Case Report

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Development of Postoperative Spinal Arteriovenous Fistula After Lumbar Laminectomy, Decompression, and Posterior Spinal Fusion

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Abstract

Spinal dural arteriovenous fistulas are a rare cause of low back pain, bilateral lower extremity weakness, or pain with sensory changes. They are typically found in males in the fifth and sixth decades of life, associated with a progressive decline in symptoms that make initial diagnosis challenging in some patients. We present a case report and literature review of an 80-year-old woman with a long-standing history of progressively worsening back pain and lower extremity pain that has limited her daily activities. When preoperative MRI of the lumbar spine showed high-grade stenosis and listhesis of L4-L5, the patient was taken to the operating room for an L4-L5 laminectomy, decompression, facetecomy, and instrumented fusion. Her postoperative course did not show improvement of symptoms, which in fact worsened, leading to gait imbalance and instability. Postoperative MRIs of the patient were concerning for a spinal dural arteriovenous fistula, which was confirmed and treated by spinal angiography and embolization.

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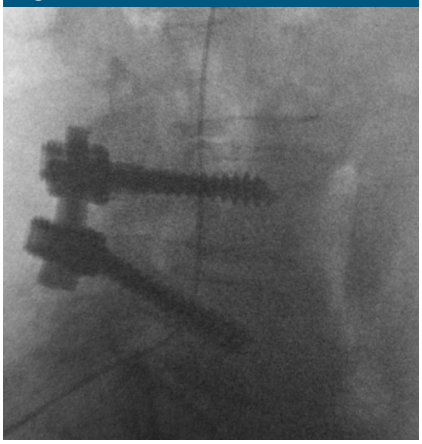
Spinal dural arteriovenous (AV) fistulas are a common type of spinal vascular malformation, accounting for approximately 70% of all lesions.[1] These lesions typically occur during the fifth and sixth decades of life, more frequently in men than in women.[1] Symptoms of presentation range from progressive pain to lower extremity weakness to sensory changes. These symptoms may occur over several years before a diagnosis is made.

A spinal dural AV fistula is caused by an abnormal connection between an artery and vein in the dura of the nerve root sleeve.[1] The arterial inflow into the venous system causes an increase in pressure of the venous plexus, which causes dilation and increased venous drainage into the spinal cord, leading to congestion and intramedullary edema.[1] Most of these fistulas are spontaneous; however, some may be caused by traumatic events.[1]

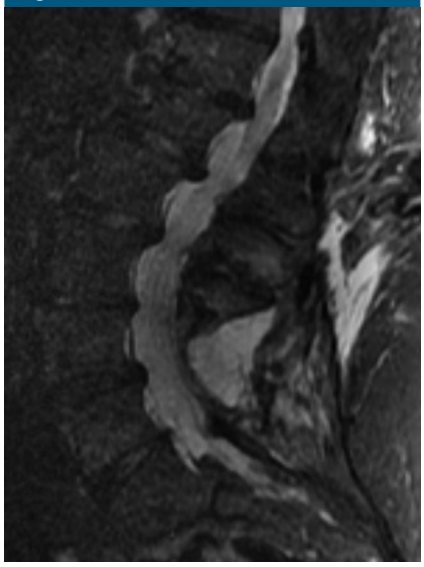
Imaging of the spinal dural AV fistula is typically achieved by MRI, which will show cord enlargement in

Figure 1



Intraoperative fluoroscopy of L4-5 pedicle screw instrumentation.

Figure 2



T2-weighted MRI of sagittal lumbar spine status postdecompression at L4-5.

the lower thoracic region and the conus with signal changes involving multiple levels.[2] On T1-weighted imaging, there is typically intramedullary hypointensity, whereas on T2-weighted imaging, there is typically diffuse intramedullary hyperintensity consistent with edema. However, spinal angiography is the benchmark to confirm the diagnosis of spinal dural AV fistula in most settings.[2]

Treatment options involve occlusion of the shunt to decrease the edema and relieve the symptoms of back pain, lower extremity weakness, pain, or sensory changes. This is commonly performed in an endovascular technique involving glue or *n*-butyl-2-cyanoacrylate (Onyx; Micro Therapeutics), with catheterization of the artery supplying the fistula.[3] Occlusion rates reported in the literature are from 85% to 98%. After treatment and edema of the spinal cord is decreased, typically patients show an improvement in motor and sensory function as well as a decrease in back and lower extremity pain.[4]

Case Report

The patient is an 80-year-old woman with a long-standing history of neurogenic claudication and progressive pain in the bilateral lower extremities. Over the past few years, her symptoms have worsened to the point that she is unable to perform activities of daily living. The patient underwent an MRI of the lumbar spine, which showed a high-grade stenosis at the L4-5 level along with a low-grade listhesis of L4-5. Severe facet hypertrophy was also noted on MRI. After our thorough discussion with the patient regarding the risks and benefits of surgical intervention, she elected to undergo surgical intervention for her severe pain in the back and lower extremities.

A subperiosteal dissection was performed to expose the posterior elements of L4 and L5 out laterally to the transverse processes bilaterally. Severe facet hypertrophy was noted at the L4-5 level. After clearing the transverse processes of L4 and L5, the pedicles of L4 and L5 were tapped for future pedicle screw placement in a typical fashion. Attention was paid to laminectomy and decompression of L4 and L5 as well as partial decompression to the L3 level. After these complete laminectomies were performed at L4-5, facetectomy was required on the left side, as well as partial facetectomy on the right side.

