



Medical malpractice and epidural hematomas: a retrospective analysis of 101 cases in the United States

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Background: Neurosurgeons face particularly high rates of litigation compared to physicians in other fields. Malpractice claims are commonly seen after mismanagement of life-threatening medical emergencies, such as epidural haematomas. Due to the lack of legal analysis pertaining to this condition, the aim of this study is to identify risk factors associated with litigation in cases relating to the diagnosis and treatment of epidural haematomas.

Materials and methods: Westlaw Edge, an online database, was used to analyze malpractice cases related to epidural haematomas between 1986 and 2022. Information regarding plaintiff demographics, defendant specialty, reason for litigation, trial outcomes, and payouts for verdicts and settlements were recorded. Comparative analysis between cases that returned a jury verdict in favour of the plaintiff versus defendant was completed.

Results: A total of 101 cases were included in the analysis. Failure to diagnose was the most common reason for litigation ($n = 64$, 63.4%), followed by negligent care resulting in an epidural haematoma ($n = 44$, 43.6%). Spine surgery ($n = 29$, 28.7%), trauma ($n = 28$, 27.7%), and epidural injection/catheter/electrode placement ($n = 21$, 20.8%) were the primary causes of haematomas. Neurosurgeons ($n = 18$, 17.8%) and anesthesiologists ($n = 17$, 16.8%) were the two most common physician specialties cited as defendants. Most cases resulted in a jury verdict in favour of the defense ($n = 54$, 53.5%). For cases ending in plaintiff verdicts, the average payout was \$3 621 590.45, while the average payment for settlements was \$2 432 272.73.

Conclusion: Failure to diagnose epidural haematomas is the most common reason for malpractice litigation, with neurosurgeons and anesthesiologists being the most common physician specialties to be named as defendants. More than half of all cases returned a jury verdict in favour of the defense and, on average, settlements proved to be more cost-effective than plaintiff verdicts.

Keywords: Epidural haematomas, Medical malpractice, Neurosurgery

Introduction

Malpractice in medicine is a common occurrence, affecting physicians of all fields. However, surgical specialists have often been identified as among the most frequently sued physicians, with neurosurgeons among those with the highest rates of paid malpractice claims^[1]. Although medical litigation was historically designed to discourage the use of unsafe treatments and to fairly compensate those who were negligently harmed, fear of litigation has resulted in physicians utilizing an increasingly

HIGHLIGHTS

- Malpractice litigation is a common occurrence for physicians, particularly neurosurgeons.
- Failure to diagnose is the primary reason for legal proceedings in the management of epidural haematomas.
- Settlements are more cost-effective for physicians than plaintiff verdicts.

defensive style of care^[2]. Such practices have been found to result in unnecessary diagnostic testing, leading to greater healthcare costs, and avoidance of patients perceived as contentious or having complex issues^[3]. As a result of the potential deleterious effects of malpractice on the overall health of physicians and the patient-doctor relationship, there has been an increased interest in understanding the factors that contribute to litigation around the management of specific neurosurgical disorders^[4,5].

Epidural haematomas are a potentially life-threatening condition that require prompt diagnosis and treatment to optimize patient outcomes. While such haematomas often occur intracranially due to a traumatic brain injury, bleeding in the epidural space can also develop along the spine and in the setting of surgical procedures, malignancies, vascular malformations, coagulopathic disorders, and infections^[6]. If undiagnosed, epidural haematomas can cause a wide array of deleterious effects, including herniation of the brain, spinal cord compression, seizures, paralysis, coma, and death^[7–10].

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At this time, analysis of litigation cases related to the management of epidural haematomas is limited. The aim of this paper is to identify factors that may increase the rate of litigation or lead to unfavourable legal outcomes for physicians when treating patients with this condition. By doing so, we hope that this information can be utilized to improve patient outcomes, mitigate the risk of physician malpractice, and limit the costs associated with medicolegal proceedings.

Methods

Data collection

A retrospective review of litigation cases related to epidural haematomas between 1986 and 2022 was conducted via Westlaw Edge (Thomas Reuters). This online legal database provides subscription users with attorney verified medicolegal information that has been documented across the United States. Institutional review board (IRB) approval was waived since Westlaw does not contain protected patient information. To identify the most comprehensive list of cases, the search terms “malpractice and epidural haematoma” and “malpractice and epidural hemorrhage” were utilized to query the database. In order to meet inclusion criteria, cases needed to be specifically related to the diagnosis and management of epidural haematomas. Additionally, each case was required to have a specified reason for litigation. Those cases that were duplicates, unrelated to epidural haematoma management, or had a non-medical focus were excluded from the analysis. Each legal document was individually read and analyzed to ensure that inclusion criteria were met. The results have been reported in line with the STROCCS criteria^[11].

