AMSER Case of the Month September 2022

65-year-old male with lower extremity weakness

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Patient Presentation

- 65-year-old male status post right total hip replacement 2/10/2022 with past medical history significant for lumbar spinal stenosis and spermatic cord liposarcoma (resected in 2006)
- Progressive, bilateral lower extremity weakness beginning shortly after a right total hip replacement
- A few months later, he developed neurogenic claudication, urinary frequency/urgency, and perineal anesthesia
- Presented to the ED with these complaints

What Imaging Should We Order?

ACR Appropriateness Criteria

Variant 4: **Low back pain with suspected cauda equina syndrome. Initial imaging.**

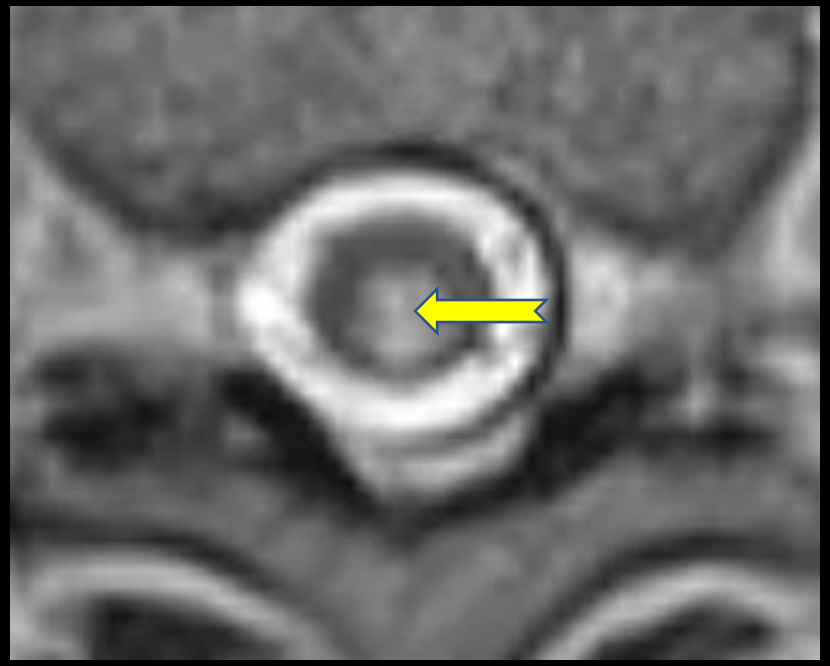
Procedure	Appropriateness Category	Relative Radiation Level
MRI lumbar spine without and with IV contrast	Usually Appropriate	O
MRI lumbar spine without IV contrast	Usually Appropriate	O
CT lumbar spine without IV contrast	May Be Appropriate	☢☢☢
CT myelography lumbar spine	May Be Appropriate	☢☢☢☢
Radiography lumbar spine	Usually Not Appropriate	☢☢☢
MRI lumbar spine with IV contrast	Usually Not Appropriate	O
Bone scan whole body with SPECT or SPECT/CT complete spine	Usually Not Appropriate	☢☢☢
CT lumbar spine with IV contrast	Usually Not Appropriate	☢☢☢
Discography and post-discography CT lumbar spine	Usually Not Appropriate	☢☢☢
CT lumbar spine without and with IV contrast	Usually Not Appropriate	☢☢☢☢
FDG-PET/CT whole body	Usually Not Appropriate	☢☢☢☢

This imaging modality was ordered by the ER physician

(and T-spine)

Initial Findings (unlabeled)

Initial Findings: (labeled)



