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Preoperative Coil-Embolization of a Large, Myelon-Compressing Vertebral Metastasis Involving the Artery of Adamkiewicz

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Abstract

Metastatic spinal cord compression causes neurologic impairment and pain, potentially improved by decompression surgery at the risk of heavy intraoperative bleeding. Preoperative embolization carries the risk of nontarget embolization, potentially causing spinal ischemia. Current evidence indicates that knowledge of artery of Adamkiewicz (AKA) location and the amount of collateralization may help estimate the risk of postinterventional spinal cord injury. In this case of a 73-year-old female patient with progression of a large, myelon-compressing vertebral metastasis of L1, protective, blood-flow-controlling occlusion of the proximal-most points of the AKA and segmental spinal arteries was safely performed prior to tumor embolization, surgical decompression, and tumor debulking.

Keywords
- artery of Adamkiewicz
- spinal cord injury
- interventional radiology

Case Report

A 73-year-old patient with a history of a metastasized renal cell carcinoma diagnosed in December 2005 was admitted for spondylodesis, decompression, and tumor debulking of a large vertebral metastasis of L1 due to progressive pain and the looming risk of acute compressive cord injury. Patient history included complete right-sided nephrectomy as well as radio-chemotherapy of the abdomen and spine prior to admittance. The current palliative treatment plan included receipt of combined immunotherapy medication (avelumab/axitinib). The baseline neurologic exam proved unremarkable, not demonstrating any signs of motor or sensory deficit. The patient reported increasing pain of the right inguinal region with radiation to the right leg over the course of 4 weeks, restricting the previously unimpeded range of movement. Computer tomography (CT) on the day of admittance showed progressive size of the L1-metastasis with infiltration of the paravertebral fat and protrusion into the spinal canal. Recommendation for preoperative, endovascular embolization of the cord-compressing metastasis was agreed upon in a multidisciplinary tumor board, to which the patient consented after being educated extensively on peri-interventional risks, and especially the risk of an anterior spinal artery syndrome. The procedure was conducted under local anesthesia within 24 hours preoperatively, following an institutional standard operating procedure on a monoplane, ceiling-mounted angiographic system (Artis Q, Siemens Healthcare, Forchheim, Germany). The right femoral artery was accessed via a 5-French (F)

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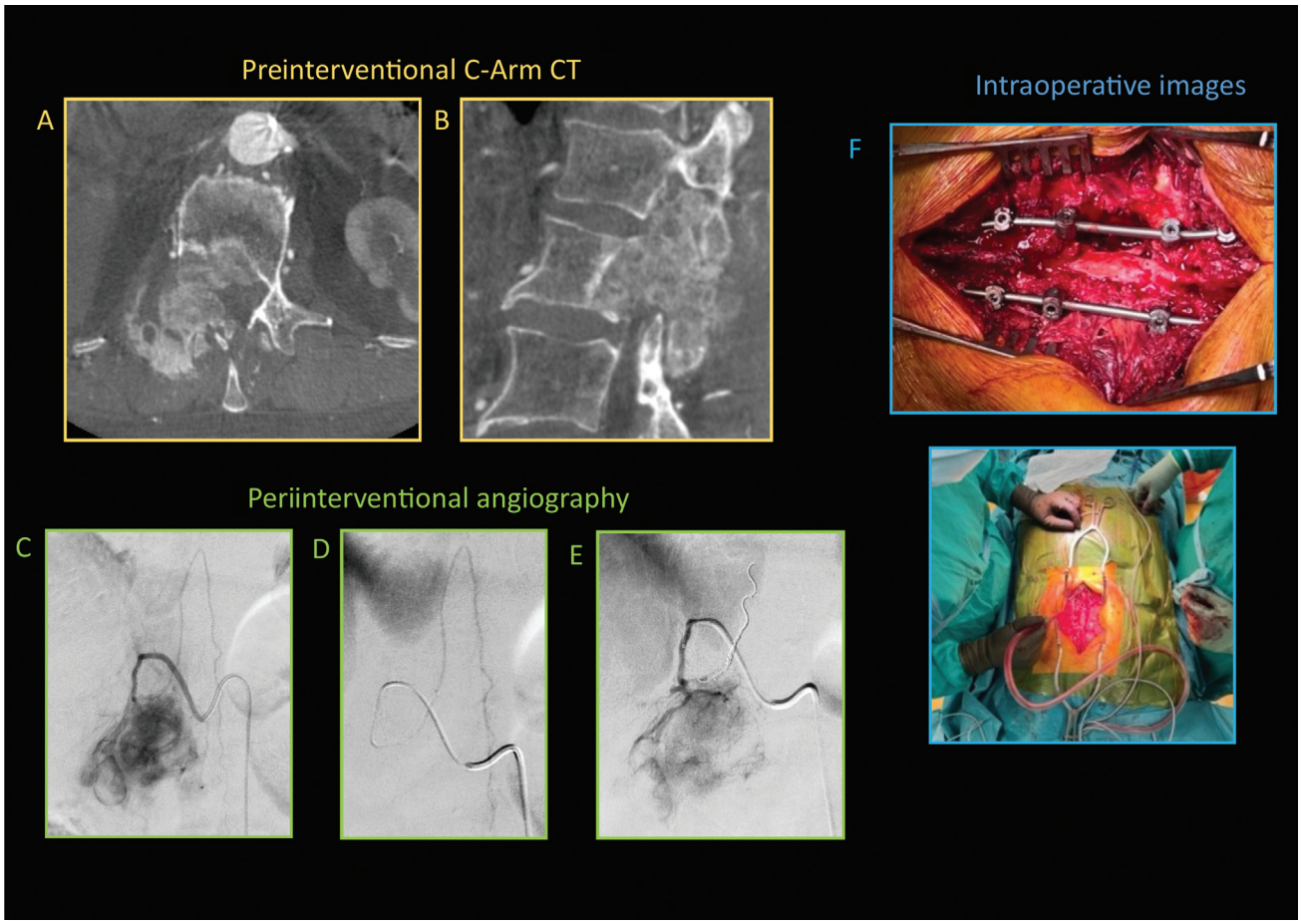