Variables of interest

Information related to the geographic location of trials, plaintiff demographics, reasons for litigation, causes of haematomas, plaintiff symptoms, and defendant specialties were collected. Case verdicts and payouts for settlements and jury trials were also recorded. Cases that resulted in a jury verdict were compared and analyzed between those that resulted in favour of the plaintiff versus the defendant.

Statistical analysis

Categorical variables were summarized using frequencies and compared between plaintiff and defendant verdicts using χ^2 or Fisher exact test. Continuous variables were analyzed using means and standard deviations. A *t*-test or Wilcoxon rank-sum test was used for comparative analysis of jury verdicts for parametric or non-parametric variables, respectively. Significance was defined as *p* value less than 0.05. All analyses were performed using SPSS Statistics Version 29.0.0.0 (IBM Corp.).

Results

Demographic information

The cases included in the analysis were comprised of 65 (64.4%) males and 35 (34.7%) females (Table 1). The average plaintiff age was 47.3 ± 23.7 years. Forty-six cases did not provide the age of the plaintiff and one case did not list plaintiff sex.

Geographic distribution

Legal proceedings regarding the management of epidural haematomas occurred in 29 states across the country (Table 1). The majority of cases developed in California ($n = 21$, 20.8%), followed by Florida ($n = 8$, 7.9%), Illinois ($n = 7$, 6.9%), New York ($n = 6$, 5.9%), and Washington ($n = 6$, 5.9%).

Defendant specialty

Hospitals, medical centres, or healthcare systems were the most cited defendants in litigation cases related to the management of epidural haematomas ($n = 57$, 56.4%) (Table 1). Other commonly listed medical specialties included neurosurgery ($n = 18$, 17.8%), anaesthesiology ($n = 17$, 16.8%), emergency medicine ($n = 10$, 9.9%) and orthopaedic surgery ($n = 9$, 8.9%). Sixteen defendant specialties were not listed.

Reasons for litigation

Failure to diagnose an epidural haematoma was the most frequently cited reason for medical malpractice, with 64 cases (63.4%) listing this as a cause for litigation (Table 1). The most common reason for a diagnostic failure was the result of a failure to order a diagnostic test, such as a computed tomography (CT) or MRI ($n = 29$, 45.3%). Inadequate postoperative management was the second most frequently listed reason for failing to diagnose an epidural haematoma ($n = 23$, 35.9%), followed by failure to refer to a specialist ($n = 14$, 21.9%) and incomplete history taking or physical examination by a physician ($n = 12$, 18.8%). Negligent care that resulted in an epidural haematoma was the second most common reason for litigation ($n = 44$, 43.6%). The majority of such cases resulted from a procedural complication or iatrogenic cause ($n = 27$, 61.4%). Medication side effects ($n = 9$, 20.5%), failure to mitigate fall risks ($n = 6$, 13.6%), and inadequate preoperative medical clearance ($n = 3$, 6.8%) were also documented as negligent causes of epidural haematomas. The remaining reasons for litigation included failure of informed consent relating to the management of epidural haematomas ($n = 14$, 13.9%), delayed treatment ($n = 12$, 11.9%), premature discharge ($n = 5$, 5%), and failure to treat ($n = 4$, 4%). Surgical complications ($n = 1$, 1%) during the management of an epidural haematoma and failure to manage postoperative complications ($n = 1$, 1%) were the least cited reasons for malpractice.

Plaintiff symptoms

The most common symptoms that plaintiffs described in the preoperative period, including those patients who never underwent surgery, was paraplegia ($n = 23$, 22.8%) and bowel or urinary incontinence ($n = 20$, 19.8%) (Table 2). Other symptoms included motor deficits ($n = 15$, 14.9%), sensory deficits ($n = 13$, 12.9%), back pain ($n = 10$, 9.9%), and leg pain ($n = 9$, 8.9%). In the postoperative period, bowel or urinary incontinence ($n = 11$, 10.9%), paraplegia ($n = 9$, 8.9%) and death ($n = 9$, 8.9%) were the most commonly reported symptoms.

Causes and locations of epidural haematomas

Spine surgery and trauma were the primary causes of epidural haematomas among plaintiffs that filed medical malpractice lawsuits ($n = 29$, 28.7%; $n = 28$, 27.7%) (Table 3).

