review of 15 anesthesia-related or anesthesia-contributing maternal deaths in the state of Michigan between 1985 and 2003, difficult intubation resulting in death/brain damage occurred upon induction of anesthesia in our review. These claims originate from injuries in 1991 to 1998 and largely predate widespread use of the laryngeal mask airway as a bridge in the management of difficult intubation. Although our numbers are small, the leading causes of nonanesthesia maternal death/brain damage also reflect those reported in the literature (*e.g.*, embolism, hemorrhage, and hypertensive disease of pregnancy).^{32,34}

Our finding that claims for maternal death/brain damage resulted in a higher frequency of payments on behalf of anesthesiologists reflects an increased likelihood of an anesthesia contribution to the maternal injury compared to newborn injury. In addition, it reflects the ASA policy that the anesthesiologist is primarily responsible for the mother and that personnel other than the surgical team should assume responsibility for resuscitation of the depressed newborn.¶¶ Payments made on behalf of anesthesiologists for maternal death/brain damage were also associated with the judgment of substandard anesthesia care; however, outcome bias may have confounded this judgment.²⁴

Maternal Nerve Injury

Our finding that nerve injury is the most common injury associated with obstetrical anesthesia claims reflects the increased liability for nerve injury with regional anesthesia.³⁷ Although a regional block may have caused the nerve injury in nearly two thirds of the nerve injury claims in our review, nerve injury resulting from obstetric causes (*e.g.*, pregnancy, vaginal delivery, fetal position, maternal position during the second stage of labor) is more likely than nerve injury resulting from regional anesthesia.³⁸ A good knowledge of neuroanatomy together with specialist neurologic examination

and appropriate investigation, such as electromyography, can aid in the accurate diagnosis of nerve injuries. Serious disabling spinal cord injuries resulting in paraplegia were noted in 11% of nerve injury claims, with causes consistent with those described in the literature.³⁹⁻⁴¹

Conclusions

Newborn death/brain damage has decreased, but it still remains a common injury leading to obstetric anesthesia malpractice claims. Maternal nerve injury and newborn death/brain damage were the most common complications in obstetric anesthesia malpractice claims from 1990 or later. Claims for newborn death/brain damage resulted in a lower frequency of payments on behalf of anesthesiologists than maternal death/brain damage claims. Anesthesia-related claims for newborn death/brain damage were associated with anesthesia delay, poor communication, and substandard anesthesia care in response to difficult intubation or block-related hypotension. Delays in diagnosis and resuscitation of high neuraxial block were preventable causes of maternal death/brain damage.

The authors thank John Campos, M.S., Research Consultant, and Linda Stephens, Ph.D., Research Scientist, for data management and also thank Lynn Akerlund, Research Coordinator, for secretarial assistance. They are members of the Closed Claims Project research staff in the Department of Anesthesiology at the University of Washington, Seattle, Washington. The authors also thank the closed claims reviewers from the American Society of Anesthesiologists and the following liability insurance companies who have given permission to be acknowledged: Anesthesia Service Medical Group, Inc., San Diego, California; Armed Forces Institute of Pathology, Silver Spring, Maryland; Ascension Health, St. Louis, Missouri; COPIC Insurance Company, Denver, Colorado; Department of Veterans Affairs, Washington, D.C.; The Doctors' Company, Napa, California; ISMIE Mutual Insurance Company, Chicago, Illinois; MAG Mutual Insurance Company, Atlanta, Georgia; Medical Liability Mutual Insurance Company, New York, New York; Midwest Medical Insurance Company, Minneapolis, Minnesota; Mutual Insurance Company of Arizona, Phoenix, Arizona; NORCAL Mutual Insurance Company, San Francisco, California; Pennsylvania Medical Society Liability Insurance Company, Mechanicsburg, Pennsylvania; Physicians Insurance A Mutual Company, Seattle, Washington; Physicians Insurance Company of Wisconsin, Madison, Wisconsin; Preferred Physicians Medical Risk Retention Group, Shawnee Mission, Kansas; ProMutual (Medical Professional Mutual Insurance Company), Boston, Massachusetts; Risk Management Foundation, Cambridge, Massachusetts; State Volunteer Mutual Insurance Company, Brentwood, Tennessee; The University of Texas Medical System, Austin, Texas; Utah Medical Insurance Association, Salt Lake City, Utah.

