Systematic Review of Malpractice Litigation in the Diagnosis and Treatment of Acute Stroke

Jack J. Haslett, BSc; Lisa Genadry, BSc candidate; Xiangnan Zhang, MSc; Lindsey A. LaBelle, JD, BA; Joshua Bederson, MD; J Mocco, MD, MS; Christopher P. Kellner, MD

Background and Purpose—The emergency management of stroke is complex and highly time-sensitive. Recent landmark trials demonstrating the strong benefit of thrombectomy have led to rapid change in stroke management. This article reviews a large number of medical malpractice lawsuits related to the emergency management of stroke to characterize factors involved in these lawsuits.

Methods—Three large legal databases were used to search for jury verdicts and settlements in cases related to the acute care of stroke patients in the United States. Search terms included "stroke" and "medical malpractice." Cases were screened to include only cases in which the allegation involved negligence in the acute care of a patient suffering a stroke.

Results—We found 246 medical malpractice cases related to the acute management of ischemic stroke and 26 related to intracranial hemorrhage. Seventy-one cases specifically alleged a failure to treat with tPA (tissue-type plasminogen activator) and 7 cases alleged a failure to treat, or to timely treat, with thrombectomy. Overall there were 151 cases (56%) which ended with no payout, 74 cases (27%) were settled out of court, and 47 cases (17%) went to court and resulted in a verdict for the plaintiff. The average payout in settlements was $1 802 693, and the average payout in plaintiff verdicts was $9 705 099.

Conclusions—Malpractice litigation is a risk in acute stroke care and can lead to significant financial consequences. The majority of malpractice lawsuits related to the emergency management of stroke allege a failure to diagnose and failure to treat. Allegations of a failure to treat acute ischemic stroke with tPA were frequently found and are common in lawsuits. Allegations of a failure to treat a large vessel occlusion with thrombectomy were less frequently found. Given recent changes in practice guidelines and the demonstrated strong treatment effect of thrombectomy, it is likely that such litigation will increase in the coming years. **(*Stroke*. 2019;50:2858-2864. DOI: 10.1161/STROKEAHA.119.025352.)**

Key Words: guideline ■ intracranial hemorrhage ■ malpractice ■ risk ■ thrombectomy

In the United States, any patient who believes he or she has suffered injury due to negligence can file a medical malpractice claim. To prove medical malpractice occurred, a plaintiff must show that during the course of treatment, the physician deviated from the standard of care as defined by the medical community, and that substandard treatment caused injury to the patient.[1,2] If a medical malpractice case reaches trial it is typically heard in a state trial court before a jury. Although some states have statutory caps limiting the amount of damages that can be awarded in medical malpractice suits, many states have no cap and damages can potentially total several million dollars.

Medical malpractice suits are, therefore, a concern for any doctor and it has been estimated that up to 99% of doctors in high-risk specialities (eg, neurosurgery, cardiovascular/thoracic surgery, and general surgery) will face a malpractice claim by the age of 65.[1] In turn, it is important to analyze the cause of action that gives rise to each medical malpractice lawsuit, and to analyze the factors that lead to the outcome of the lawsuit. Researchers have previously used legal databases to search for cases related to specific areas of medicine to conduct quantitative analysis of these factors. Previous reviews have focused on litigation in relation to areas of medicine such as neurosurgery,[3] spinal surgery,[4] incidental durotomy tear in spinal surgery,[5] endovascular procedures,[6] management of brain aneurysms,[7] and for giving or not giving tPA (tissue-type plasminogen activator) for acute ischemic stroke (AIS).[8]

With the production of robust clinical evidence in support of thrombectomy for emergent large vessel occlusion (ELVO) in 2015, the medical system now has a highly effective procedure that requires immediate and dramatic changes in policy, prehospital triage systems, procedural oncall teams, and expertise beyond that available at many hospitals. This sudden change in the standard of care requires reorganization in the way these patients are triaged and managed acutely, which may lag behind the new treatment guidelines.

Received February 22, 2019; final revision received July 1, 2019; accepted July 9, 2019.

From the Department of Neurosurgery, Icahn School of Medicine at Mount Sinai, New York City, NY (J.J.H., L.G., X.Z., J.B., J.M., C.P.K.); and University of St Thomas, School of Law, Saint Paul, MN (L.A.L.).

The online-only Data Supplement is available with this article at https://www.ahajournals.org/doi/suppl/10.1161/STROKEAHA.119.025352.