Table 1
Summary of key characteristics

	Total cases (n = 101)
Demographic information	
No. males, n (%) ^a	65 (64.4)
No. females, n (%)	35 (34.7)
Plaintiff age in years (mean ± SD) ^b	47.1 ± 23.6
Geographic distribution, n (%)	
California	21 (20.8)
Florida	8 (7.9)
Illinois	7 (6.9)
New York	6 (5.9)
Washington	6 (5.9)
Missouri	5 (5.0)
New Jersey	4 (4.0)
Ohio	4 (4.0)
Texas	4 (4.0)
Alabama	3 (3.0)
Colorado	3 (3.0)
Massachusetts	3 (3.0)
Alaska	2 (2.0)
Arizona	2 (2.0)
Georgia	2 (2.0)
Iowa	2 (2.0)
Louisiana	2 (2.0)
Minnesota	2 (2.0)
Oklahoma	2 (2.0)
Pennsylvania	2 (2.0)
Utah	2 (2.0)
Virginia	2 (2.0)
Hawaii	1 (1.0)
Idaho	1 (1.0)
Michigan	1 (1.0)
Nevada	1 (1.0)
North Carolina	1 (1.0)
South Carolina	1 (1.0)
Tennessee	1 (1.0)
Defendant specialty, n (%) ^c	
Hospital, medical centre, or healthcare system	57 (56.4)
Neurosurgery	18 (17.8)
Anaesthesiology	17 (16.8)
Emergency medicine	10 (9.9)
Orthopaedic surgery	9 (8.9)
Government	7 (6.9)
Nurse	6 (5.9)
Obstetrics and Gynaecology	5 (5.0)
Family medicine	5 (5.0)
Paediatrics	4 (4.0)
Haematology/Oncology	2 (2.0)
Radiology	2 (2.0)
Internal medicine	2 (2.0)
Neurology	2 (2.0)
University	2 (2.0)
Pharmacist	2 (2.0)
Trauma surgery	1 (1.0)
Cardiology	1 (1.0)
Unknown	16 (15.8)
Reasons for litigation, n (%) ^d	
Failure to diagnose	64 (63.4)
Failure to order diagnostic test	29 (45.3)
Inadequate neurosurgical post-op management	23 (35.9)
Failure to refer	14 (21.9)
Failure to take complete history/physical exam	12 (18.8)
Misdiagnosis	4 (6.3)
Failure to interpret diagnostic test	4 (6.3)

Table 1
(Continued)

	Total cases (n = 101)
Negligent care resulting in epidural haematoma	44 (43.6)
iatrogenic/procedural complication	27 (61.4)
Medication side effect	9 (20.5)
Failure to mitigate fall risk	6 (13.6)
Inadequate pre-op medical clearance	3 (6.8)
Failure of informed consent	14 (13.9)
Delayed treatment	12 (11.9)
Premature discharge	5 (5.0)
Failure to treat	4 (4.0)
Surgical complication	1 (1.0)
Failure to manage post-op complication	1 (1.0)

^a1 case did not list sex.

^b46 cases did not list age.

^c56 cases had more than one type of defendant.

^d33 cases had more than one reason for litigation.

Laminectomy was the most common type of spine surgery that resulted in an epidural haematoma (n = 12, 41.4%). Other cited causes included epidural injections/catheter/electrode placement (n = 21, 20.8%), medication side effects (n = 11, 10.9%), obstetric complications (n = 5, 5%), clotting disorders (n = 2, 2%), brain surgery (n = 1, 1%), and lumbar puncture (n = 1, 1%). Twelve cases did not list the cause of the epidural haematoma. Sixty-three cases documented the location of the epidural haematoma to be in the spine (62.4%) and 33 in the intracranial space (32.7%). Five cases did not list the location of the haematoma.

Verdicts and payouts

The majority of cases resulted in a jury verdict in favour the defense (n = 54, 53.5%), followed by plaintiff verdicts (n = 28, 27.7%) and settlements (n = 26, 25.7%) (Table 4). Seven cases listed a dismissal for at least one of the named defendants. One case did not list the legal outcome of the case. For those cases that resulted in a plaintiff verdict, the mean payout was \$3 621 590.54 (range: \$110 000.00–32 400 177.00). The mean settlement payout was \$2 432 272.73 (range: \$80 000.00–24 000 ,000.00). Eight cases resulted in more than one type of jury verdict for the defendants under trial. Four settlement amounts were confidential.