T2 Sequence, Axial View

STIR sequence, Sagittal view

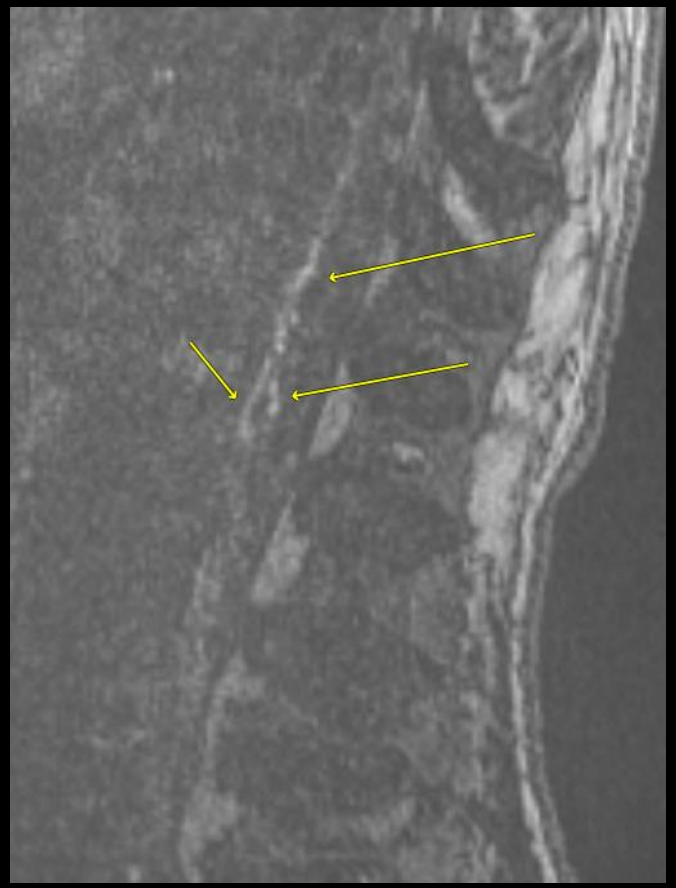
Findings: “There is moderate expansion and increased in T2 and STIR signal in the inferior thoracic cord extending down through the conus”

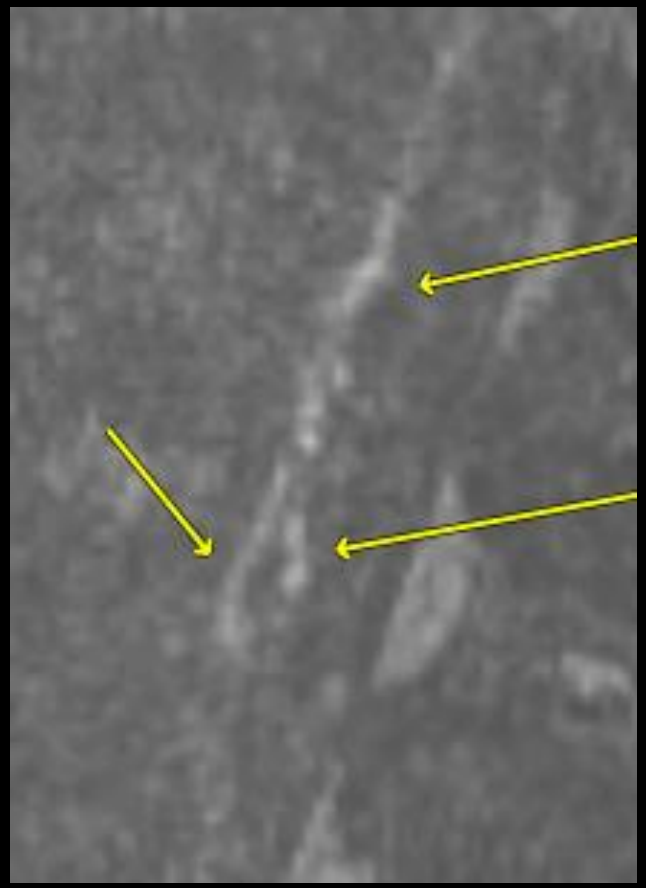
- This hyperintensity likely represents edema, though there are multiple potential underlying etiologies
- The cord expands in this region, though this can be expected

Early Differential, TWIST MRA Discussion

- **Impression from MRI**: “suspicious for myelitis/ADEM.”
- Other considerations? Intradural mass (e.g. Astrocytoma, ependymoma), vascular lesion with associated edema (AVM vs dural arteriovenous fistula)
- Neuroradiology recommended investigating a vascular etiology using the TWIST sequence
  - Time-resolved angiography With Interleaved Stochastic Trajectories
  - One type of **time-resolved MRA**, but there are others (e.g. TRICKS)
- Allows for **improved temporal resolution while mitigating loss of spatial resolution**
- Excellent for vascular imaging

