Complications of lumbar drainage after thoracoabdominal aortic aneurysm repair

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Objectives: **Paraplegia remains a frequent complication of thoracoabdominal aortic aneurysm (TAAA) repair. Many adjunct therapies have been developed to address this complication. Lumbar drainage is frequently used in an attempt to decrease intrathecal pressure and improve intramedullary perfusion pressure. The effectiveness of this therapy is unclear, and the complications of lumbar drainage used for this indication are unknown. We present a case of intraspinal hematoma with significant neurologic deficit after TAAA repair and review the associated complications of lumbar drains placed for TAAA.**

Methods: **The charts of all patients undergoing operations for TAAA repair were reviewed. Patients who underwent perioperative placement of a lumbar drain were included regardless of aneurysm type or etiology. Demographics, Crawford grade, and perioperative parameters and complications were reviewed.**

Results: **Sixty-five patients underwent TAAA repair with 62 (95%) receiving a preoperative lumbar drain. There were two (3.2%) intraspinal hemorrhagic complications, including one patient with a poor neurologic outcome. No infections or other complications directly related to drainage were identified. Multivariate logistic regression analysis failed to demonstrate a significant association between lumbar drain complications and perioperative and intraoperative parameters such as blood loss or hypotension, level of drain placement, and Crawford grade.**

Conclusions: **Lumbar drainage is a frequent adjunct to TAAA repair. However, placement of the drain itself can be associated with significant complications whose aggravating factors may be unidentifiable. Complications resulting from lumbar drainage should be considered in any patient who has postoperative lower extremity neurologic deficits. (J Vasc Surg 2001;34:623-7.)**

Paraplegia after repair of thoracoabdominal aortic aneurysms (TAAAs) remains a vexing problem. The operation may be a technical success only to have the patient awaken with profound neurologic deficits. This frightful outcome has been reported to be as high as 24% for TAAAs involving the descending aorta and 40% in dissecting aneurysms.[1] Multiple therapies have been implemented in an attempt to minimize this complication, including cardiopulmonary and aortofemoral pump bypass graft, reimplantation of lumbar and intercostal arteries, hypothermia, evoked potential monitoring, preoperative angiographic identification of spinal cord feeders, and a veritable pharmacopoeia of agents, all without convincing evidence of significant benefit.[2-5] Several recent studies suggest a benefit to perioperative lumbar drainage, but others question this result.[6-10] The thoracolumbar spinal cord receives most of its blood supply through radicular arteries classically described to be most critical at T9 through L2.[3] Cerebrospinal fluid (CSF) drainage is hypothesized to decrease intrathecal pressure, thus increasing medullary perfusion pressure and ultimately minimizing potential spinal cord ischemia. This adjunct therapy has become widely accepted and is frequently used during TAAA repair. Potential complications of lumbar drainage, including neurologic deficits, may be devastating and must not be discounted by the surgeon or anesthesiologist. The complications of drainage used for this purpose should be considered in the decision to place a lumbar subarachnoid catheter. Sequelae of spinal epidural catheters for analgesia and lumbar drains for otolaryngologic and neurosurgical procedures have been addressed in the literature[11-15]; complications of lumbar drainage as an adjunct to TAAA repair have not. This is an increasingly frequent procedure, and the potential risks must be known to derive the overall benefit of drain placement. We have reviewed the cases of TAAA repair at our institution in which lumbar drainage was used in an attempt to determine the frequency of complications and any associated risk factors in this population.

ILLUSTRATIVE CASE

A 58-year-old white man presented to his urologist with a history of abdominal pain initially attributed to peptic ulcer disease that he had for several years. The evaluation included an abdominal computed tomography (CT) scan that demonstrated a Crawford type IV TAAA with suprarenal and infrarenal components measuring 5.5 and 7.5 cm, respectively, and extension into both common iliac arteries. All visceral branches were patent with mild aneurysmal dilatation of the superior mesenteric artery.

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Competition of interest: nil.