Correspondence to Jack J. Haslett, BSc, Department of Neurosurgery, Icahn School of Medicine at Mount Sinai, One Gustave L Levy Pl, Box 1136, New York, NY 10029. Email jackjhaslett@gmail.com

These changes in care patterns may be reflected in the litigation landscape. This study aimed to analyze litigation related to acute stroke care, to explore common factors involved in these lawsuits and to assess the impact of thrombectomy on this type of litigation.

Methods

This systematic review was performed according to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis guidelines. The data that support the findings of this study are available from the corresponding author on reasonable request.

Databases

The online legal databases Westlaw, LexisNexis, and VerdictSearch were queried for jury verdicts and settlements related to medical malpractice and stroke. Westlaw and LexisNexis are 2 major legal research platforms, each with a jury verdict and settlement database collectively containing over 1.1 million reports. VerdictSearch is a database containing over 200 000 summaries of jury verdicts and settlements. Together, these databases collect information on jury verdicts and settlements from all 50 states and Washington, DC and present the facts of the case, the cause of action, list of attorneys and experts, case analysis, and an award breakdown.

Search Terms

LexisNexis and Westlaw were queried for all jury verdicts and settlements with the terms "stroke" and "medical malpractice." The VerdictSearch database was queried for medical malpractice jury verdicts and settlements with the term "stroke."

Screening Methods

Cases were screened for relevance by reviewers J.J. Haslett and L. Genadry. Any uncertain legal aspects of a case were clarified by reviewer L.A. LaBelle. Relevance was considered to be cases in which the allegation was negligence by a hospital and doctor in the acute treatment of a patient presenting with acute stroke and in which the legal outcome of the case was listed. This included allegations of; failure to timely diagnose, failure to timely treat, failure to timely refer to an appropriate doctor, failure to timely transfer, inappropriate treatment, and lack of informed consent. Cases related purely to stroke management in the subacute phase (eg, falls in hospital, second stroke due to failure to start anticoagulation, failure to refer to rehabilitation) were not considered relevant. Cases claiming malpractice leading to a stroke (eg, chiropractic maneuvers causing dissection and stroke, failure to diagnose transient ischemic attack resulting in a later stroke, strokes suffered due to failure to appropriately anticoagulate) were not considered relevant. Cases which claimed a failure to diagnose an "impending stroke" were not considered relevant where it was unclear that a stroke was occurring at the time of evaluation. Cases in which an ambulance/paramedics failed in the diagnosis/care of stroke patients were excluded. Cases where a stroke was not diagnosed in prison were excluded. Cases of subarachnoid hemorrhage were not included.

Case Factor Classification and Statistics

Multiple factors were collected for each relevant case including state, stroke type; year of stroke and of case/settlement; defendant characteristics; plaintiff characteristics; hospital type; case outcomes; reasons for the lawsuit/allegations; injury severity and others (all factors recorded are listed in appendix 1). Cases with multiple defendants in which there were differing verdicts (eg, one defendant settled out of court and another defendant went to trial and the jury returned a plaintiff verdict) were separated to reflect the different verdicts. Cases in which the report stated that the patient had a stroke but did not specify whether the stroke was ischemic or hemorrhagic were analyzed as ischemic strokes where there was no mention of bleeding or other factors identifying the stroke as hemorrhagic. In cases where a judgment amount exceeded the statutory cap and was reduced to that cap, this reduced amount (which is what would have been paid) is what was listed as the verdict amount. Injury severity was collected where sufficient details were given to assign a patient as mild, moderate, severe, or dead based on the following categories. Severity was categorized as mild (equivalent modified Rankin Scale score of 0–1), moderate (equivalent to modified Rankin Scale score of 2–3), severe (equivalent modified Rankin Scale score of 4–5), and death. Descriptive statistics and *t* tests were run where appropriate.

Results

Case Selection and Characteristics

VerdictSearch returned 363 results, LexisNexis returned 1065 results, and Westlaw returned 797 results. After screening for relevance 251 case descriptions were obtained (Figure). Twenty-one case descriptions contained multiple verdicts totaling 272 cases for analysis. Fifty-six of these were available through VerdictSearch, 133 were available through LexisNexis, and 191 were available through Westlaw. Two hundred and forty-six of these were related to AIS, and 26 were related to intracranial hemorrhage (ICH). Decisions dated from 1987 through 2017. The average time from incident to case outcome was 4.9 years (range, 1–13). Thirty-eight states were represented, with the highest number of cases coming from New York (37 cases), California (34 cases), and Florida (32 cases; full data are available in Table I in the online-only Data Supplement).

