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Spinal Arteriovenous Fistula: Case Report and Review of the Literature

STH[1], MSI[2],MMR[3],SIK[4],MSB[5]

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Abstract

Spinal arteriovenous malformations(sAVFs) are a rare type of vascular abnormality in the spine that cause vascular engorgement and clinical symptoms related to ischemia and mass impact. Together with a discussion of the most recent classification and imaging techniques, wealso provide the patient's clinical course after a spinal AVM suspicion.

Introduction

An uncommon and diverse set of incorrectly formed spinal blood arteries known as spinal arteriovenous malformations (AVMs) has a higher risk of hemorrhage and morbidity. In particular, these abnormalities cause the shunting of blood from veins with an aberrant capillarybed to arteries. Around 300 spinal AVM cases are diagnosed and treated each year in hospitals [1]. This rarity and variety of AVMs ultimately result in a wide range of therapy choices that depend on the classification of the AVM. It is crucial to comprehend the AVM classification scheme for this reason. While other classification schemes have been employed as our understanding of the formation of AVMs deepens, our report will concentrate on the more popular scheme developed by Anson and Spetzler in 1992. [2]

Pathophysiology

Although the mechanism of spinal AVM development is not fully understood, the majority appear during birth rather than later in life. Around 70% of arterial pressure is conveyed tothe venous system as a result of the shunting of arteriole blood to the venous system without capillary access and resistance [3]. Venous hypertension can lead to numerous neurological impairments brought on by the mass effect, interruption of normal spinal blood flow, and an increased risk of hemorrhage. [4]

Classification

Spinal Dural Arteriovenous Fistula, Type I

Up to 85% of lesions in the spine are spinal Dural arteriovenous fistulas (DAVFs), the most prevalent type of spinal vascular malformation [5]. Five to one in favor of men being affectedby spinal DAVF. In addition, people between the ages of 50 and 60 who have this form of sAVM experience gradually worsening back discomfort or radicular pain [6]. DAVFs are fistulas that exist on the dural surface, as their name suggests. These fistulas discharge intradural fluid retrogradely through the medullary vein and the AV connection to the coronalvenous plexus. Thus, venous plexus engorgement is the most plausible reason for the clinicalappearance.

Intramedullary Arteriovenous Malformation, Type II

The thoracolumbar area, specifically the T4 and L3 levels, is the location where intramedullary AVMs most frequently develop [7]. Type IIAVMs frequently manifest clinically in young adults, with an average age in the mid-20s [8]. Myelopathy related to a mass effect, ischemia, orbleeding may develop in patients. A previous study using a pooled analysis of several studiesfound that the annual hemorrhage rate for type IIAVMs was 4%, rising to 10% for AVMs with prior hemorrhage [9]. The higher mortality rate of intramedullary AVMs is a result of the increased risk of bleeding.

Extradural-intradural artery-venous malformations, type III

Juvenile vascular malformations, also known as intradural-extradural spinal AVMs, are a rare, intricate, and locally aggressive lesion that can affect the bone, muscle, dura, spinal cord, and nerve roots [10]. In one research of 51 individuals, this lesion frequently manifests in younger patients, resulting in an average age of 15.0 years (SD of 10.5) [11]. While type IIIAVMs mightexhibit acute hemorrhages and myelopathy similar to type IIAVMs, they can be distinguished by the presence of symptoms indicating local tissue involvement. The occurrence of spinal instability as a result of vertebral body involvement and degeneration following AVM bleeding is one instance [12]. The major form of treatment is embolization for symptomatic relief and bleeding prevention because type IIIAVMs often have many feeding vessels, endangering the patient's surgical candidacy [11].

Intradural perimedullary venous fistula of type IV

As a result of a shunt between a radicular artery and intradural veins, which causes their engorgement, intradural perimedullary AVFs are an uncommon type of fistula. Although theselesions are uncommon and it can be challenging to estimate their exact incidence rate, recent research found that spinal AVMs generally had a prevalence of between 4% and 17% [13].

Clinically, these lesions show up as subarachnoid hemorrhage, acute neurological impairments,or progressive myelopathy. In order to close the fistula, embolization is typically employed dueto the likelihood of SAH [14]

Imaging/detection

Digital subtractive angiography of the spine (DSA)

The current gold standard for identifying and characterizing spinal AVMs before treatment is spinal digital subtraction angiography (DSA). Nevertheless, a recent study by Chen and Gailloud shown that this designation is a result of historical data where several intraoperative factors led to a greater complication rate. Spinal DSA is frequently characterized as a dangerousoperation resulting to numerous problems. In actuality, the study came to the conclusion that DSA carries a low risk of neurological and systemic consequences [15]. It is significant to note that current research has shown operator-dependent and preventable missed diagnoses in patientpopulations.