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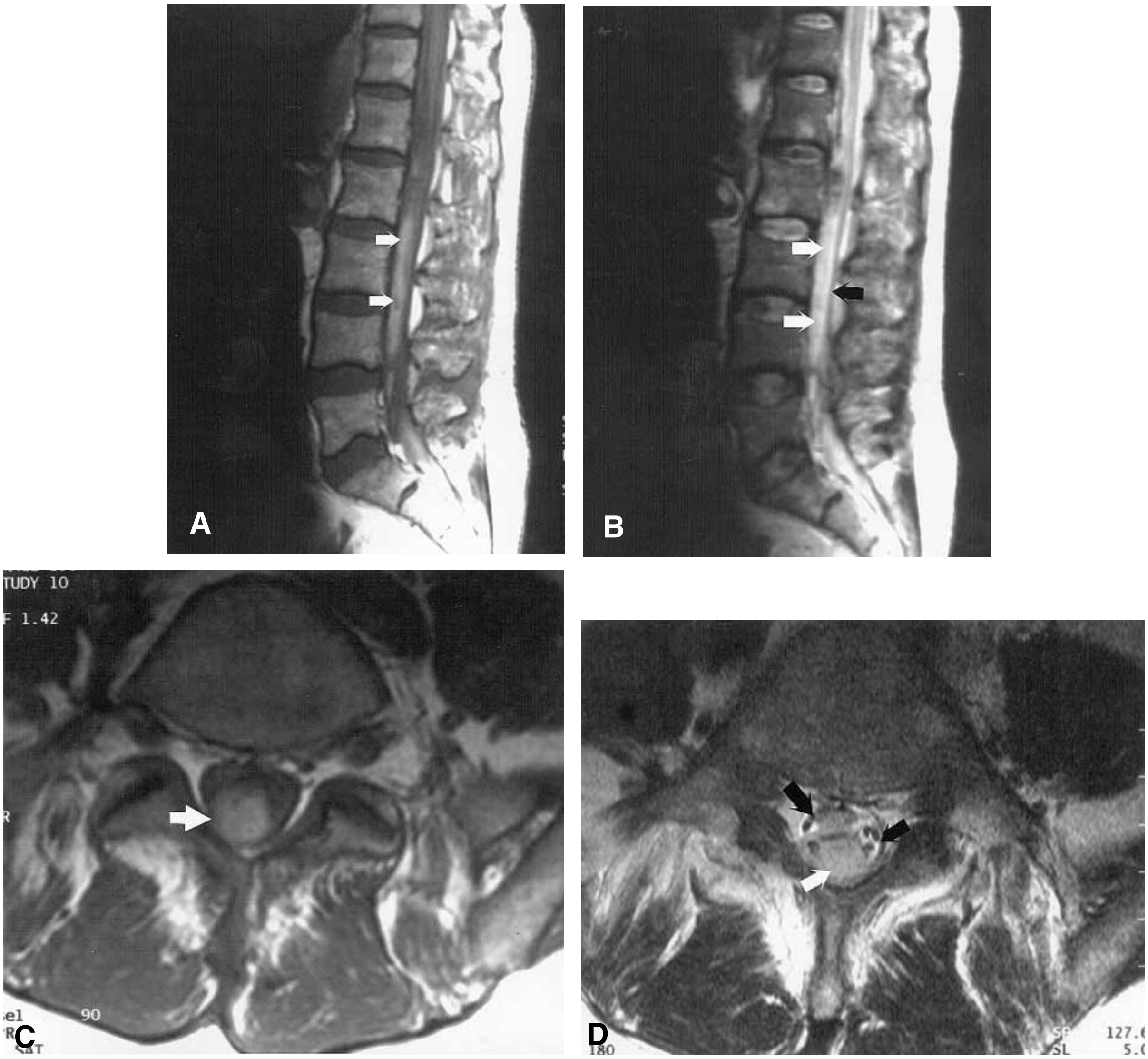

A 58 year-old man with type IV TAAA repair with subsequent paraplegia after removal of lumbar drain. **A,** T1- and **(B)** T2-weighted sagittal magnetic resonance images of the lumbar spine demonstrating mass with signal characteristics of extracellular methemoglobin compressing cauda equina. **C,** T1- and **(D)** T2-weighted axial magnetic resonance images. On all images *white arrows* demonstrate hematoma and *black arrows* the compressed nerve roots of cauda equina.

However, subsequent arteriography demonstrated supradiaphragmatic extension, and the lesion was reclassified as a type III aneurysm.

Before aneurysmorrhaphy, an epidural catheter was placed at T6 through T7 without complications. A lumbar drain was placed at L4 through L5, also without difficulty. An appropriate perioperative waveform was obtained. After initial dissection, the aneurysm was confirmed to be a Crawford type III aneurysm. A cross-clamp was placed on the middescending thoracic aorta. The aneurysm repair was uneventful and included reimplantation of the celiac, superior mesenteric, and right renal arteries as a single cuff. The left renal artery was reimplanted separately. Two small intercostal arteries near the proximal anastomosis were oversewn. The right common iliac artery was unsuitable for grafting, and the right limb of the graft was tunneled to the groin and anastomosed to the right femoral artery. The patient's mental status remained poor immediately after the operation, and the decision was made to continue lumbar drain for pressure monitoring in lieu of an adequate neurologic examination. The drain was removed once the patient awakened, and lower extremity function could be assessed reliably. The lumbar drain was removed on the sixth postoperative day. Lower extremity strength was full bilaterally after drain removal. The next day the patient demonstrated progressive lower extremity paresis with loss of reflexes and rectal tone. Magnetic resonance imaging examination of the lumbar spine was obtained. This study (Figure) demonstrated an acute intradural hematoma compressing the cauda equina. Coagulation parameters remained within normal limits during the perioperative period. The patient was taken for emergency L2 through L5 laminectomies for compression of the neural elements, and the radiographic findings were corroborated. Postoperatively, there was minimal improvement in the patient's lower extremity and bowel function.