Plaintiff and Defendant Characteristics

In 17 cases (6%) the plaintiff sex was not reported, in 149 cases (55%) the plaintiff was male, and in 106 cases (39%) the plaintiff was female. The average plaintiff age at time of verdict was 50 years old (range, 1–102). Racial/ethnic information was not available.

Defendant Characteristics

Seventy-nine cases (30%) included only a doctor/doctors as a defendant, 132 cases (50%) included both a doctor and a hospital as defendants and 53 cases (20%) included only a hospital as a defendant. Nine of these cases also involved a nurse/nurse practitioner/physician's assistant as co-defendants. Two cases were against only a nurse or physician's assistant. Six cases had unknown/confidential defendants. Doctors in a variety of specialties were involved in litigation (Table). Emergency department doctors, primary care physicians/family doctors, and neurologists were frequently named as defendants. Less frequently named specialists included cardiologists, ophthalmologists, anesthesiologists, geriatric doctors, critical care specialists, obstetrician-gynecologists, chiropractors, and others.

The hospital name/details were confidential or not included in 68 cases. There were 171 cases in which the negligence occurred at community hospitals or private clinics, 26 which occurred at academic hospitals and 5 cases which occurred at Veterans Administrations.

Case Details

We found 40 (14.7%) cases which involved strokes which occurred after surgical procedures. Common procedures

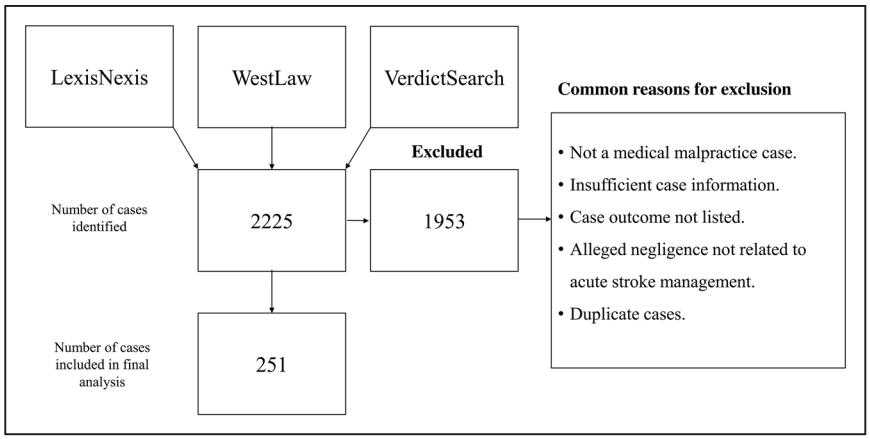

Figure. Flowchart of case search and screening methodology.

included carotid endarterectomy, obstetrics delivery, and angiogram/cardiac catheterization. In 98 (36%) cases, the patient was discharged from the hospital, or not admitted, and subsequently discovered to have suffered a stroke. In these cases, it was claimed that there was a failure to diagnose a stroke-in-evolution. There were 5 cases in which a doctor was named as a defendant where he or she was only involved via a telephone call. In 5 case descriptions, it was explicitly stated that the verdict was reduced to reflect a statutory cap on damages.

Allegations

Common allegations are listed in Table II in the online-only Data Supplement. A failure to diagnose and treat are the most common allegations leading to medical malpractice in the treatment of acute stroke. Less common allegations included lowering blood pressure in AIS and ELVO, giving heparin in a patient who was suffering an ICH and failure to treat a patient suffering a post-carotid endarterectomy stroke. Several cases alleged not only negligence in regard to the treatment of stroke but also contained co-allegations of negligence not related to acute care such as a longer-term failure to medically manage a patient to avoid the stroke and a failure to treat a patient for a fall suffered after a stroke.

Injury Severity

There were 109 cases which did not provide sufficient information to reliably assess injury severity. Two cases only had minor injuries, 41 cases had moderate injuries, 75 cases had severe injuries, and 49 cases involved a deceased plaintiff (Table III in the online-only Data Supplement). More severe injury had higher average payouts with severe injury leading to higher payouts on average than death.