Following complete decompression, pedicle screws were placed. After intraoperative fluoroscopy views were taken to confirm placement of the screws, the screws were secured with appropriate torque. Bone graft was placed into the facet joints, and the wound was thoroughly irrigated and closed in an interrupted fashion (Figure 1).

In the postoperative setting, the patient's neurological examination was consistent with her preoperative examination. She continued to have full strength in the bilateral lower extremities, symmetrical reflexes, and normal sensation to light touch. She did still complain of vague back pain and some pain in the bilateral lower extremities, which was unchanged from the preoperative setting.

Over the next few weeks, the patient remained on rehab facility without complications; however, she reported that her back pain did not improve significantly from the preoperative setting. Then, 8 weeks after surgery, the patient presented to our emergency department after multiple falls and a feeling of worsening bilateral lower extremity weakness and gait imbalance that was not present before surgery.

The patient reported that she had numbness that had been worsening after surgery. Of note, the patient did not have any objective weakness, bowel or bladder dysfunction, saddle anesthesia, or decrease in rectal tone. MRI with and without gadolinium contrast was ordered at the time of examination. A cross section of the lumbar spine MRI is shown in Figure 2.

The MRIs that were obtained were concerning for development of an abnormal signal in the lower thoracic

and lumbar spinal cord. There were numerous regional curvilinear vessels within the thecal sac, which was concerning for a dural AV fistula. After the MRI was completed, neurosurgical and interventional radiology consultation was requested, and recommendations for spinal angiogram were made.

A spinal angiogram was performed that showed a spinal dural AV fistula within the left T7-8 neuroforamen. The left T7 intercostal artery was embolized with Onyx. At that time, the plan was to repeat spinal angiogram and embolization the following day (Figure 3).

The next day, the patient was taken back for repeat spinal angiogram and successful completion of the spinal AV fistula with Onyx and glue through the left T8 intercostal artery. At this time, there was complete occlusion of the spinal dural AV fistula. The patient tolerated the procedure well and was monitored overnight in the surgical intensive care unit without any complication.

In the postoperative setting, the patient was doing very well with near-complete alleviation of her back pain. She did report some form of residual paresthesia in the office at the 6-week and 3-month follow-ups; however, these were improving, as well. Her weakness in the bilateral lower extremities had also improved during each office visit to the point where she is now ambulating without a walker or assistive device.

Discussion

Spinal dural AV fistulas are the most commonly reported venous malformations in the spine. Krings and Geibprasert[5] reported that treatment is aimed at occluding the shunting zone. This aforementioned zone is the most distal part of the artery together with the most proximal part of the draining vein. It is important for the occluding agent to pass through the nidus and reach the proximal segment to prevent intradural collateral filling of the fistula.[5]

There seems to be a male predilection, and symptoms typically arise in the middle age.[5] There was no association of trauma and development of spinal dural AV fistulas reported in 4% of patients in a study by Jellema et al.[6]

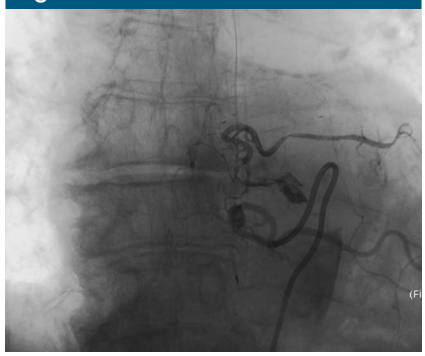
The pathophysiology typically involves a feeding artery that forms an AV fistula within the dorsal surface of the dural root sleeve in the intervertebral foramen.[5,6] This then increases venous pressure and creates chronic venous hypertension and decreased tissue perfusion, leading to spinal cord edema and progressive myelopathy.[6] It has been reported that the radicular veins present in the lower thoracic and proximal lumbar spine are fewer in number and smaller in caliber compared with the veins in the cervical spine.[5,6] Therefore, the venous system in the lower thoracic and proximal lumbar spine is more vulnerable to hemodynamic changes.[6]

Jellema et al[6] reported that there were several factors that were important to consider in these patients: duration of symptoms, pretreatment disability, and success of the procedure to occlude the fistula. In 1974, Aminoff and Logue[7] created a disability scale as a way to describe the long-term follow-up for these patients. Multiple studies have shown a mean reduction of one grade on the Aminoff-Logue motor scale in a large number of patients.[3,8–10]

Our patient did not present in a typical fashion as reported in the literature. Postoperatively, the patient became myelopathic in the lower extremities and developed gait imbalance, coupled with continued back pain and lower extremity pain that did not markedly improve.

We are unaware of any literature at this time that discusses consecutive MRIs and the development of spinal dural AV fistulas. We propose that the mobilization and interrogation of the spinal cord during the decompression may have resulted in a chain of events that worsened the already present spinal dural AV fistula. It is likely that an increase in venous congestion was generated in the postoperative setting that caused cord edema, resulting in the patient's progressive myelopathy and gait imbalance.

Figure 3



Spinal angiogram of the left T8 intercostal artery with Onyx embolization.

Summary

In conclusion, spinal dural AV fistulas represent a rarely encountered entity of the orthopaedic community and can be misdiagnosed in patients with severe spinal stenosis. Understanding the subtle findings that are present on MRIs in the preoperative setting, along with careful history taking, can help provide an accurate diagnosis and provide the patient the best chance at full recovery. With the pathophysiology being well understood, and given successful treatment options, it is important to have awareness and use a multidisciplinary team approach in the treatment of these patients.

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