Issues included inadequate injection resulting in poor visibility, involvement of veins outside ofthe spine, reported but unidentified lesions, failure to document regions of interest [16].

MRI

The preferred method for initial spinal AVM visualization is MRI. Although MRI lacks the spatial and temporal specificity of DSA, its use to examine the spinal cord and its surrounding tissues can assist reduce the range of possible diagnoses. The presence of cord edema with increased T2 signal and flow voids are significant indicators that can guide surgeons to AVMs. On T2-weighted imaging, a dilated intervertebral vein can also be seen, which should aid in theidentification of an AVM [17].

MRA

A common addition to MRI is magnetic resonance angiography (MRA), which helps to determine how many potential artery feeders may supply the abnormality. As a result, this modality facilitates additional imaging of the spinal AVM using DSA [18]. Moreover, spinalangiography doses of radiation and contrast material can be greatly reduced with the use of MRI.

CTA

For the imaging of spinal AVMs, computed tomographic angiography (CTA) has been shown tobe a reliable choice. The spatial resolution of multidetector spiral CTA has risen recently, enabling wider use of this modality [19]. DSA is a more relevant modality for pre-operative planning, nevertheless, due to its greater spatial resolution [19].

Case Presentation

A 60-year-old man came in with the main complaint of progressively weakening and numbing bilateral lower extremities. The patient said that after feeling lower extremities numbness, he had visited another hospital, where tests had been done and he had been released. He tried to walk home, but it was too late. The patient came to our facility for a reevaluation of his ongoingbilateral lower extremities paralysis due to the recurrence of his symptoms.

The patient had saddle anesthesia when examined physically. A Foley catheter was placed uponadmission for urine retention, despite the patient's denial of bowel or bladder incontinence.

According to American Spinal Cord Injury Association (ASIA) standards, the patient had a T11sensory level and was classified as ASIA A. A thoracic spine MRI with and without contrast was requested, and the findings on T2 weighted imaging aroused concern for a spinal AVM at T9-10 (Figure 1)