For defendant specialties listed in at least three cases, the highest mean payouts were for cases against neurosurgeons that resulted in a plaintiff verdict (\$13 562 544.25, n = 4) (Table 5; Fig. 1). The next highest mean plaintiff verdict was against cases that listed a hospital, medical centre, or healthcare system as a defendant (\$2 786 673.89, n = 16), followed by orthopaedic surgeons (\$2 520 754.33, n = 3). Among those trials that resulted in a settlement, the highest mean payout for defendants listed in at least 3 cases was against hospitals, medical centres, or healthcare systems for an amount of \$3 493 181.82.

Comparative analysis of jury verdicts

Comparative analysis of court trials that returned a jury verdict revealed that the majority of cases resulted in a defendant rather than plaintiff verdict (Table 6). With the exception of radiologists, a greater proportion of cases that listed a medical specialty or a hospital, medical centre, or healthcare system as a

Table 2
Plaintiff Symptoms

	Total cases (<i>n</i> = 101)
Preoperative, <i>n</i> (%)	
Paraplegia	23 (22.8)
Bowel/urinary incontinence	20 (19.8)
Motor deficits	15 (14.9)
Decreased sensation	13 (12.9)
Back pain	10 (9.9)
Leg pain	9 (8.9)
Cauda equina syndrome	7 (6.9)
Death	7 (6.9)
Cognitive impairment	6 (5.9)
Headache	6 (5.9)
Quadriplegia	5 (5.0)
Hemiplegia	4 (4.0)
Sexual dysfunction	4 (4.0)
Unconsciousness	4 (4.0)
Coma	3 (3.0)
Nausea/vomiting	3 (3.0)
Dilated pupils	2 (2.0)
Seizure	2 (2.0)
Lethargy	2 (2.0)
Vision impairment	1 (1.0)
Hearing impairment	1 (1.0)
Speech impairment	1 (1.0)
Arm pain	1 (1.0)
Respiratory distress	1 (1.0)
Neuropathy	1 (1.0)
Dizziness	1 (1.0)
Paraesthesia	1 (1.0)
Indigestion	1 (1.0)
Memory loss	1 (1.0)
Postoperative, <i>n</i> (%)	
Bowel/urinary incontinence	11 (10.9)
Paraplegia	9 (8.9)
Death	9 (8.9)
Motor deficits	4 (4.0)
Quadriplegia	4 (4.0)
Speech impairment	2 (2.0)
Cognitive impairment	2 (2.0)
Dilated pupils	1 (1.0)
Cauda equina syndrome	1 (1.0)
Sexual dysfunction	1 (1.0)
Neuropathy	1 (1.0)
Decreased sensation	1 (1.0)
Coma	1 (1.0)
Headache	1 (1.0)

defendant resulted in a jury verdict in favour of the defense. However, there was no statistically significant difference between verdict outcome and plaintiff age, sex, geographic location, reason for litigation, or defendant specialty.

Discussion

This study details a 36-year review of medical malpractice cases related to the management of epidural haematomas in the United States. The most common reason for litigation against physicians treating patients with this condition was determined to be a failure in diagnosis (*n* = 64, 63.4%), with lack of appropriate diagnostic testing being the greatest contributing factor (*n* = 29,

Table 3
Cause of Epidural Haematoma

	Total cases (<i>n</i> = 101)
Cause of haematoma ^a , <i>n</i> (%)	
Spine surgery	29 (28.7)
Laminectomy	12 (41.4)
Discectomy	3 (10.3)
Spinal fusion	1 (3.4)
Spine decompression, unspecified	4 (13.8)
Not specified	9 (31.0)
Trauma	28 (27.7)
Epidural injection/catheter/electrode placement	21 (20.8)
Medication side effect	11 (10.9)
Childbirth/obstetric complication	5 (5.0)
Clotting disorder	2 (2.0)
Brain surgery	1 (1.0)
Lumbar puncture	1 (1.0)
Unknown	12 (11.9)
Location of haematoma, <i>n</i> (%)	
Spine	63 (62.4)
Intracranial	33 (32.7)
Not specified	5 (5.0)

^a9 cases had 2 causes of epidural haematoma.

