Spinal MR Angiography for the Reliable Identification of the Artery of Adamkiewicz and its Tributary Arteries

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Introduction – Spinal MR Angiography With A Focus On The Adamkiewicz Artery

This poster focuses on the image acquisition, identification, and precise reporting of the main feeder of the anterior spinal artery in the thoraco-lumbar segments. This feeder artery is also known as the Adamkiewicz artery (AKA, named after the neurologist Albert Wojciech Adamkiewicz, 1850 - 1921) or as the *A. radiculomedullaris magna*. The AKA branches off the posterior ramus of a posterior intercostal or lumbar artery, usually at a level between T5 to L2[1,2,3]. At our institution, we have developed protocols for high-resolution 3T spinal MRA's (both stady-state and first-pass) for patients with aortic aneurysms as a preoperative exam to help the cardiovascular surgeons prioritize which intercostal arteries are crucial for the perfusion of the anterior spinal artery and need to be inserted into the aortic graft. Spinal MRA has replaced CTA and DSA as the modality of choice for preoperative imaging of the spinal arterial supply in patients with aortic aneurysms at our institution.

Figure 1
Schematic and MIP of an abdominal aortic aneurysm (AAA) prior to open aortic replacement surgery. (A) Posterior intercostal artery (PIA), (B) Adamkiewicz artery, (C) Anterior spinal artery.