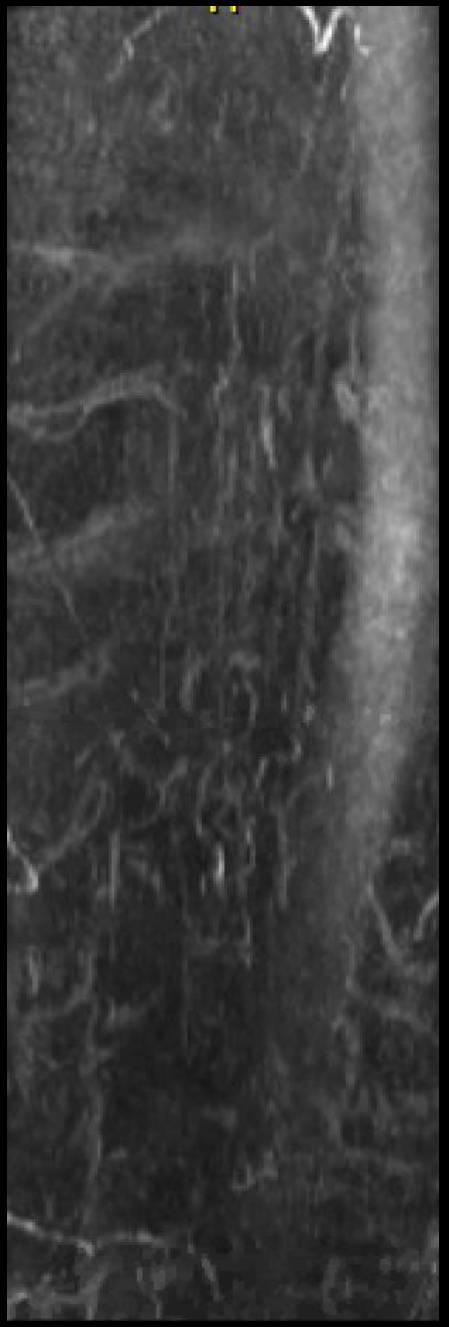
MRA TWIST Sagittal View





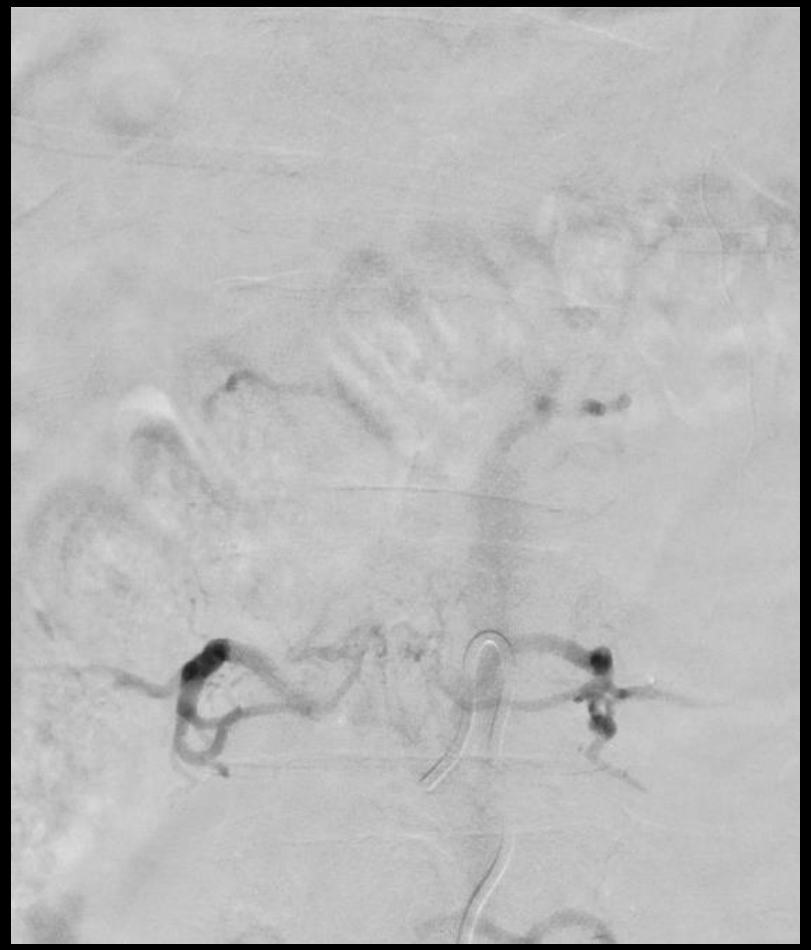
Impression:
"Thoracolumbar MR angiography: Enhancing vessels around the area of cord and conus edema and around the cauda equina **suggestive of venous congestion related to dural arteriovenous fistula**."

