Case Report:
Thoracic Spine Angiogram

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Patient history

A 71-year-old male presented to our department with a six month history of progressive myelopathy and also complained of persistent abdominal pain. MRI of the thoracic cord performed elsewhere, demonstrated cord oedema from T5 to T8/9 with prominent adjacent vessels, likely in the subarachnoid space. A CT angiogram had been performed with IV contrast and multiplanar reconstructions. A prominent leash of vessels in the mid and lower thoracic spinal cord extending from T6 to T10 consistent with distended views was reported. CT report stated that dural fistula is fed likely on the left from T6-7. It was reported that this feeding vessel would better be demonstrated on MRA. With a spinal dural fistula suspected, the patient was referred to us for spinal MRA.

Sequence details

The images have been acquired on our 3T MAGNETOM Verio using software version *syngo* MR B15.

1. Sagittal T2-weighted Turbo Spin Echo (TSE) of the cervical and thoracic spine. This automatically (using Set-n-Go Protocol) inline composed to produce one long field-of-view (FOV) image. TR/TE = 4810/109, FOV of 280 x 2 = 560 mm (FOV phase 100%), 12 slices of 3.3 mm sagittal in the cervical and thoracic spine, distance factor 25%, PAT factor 2, 1 concatenation, 1 average, base resolution of 512 and 448 respectively (phase resolution 70% for both), BW 238 Hz/pixel, turbo factor 21, echo spacing = 11.9 ms, no fat sat, TA = 2 min and 19 sec + 1 min 20 sec (3.39).
2. Axial T2-weighted TSE with no fat sat. TR/TE = 3210/87, FOV 240 mm (FOV phase 100%), 19 slices of 4 mm, distance factor 30%, PAT factor 0, 2 concatenations, 1 average, base resolution of 448 (phase resolution 70%), BW 248 Hz/pixel, turbo factor 21, echo spacing = 9.67 ms, TA = 2 min 3 sec.
3. Pre contrast-enhanced T1-weighted 3D-FLASH sagittal pulse sequence of the thoracic spine performed, which

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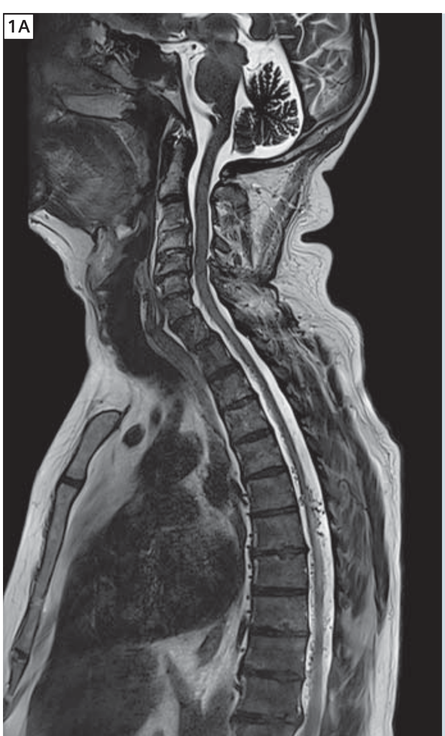
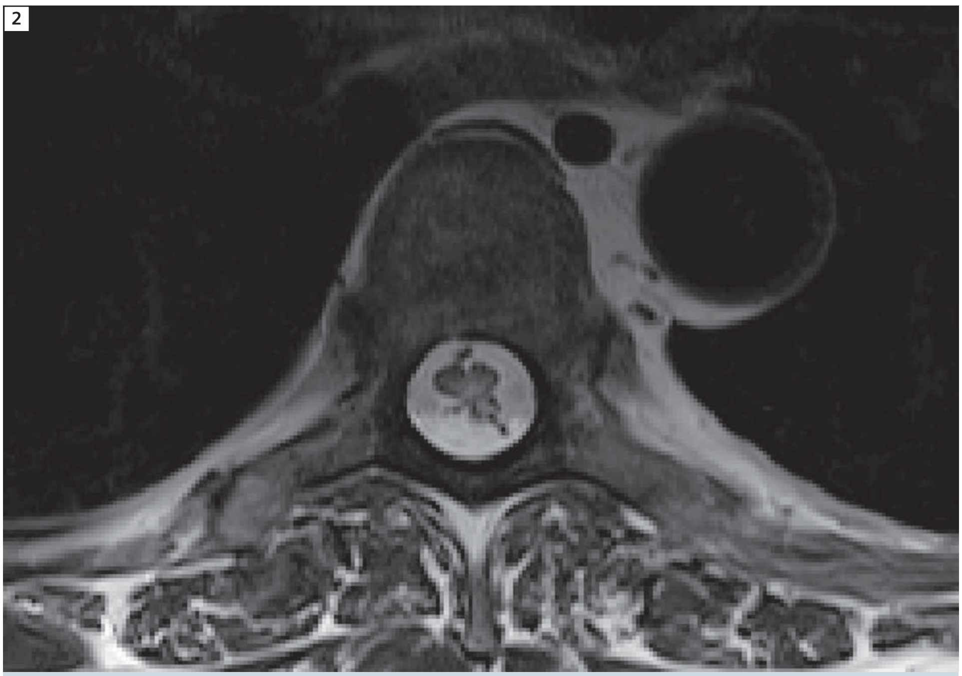