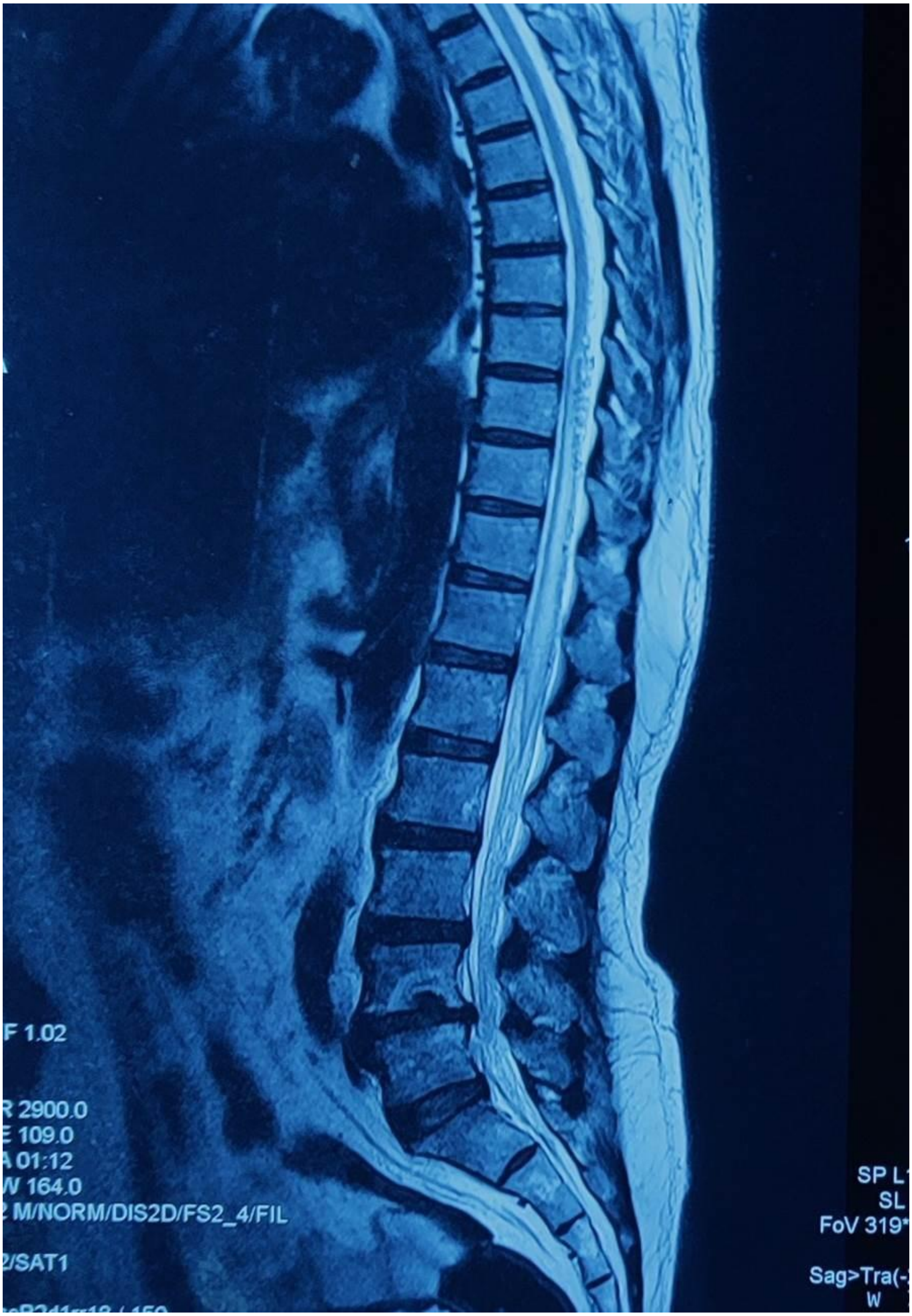

Figure 1: pre operative MRI, T2 weighted

Preoperative spinal digital subtraction angiography was performed on the patient to characterizethe lesion and rule out the possibility of AVM embolization. The right pedicle of T9 was the location of the nidus, which was around 1 cm in size (Figure 2). The lesion covered the T7 through T11 vertebrae. The patient was transferred to the operating room (OR) for surgery fromthe angiography suite. A feeding artery was discovered penetrating the dura close to the inferior edge of the right T9 pedicle after a right-sided hemi-laminectomy and durotomy were done at T8-T11. This artery was surrounded by several arterialized veins. Cauterization was done by bipolar diathermy and there was no longer any flow within the vascular malformation when the micro-doppler was used for auscultation. After surgery, the patient was brought back to the angiography room to ensure that the AVF had been removed. Digital subtraction angiography revealed that the pedicle of T9 was not the source of any remaining AVM. Also, it attested to the artery of Adamkiewicz's preservation.