45.3%). At this time, the primary method used to definitively diagnose the presence of epidural bleeding is with the use of MRI or CT imaging. While MRI's have been reported to have similar accuracy rates to the use of CT scans in the acute setting, use of CT imaging remains preferable as they often can be completed with minimal delay, allowing for prompt diagnosis and management of epidural haematomas^[12]. Given that time from symptom onset to surgical evacuation of haemorrhages is negatively correlated with patient outcomes, timely diagnosis of epidural haematomas is imperative^[13]. As a result of the detrimental consequences associated with untreated epidural haematomas, the high rates of litigation associated with a missed diagnosis is of no surprise. In this study, some of the most common symptoms outlined in legal trials for those who did not undergo surgical management included paraplegia (*n* = 23, 22.8%), bowel/urinary incontinence (*n* = 20, 19.8%), motor deficits (*n* = 15, 14.9%), and death (*n* = 7, 6.9%). In review of these outcomes, it may be important for physicians to re-evaluate their threshold for

Table 4
Jury verdicts and mean payouts

	Total cases (<i>n</i> = 101)
Jury verdicts, <i>n</i> (%) ^a	
Defendant	54 (53.5)
Plaintiff	28 (27.7)
Settlement	26 (25.7)
Dismissal	7 (6.9)
Unknown outcome	1 (1.0)
Mean payouts ^b	
Plaintiff verdict	\$3 621 590.45
Settlement	\$2 432 272.73
Plaintiff verdict range	\$110 000.00–\$32 400 177.00
Settlement range	\$80 000.00–\$24 000 000.00

^a8 cases had more than one type of jury verdict.

^b4 settlement amounts were confidential.

Table 5
Average payout of defendants based on medical specialty

Specialty	Average payout	
	Plaintiff verdict	Settlement ^a
Hospital, medical centre, or healthcare system	\$2 786 673.89 (16)	\$3 493 181.82 (14)
Neurosurgery	\$13 562 544.25 (4)	\$637 500.00 (2)
Anaesthesiology	\$903 402.79 (4)	(0)
Emergency medicine	\$1 634 450.50 (2)	\$1 250 000.00 (1)
Orthopaedic surgery	\$2 520 754.33 (3)	\$750 000.00 (1)
Government	(0)	\$2 233 333.33 (4)
Obstetrics and Gynaecology	\$1 100 000.00 (2)	\$1 800 000.00 (1)
Nurse	\$16 472 588.50 (2)	\$1 250 000.00 (1)
Family medicine	(0)	\$5 000 000.00 (1)
Paediatrics	\$3 100 000.00 (1)	\$90 000.00 (2)
Radiology	\$7 882 500.00 (2)	(0)
Neurology	\$32 400 177.00 (1)	(0)
Unknown	\$2 199 600.00 (4)	\$1 372 000.00 (7)

^a4 settlement amounts were confidential.

ordering diagnostic imaging and to consider ordering CT or MRI scans with lower suspicion. Further training to strengthen clinical judgement on the use of imaging studies and revised neuroimaging guidelines may be warranted.

Spine surgery was the most frequently identified cause of epidural haematomas identified in this study ($n = 29, 28.7\%$). It follows that negligent care, primarily due to a procedural or iatrogenic complication relating to spinal procedures, was one of

the most common reasons for litigation among plaintiffs. Compared to all neurosurgical specialties, those who specialize in the spine have been estimated to account for almost 60% of medical malpractice claims^[14]. Given the intricate anatomy of the spine and the potential for serious surgical complications, high rates of litigation for spine surgeries are not unexpected. Previous legal analyses have reported that the majority of malpractice cases pertaining to spine surgery are related to elective rather than emergent procedures, with treatment of back pain, spinal stenosis, and intervertebral disc disease commonly cited in litigation trials^[15,16]. These findings demonstrate the potential need for more in-depth informed consent discussions around elective spinal procedures and increased patient education prior to surgery. Furthermore, the high rates of lawsuits in this study that cited inadequate post-op management of neurosurgical procedures as a reason for litigation highlights the need for enhanced monitoring of patients to timely diagnose potential post-surgical complications.

In this analysis, the most frequently cited defendant specialties were neurosurgeons ($n = 18, 17.8\%$), followed by anesthesiologists ($n = 17, 16.8\%$), emergency medicine physicians ($n = 10, 9.9\%$) and orthopaedic surgeons ($n = 9, 8.9\%$). Given that neurosurgeons are generally responsible for the management of patients with epidural haematomas, it is unsurprising that they are most commonly implicated in lawsuits. Although both neurosurgeons and orthopaedic surgeons can manage spinal procedures, neurosurgeons perform more than three times the number of surgeries in the spine compared to their orthopaedic colleagues^[17]. These results are reflected in the fact that neurosurgeons were implicated in twice as many malpractice cases compared to orthopaedic surgeons. Interestingly, anesthesiologists were among