1B


1 Sagittal T2-weighted TSE sequence of the thoracic spine. Sagittal T2-weighted TSE of cervical and thoracic spine composed. Note cord oedema from T5 to T8/9 with prominent adjacent oedema.



2 Transverse T2-weighted TSE sequence of the thoracic spine. This confirmed cord oedema without cord expansion. No enhancing lesion was seen on post contrast examination.

3 Post contrast-enhanced MRA of the thoracic spine. T1-weighted 3D FLASH.

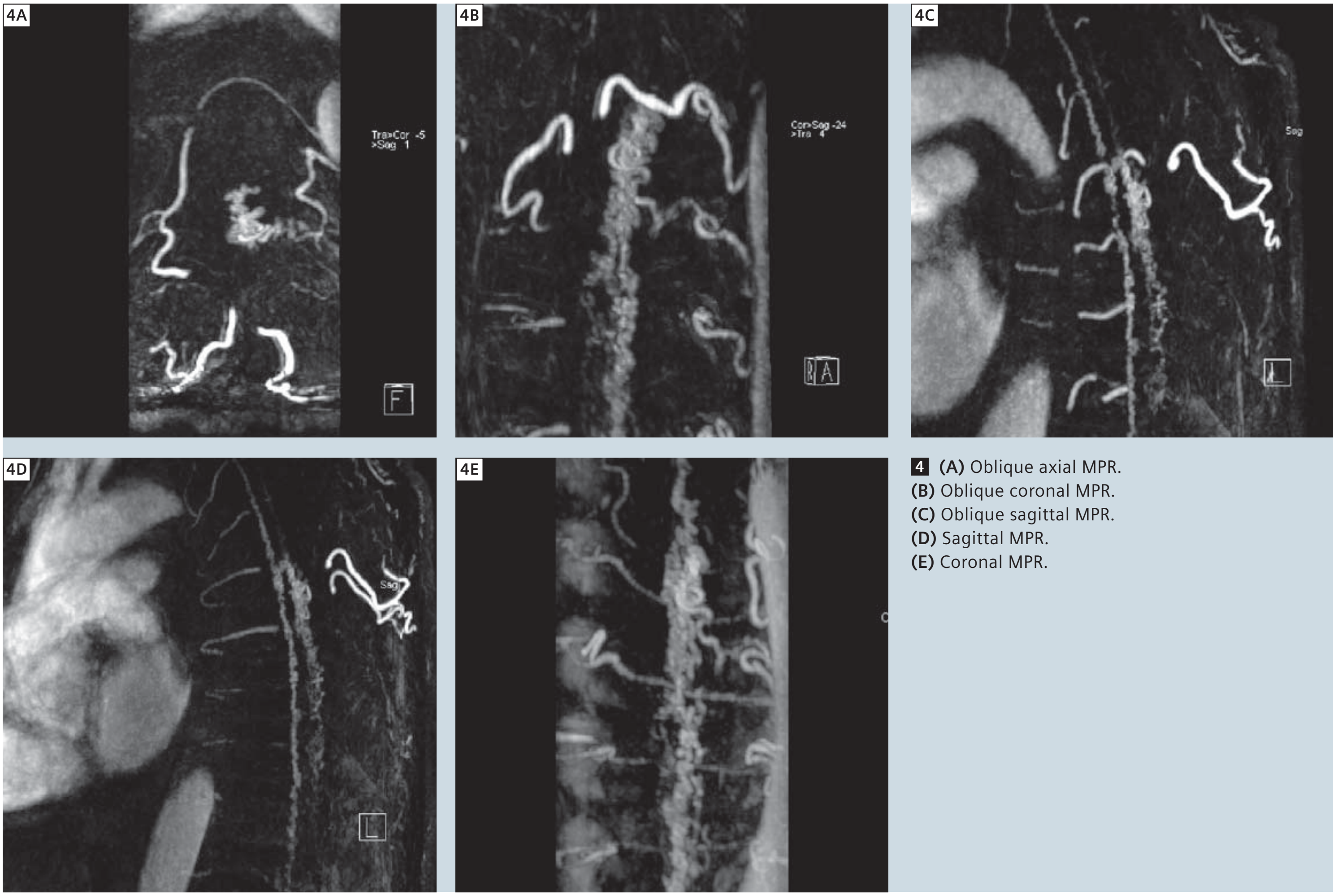
would allow subtraction to be performed. We did not find this necessary in this case.