PATIENTS AND METHODS

After approval by the University of North Carolina-Chapel Hill School of Medicine Institutional Review Board, a retrospective chart review was conducted. Patients were identified by searching both hospital and division records for codes of the *International Classification of Diseases, Ninth Revision* for TAAA. Inclusion criteria were operation for TAAA and perioperative lumbar drainage. Lumbar drainage catheters were placed by the anesthesia team with the use of standard technique. Briefly, a 14-gauge Touhy needle was inserted into the lumbar subarachnoid cistern preferentially at the L4 to L5 interspace. Once CSF flow from the needle was confirmed, the needle was angled cephalad, and a standard Medtronic (Goleta, Calif) lumbar drain catheter was inserted 30 cm. Data were collected for basic demographics, level of lumbar drainage and spinal epidural catheter placement, comorbidities, intraoperative fluid and blood requirements, blood loss, and intraoperative and postoperative complications.

Analysis of the data was performed with StatView (SAS Institute, Inc, Cary, NC). Multivariate logistic regression analysis was used to determine the contribution of multiple independent variables to the occurrence of lumbar drain–related complications.

RESULTS

Demographics and patient characteristics. Between July 1991 and April 1998, 65 patients underwent operation for TAAA with 62 (95%) having preoperative placement of lumbar drains. All aneurysm etiologies were included in the review with five dissections and two traumatic aneurysms (8.1% and 3.2% of total, respectively). The mean age of patients was 67.1 years. Forty-five (69%) of the patients were male, and 20 (31%) were female. The Crawford grade of the aneurysm was available for all patients (types I-IV: 8%, 16.1%, 32.2%, and 43.5% of patients, respectively).

Lumbar drain characteristics and complications. The level at which lumbar drains were placed was available for 28 patients (45%; Table). The drains were removed on mean postoperative day 2.4 (range, 1-6 days). Drainage parameters such as high, low, and mean pressures, and volume of CSF drained were incompletely documented and thus were not analyzed. Two complications (3.2%) occurred directly as a result of lumbar drainage, both intradural hematomas at the insertion site (one the index case), with only the index case requiring operative decompression. There were no cases of meningitis or infections related to catheter placement. Fifty-six (90%) of 62 patients had preoperative placement of spinal epidural catheters for anesthesia. There were no complications associated with these catheters.

Level of lumbar drain placement

Level	*n*	*% (total n recorded = 28)*
L2-L3	6	21.4%
L3-L4	15	53.6%
L4-L5	7	25%

Surgical variables and complications. Intraoperative variables and complications and postoperative complications were investigated. The overall mortality rate was 8.1% (5/62 with 2 intraoperative and 3 postoperative deaths). Two deaths resulted from emergency operations, one each for traumatic rupture and dissection. Thus, the mortality rate for elective procedures was 4.8% (3/62). Six (9.7%) of 62 patients had postoperative lower extremity paresis. Eleven patients (17%) underwent reimplantation of intercostal arteries. Of the five patients with postoperative neurologic deficits, two (40%) underwent intercostal reimplantation. No perioperative factors were shown by multivariate logistic regression analysis to contribute significantly to complications of lumbar drainage for this specific indication. Similarly, aneurysm Crawford grade, intercostal reimplantation, and placement site of the lumbar drain had no effect on complications, including neurologic, as determined by multivariate logistic regression analysis.

DISCUSSION

Paraplegia after TAAA repair remains a complication of this procedure despite significant research directed toward improving patient outcome. Frequently, the aneurysmorrhaphy itself is technically uncomplicated, but the patient awakens paralyzed with no perioperative or intraoperative factors identified to explain this disappointing result.[16] Many advocate perioperative lumbar drainage in an attempt to optimize spinal cord perfusion pressure. However, when one makes the decision to drain or not, it is imperative to understand that lumbar drainage itself is not a benign procedure. Complications from lumbar drainage may mimic signs of iatrogenic spinal cord ischemia, and this may result in a delay in diagnosis.