Fig. 1 Axial and sagittal reformations of preoperative C-arm computed tomography (CT) images of the vertebral metastasis L1 (yellow edging: **A**, **B**). Intrainterventional digital subtraction angiography images (green edging: **C**–**E**) showing the artery of Adamkiewicz arising from the right intercostal artery T12 in a "hairpin" configuration before (**C**, **D**) and after embolization via coils (**E**). Intraoperative images (**F**) showing 2-level laminectomy, tumor debulking, and nerve root decompression.

vascular sheath (Avanti +, Cordis, Waterloo, Belgium), with the insertion of an appropriate diagnostic catheter in the descending aorta. Acquisition of a C-arm CT was performed to gather precise anatomical information and enable further planning of the procedure. Lumbar artery catheterization demonstrated involvement of L1-L3 on the right and L1-L2 on the left in perfusing the vertebral metastasis L1 and enhancement of the artery of Adamkiewicz (AKA) (►**Figs. 1**, **2**), arising from the right intercostal artery T12. Protective embolizations of nontumor feeding branches of the lumbar arteries L1, L2 of muscle-perfusing arteries, and of the proximal Adamkiewicz-artery were executed via pushable (micro-) coils of appropriate forms and sizes. Then, embolization of tumor-feeding branches of the right- and left-sided T12 to L2 via Embospheres of 500 to 700 µm was carried out until achievement of stasis. Control angiography showed successful occlusion without residual flow of contrast. No inadvertent, nontarget embolization occurred. Following decompression with laminectomy, nerve root decompression, wide tumor resection, and debulking as well as pedicle screw instrumentation with minimal blood loss, the patient was discharged 6 days later with complete resolution of pain symptoms and no neurological deficits.

Discussion

Preoperative embolization of hypervascular vertebral tumors has been described as safe and effective in previous studies,[1–3] potentially limiting blood loss and rendering previously unresectable tumors resectable.[4] However, spinal cord ischemia with transient or permanent paraplegia after inadvertent interruption of the AKA represents dreaded complications of surgical and interventional radiological procedures of the spine and thoracoabdominal cavity.[5,6] There is a lack of consensus and high-level evidence concerning the iatrogenic sacrifice of the AKA (and possibly various segmental spinal arteries), its potential neurological detriment, as well as preventative or restorative measures in case of spinal cord ischemia.[7] Studies in animals[8,9] as well as human subjects[10,11] indicate an existing but relatively low risk of postinterventional/postoperative neurological motor deficit of AKA occlusion that may well depend upon the amount of occluded segmental vessels, the degree of collateralization, as well as the localization of the embolization, with possible resumption or maintenance of blood flow through the AKA despite focal occlusion.[7,11–14] While both CT angiography and magnetic resonance angiography may be useful in identifying both the level and the laterality of the

