



Commentary

MEDICOLEGAL CORNER. Failure to replace obstructed lumbar drain after thoracic-abdominal aortic aneurysm repair leads to paraplegia

Nancy E. Epstein

Clinical Professor of Neurosurgery, School of Medicine, State U. of NY at Stony Brook.

E-mail: *Nancy E. Epstein, - nancy.epsteinmd@gmail.com



***Corresponding author:**

Nancy E. Epstein, M.D.,
Clinical Professor of
Neurosurgery, School of
Medicine, State University of
New York at Stony Brook, New
York, United States.

nancy.epsteinmd@gmail.com

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ABSTRACT

Background: To avoid spinal cord ischemia following endovascular/open thoracic-abdominal aortic aneurysm (T-AAA) repair, lumbar drains (LDs) are placed to reduce intraspinal pressure, and increase spinal perfusion pressure. Here, we present a medicolegal case in which a critical care (CC) physician knew that the LD was obstructed following a T-AAA repair, but did not replace it until the patient became paraplegic. The patient was left with permanent sphincter loss, and a severe paraparesis.

Methods: A geriatric patient with multiple medical/cardiovascular comorbidities first underwent an endovascular T-AAA (Crawford Type II T-AAA) repair several years ago. Due to continued expansion of the aneurysm, the patient now required an open T-AAA repair.

Results: Prior to the open T-AAA surgery, a prophylactic LD was placed. Postoperatively, the patient required a second emergency operation to repair a leaking intercostal artery anastomosis. The next morning, the CC physician clearly documented the drain was obstructed, but chose to follow the patient; 3.5 hours later, the patient became paraplegic. The LD was replaced after the patient was first sent to MRI to rule out a spinal cord hematoma, resulting in a total delay of more than 6.5 h from when the CC physician first became aware of the non-functioning LD. The patient later regained only partial function, remaining significantly paraparetic with total loss of bowel/bladder function.

Conclusion: LD for endovascular/open T-AAA repairs reduce spinal fluid pressure, increase spinal cord perfusion pressures, and limits the frequency (i.e. 2.3–2.6%) of resultant spinal cord ischemia/paralysis. Here, despite the CC physician's failure to replace an obstructed LD after an open T-AAA, repair, the jury rendered a defense verdict.

Keywords: Cerebrospinal fluid pressure, Crawford Type II, Defense verdict, Lumbar drain, Medicolegal corner, Paralysis, Repair, Thoracic-abdominal aortic aneurysm

INTRODUCTION

The literature supports prophylactically using lumbar drains (LDs) to reduce intraspinal pressure (ISP), and thereby increase intraspinal perfusion pressure for patients undergoing endovascular/open thoracic-abdominal aortic aneurysm (T-AAA) surgery.^[1-3] Here we present a medicolegal case in which the critical care (CC) physician followed a geriatric patient for over 3.5 h with a known obstruction of the LD after a Type II Crawford T-AAA repair. Notably, the LD had been found to be obstructed at least 5 hours prior to the CC physician's assessment at 9 AM

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the following morning. Once the patient became paraplegic, the CC physician first ordered a lumbar MR, and then replacement of the LD. This resulted in a total delay of more than 6.5 h from the time the CC physician (i.e. who was taking care of the patient since 9 AM) became aware of the malfunctioning LD, and the time it was actually replaced.

CASE REPORT

Mechanism of increasing Intraspinous Pressure (ISP) with T-AAA repairs

The following equation governs the spinal perfusion pressure (SPP): $SPP = \text{Spinal mean arterial pressure (SMAP)} - \text{ISP}$. During the Crawford T-AAA Type II procedure, cross clamping the aorta increases the mean arterial intracranial pressure, increases the production of intracranial cerebrospinal fluid (CSF), and thus increases the intracranial pressure. This then results in an increase in both intracranial and intraspinal CSF pressures (ISP). Placement of a lumbar spinal drain (LD) prior to these T-AAA operations decreases the ISP, increases SPP, and helps limit the risk of spinal cord ischemia.

Medicolegal case report of patient undergoing open Crawford T-AAA Type II repair

Here, we present a medicolegal case in which a patient undergoing an open T-AAA repair had an obstructed CSF drain after his second T-AAA operation (e.g. reoperation); this was documented at 4 AM. The patient was seen at 9 AM by the CC physician, who simply observed the patient for an additional 3.5 hours after which time the patient became paraplegic. Following an emergent MR that was negative for a postoperative hematoma, a new LD was finally placed a total of 6.5 hours after the CC original consult (i.e. at 9 AM), and 11.5 hours after the obstruction had originally been documented (i.e. at 4 AM).