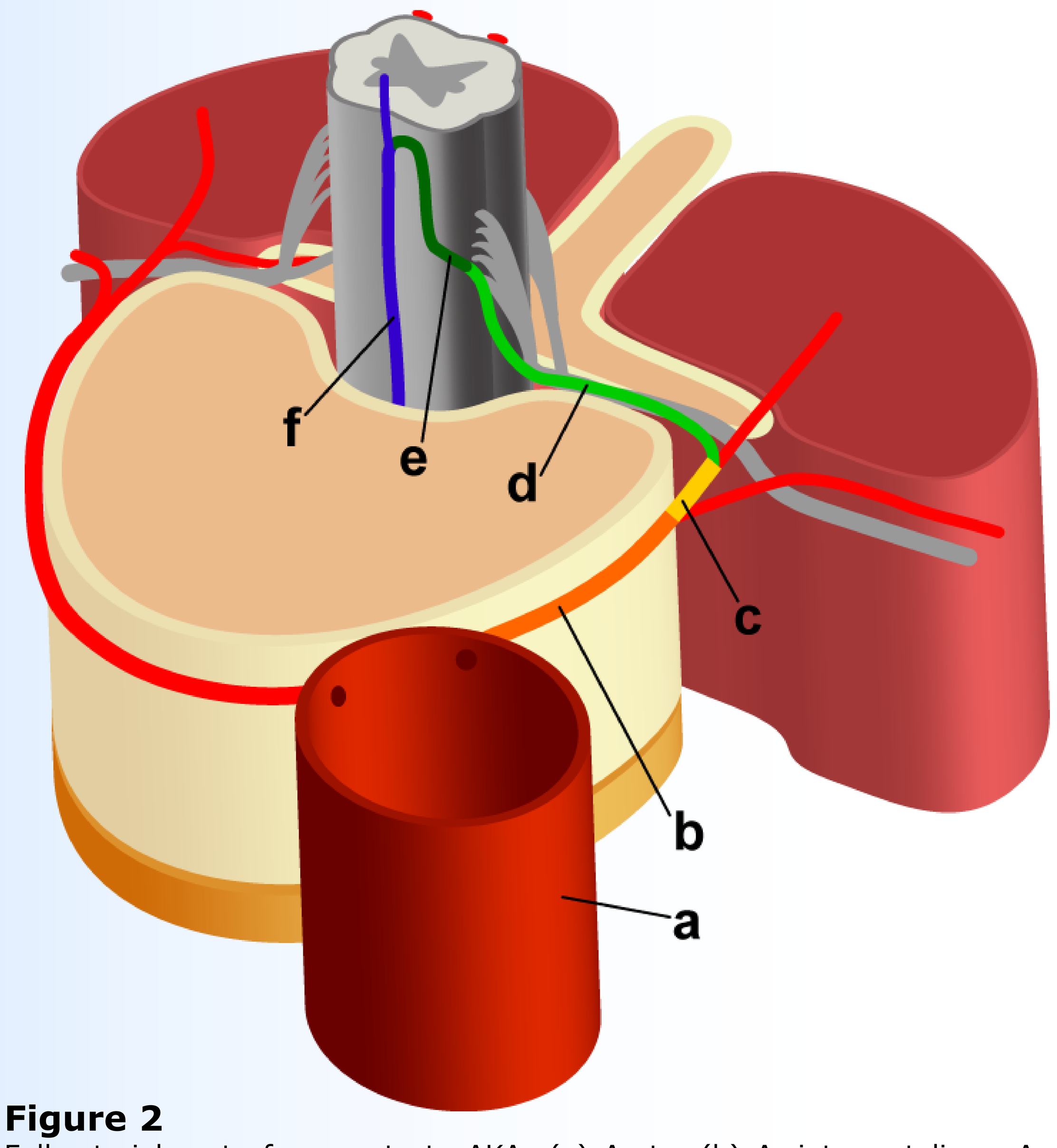

Figure 2
Full arterial route from aorta to AKA: (a) Aorta, (b) A. intercostalis or A. lumbalis (orange), (c) Ramus posterior (yellow), (d) A. radiculomedullaris magna (green) with (e) its typical "hairpin" structure (dark green), feeding (f) A. spinalis anterior (blue), running mainly caudally, but also cranially from the top of the "hairpin".