Jury Verdicts, Settlements, and Awards

Overall, cases resulted in 151 outcomes in favor of the defendant where no payout was made (56%), 74 were resolved via a settlement outside of court (27%), and 47 cases went to trial and resulted in a plaintiff verdict (17%). The value of 31 settlements was confidential or not listed so 43 cases listed the settlement amount. For these cases, the mean payout was $1 802 693 (median $1 000 000 and range $7500–$10 000 000). For the 47 plaintiff verdicts, the mean payout was $9 705 099 (median $1 707 790 and range $150 000–$216 849 187). This was not a statistically significant difference (P=0.11) likely because of the large variances in outcomes for both settlements and plaintiff verdicts (Table IV in the online-only Data Supplement).

Of the 272 verdicts analyzed 168 (62%) actually proceeded to a jury trial with the other cases resulting in settlement, arbitration, dismissal, or resolution via some other method. Of these cases which proceeded to a jury trial, there were 127 defense verdicts (76%) and 41 plaintiff verdicts (24%).

ICH Cases

There were 26 cases (10%) in this analysis which were related to ICH. Twelve of these were resolved for the defense with no payout (46%), 7 were settled outside of court (27%), and 7 went to trial and resulted in verdicts for the plaintiff (27%). The average payout in cases which settled was $2 749 975 (median $3 250 000 and range $499 900–$4 000 000), and the average payout in plaintiff verdicts was $8 698 920 (median $1 725 000 and range $248 843–$51 219 782).

Failure to Treat With Thrombectomy

Seven cases alleged a failure to treat or to timely treat with thrombectomy. The strokes leading to these lawsuits were suffered between 2009 and 2012 with the cases being resolved between 2010 and 2016. These cases resulted in 3 defense verdicts with no payout, 1 case resulted in a confidential settlement for an unknown amount, 1 case settled after mediation for $5 300 000 and 2 cases went to trial and resulted in plaintiff verdicts for $3 720 000 and $38 614 587.

Table. Defendant Doctor Specialties

Defendant Specialty	Number
Emergency department doctor	83 (33%)
Primary care physician/family doctor/internist	68 (27%)
Neurologist	43 (17%)
Neurosurgeon/interventional radiologist	23 (9%)
Radiologist	10 (4%)
Other	22 (9%)
Total	249

Allegations and Factors Associated With Defendant Verdicts

Allegations which were more commonly defended (≤40% of cases involved a payout) include a failure to timely treat with no failure to timely diagnose, a failure to treat with tPA, a failure to timely refer to a specialist and allegations of a lack of informed consent.

Having a neurologist named as a defendant was also more likely to result in a verdict favoring the defense. In such cases where a neurologist was named, alone or as a codefendant, 27 were defense verdicts (63%), 12 were settlements (28%), and 5 were plaintiff verdicts (12%).

Allegations and Factors Associated With a Payout

Allegations which commonly resulted in payout (≥60% of cases involved a payout) included failure to timely transfer to another hospital and cases in which it was coalleged the defendant was also negligent in the performance of a surgical procedure which caused the stroke alongside their failure to subsequently timely diagnose/treat it.

Discussion

Due to the time-sensitive and multidisciplinary nature of stroke care, doctors from a variety of specialties can be named in litigation. Emergency department doctors and primary care physicians can often be the first point of contact for stroke patients and are, therefore, at a relatively high risk of litigation. Neurologists are also typically involved in the emergency care of stroke patients and are at risk of being named in litigation. Even doctors not routinely involved with acute stroke patients can have patients suffering strokes present to them and can be found negligent for their subsequent care. Several previous papers have looked at medicolegal aspects of stroke care.[8–13] This is, however, the first quantitative analysis attempting to look broadly at litigation related to the emergency management of acute stroke. We found 272 cases related to the emergency management of stroke. Approximately 10% of these were related to ICH and 90% related to AIS which suggests the likelihood of litigation is similar in both accounting for the prevalence of each disease.

Outcomes

Overall 151 cases (56%) resulted in a verdict favoring the defense and the defendant healthcare providers did not have to make any payment. Included in this group were cases that were dismissed or resolved by a judge without ever making it to trial, cases where the lawsuit was dropped by the plaintiff, and cases which went to court and were resolved in the defendant's favor. Even in such situations where there was no monetary cost there may have been considerable time and emotional costs on the defendant healthcare providers. The finding that more than half of these cases result in no payout is consistent with most previous analysis of this type,[5,6,8,14–19] although not all analysis has shown this.[3,7] In total 74 cases (27%) were resolved via a settlement outside of court. Cases may be settled outside of court for many reasons. From a defendant's perspective, settlement may be favorable because it reduces potential negative publicity for the hospital and doctor and removes the risk of runaway damages. From a plaintiff's perspective a settlement typically guarantees that there will be some recovery as opposed to the risk of losing in court. There were 47 cases (17%) which went to trial and were resolved in a verdict for the plaintiff. In these cases, damages were often considerable. Although several judgements likely exceeded defendant doctors policy limits, previous studies have shown that instances of physicians having to personally pay towards damages are rare and usually small.[20] Discussion on cases which included high-low agreements and of cases which involved statutory caps is included in the online-only Data Supplement.