Original endovascular T-AAA repair

Of note, this geriatric patient with multiple medical/cardiovascular comorbidities had previously undergone a Crawford Type II endovascular Type II T-AAA repair several years previously. Due to further enlargement of the aneurysm, they required an open T-AAA repair. Notably, this operation required cross-clamping the aorta, bypassing the left subclavian artery to the aortic bifurcation, and reimplanting multiple arteries; i.e. several intercostals, both renals, the superior mesenteric artery, and several lumbar arteries. Prophylactically, prior to the index surgery, a LD was placed to reduce the risk of spinal cord ischemia as enumerated above.

Postoperative rebleed requiring secondary surgery

Eight hours postoperatively, the patient rebled and required emergent secondary surgery. Several hours prior to this second

procedure, the LD was found to be obstructed. However, the anesthesiologist “unblocked” the “obstructed” LD just prior to starting the emergent second procedure. When the patient came out of surgery, the cardiovascular nurse noted the drain was not draining (i.e. at 4 AM). Five hours later, at 9 am in the morning, the CC physician documented the drain was obstructed. Rather than order a new drain, the CC chose to follow the patient’s neurological status “every hour”. Finally, 3.5 h after the CC physician had taken over (i.e. now at 12:30 PM), the patient became paraplegic. The CC physician ordered an emergent MR that ruled out a spinal hematoma, and finally a new LD was placed 6.5 h after the CC physician was aware it was obstructed (i.e. at 3:28 pm). Once the new LD was placed, the patient immediately started to improve. However, they ended up with a permanent total loss of bowel/bladder function, and an incomplete sensory/motor paraparesis.

Focused literature review

The literature supports the prophylactic placement of LD’s for patients undergoing Crawford Type II T-AAA surgery.^[1-3] In 2002, Coselli *et al.* evaluated the efficacy of prophylactic placement of CSF drainage (CSFD=LD) prior to Type I/II T-AAA surgery.^[1] CSFD reduced the risk of neurological deficits (no acute paraplegia) to 2/76 patients (2.6%) while 9 of 69 patients without CSFD (13%) developed paraplegia/paraparesis. They concluded that the utilization of prophylactic CSFD reduced the risk of postoperative deficits with Types I/II T-AAA surgery by 80%. Khan *et al.* in 2016, in their review of 10 articles that met their inclusion criteria for “random and fixed-effect meta-analyses” concluded the use of CSFD decreased spinal cord injury for AAA repairs by “nearly half.”^[3] In Epstein’s review article of 2018, CSFD employed for 15–72 postoperative h after T/TL-AAA surgery effectively decreased the risks of spinal cord injury from a maximum of 20% to a minimum of 2.3%.^[3]

DISCUSSION

This case went to court, and the jury of 7 rendered a defense verdict. They concluded that the CC physician met the “standard of care.” In court, the importance of placing a prophylactic LD and its maintaining a functioning drain during/after performing an endovascular/open Crawford Type II T-AAA repair was clearly established. It was also clearly established that the CC physician knew the drain was not working during the 3.5 h that they were responsible for the patient’s care prior to the onset of paraplegia. Despite the known risks of paralysis with a non-functioning LD, nothing was done until the patient became fully paralyzed. This has now left the patient without sphincter function, and severely paraparetic. The question here remains, why the choice of inaction, and the failure to replace the LD in a timely fashion was consistent within the “standard of care.”

Based on a post-verdict juror interview, it appeared that the strongest factors in the jury's consideration were: (1) the defendant CC physician's in-court presentation as a knowledgeable and compassionate practitioner; (2) the fact that the situation requiring replacement of a non-functioning LD in a T-AAA repair patient is an admittedly rare occurrence; and (3) the apparently persuasive testimony of the defense experts that the risks of replacement of the non-functioning LD were substantially higher than the perceived benefit of doing so prior to the onset of a neurological deficit, even in the face of low SMAP values and a non-functioning LD.

It is worth noting that the trial court did not permit cross-examination of the defense experts on the additional 3 h delay between the onset of paralysis and placement of the LD (i.e. from 12:30 pm to 3:28 pm, once the patient became fully paralyzed). As noted above, this delay was caused by the defendant CC physician's ordering of an MRI prior to replacement of the LD. It is suspected that the narrowed scope of that cross-examination may have played a pivotal role in the trial outcome. Instead of allowing the jury to consider the defendant CC physician's failure to immediately replace the LD even at 12:30 pm after the presentation of a profound neurological deficit, the focus of the trial remained on the initial decision not to replace the LD at approximately 9:00 am. As evidenced by the verdict, the jury viewed the defendant CC physician's decision at that time as a reasonably prudent one.

CONCLUSION

LD for endovascular/open T-AAA repairs reduce intraspinal fluid pressures, increase (ISP), increase spinal cord perfusion pressures, and limit the frequency (i.e. 2.3–2.6%) of resultant

spinal cord ischemia/paralysis. Here, despite the CC physician's failure to replace an obstructed LD after an open T-AAA repair, the jury rendered a defense verdict.

Declaration of patient consent

Patient's consent not required as patients identity is not disclosed or compromised.

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Conflicts of interest

There are no conflicts of interest.

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