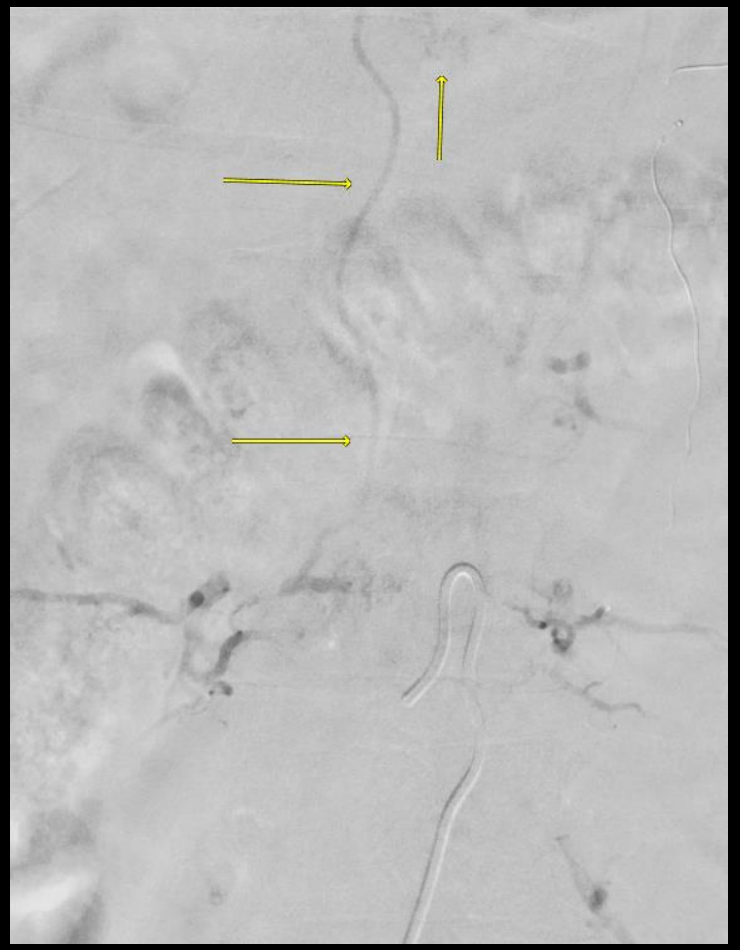
- These findings prompted confirmatory testing: spinal angiography



The abnormal, serpiginous hyperintensity within the spinal cord is readily visualized here, indicated by the yellow arrows