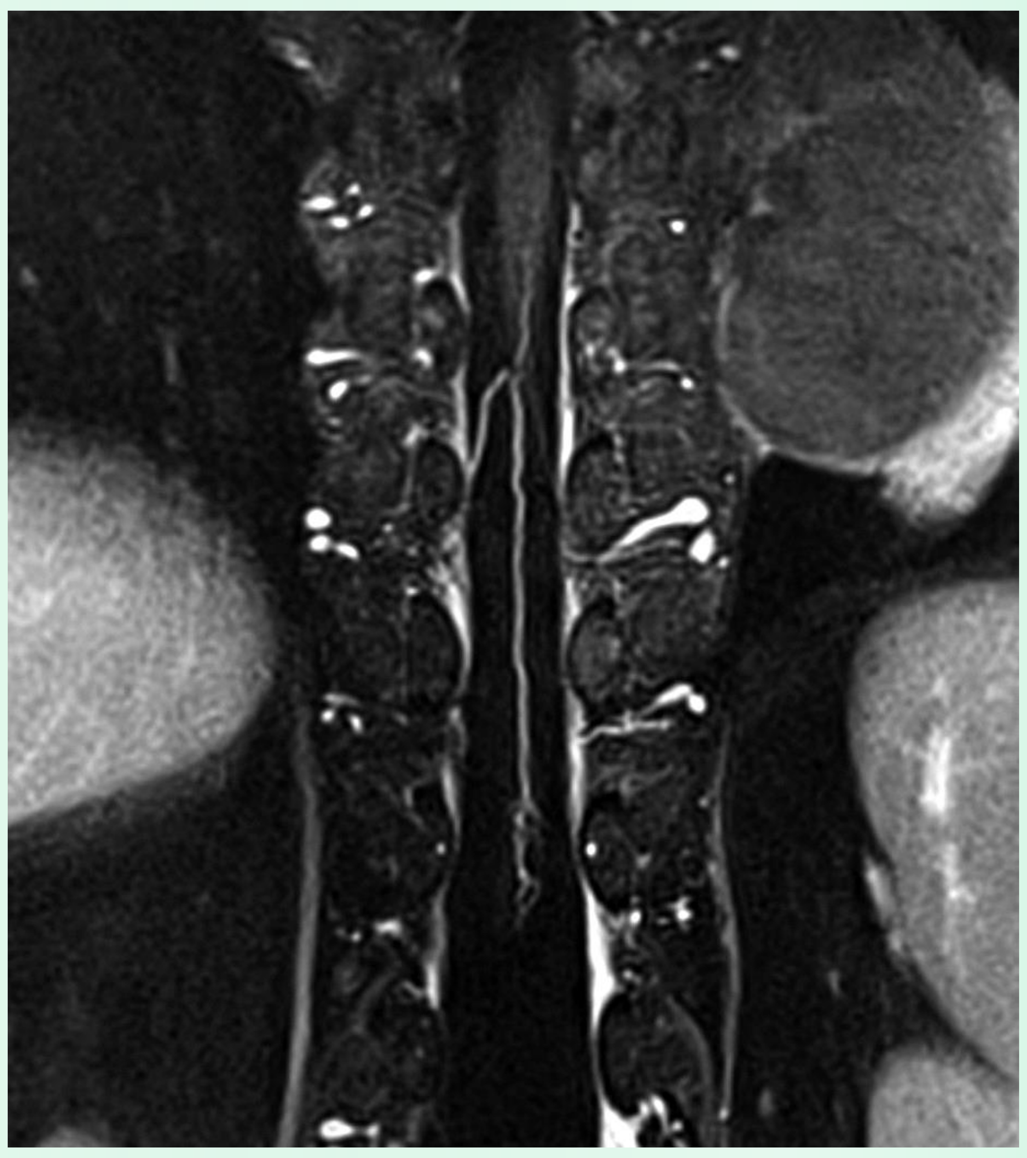

Figure 3
Classical appearance of the AKA in the coronal plane (reformatted T1 steady-state radial VIBE MRA with fat saturation, i.v. gadofosveset trisodium).