The paraplegia rate after TAAA repair is proportional to the extent of the aneurysm/repair and number of intersegmental vessels interrupted with Crawford type II aneurysms, having both the highest mortality and paraplegia rates.[1,17,18] A more extensive resection increases the probability of a significant time of spinal cord ischemia by either decreased arterial inflow or impaired venous outflow. Regardless of mechanism, the result is spinal cord injury and some compromise of lower extremity or bowel and bladder dysfunction. This neuronal injury may be confirmed intraoperatively by changes in spinal somatosensory evoked potentials[19-21] and CSF lactate.[22]

Although CSF pressure increases significantly after aortic cross-clamping, no correlation between this increase and increased paraplegia has been consistently documented.[22] The hypothesis that decreased intrathecal pressure by CSF drainage will compensate for decreases in arterial inflow and maintain a reasonable medullary perfusion pressure has prompted a sizable number of studies addressing this adjunctive therapy with demonstration of its utility.[6-9] A recent review by Coselli et al[23] suggests that an 80% relative risk reduction in paraplegia and paraparesis may be obtained with spinal drainage in patients undergoing operations for type I and II aneurysms. Neurologic deficits due to delayed postoperative spinal cord ischemia have also been identified. Work by Safi et al[24] and Azizzadeh et al[25] has shown that these deficits may be reversed if aggressive lumbar drainage is instituted immediately after recognition of the neurologic deterioration. Preoperative placement of lumbar drains by the anesthesiology team is now as frequent an antecedent to TAAA repair as is placement of a spinal epidural catheter. The risks of the latter in this and similar patient populations have been well characterized, whereas those of the former have not.[14] In general, lumbar drains appear to be well tolerated with most of the complications associated with the primary neurologic or otolaryngologic disorder for which the drain was originally placed.[13,15] Infections and complications of lumbar drains placed for these indications are under 5%.[26] However, the patient population undergoing preoperative lumbar drain placement for TAAA repair is significantly different, and the findings for other disease categories is unlikely transferable to this specific group.

There were two complications of lumbar drainage for TAAA at our institution, occurring in 3.2% of the 62 patients with drains placed. As the paralysis rate of less than 10% compares favorably with that reported in the literature, the overall mortality rate is higher and may be due to the inclusion of emergency procedures, post-traumatic aneurysms, and dissections in the analysis. The small number of events and low power of this study confound the ability to find significant associated factors and likely contribute to the high P values derived from the multivariate logistic regression analysis. Coagulopathy, hypotension, intraoperative fluid and blood losses/requirements, and the extent of the pathologic condition could all be expected to contribute to both postoperative paralysis and lumbar drain complication rates. Even more concerning is the lack of any identifiable factors associated with the large intradural hematoma that developed in the index case, as is frequently also the case with postoperative paralysis. Recovery of significant neurologic function after spinal cord ischemia due to traumatic or iatrogenic aortic injury is unfortunately minimal.[27]

Evaluation of the patient after TAAA with delayed neurologic deficits is relatively straightforward. The appearance of blood in the drainage system is an insensitive finding for hematoma because the hematoma may be epidural and thus outside of the CSF space. Similarly, a lumbar catheter accidentally directed cephalad may fail to disclose a dependent hematoma in the lumbosacral subarachnoid cistern. Also, clotted blood may not drain externally and may result in catheter malfunction. The best method for differentiating between ischemia and hematoma-induced neurologic compromise is with magnetic resonance imaging. Ischemia causes increased signal on T2-weighted and diffusion sequences, and the presence of blood and its relative age may be determined by differential signal intensities on T1- and T2-weighted images. However, magnetic resonance imaging may not be feasible in the critically ill patient. Under these circumstances, an emergency CT scan of the spine is recommended. An intraspinal hematoma will be visualized, but ischemia will not. In the presence of delayed neurologic deficits and negative CT findings, a presumptive diagnosis of delayed ischemia should be made and lumbar drainage urgently initiated.

CONCLUSIONS

Lumbar drainage has become a frequent adjunct to TAAA repair in an attempt to decrease the significant rate of postoperative paralysis and its associated devastating effect on quality of life. The literature is replete with studies addressing the benefits, or lack thereof, of perioperative drainage, and further speculation about its merits is beyond the scope and design of this study. This technique ultimately may be proven to decrease paralysis rates, but a solution to this debate is not addressed in this paper. However, in the meantime, the small but real complication rate of lumbar drainage should be considered when making the decision to include this intervention in surgical therapy for TAAA. Any postoperative decrease in lower extremity neurologic functioning should not be assumed to be only a result of thromboembolic or delayed ischemic complications. The possibility of other intraspinal pathologic conditions due to lumbar drainage must also be considered and should be vigorously investigated with CT or magnetic resonance imaging when it occurs during the postoperative period.

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