References

1. MacLennan A, Nelson KB, Hankins G, Speer M: Who will deliver our grandchildren? Implications of cerebral palsy litigation. *JAMA* 2005; 294:1688-90
2. Barbieri RL: Professional liability payments in obstetrics and gynecology. *Obstet Gynecol* 2006; 107:578-81
3. Hankins GD, MacLennan AH, Speer ME, Strunk A, Nelson K: Obstetric litigation is asphyxiating our maternity services. *Obstet Gynecol* 2006; 107:1382-5
4. Chervenak JL: Overview of professional liability. *Clin Perinatol* 2007; 34:227-32
5. Blumenthal I: Cerebral palsy-medicolegal aspects. *J R Soc Med* 2001; 94:624-7
6. Freeman JM, Freeman AD: No-fault birth-related neurologic injury compensation: perhaps its time has come, again. *Harv Risk Manage Found Forum* 2003; 23:5-6
7. Chadwick HS, Posner K, Caplan RA, Ward RJ, Cheney FW: A comparison of obstetric and nonobstetric anesthesia malpractice claims. *ANESTHESIOLOGY* 1991; 74:242-9

8. Eichorn JH, Cooper JB, Cullen DJ, Maier WR, Philip JH, Seeman RG: Standards for patient monitoring during anesthesia at Harvard Medical School. *JAMA* 1986; 256:1017-20
9. Gibbs CP, Krischer J, Peckham BM, Sharp H, Kirschbaum TH: Obstetric anesthesia: a national survey. *ANESTHESIOLOGY* 1986; 65:298-306
10. Hawkins JL, Gibbs CP, Orleans M, Martin-Salvaj G, Beaty B: Obstetric anesthesia work force survey, 1981 *versus* 1992. *ANESTHESIOLOGY* 1997; 87:135-43
11. Bucklin BA, Hawkins JL, Anderson JR, Ullrich FA: Obstetric anesthesia workforce survey: twenty year update. *ANESTHESIOLOGY* 2005; 103:645-53
12. Blair E, Stanley FJ: Intrapartum asphyxia: a rare cause of cerebral palsy [published correction appears in *J Pediatr* 1988;113:420]. *J Pediatr* 1988; 112: 515-9
13. Badawi N, Kurinczuk JJ, Keogh JM, Alessandri LM, O'Sullivan F, Burton PR, Pemberton PJ, Stanley FJ: Antepartum risk factors for newborn encephalopathy: the Western Australian case-control study. *BMJ* 1998; 317:1549-53
14. Badawi N, Kurinczuk JJ, Keogh JM, Alessandri LM, O'Sullivan F, Burton PR, Pemberton PJ, Stanley FJ: Intrapartum risk factors for newborn encephalopathy: the Western Australian case-control study. *BMJ* 1998; 317:1554-8
15. MacLennan A: A template for defining a causal relation between acute intrapartum events and cerebral palsy: international consensus statement. *BMJ* 1999; 319:1054-9
16. Reddihough DS, Collins KJ: The epidemiology and causes of cerebral palsy. *Aust J Physiother* 2003; 49:7-12
17. Hankins GD, Speer M: Defining the pathogenesis and pathophysiology of neonatal encephalopathy and cerebral palsy. *Obstet Gynecol* 2003; 102:628-36
18. Jacobsson B, Hagberg G: Antenatal risk factors for cerebral palsy. *Best Prac Res Clin Obstet Gynaecol* 2004; 18:425-36
19. Cheney FW, Posner K, Caplan RA, Ward RJ: Standard of care and anesthesia liability. *JAMA* 1989; 261:1599-603
20. Cheney FW: The American Society of Anesthesiologists Closed Claims Project. What have we learned, how has it affected practice, and how will it affect practice in the future? *ANESTHESIOLOGY* 1999; 91:552-6
21. Posner KL, Sampson PD, Caplan RA, Ward RJ, Cheney FW: Measuring interrater reliability among multiple raters: an example of methods for nominal data [published correction appears in *Stat Med* 1992;11:1401]. *Stat Med* 1990; 9:1103-15