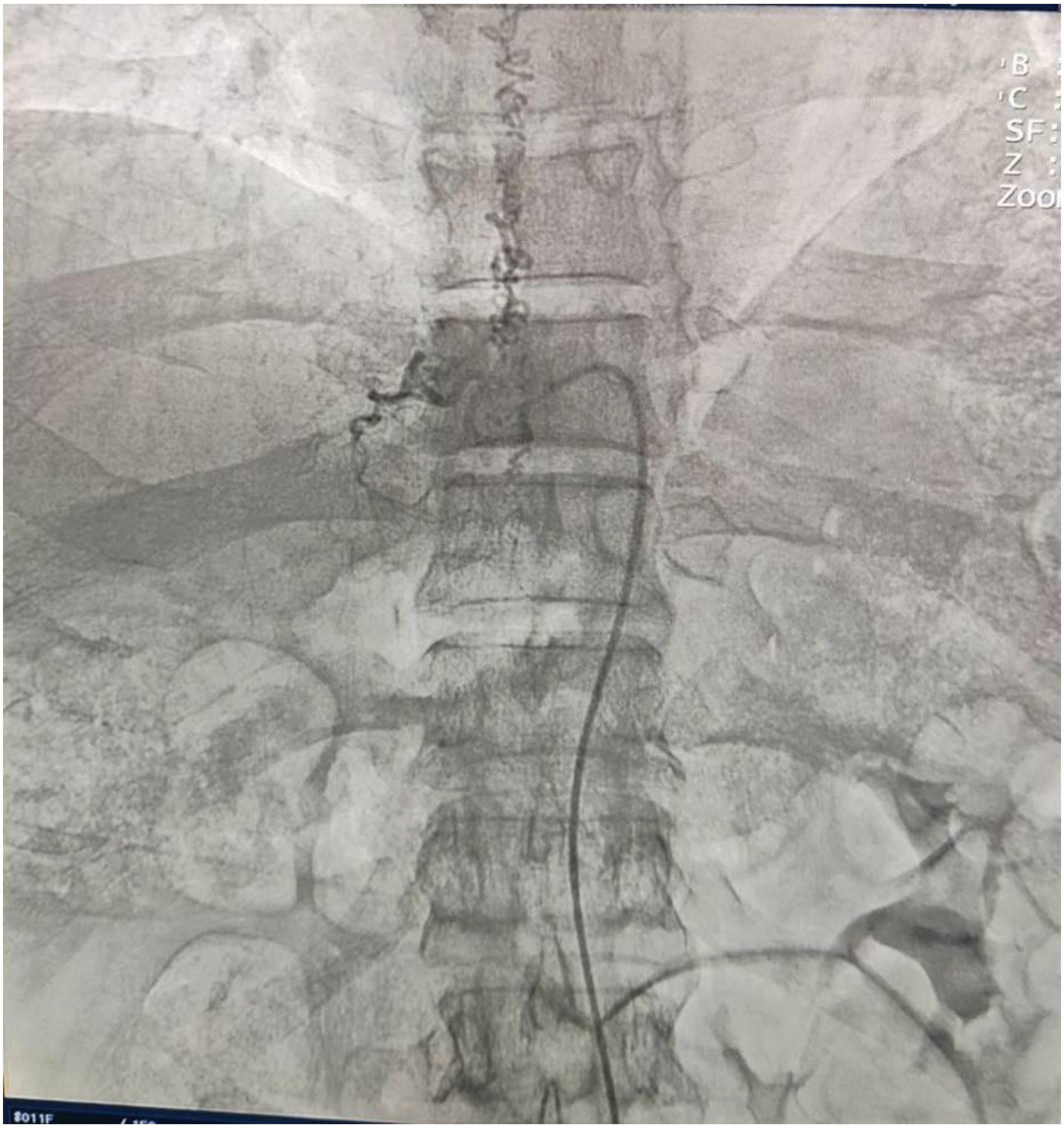

Figure-2: spinal digital subtraction angiogram showing theAVM with the nidus at the right D9-10 level.

