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Controversies in the Anesthetic Management of Lumbar Drains for Aortic Surgery

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Abstract

Lumbar drain insertion is an integral aspect of perioperative care for patients undergoing thoracoabodminal aortic aneurysm (TAA) repair. It has been shown to reduce incidence of paraplegia when both open and endovascular technique is used. Controversy exists in terms of optimal management of these catheters. This commentary will present current guidelines as well as experienced recommendations for their use.

Keywords: Lumbar drain; Thoracoabodminal aortic aneurysm; Cerebrospinal fluid

Description

Despite the increased use of endovascular techniques for thoracoabdominal aortic aneurysms (TAA), the risk of paraplegia after repair remains a significant concern for both the surgical and anesthesiology teams. Spinal cord ischemia or infarction with subsequent neurologic dysfunction occurs with an incidence of 4-13% after thoracic endovascular aortic repair (TEVAR) [1-3]. Decreased spinal cord perfusion persists postoperatively when episodes of hypotension, hemorrhage and elevated cerebrospinal fluid (CSF) pressure occur, which further increases likelihood of paraplegia after TEVAR [4]. Variation in both recommendations and practice continues to exist due to lack of consensus. Given the high acuity of these patients, the significant morbidity, and the necessity for optimal communication among all members of the perioperative care team, we present the recommendations based on current literature as well as commentary regarding anesthetic practices at our own institution, where a significant number of TEVAR cases are performed.

The greatest risk factors for paraplegia after TEVAR are the extent of endovascular stent coverage and prior distal aortic repair [5]. Increasing spinal cord perfusion through augmentation of arterial pressure, lumbar CSF drainage and reattachment of segmental arteries has been shown to reduce the incidence of paraplegia [6]. Spinal cord perfusion pressure is a function of lumbar CSF pressure subtracted from mean arterial pressure (MAP). Lumbar CSF drainage effectively improves spinal cord perfusion pressure via reduction of CSF pressure. Two separate meta analyses including 3 randomized controlled trials have demonstrated the efficacy of controlled drainage of CSF for prevention of neurological injury [6,7]. At our institution, we highly encourage the placement of lumbar drains for those patients at risk for paraplegia.

The placement of lumbar CSF drains is relatively safe and recommended for TEVAR. However, contraindications to placement include pre-existing coagulopathy, elevated intracranial pressure, and frequently, emergent surgery [8]. The procedure itself carries potential side effects, including intracranial hemorrhage (ICH) and neuraxial hematoma. The American Society of Regional Anesthesia and Pain Medicine (ASRA) advises that instrumentation of the neuraxis be avoided in patients with pre-existing coagulopathy, which may increase risk of bleeding with intrathecal catheter insertion [9]. This risk is elevated with recent or concurrent administration of antiplatelet agents or anticoagulants. In addition, guidelines state that the time from the procedure and anticoagulation dosing should exceed 60 minutes and that the lowest dose of heparin be administered [9].

CSF drainage can be performed prior to the operation in high risk patients or after the procedure if symptoms of spinal cord ischemia occur. The timing of placement varies by center. Benefits of pre-induction placement include knowledge of the baseline CSF pressure, increased length of time prior to anticoagulation as well as knowledge of the patient's pain or paresthesis during placement, which could indicate potential nerve injury [10,11]. In patients pre-screened as high risk or difficult placement, it may be beneficial to place the lumbar drain well before the start of the case when alternative methods such as fluoroscopy can be utilized. Unfortunately, such management requires the patient to be hospitalized preoperatively, which increases cost. Furthermore, prolonged catheter insertion can also place the patient at increased risk for infection [11]. The majority of patients at our institution receive their lumbar drain at the time of surgery. For high risk patients, arrangements are made to have fluoroscopy available at the time of surgery to facilitate placement.

The drain should be placed at the L3-4 or L4-5 level in either the seated or lateral decubitus position. Positioning is at the discretion of the anesthesiologist, as both positions offer advantages. The seated position allows for easier palpation of spinous processes through a midline insertion, which avoids the more lateral epidural plexus. In addition, the improved lumbar flexion allows potentially more space for needle insertion. Thus, the risk for bloody tap is decreased [8]. On the other hand, the lateral decubitus position limits hydrostatic pressure of CSF and therefore the potential risk of over-draining CSF [8]. The drain should be inserted 8-10 cm, however depths as great as 30 cm have been reported [12]. Although deeper insertion minimizes the risk of inadvertent removal, it may also contribute to paresthesias and possible nerve root injuries [8].

Should a bloody tap be encountered during placement, the appropriate response varies by institution. Traumatic instrumentation of the neuraxis has been associated with up to 50% of neuraxial hematomas [8,9]. The occurrence of neuraxial hematoma is rare. In a case series of 162 patients undergoing full heparinization for extracorporeal circulation, there were no spinal hematomas [13]. Another retrospective study, however, reported two spinal hematomas in sixty five patients undergoing TAA repair [10]. At ours and other institutions, if a bloody tap is encountered, the practice is to discontinue drainage and proceed with placement at another level. If bloody tap results a second time, case cancellation is considered after discussion with the operative team [10]. It has been suggested that the case be delayed up to 24 hours, however, based on ASRA guidelines this is only indicated for cases involving full heparinization for cardiopulmonary bypass, and otherwise there is no data supporting case cancellation [8,9].