Case Types

Cases with a stroke after a procedure were relatively common. Common procedures which led to strokes and to litigation included carotid endarterectomies and obstetrics delivery. The allegations in these cases resolved around a failure to diagnose a stroke post-procedure and a failure to timely treat this stroke. This analysis found 5 cases in which a doctor was named as a defendant due only to advice given to a patient, or to another medical provider, over the phone. This included cases where a doctor only spoke to the patient over the phone and failed to interpret stroke symptoms and send the patient to the hospital and cases where a doctor was (allegedly) consulted over the phone in regards to the care of a stroke patient.

Failure to Refer

Neurologists were named as defendants in only 37 (14%) cases. Given that the majority of patients presenting with a possible stroke will have a neurologist involved in their acute care, this percentage is surprisingly low. These cases where a neurologist was named as a defendant led to a payout only 37% of the time. A failure to timely refer to a specialist (typically a neurologist) was an allegation in 59 cases (22%). These numbers suggest doctors put themselves at greater legal risk by not involving a neurologist in the evaluation of a possible stroke patient. It is also possible several lawsuits, which did not have a specified allegation of a failure to involve a neurologist, may have nonetheless been avoided had a neurologist been timely involved.

Injury Severity

In this analysis, the average payout increased as injury severity increased. This is expected given that one of the primary purposes of litigation is to compensate patients for their injuries. Severe injury resulted in higher average payouts than cases in which the patient died. It has been found in previous analyses that severe and permanent injury results in higher payouts than death for medical malpractice cases in general.[21] Stroke can frequently lead to severe and long-term injuries and, therefore, often leads to very high payouts in medical malpractice cases.

Failure to Treat With tPA and Thrombectomy

The approval of tPA for AIS in 1996 gave doctors an effective treatment option for this damaging disease. Litigation related to a failure to give tPA for AIS has steadily risen since with

this analysis discovering a case occurring as early as for a patient suffering a stroke in 1997 with the case taking place in 2001. Previous articles have reported on litigation specifically in relation to tPA for AIS.[8,10,11] In 2015, the American Heart Association provided a Level 1 recommendation for thrombectomy for appropriate patients presenting with ELVO.[22] In many states for a medical malpractice case to be successful a plaintiff will have to prove that, had their illness been treated appropriately, it would have been more likely than not (>50% chance) that they would have had a better outcome. This has been an issue of contention in many cases alleging a failure to treat with tPA and different cases have resulted in different outcomes. There are also a significant number of states which do allow for successful lawsuits in cases where the chance of a better outcome was <50% due to a loss of chance doctrine.[9] The loss of chance doctrine only requires that the alleged negligence resulted in a loss of chance of a better outcome and is a less stringent requirement than the more likely than not doctrine. Whether a state allows recovery due to the loss of chance doctrine has a major effect on whether a medical malpractice lawsuit related to a failure to treat with tPA will be successful. Several trials have shown the benefit of thrombectomy for patients suffering ELVO. The inclusion criteria used varied by trial with most, but not all, trials requiring perfusion imaging demonstrating salvageable penumbra for patient selection. This means that not all ELVO patients are eligible to receive thrombectomy and patient selection is an important factor in the efficacy of this treatment. A patient-level meta-analysis of the randomized clinical trials evaluating thrombectomy published in 2015 demonstrated an odds ratio of 2.49 for reaching functional independence at 90 days and a number needed to treat of 2.6 to decrease 1 point on the modified Rankin Scale.[23] The strong efficacy of this treatment will be an important factor in cases alleging failure to perform thrombectomy and increases the possibility of a successful claim, especially in cases where eligibility can be clearly established.