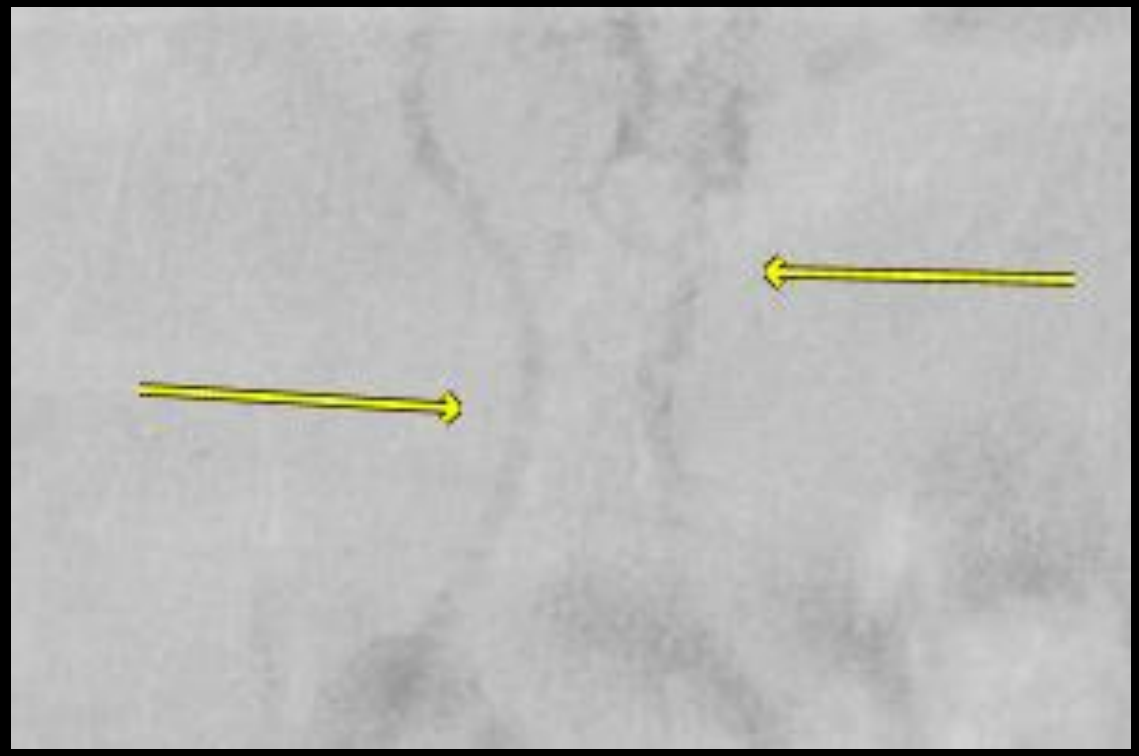
Spinal Angiogram Findings

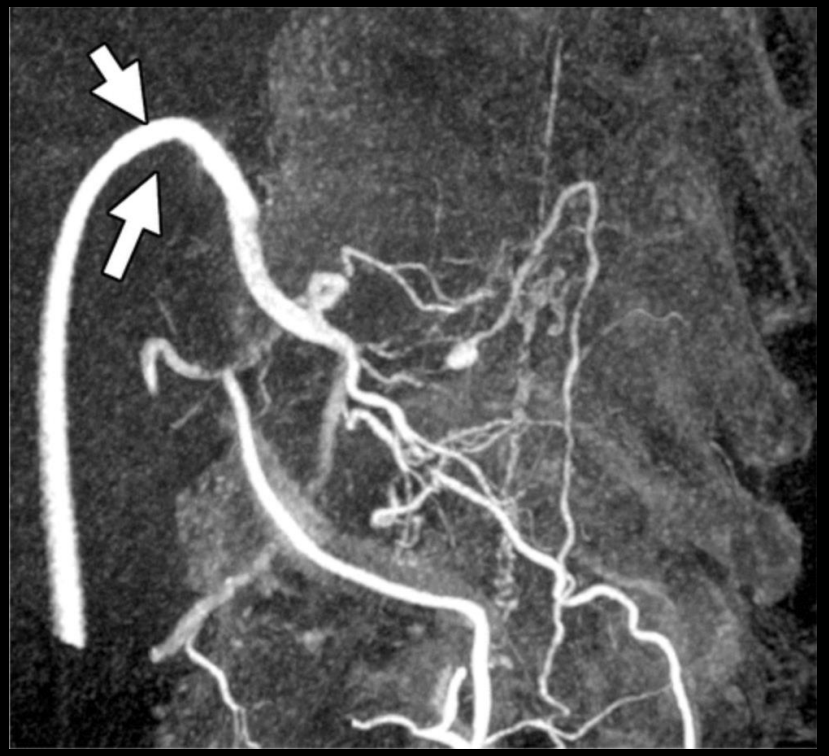




Here we can see contrast being injected into the segmental artery (first arrow) at the level of L2 with the aim of confirming the presence of abnormal vasculature. Images are presented in chronological order from left to right to demonstrate contrast flow over time.

Spinal Angiogram Findings





- Aberrant vasculature is filled with contrast (yellow arrows) and can be seen ascending along the spinal cord from L2 to about the level of T12
- Note the associated early venous filling. This confirms the presence of a spinal dural arteriovenous fistula.

- MR angiogram of the thoracic spine from “Nontraumatic Spinal Cord Compression: MRI Primer for Emergency Department Radiologists”
- Presented here to clarify the findings shown in the patient’s angiography on the left. Here, on the right, we can see arrows indicating a feeding artery (radiculomedullary) with an aberrant connection to T10 perimedullary veins.

Final Dx:

Spinal Dural Arteriovenous Fistula

Pathophysiology, Etiology, & Epidemiology

- Thought to be acquired (underlying cause is unknown)
- Ultimately, an abnormal connection between the arterial system and the venous system arises
- This then causes venous congestion within the spinal cord
- Increased venous pressure reduces the arteriovenous pressure gradient, causing edema and ischemia
- More common in men (five times more than women)
- Mean age of presentation: 55-60
- Most common spinal vascular malformation (~70%)

Epidemiology, Presentation, & Treatment

- Presentation
  - Slowly progressive bilateral lower extremity weakness.
  - There may be associated incontinence or back pain
- Treatment:
  - May be done either via endovascular embolization or via surgical obliteration of the fistula
  - Signs and symptoms may stabilize or reverse following treatment (this varies).