4. Test axial bolus. TR/TE = 62.59/1.63, FOV of 350 mm (FOV phase 100%), 1 slice 2D transverse 18 mm thick, distance factor 20%, PAT factor 0, 1 average, base resolution on 256 (phase resolution 75%), BW 400 Hz/pixel, TA = 1 min 30 sec.
   The IV bolus was performed as a slow infusion. Viewing this in mean curve application, the exact time of peak enhancement was measured, using time-intensity curve. There are multiple factors that may affect the circulation time, including the hemodynamic situation of the patient. Using the test bolus technique ensures correct timing of the MRA sequence.
5. Post contrast-enhanced (MRA) T1-weighted 3D FLASH sagittal pulse sequence of the thoracic spine. TR/TE = 3.21/1.2 ms, FOV of 250 mm (FOV phase 100%), 88 slices per slab (1 slab), slice thickness 0.9 mm, distance factor 20%, PAT factor 3, flip angle 25 degrees, no fat suppression, 1 average, base resolution of 256 (phase resolution 100%, slice resolution of 60%), phase partial Fourier 7/8, slice partial Fourier 6/8, BW 650 Hz/pixel, voxel size 1 x 1 x 0.9 mm, TA = 17 sec.
   This sequence can be repeated as many times as thought required. We found the first pass best to visualise the lesion, due to the slower infusion on contrast, and not the usual high concentration bolus technique. The IV bolus was performed as a slow infusion.

Additional Post contrast-enhanced sagittal TSE with fat sat, and axial VIBE scans were performed of the thoracic spine to exclude additional enhancing lesions. Post processing is required to visualise the number and level of the feeding vessels. This is achieved with multiplanar reformats (MPR) and maximum intensity projection (MIP) images.

Results

Diffuse cord oedema is seen extending from T6-T9 secondary to dural fistula supplied via the left T6-7 intervertebral foramen. No mass lesion is seen. There is no enhancement within the cord. This examination was a combination of standard thoracic spine imaging and spinal cord MR angiography to detect and localize arterial feeders of this vascular lesion.



4 **(A)** Oblique axial MPR.
(B) Oblique coronal MPR.
(C) Oblique sagittal MPR.
(D) Sagittal MPR.
(E) Coronal MPR.

Identification of the vascular supply of both spinal cord and adjacent arteries and veins is difficult. Displaying these small structures, due to their low-to-modest contrast relative to the surrounding tissue, requires high resolution and correct timing of contrast MRA sequence. Multi-planar reformatting (MPR) and maximum intensity projection (MIP) post processing is essential to display the relevant anatomy. Subtraction pre MRA from post contrast-enhanced sequences may also be required.
There is no significant patient preparation requirement to perform this study. The patient was pre cannulated with a 20 gauge needle and connected to the injection pump. He was positioned supine on our standard 24-channel spine matrix coil, with the anterior half of the 32-channel cardiac coil placed over the abdominal area. The use of the Tim (Total imaging matrix) system allowed us to image the entire spine in a matter of minutes and without limiting us to the thoracic region only.

Conclusion

The contrast enhanced MRA confirmed the level of the fistula and established it was feed only from the left. Post processing visualises both vessels and determines that only the left connects with the fistula with no supply coming from the right. This then allowed the interventional radiologist to perform a much simplified embolisation procedure. Reduction of the complexity of the DSA procedure is beneficial to the patient, as previously each spinal artery would have had to be individually cannulated and imaged bilaterally. DSA confirmed the MRI findings, and a successful single level super-selective spinal procedure was achieved.

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