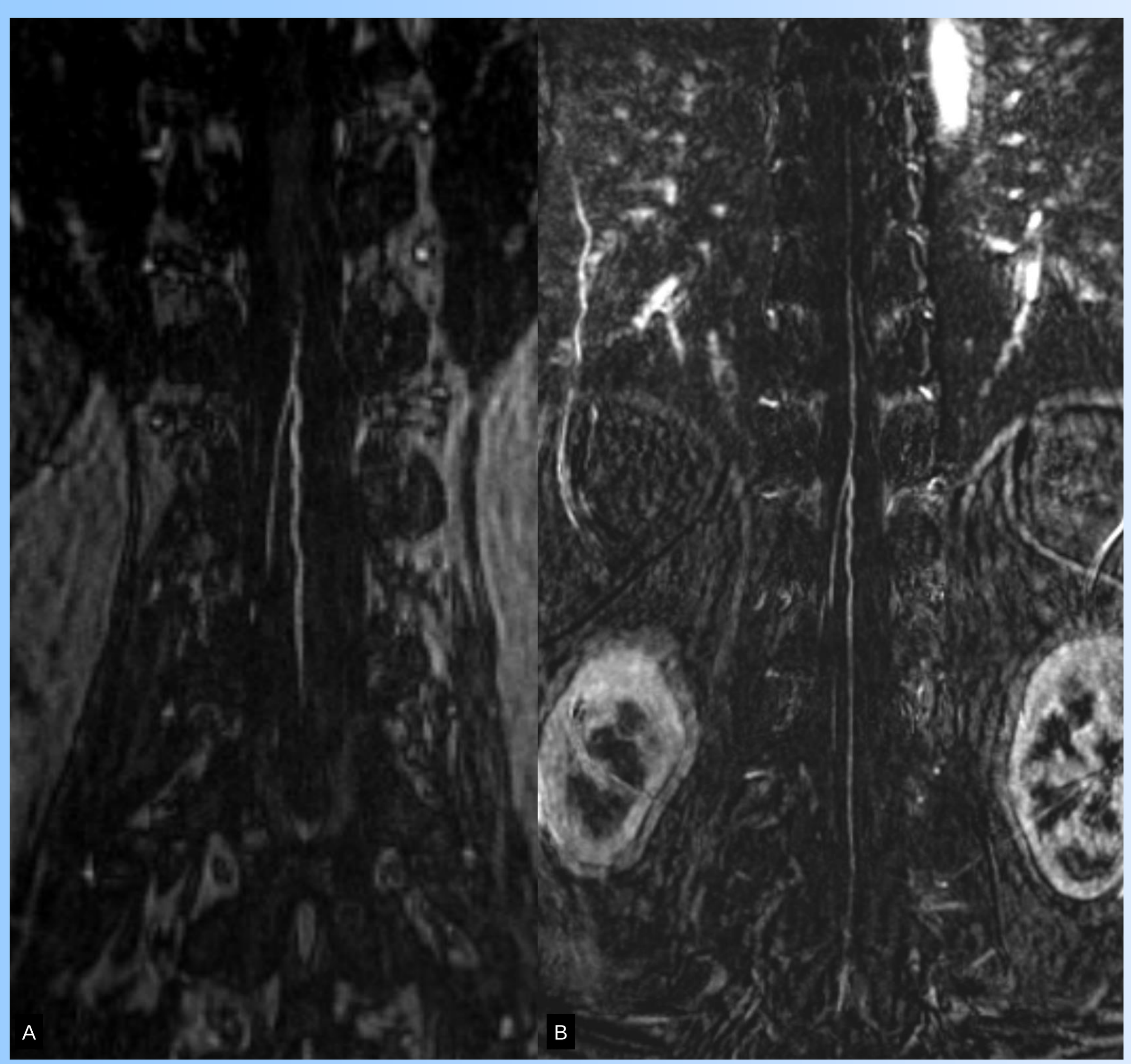

Figure 4
(A) A trained radiologist can spot the typical Artery of Adamkiewicz "hairpin turn" in the regular coronal reformats of the non-subtracted MRA, despite only a short stretch of the spinal vasculature being depicted in each plane.
(B) But it is much easier for the referring clinician to appreciate the anterior spinal artery on curved coronal reformats custom-made by the radiology resident (first-pass subtracted MRA with i.v. gadobenate dimeglumine).