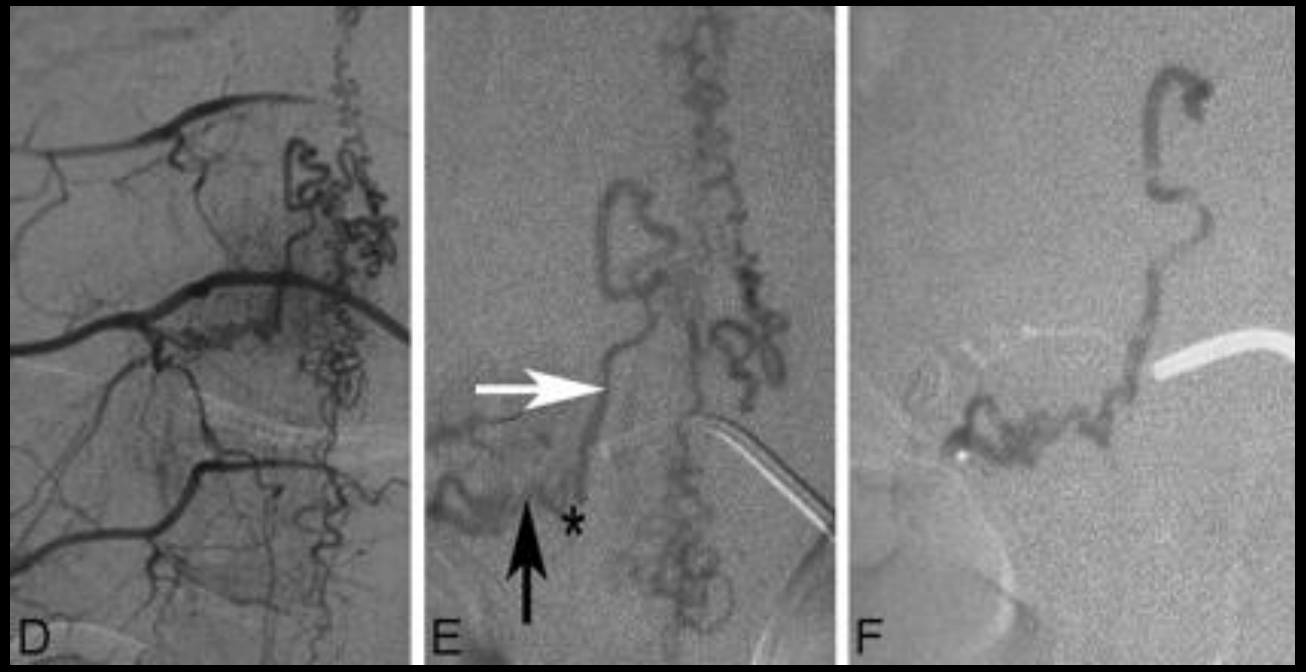


Image of endovascular embolization from “Spinal Dural Arteriovenous Fistulas”

Here we see the feeding artery (black arrow) draining into the connected vein (white arrow). The goal of embolization is for the glue to lodge within the draining vein, as was successfully done here.

More MRI Findings: Dorsal Flow Voids on T2

- A finding which is specific for dorsal flow voids is the presence of flow voids on the dorsal surface of the spinal cord
- This finding is demonstrated on this image showing a sagittal on a T2 sequence.
- These flow voids are caused by distended intradural veins
- Despite vessels containing fluid, they are hypointense here (“flow voids”) on T2 because of the high velocity of the blood within
- This finding could not be well-visualized in this patient, making the diagnosis more difficult

Image of dorsal flow voids from “Spinal Dural Arteriovenous Fistulas”

References:

1. Elster, A. D. (n.d.). *Tricks / twist*. MRIQUESTIONS.com. Retrieved July 24, 2022, from https://mriquestions.com/tricks-or-twist.html

2. Gofur, E. M. (2021, July 26). *Anatomy, back, vertebral canal blood supply*. StatPearls. Retrieved July 24, 2022, from https://www.statpearls.com/ArticleLibrary/viewarticle/36647

3. O. Laur, H. Nandu, D. S. Titelbaum, D. B. Nunez and B. Khurana. **Nontraumatic Spinal Cord Compression: MRI Primer for Emergency Department Radiologists.** RadioGraphics 2019 Vol. 39 Issue 6 Pages 1862-188. DOI: 10.1148/rg.2019190024

4. T. Krings, S. Geibprasert. Spinal Dural Arteriovenous Fistulas. American Journal of Neuroradiology Apr 2009, 30 (4) 639-648; **DOI:** 10.3174/ajnr.A1485

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