Another important medicolegal consideration of thrombectomy is the time window for treatment. Thrombectomy was originally approved for up to 6 hours after last known well and the recent American Heart Association stroke guidelines recommended thrombectomy in specific patients up to 16 hours from time last known well with Class of Recommendation 1 and Level of Evidence A backing.[24] This increased window will mean more patients are potentially eligible for treatment. There is now extreme importance on timely evaluation, transfer, and treatment in a system in which only 13% of hospitals in the United States are capable of delivering thrombectomy. Systems of care necessarily lag behind updated recommendations which will likely lead to an increase in litigation related to timely treatment of AIS. One factor which is often involved in cases alleging a failure to give tPA is whether tPA could have been given within the time window for treatment with tPA. The 3-hour window for the use of tPA is well established and most commonly used in lawsuits. The four and a half-hour window for tPA is not unanimously accepted as it was endorsed by the American Heart Association but was not approved by the Food and Drug Administration. Nonetheless, some lawsuits have been filed arguing for the four and a half window as the standard of care for giving tPA. Due to this relatively narrow time window patients presenting outside of this window cannot claim failure to treat with tPA. The original 6-hour window for thrombectomy expanded on this window increasing the potential for ELVO strokes to present within the treatment window. The recent increase to 16 (or 24) hours may further increase the risks or litigation related to failure to diagnose and treat ELVO.

We report here that the average time to resolution of cases involving management of stroke was 4.9 years. The first case related to a failure to treat AIS with tPA occurred 5 years after the guidelines were changed in 1996. Because of this time delay between an incident occurring and a case being concluded, no US cases have yet resolved and been reported after thrombectomy guidelines changed in 2015. As with cases alleging failure to treat with tPA, it is probable that cases alleging failure to perform thrombectomy will increase and there will be an increasing number of claims in the coming years.

Seven cases involving thrombectomy were identified in this review. All of these strokes occurred before 2015. These cases involved multiple allegations (eg, failure to timely diagnose the stroke, failure to give tPA, and a failure to perform thrombectomy) which is likely a factor in why some of these cases led to plaintiff verdicts before the proven efficacy of thrombectomy. Nonetheless the inclusion of a failure to perform thrombectomy as an allegation is surprising and these cases highlight the critical role of factors other than adhering to medical evidence in determining the outcome of a legal case. The cases resulted in 3 defense verdicts with no payout, 1 case resulted in a confidential settlement for an unknown amount, 1 case settled after mediation for $5 300 000 and 2 cases went to trial and resulted in plaintiff verdicts for $3 720 000 and $38 614 587. These are numbers that will likely evolve in the coming years and should incentivize practitioners and hospital systems to upgrade rapidly to meet guidelines and avoid litigation.

Failure to Timely Transfer

Thirty-two cases (12%) in this analysis allege a failure to timely transfer the patient amongst the allegations. Sixty percent of these resulted in a payout which is above the average and suggests that this allegation in more likely to be associated with a payout. The majority of these cases alleged both a failure to diagnose the stroke and a failure to transfer to a hospital better able to diagnose and treat stroke. Only 3 cases alleged a failure to timely transfer a patient without a failure to timely diagnose the stroke. All of these cases resulted in payouts. Given the efficacy of thrombectomy as a treatment for stroke and the increased time window for which it can be beneficial it is likely both diagnosed and undiagnosed ELVO strokes will be at increased risk of litigation with allegations of a failure to timely transfer. One lawsuit in the United Kingdom has been reported on in which an ambulance failed to transport a patient suffering an ELVO in 2015 directly to the correct specialist stroke unit resulting in over £1 million in compensation.[12] This case highlights the medicolegal importance of the timely transport/transfer of stroke patients to the appropriate center able to provide the best possible treatment.

Complications Related to Treating Acute Stroke

Compared with the 71 cases which were found related to failure to treat stroke with tPA only 1 case was found in this analysis related to complications suffered after tPA administration. In this case, a patient suffered a hemorrhage after tPA administration and it was alleged the doctors failed to adhere to tPA administration protocols. This single-case was dismissed via summary judgment meaning that a judge did not find sufficient evidence of negligence to justify sending the case to a jury trial. Several previous articles have focused on medical malpractice related to tPA administration. They have all found litigation related to a failure to give tPA is more common than for cases where tPA was administered[8,10,11,13] although the difference was not quite so pronounced.

No cases related to complications or poor outcome after thrombectomy were found in this analysis. There were also 2 cases found which alleged negligence in administering heparin to a stroke patient before obtaining a computed tomography scan who were found to be suffering an ICH.