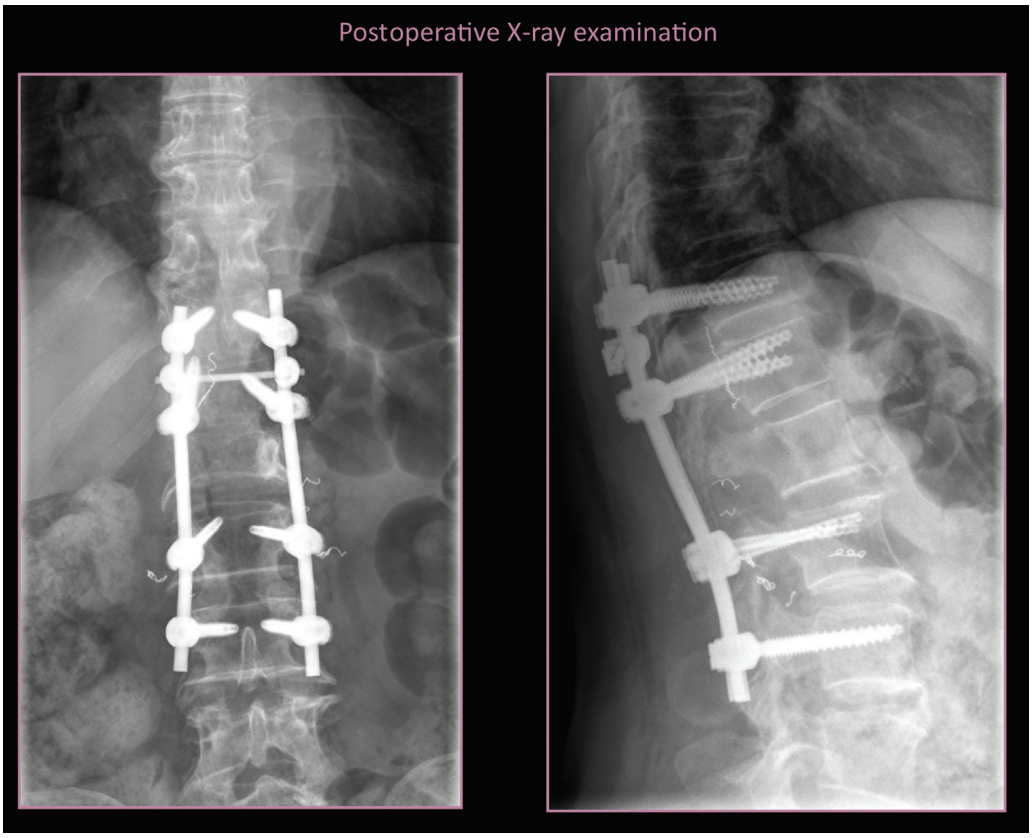

Fig. 2 Postoperative frontal and lateral views of the thoracic and lumbar spine after spondylodesis from Th11 to L3. Note the paravertebral coil material after embolization.

artery,[6,15] digital subtraction angiography has proven superior in terms of evaluating vessel continuity or depiction of collaterals.[16] In the absence of the aforementioned anatomical insights, a systematic review by Tan et al recommend that ligation of the AKA and segmental spinal arteries be performed only when absolutely necessary due to the non-negligible risk of paralysis or paresis.[7] In our specific case, the planned embolization of the AKA before its inevitable resection during surgery and its possibly predominantly tumor feeding nature might have played a vital part in facilitating surgical resection by limiting blood loss and enabling an unimpeded view of the surgical field, with the reported lack of spinal cord ischemia.

Conclusion

Preoperative, protective embolization of the proximal-most points of the AKA and adjacent segmental arteries could be performed without consecutive neurological deficits in a patient with cord-compressing, vertebral metastasis of L1. Current evidence indicates that knowledge of AKA location and amount of collateralization may help estimate the risk of postinterventional spinal cord injury.

Ethical Approval

Ethical approval was waived, and written informed consent was obtained from the patient for publication of this case report and accompanying images.

Consent for Publication

Written informed consent was obtained from the patient for publication of this case report and accompanying images.

Authors' Contributions

All authors have made a substantial contribution to the concept and design of the article as well as the acquisition and analysis of the data presented. L.B. and E.R.B. drafted the article, while T.S. and J.H. revised it critically for important intellectual content. All authors approved the version to be published.

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Conflict of Interest

None declared.

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