Animal models have demonstrated a decreased risk for ischemic injury when goal CSF pressure is below 10 mmHg [6]. Studies finding CSF drainage to be ineffective limited the total CSF drained to 50 mL as well as allowing the CSF pressure to elevate above 10 mmHg [6]. Continuous monitoring intraoperatively with intermittent drainage allows awareness of sudden wave form disruption and possible drain occlusion. It also avoids high volume or rate drainage and potential intracranial hypotension. Protocols for CSF drainage from the lumbar drain range from 10 to 20 mL/hour depending on patient condition [8]. However, at our institution, it is rare to have >20 ml/hour drained in neurologically intact patients.

Management postoperatively requires vigilance in serial neurologic examinations. In asymptomatic patients, management goals of CSF pressure should continue to be below 10 mmHg with a rate limit of 10-15 mL/h. Patients with neurologic deficit may require drainage down to 5 mmHg or as much as 20 mL/hour, which has been shown to improve symptoms [8,10]. At our institution, the catheter is opened to passive drainage for CSF pressures greater than 10 mmHg, and pressure is then reassessed after each 15 mL of CSF drained. Maximum CSF drainage rate is 20 mL/hour and up to 250 mL/day. If the pressure is persistently elevated after 150 mL are drained, the drain position is evaluated and the transducer re-zeroed. If the patient reveals any neurologic signs or symptoms, the catheter is drained to below 10 mmHg coupled with blood pressure augmentation to a MAP>90 mmHg.

Blood in the draining CSF is another issue that may be encountered. This may be an indication of an intracranial bleed, the risk of which is associated with excessive CSF drainage and development of intracranial hypotension [14,15]. Bloody drainage has been shown to be a poor marker of an epidural cord hematoma [10]. Should a change in neurologic status accompany blood within the drain, recommended workup includes immediate imaging [8,10]. At our institution, brain imaging is additionally recommended for asymptomatic persistent bloody CSF drainage lasting more than 4 hours.

Based on current literature, drainage should be discontinued after 2-3 days if there is no sign of spinal cord ischemia. After this period, a fibrotic response will have occurred around the catheter, which seals the puncture site. Clamping the drain prior to removal may lead to greater chance of CSF leak secondary to elevated CSF pressure [10]. However, our institution recommends that the drain be clamped for 12-24 hours and the patient monitored for neurologic symptoms prior to removal. If a CSF leak occurs, conservative measures such as bed rest, limiting head of bed elevation and hydration are recommended [10].

Lumbar catheters are usually removed if there is no sign of neurologic dysfunction or spinal cord ischemia. Removal of the lumbar drain should always be performed by an experienced practitioner who is familiar with the catheters. Pulling the catheter out slowly and steadily will reduce the risk of catheter fracture. Positioning in the lateral decubitus position with hip and back flexion increases the space between the vertebrae and spinous processes. This reduces the force required for removal, thus reducing the risk of fracturing the catheter [8]. If catheter breakage occurs, it is essential to perform a CT scan of the spine to determine the track and position of the retained fragment. The decision to remove the retained portion should be made on a case by case basis [16].

It is common in many institutions as well as our own to obtain an anticoagulation profile and platelet count prior to removal of the lumbar drain. For patients on a heparin infusion, it should be discontinued 2-4 hours prior to removal and not restarted for a full 12 hours afterward and coagulation status should be assessed. Indwelling catheters can be removed 2-4 hours after the previous subcutaneous heparin dose, and the next dose administered one hour after removal [9]. Although there is a paucity of evidence, ASRA guidelines do not require assessment of PTT with subcutaneous heparin administered twice or thrice daily. However, at our institution, anticoagulation profiles are recommended since thrice daily dosing may cause an elevation in PTT in some patients [9]. Lastly, the catheter can be removed 12 hours after the last dose of once daily low molecular weight heparin. Twice daily dosing of low molecular weight heparin should not be initiated until after catheter removal. Adequate surgical hemostasis and reversal of coagulopathy should always be assured [9]. Additionally, at our institution, it is common practice to obtain a platelet count prior to drain removal, with 100,000/mcL being the minimal adequate count. Recently, our institutional guidelines were changed to recommend discontinuation of both prophylactic and therapeutic heparin administration to patients with lumbar drains.

The optimal management of lumbar drain catheters for TEVAR lacks consensus and requires further evaluation. Given the number of studies revealing benefit and rare incidence of complications, the procedure will continue to be an integral aspect of perioperative care of these patients. Vigilance is required to evaluate the patient not only for neurologic sequelae of their operation, but for potentially catastrophic consequences of the indwelling drain. Through the use of education and awareness at all levels of care, reduction in paraplegia can be safely achieved.

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