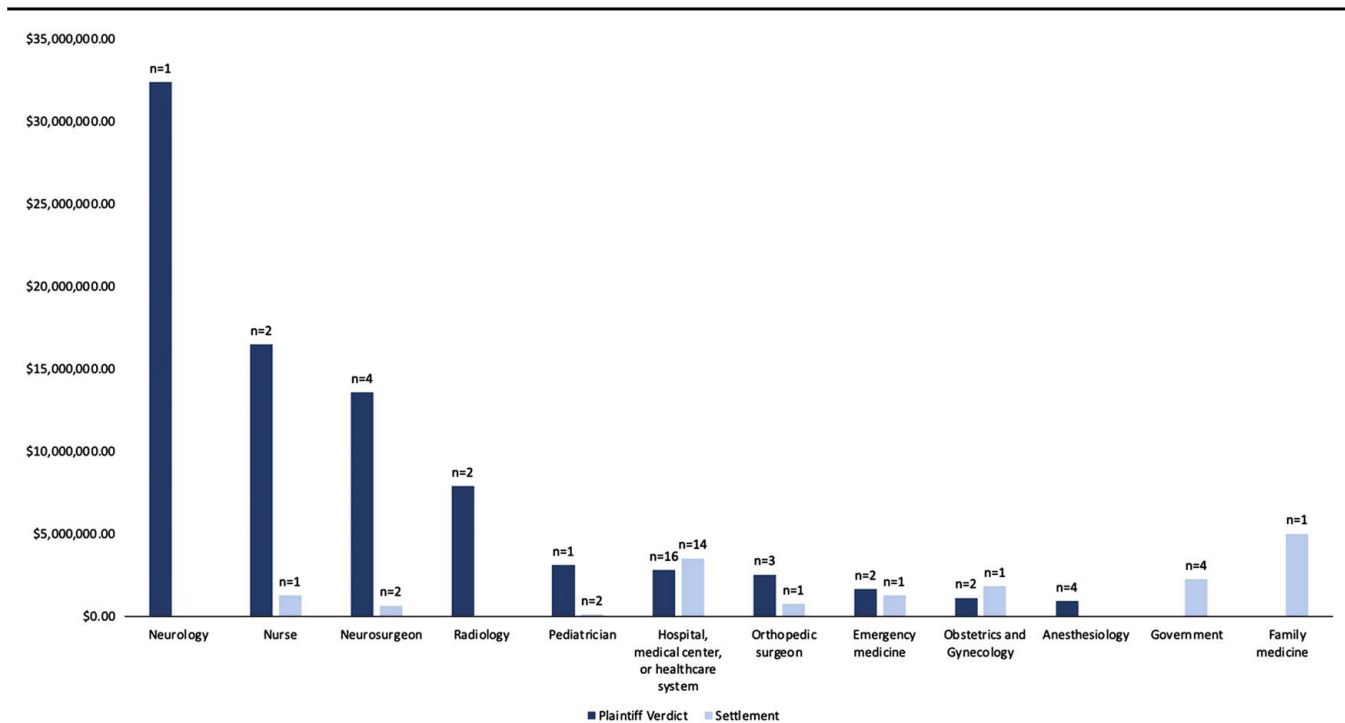


Figure 1. For those specialties listed in at least three litigation cases, neurosurgeons faced the highest mean plaintiff verdict payout ($n = 4, \$13,562,544.25$) and hospitals, medical centres, or healthcare systems had the highest mean settlement rate ($n = 14, 3,493,181.82$).