Potential Future Legal Issues in Stroke Litigation

Despite the efficacy of both tPA and thrombectomy for treating stroke there are several areas of controversy in AIS which could present future legal questions. One such question which could arise is in relation to patients with ELVO alleging a failure to treat with thrombectomy after the 6-hour window where perfusion imaging was not performed. For these patients, it will be difficult to prove that they met criteria for endovascular therapy without perfusion imaging demonstrating a salvageable area of penumbra. These lawsuits may, therefore, be more likely to lead to payouts in states allowing a loss of chance doctrine. Another area of contention may be in relation to not treating with tPA or thrombectomy for patients presenting with a low National Institutes of Health Stroke Score. It is unclear if doctors choosing not to immediately treat these patients may be at increased risk of litigation should these patients later deteriorate given the finding that litigation related to a failure to treat is much more common than litigation related to complication related to treating AIS.

Limitations

Medical malpractice cases which go to trial can result in payouts which are significantly higher than a typical payout, and a small number of these cases can significantly increase the average. For example, one case resulted in a payout of $216 849 187. This was in a case in which the patient was misdiagnosed by an unlicensed physician's assistant who was only approved to act as a scribe, however, for this patient allegedly conducted the examination of record. The hospital/defence then attempted to hide the PA's involvement. Over $100 million of the damages were punitive damages. For this reason, it is important to also consider medians as well as average payouts in cases which go to trial and result in plaintiff verdicts.

The databases used in this analysis do not offer a comprehensive list of all litigation filed across the United States. It is, therefore, not possible to assess the overall prevalence of stroke litigation or the number of lawsuits relative to the number of strokes. They can, however, be used as a representation of this litigation. These databases are typically used by lawyers when assessing a potential medical malpractice case for precedent in outcome and value. The content available in each database varies by jurisdiction as well as the reporting practices of each jurisdiction, and it is possible there could be some selection bias in the included cases. Furthermore, these databases are also less likely to include cases which are resolved before reaching trial. This is important as up to 85% of malpractice cases are dropped, dismissed, or settled before trial.[7] In addition, medical details are not consistently clearly presented, making it challenging to accurately categorize some cases.

Conclusions

The acute diagnosis and management of stroke is a complex, time-sensitive, and high-stakes area of medicine. Perceived negligence in caring for stroke patients can lead to litigation which can potentially lead to extremely high damages. One possible method of reducing the likelihood of being found liable include a timely referral to a neurologist or other appropriate specialist. Failure to administer tPA is a prevalent allegation in stroke medical malpractice. Allegations of a failure to timely transfer a patient and a failure to timely perform thrombectomy were also seen in this analysis, and it is anticipated that cases with these allegations will increase in frequency in the coming years.

Disclosures

None.

References

1. Jena AB, Seabury S, Lakdawalla D, Chandra A. Malpractice risk according to physician specialty. *N Engl J Med.* 2011;365:629–636. doi: 10.1056/NEJMsa1012370
2. Bal BS. An introduction to medical malpractice in the United States. *Clin Orthop Relat Res.* 2009;467:339–347. doi: 10.1007/s11999-008-0636-2
3. Thomas R, Gupta R, Griessenauer CJ, Moore JM, Adeeb N, Motiei-Langroudi R, et al. Medical malpractice in neurosurgery: a comprehensive analysis. *World Neurosurg.* 2018;110:e552–e559. doi: 10.1016/j.wneu.2017.11.051
4. Daniels AH, Ruttiman R, Eltorai AEM, DePasse JM, Brea BA, Palumbo MA. Malpractice litigation following spine surgery. *J Neurosurg Spine.* 2017;27:470–475. doi: 10.3171/2016.11.SPINE16646
5. Durand WM, Eltorai AEM, Shantharam G, DePasse JM, Kuris EO, Hersey AE, et al. Medical malpractice claims following incidental durotomy due to spinal surgery. *Spine (Phila Pa 1976).* 2018;43:940–945. doi: 10.1097/BRS.0000000000002469
6. Oh K, Savulionyte G, Muluk S. Malpractice litigation in the endovascular era. *J Vasc Surg.* 2018;68:219–224. doi: 10.1016/j.jvs.2017.10.081
7. Gupta R, Griessenauer CJ, Moore JM, Adeeb N, Patel AS, Ogilvy CS, et al. An analysis of malpractice litigation related to the management of brain aneurysms. *J Neurosurg.* 2017;127:1077–1083. doi: 10.3171/2016.9.JNS161124
8. Bhatt A, Safdar A, Chaudhari D, Clark D, Pollak A, Majid A, et al. Medicolegal considerations with intravenous tissue plasminogen activator in stroke: a systematic review. *Stroke Res Treat.* 2013;2013:562564. doi: 10.1155/2013/562564
9. Fisher M, Schneider P. Stroke and the law: principles and practice. *Stroke.* 2014;45:3141–3146. doi: 10.1161/STROKEAHA.114.002864
10. Liang BA, Zivin JA. Empirical characteristics of litigation involving tissue plasminogen activator and ischemic stroke. *Ann Emerg Med.* 2008;52:160–164. doi: 10.1016/j.annemergmed.2007.12.017