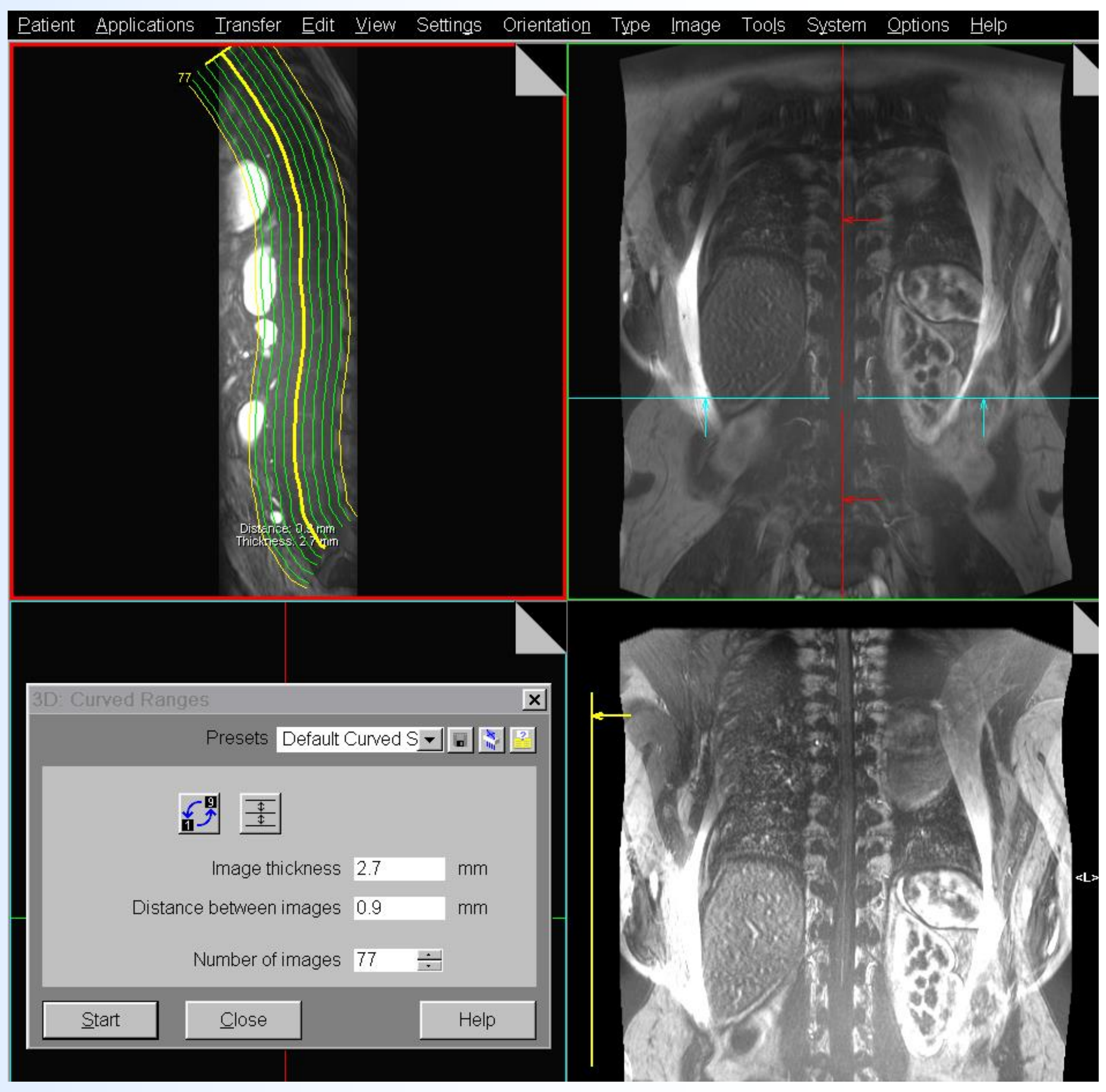

Figure 5
Curved reformats generated with a commercially available software package[4].The 3D MRA data set is displayed in MPR modus in the mid-sagittal view. A curved line closely following the curvature of the spinal canal is then drawn with the PC mouse (yellow line in the upper left inlay). The software then generates a stack of longitudinally only bent coronal planes which are equidistant to the one defined by hand (green lines in the upper-left quadrant).

Figure 6
The spinal veins running along the anterior and posterior aspects of the spinal cord might mimic the AKA and the anterior spinal arteries, such as this great anterior radiculomedullary vein (GARV) on the anterior surface of the spinal cord.

Imaging Acquisition, Reading and Reporting

Images are acquired on a 3T scanner[4] using two 30-channel body coils. A T1 weighted, steady-state radial VIBE MRA with spectral fat saturation (TA = 10 min.) is acquired. Postprocessing includes curved coronal MPR reformations to provide the clinician with a better visualization.
Reading: The typical "hairpin" structure of the distal AKA is the first to be identified on coronal planes (figure 2e, top of the dark green arterial segment). Exploring the 3D MRA dataset in MPR mode on PACS, the AKA is back-traced proximally via the radiculomedullary artery (*A. radiculomedullaris*, green segments), the posterior ramus (*Ramus posterior*, yellow segment) and finally the intercostal artery (*A. intercostalis posterior* for thoracic or *A. lumbalis* for lumbar spine, accordingly, orange segment).
Reporting: As the position of the origin of the posterior intercostal or lumbar artery which ultimately feeds the AKA is the most important information for the clinician, the sequence of reporting of the arteries/segments is reversed as compared to the sequence in which they were identified on PACS.
1. The main tributary of the AKA branching off the aorta, the posterior intercostal/lumbar artery (left or right of the aorta) is specified, the adjacent vertebral body is named.
2. The course of the posterior ramus of the PIA is described.
3. The course of the radiculomedullary artery as it enters the dura and spinal canal is described, including the specific vertebral bodies.
4. The level at which the "hairpin" is localized is described, naming the adjacent vertebral bodies.
5. Description of anatomical variants of the AKA, including prominent veins which might be mistaken for the AKA.

Summary

High-resolution MRA of the spinal arteries can be achieved with excellent image quality using standard clinical equipment. Advantages of MRA over micro-invasive intra-arterial catheter-based angiography become evident with proper image acquisition, processing as well as focused reporting.

References

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