Table 6
Comparative analysis of defendant versus plaintiff verdicts

	Defendant (n = 54)	Plaintiff ^a (n = 28)	p
Demographics			
Sex, n (%)			0.913
No. females	18 (33.3)	9 (32.1)	
No. males	36 (66.7)	19 (67.9)	
Patient age (years)			
Mean ± SD	48.0 ± 22.3	44.8 ± 24.5	0.664
Range	11–87	0.5–87	
Geographic distribution, n (%)			0.464
California	11 (20.4)	4 (14.3)	
Florida	5 (9.3)	3 (10.7)	
Illinois	2 (3.7)	3 (10.7)	
New York	3 (5.6)	2 (7.1)	
Washington	0	3 (10.7)	
Missouri	3 (5.6)	2 (7.1)	
New Jersey	1 (1.9)	1 (3.6)	
Ohio	4 (7.4)	0	
Texas	3 (5.6)	1 (3.6)	
Alabama	1 (1.9)	2 (7.1)	
Colorado	3 (5.6)	0	
Massachusetts	1 (1.9)	1 (3.6)	
Alaska	1 (1.9)	1 (3.6)	
Arizona	2 (3.7)	0	
Georgia	1 (1.9)	1 (3.6)	
Iowa	1 (1.9)	1 (3.6)	
Louisiana	1 (1.9)	1 (3.6)	
Minnesota	0	1 (3.6)	
Oklahoma	2 (3.7)	0	
Pennsylvania	2 (3.7)	0	
Utah	2 (3.7)	0	
Virginia	2 (3.7)	0	
Nevada	1 (1.9)	0	
North Carolina	0	1 (3.6)	
South Carolina	1 (1.9)	0	
Tennessee	1 (1.9)	0	
Reasons for litigation, n (%)			
Failure to diagnose	32 (59.3)	18 (64.3)	0.658
Misdiagnosis	1 (3.1)	1 (5.6)	
Failure to take complete history/ physical exam	6 (18.8)	3 (16.7)	
Failure to order diagnostic test	14 (43.8)	8 (44.4)	
Failure to interpret diagnostic test	3 (9.4)	2 (11.1)	
Failure to refer	5 (15.6)	4 (22.2)	
Inadequate post-op management	12 (37.5)	8 (44.4)	
Negligent care resulting in epidural haematoma	28 (51.9)	12 (42.9)	0.440
Iatrogenic/procedural complication	16 (57.1)	7 (58.3)	
Medication side effect	6 (21.4)	3 (25.0)	
Failure to mitigate fall risk	3 (10.7)	2 (16.7)	
Inadequate pre-op medical clearance	3 (10.7)	0	
Failure of informed consent	10 (18.5)	4 (14.3)	0.762
Delayed treatment	5 (9.3)	6 (21.4)	0.125
Premature discharge	3 (5.6)	1 (3.6)	1.000
Failure to treat	3 (5.6)	2 (7.1)	1.000
Surgical complication	1 (1.9)	0	1.000
Defendant specialties, n (%)			
Hospital, medical centre, or healthcare system	25 (46.3)	16 (57.1)	0.352
Neurosurgery	11 (20.4)	4 (14.3)	0.563
Anaesthesiology	12 (22.2)	4 (14.3)	0.559
Emergency medicine	7 (13.0)	2 (7.1)	0.711
Orthopaedic surgery	5 (9.3)	3 (10.7)	1.000

Table 6
(Continued)

	Defendant (n = 54)	Plaintiff ^a (n = 28)	p
Government	2 (3.7)	0	0.545
Obstetrics and Gynaecology	2 (3.7)	2 (7.1)	0.603
Nurse	1 (1.9)	2 (7.1)	0.267
Family medicine	4 (7.4)	0	0.294
Paediatrics	1 (1.9)	1 (3.6)	1.000
Haematology/Oncology	1 (1.9)	0	1.000
Radiology	0	2 (7.1)	0.114
Internal medicine	1 (1.9)	0	1.000
Neurology	1 (1.9)	1 (3.6)	1.000
Pharmacist	2 (3.7)	0	0.545
Trauma surgery	1 (1.9)	0	1.000
Cardiology	1 (1.9)	0	1.000

^a1 case returned a plaintiff verdict and defendant verdict for different defendants.

the top defendants named in cases. Although they hold responsibility for the administration of epidural injections, haematomas resulting from these procedures are exceedingly rare^[18,19]. However, previous reports have demonstrated a lack of fully detailed informed consent discussions regarding such procedures, with anesthesiologists describing the possibility of severe complications, such as paralysis and death, with less than half of all patients^[20]. As a result, despite the infrequency with which epidural haematomas may develop in these situations, patients may be more likely to pursue legal action in the event that they do occur.

Jury verdicts in favour of the defendant occurred in the majority of cases ($n = 54, 53.5\%$), with plaintiff verdicts ($n = 28, 27.7\%$) and settlements ($n = 26, 25.7\%$) occurring less frequently. These results support prior medicolegal analyses identifying juries to more often rule in favour of medical defendants than plaintiffs^[21,22]. Comparative analysis revealed that almost every physician specialty listed as a defendant in jury trials was more likely to return a verdict in their favour. Radiologists were the only physicians to return more plaintiff verdicts ($n = 2$), which may demonstrate the decreased tolerance with which jurors have towards the inaccurate identification of epidural haematomas on neuroimaging studies. However, given the small dataset and lack of statistical significance, interpretation of these results is limited. In comparing the payouts of settlements versus jury verdicts, payouts for plaintiff verdicts were \$1 189 317.73 greater than those cases ending in settlements. Furthermore, the highest plaintiff verdict was \$8 400 177.00 greater than the most expensive settlement among the cases included in this study. These results are similar to prior studies demonstrating that settlements offer lower payouts compared to jury verdicts^[21,23]. However, analysis of the factors that may increase the likelihood of entering into a settlement agreement and contribute to the lower costs of settlements compared to plaintiff verdicts is warranted. To start, settlements generally decrease the duration of litigation cases, which limits attorney fees and the overall cost of trial^[24]. This is beneficial for plaintiffs who may prioritize decreasing out-of-pocket expenses and prefer the assurance of receiving a set payment rather than undergo the delays and risk of loss associated with jury trial. Strength of evidence in support of negligent care may also influence the probability that a plaintiff pursues a settlement rather than proceed to trial. Previous studies