11. Bruce NT, Neil WP, Zivin JA. Medico-legal aspects of using tissue plasminogen activator in acute ischemic stroke. *Curr Treat Options Cardiovasc Med.* 2011;13:233–239. doi: 10.1007/s11936-011-0122-0
12. Leung GK, Porter G. Malpractice litigation in acute stroke care - where are we now? *Med Leg J.* 2018;86:134–139. doi: 10.1177/0025817217750494
13. Bambauer KZ, Johnston SC, Bambauer DE, Zivin JA. Reasons why few patients with acute stroke receive tissue plasminogen activator. *Arch Neurol.* 2006;63:661–664. doi: 10.1001/archneur.63.5.661
14. Svider PF, Vidal GP, Zumba O, Mauro AC, Haser PB, Graham A, et al. Adverse events in carotid endarterectomy from a medicolegal perspective. *Vasc Endovascular Surg.* 2014;48:425–429. doi: 10.1177/1538574414544382
15. Branach CS, Khaja MS, Bundy JJ, Chick JFB, Boothman R, Gemmete JJ, et al. Medical malpractice in image-guided procedures: an analysis of 184 cases. *J Vasc Interv Radiol.* 2019;30:601–606. doi: 10.1016/j.jvir.2018.11.025
16. Rynecki ND, Coban D, Gantz O, Gupta R, Ayyaswami V, Prabhu AV, et al. Medical malpractice in orthopedic surgery: a westlaw-based demographic analysis. *Orthopedics.* 2018;41:e615–e620. doi: 10.3928/01477447-20180621-06
17. Oh K, Hingorani A. Outcomes and associated factors in malpractice litigation involving inferior vena cava filters. *J Vasc Surg Venous Lymphat Disord.* 2018;6:541–544. doi: 10.1016/j.jvsv.2018.01.016
18. Phair J, Trestman EB, Skripochnik E, Lipsitz EC, Koleilat I, Scher LA. Why do vascular surgeons get sued? Analysis of claims and outcomes in malpractice litigation. *Ann Vasc Surg.* 2018;51:25–29. doi: 10.1016/j.avsg.2018.02.024
19. Ganesh Kumar N, Hricz N, Drolet BC. Litigation following carpal tunnel release. *Hand (NY).* 2019;14:466–470. doi: 10.1177/1558944718760032
20. Zeiler K, Silver C, Black B, Hyman DA, Sage WM. Physicians' insurance limits and malpractice payments: evidence from texas closed claims, 1990–2003. *J Legal Stud.* 2007;36:S9–S45.
21. Vidmar N. Juries and medical malpractice claims: empirical facts versus myths. *Clin Orthop Relat Res.* 2009;467:367–375. doi: 10.1007/s11999-008-0608-6
22. Powers WJ, Derdeyn CP, Biller J, Coffey CS, Hoh BL, Jauch EC, et al; American Heart Association Stroke Council. 2015 American Heart Association/American Stroke Association focused update of the 2013 guidelines for the early management of patients with acute ischemic stroke regarding endovascular treatment: a guideline for healthcare professionals from the American Heart Association/American Stroke Association. *Stroke.* 2015;46:3020–3035. doi: 10.1161/STR.0000000000000074
23. Goyal M, Menon BK, van Zwam WH, Dippel DW, Mitchell PJ, Demchuk AM, et al; HERMES collaborators. Endovascular thrombectomy after large-vessel ischaemic stroke: a meta-analysis of individual patient data from five randomised trials. *Lancet.* 2016;387:1723–1731. doi: 10.1016/S0140-6736(16)00163-X
24. Powers WJ, Rabinstein AA, Ackerson T, Adeoye OM, Bambakidis NC, Becker K, et al; American Heart Association Stroke Council. 2018 guidelines for the early management of patients with acute ischemic stroke: a guideline for healthcare professionals from the American Heart Association/American Stroke Association. *Stroke.* 2018;49:e46–e110. doi: 10.1161/STR.0000000000000158