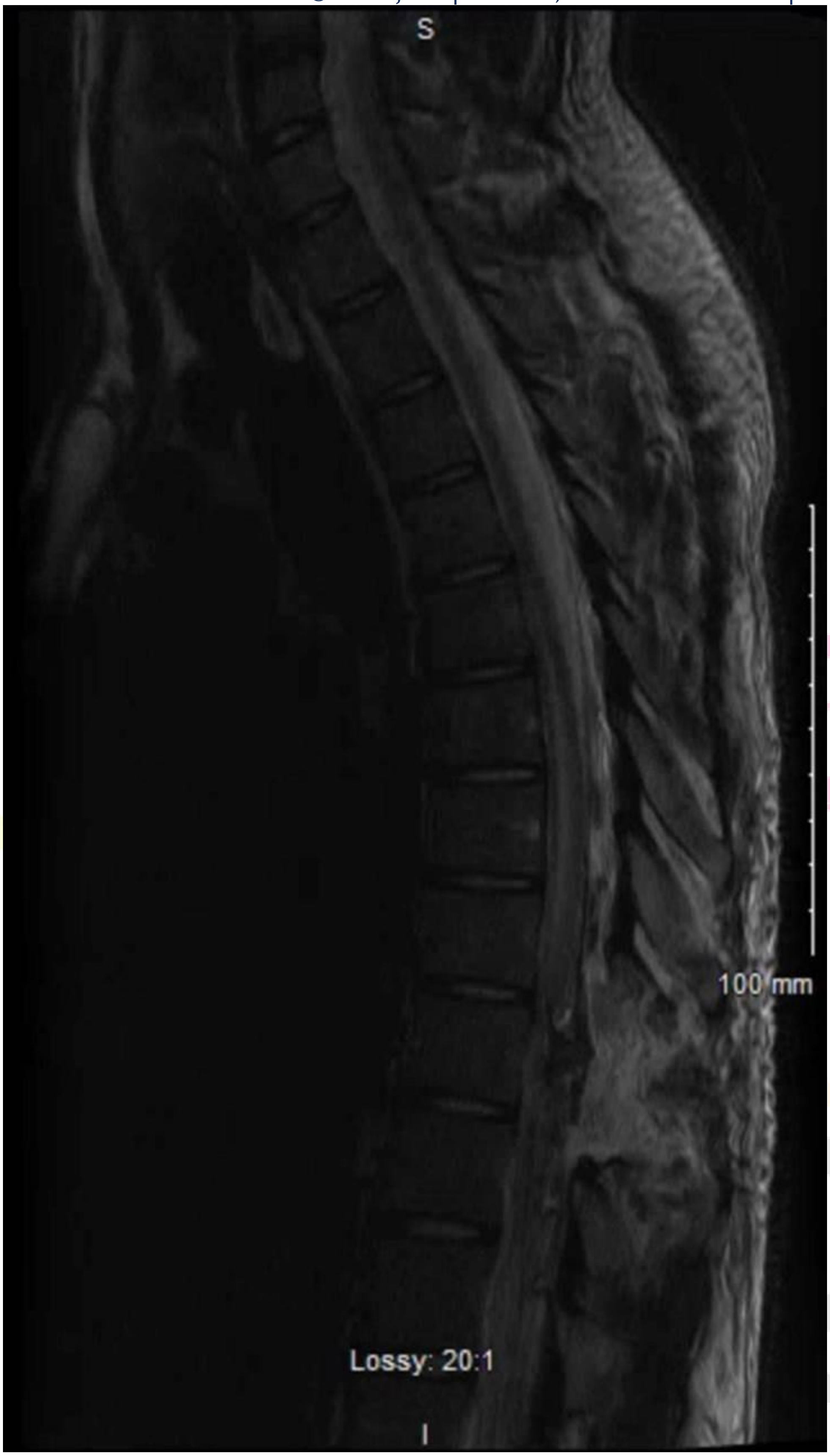

Figure-3: post operative MRI,T2 weighted

After surgery, the patient continued to have a sensory level of T11 and patchy but inconsistentfeeling in both lower limbs. Because to continued retention and bed confinement, the patient was sent to acute inpatient rehabilitation with a Foley catheter in situ. The patient had a steadypresentation when he was visited for his postoperative clinic appointment. Acute inpatient therapy is still being provided to the patient, who exhibits no indications or symptoms of an AVF recurrence.

Discussion

The clinical appearance of spinal AVFs is depending on the damaged spinal segment and the extent of the abnormality. They are a varied collection of vascular lesions. A 60-year-old Asian male with saddle anesthesia and bilateral lower extremities weakness and numbness that worsened over time due to a spinal AVF is the case study we're going to present. This was probably a type IIIAVM, according to the imaging characteristics, intraoperative results, and patient demographics. Even though this form of AVM is uncommon, our patient's age and appearance fit the mold. Furthermore, it should be noted that surgical cutting was more practical in this situation even though theseAVMs are normally embolized to relieve symptoms. The treatment went smoothly, and the patient's back discomfort has subsided. In spite of the factthat his ASIA level has not improved, he does experience subjective sensory patchiness in both lower limbs. In this example, a better neurological outcome may have been achieved with earlier suspicion, investigation, diagnosis, and treatment. Progressive deficiencies may eventually lead to lifelong disability, much like with other compressive spinal cord pathologies like a tumor [11]. The patient's developingAVM and potential severe rupture may have resultedin mortality if the therapy had been delayed much longer [10]. Furthermore, even though adult
AVM patients have a low recurrence risk, it's crucial to do a long-term follow-up to keep trackof recurrence. This is especially true for individuals under the age of 18, as prior case reports/series reported a recurrence rate between 5.5% and 17.5% with the recurrence period spanning from one to five years following full resection [20].

The artery of Adamkiewicz, which normally runs on the left side of the aorta from T8 to L2, is close by at the level of this lesion, which is an important point to be noticed. Similar to anterior spinal artery syndrome, injury to this artery has the potential to induce significant spinal cord ischemia and, as a result, neurological impairments such as lower limb paralysis and paresis as well as incontinence of the feces and urine. The preservation of this artery was crucial because, despite the fact that our patient had had total motor loss in both of his lower limbs, he still had achance to regain bowel and bladder function. In actuality, embolization was not an option due to the position of this artery in respect to our patient'sAVM.

Conclusions

We discuss the case of a 60-year-old south Asian man who experienced bilateral lower extremities weakness and numbness that worsened over time before a spinal AVM was discovered. Imaging later revealed a T9-T10 spinal AVM, which was treated with diathermy that blocked the feeding arteries. This case demonstrates a categorization methodand modern imaging techniques while also highlighting the clinical evolution and managementof spinalAVMs.

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