have reported that physician defendants are often favored in the legal system, with up to 90% of jury cases favoring physicians in cases with ‘weak’ supporting evidence of malpractice^[25]. Therefore, in cases where plaintiffs may lack strong evidence of negligence, settlements may be preferred when given the option. On the other hand, physicians and hospitals may prefer settlement negotiations prior to entering into a legal trial. This is particularly true for cases with strong evidence of physician liability that are more likely to return a plaintiff verdict associated with greater payout costs compared to cases with minimal proof of negligent care^[26]. Furthermore, the potential publicity of malpractice cases that proceed to lengthy court trials may serve as a deterrent for many physicians who wish to mitigate any damages to their reputation. Weighing the risks and benefits of pursuing a settlement agreement or proceeding to court trial remains a difficult decision and should continue to be made on a case-by-case basis depending on the quality of supporting evidence illustrating proof of appropriate care.

In addition to the results presented in this paper, further work is needed to elucidate the nuances related to medical malpractice litigation and trial outcomes. Given the limited data and granularity of cases presented through Westlaw, development of a more comprehensive and detailed medico-legal database is needed to allow for a more accurate analysis of cases. Additionally, research into plaintiff perspectives regarding reasons for litigation and actions that they believe physician providers may take to mitigate litigation could prove informative. Furthermore, given that a large proportion of cases listed failure to order diagnostic testing as a cause for litigation, future studies investigating physician factors that may lead to failed diagnostic imaging is needed. This is particularly important given recent efforts to reduce defensive medicine practices, therefore, future work investigating the effects of mitigating defensive medicine on patient outcomes will be imperative.

Limitations

Use of the Westlaw database is subject to several limitations that should be addressed. First, the use of a single legal database can result in failure to comprehensively include all cases related to epidural haematoma litigation. Second, as a result of the small sample size included in this study, the strength of statistical analysis remains limited. Furthermore, variability in the level of detail provided by some legal descriptions may reduce the quality of the data gathered and the ability to accurately compare cases. Lastly, this study may lack international generalizability as the cases included in the analysis only focused on litigation occurring within the United States.

Conclusion

This study presents an analysis of 101 cases related to the management of epidural haematomas and malpractice litigation. Failure to diagnose was the most common reason for litigation, with failure to order diagnostic testing as the most frequent cause. Despite increasing awareness of defensive medicine practices, attempts to avoid the overuse of diagnostic imaging in acute care settings should be made with careful consideration. A lower threshold for ordering CT or MR imaging to rule out epidural haematomas may be warranted to prevent misdiagnosis of this

condition, as the consequences of doing so can be devastating. In this paper, elective spine surgery was the most common cause of epidural haematomas resulting in litigation. More detailed informed consent discussions around these procedures and increased patient education prior to surgery may reduce the risk of legal action being pursued. Lastly, given the significantly lower payout rates of settlements compared to jury verdicts, pre-trial agreements may offer considerable benefit to physician defendants.

Ethical approval

No ethics approval was needed for this study. This study was conducted using an online legal database that is publicly available. This database does not contain protected patient information.

Consent

No consent was needed for this experimental research. This study was conducted using an online legal database that is publicly available. This database does not contain protected patient information.

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Author contribution

I.L.P.: conceptualization; data curation; formal analysis; investigation; writing—original draft; writing—review and editing. V.A.: conceptualization; project administration; methodology; resources; supervision; writing—review and editing.

Conflicts of interest disclosure

There are no conflicts of interest.

Research registration unique identifying number (UIN)

No clinical trials were conducted. Information was obtained from an online database containing deidentified, publicly accessible information.

Guarantor

Vijay Agarwal.

Data availability statement

Data are available upon reasonable request.

Provenance and peer review

Not invited.

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