22. Caplan RA, Ward RJ, Posner K, Cheney FW: Unexpected cardiac arrest during spinal anesthesia: a closed claims analysis of predisposing factors. *ANESTHESIOLOGY* 1988; 68:5-11
23. Lee LA, Domino KB: The Closed Claims Project. Has it influenced anesthetic practice and outcome? *Anesthesiol Clin North America* 2002; 20:485-501
24. Caplan RA, Posner KL, Cheney FW: Effect of outcome on physician judgments of appropriateness of care. *JAMA* 1991; 265:1957-60
25. Cheney FW, Posner KL, Lee LA, Caplan RA, Domino KB: Trends in anesthesia-related death and brain damage: a closed claims analysis. *ANESTHESIOLOGY* 2006; 105:1081-6
26. D'Angelo R: Anesthesia-related maternal mortality: a pat on the back or a call to arms? *ANESTHESIOLOGY* 2007; 106:1082-4
27. Hove LD, Bock J, Christoffersen JK, Hedegaard M: Analysis of 127 peripartum hypoxic brain injuries from closed claims registered by the Danish Patient Insurance Association. *Acta Obstet Gynecol Scand* 2008; 87:72-5
28. James D: Caesarean section for fetal distress. *BMJ* 2001; 322:1316-7
29. MacKenzie IZ, Cooke I: Prospective 12 month study of 30 minute decision to delivery intervals for "emergency" caesarean section. *BMJ* 2001; 322:1334-5
30. Tufnell DJ, Wilkinson K, Beresford N: Interval between decision and delivery by caesarean section - are current standards achievable? *Observational case series. BMJ* 2001; 322:1330-3
31. American Society of Anesthesiologists Task Force on Obstetric Anesthesia: Practice guidelines for obstetric anesthesia: an updated report by the American Society of Anesthesiologists Task Force on Obstetric Anesthesia. *ANESTHESIOLOGY* 2007; 106:843-63
32. Berg CJ, Atrash HK, Koonin LM, Tucker M: Pregnancy-related mortality in the United States, 1987-1990. *Obstet Gynecol* 1996; 88:161-7
33. Hawkins JL, Koonin LM, Palmer SK, Gibbs CP: Anesthesia-related deaths during obstetric delivery in the United States, 1979-1990. *ANESTHESIOLOGY* 1997; 86:277-84
34. Panchal S, Arria AM, Labhsetwar SA: Maternal mortality during hospital admission for delivery: a retrospective analysis using a state-maintained database. *Anesth Analg* 2001; 93:134-41
35. Mhyre JM, Riesner MN, Polley LS, Naughton NN: A series of anesthesia-related maternal deaths in Michigan, 1985-2003. *ANESTHESIOLOGY* 2007; 106:1096-104
36. Wlody D: Complications of regional anesthesia in obstetrics. *Clin Obstet Gynecol* 2003; 46:667-78
37. Lee LA, Posner KL, Domino KB, Caplan RA, Cheney FW: Injuries associated with regional anesthesia in the 1980s and 1990s: a closed claims analysis. *ANESTHESIOLOGY* 2004; 101:143-52
38. Reynolds F: Auditing complications of regional analgesia in obstetrics. *Int J Obstet Anesth* 1998; 7:1-4
39. Moen V, Dahlgren N, Irestedt L: Severe neurological complications after central neuraxial blockades in Sweden 1990-1999. *ANESTHESIOLOGY* 2004; 101: 950-9
40. Broadbent CR, Maxwell WB, Ferrie R, Wilson DJ, Gawne-Cain M, Russell R: Ability of anaesthetists to identify a marked lumbar interspace. *Anaesthesia* 2000; 55:1122-6
41. Reynolds F: Damage to the conus medullaris following spinal anaesthesia. *Anaesthesia* 2001; 56:238-47