

Two-stage multilevel en bloc spondylectomy with resection and replacement of the aorta

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Abstract

Objective We report a case of multilevel spondylectomy in which resection and replacement of the adjacent aorta were done. Although spondylectomy is nowadays an established technique, no report on a combined aortic resection and replacement has been reported so far.

Methods The case of a 43-year-old man with a primary chondrosarcoma of the thoracic spine is presented. The local pathology necessitated resection of the aorta. We did a two-stage procedure with resection and replacement of the aorta using a heart–lung machine followed by secondary tumor resection and spinal reconstruction.

Results The procedure was successful. A tumor-free margin was achieved. The patient is free of disease 48 months after surgery.

Conclusion En bloc spondylectomy in combination with aortic resection is feasible and might expand the possibility of producing tumor-free margins in special situations.

Keywords Chondrosarcoma · Spondylectomy · Resection of the aorta · Multilevel

Introduction

Chondrosarcoma is the most common primary malignant bone tumor in adults with an incidence of 2 per 1 million [1, 2]. Although different subtypes exist, most are so-called conventional chondrosarcomas which usually grow slowly [1, 2]. Surgery is the only efficient treatment for this tumor entity [1, 3, 4]. The overall prognosis mainly depends on the histologic differentiation, the surgical resection margin and the location of the tumor [1–4]. Tumors of the spine and pelvis have a worse prognosis than those located in the extremities [3, 4]. Nowadays, en bloc spondylectomy is an established technique to treat primary tumors of the spine [5–7].

Although numerous articles about spondylectomy do exist in the literature, the combination of spondylectomy and resection of the adjacent tumor infested aorta has not been reported so far. Thus, a case of concomitant spondylectomy and aortic replacement for chondrosarcoma is presented and discussed.

Case

A 43-year-old gravedigger presented with a 1-year history of thoracolumbar back pain. The symptoms had exaggerated 3 weeks prior to admission. The neurologic status was ASIA E, and motor function was 5 out of 5 on the Strength Grading Scale (1–5). The MRI showed a pathologic fracture of vertebra Th12 with a tumor mass breaking through the anterior cortex (Fig. 1). This mass surrounded the

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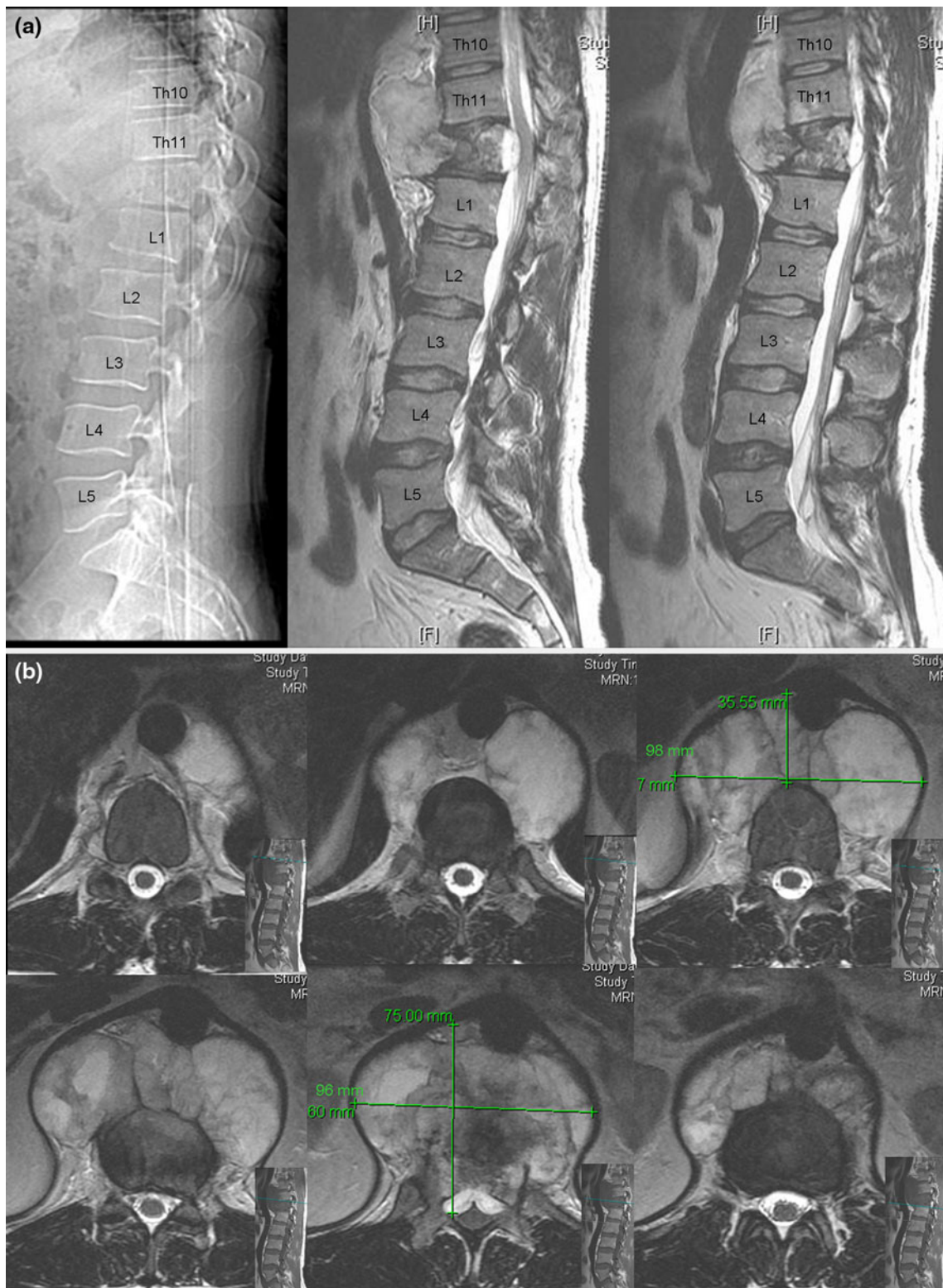


Fig. 1 **a** Lateral radiograph and sagittal MRI plane of the thoracolumbar spine. Note the fracture of Th12 and the huge extrasosseous tumor mass. **b** Horizontal MRI planes show the relation of the tumor to the aorta and spinal cord

vertebral bodies of Th11 to L1 reaching the heads of the ribs. The dimension of the extrasosseous mass was: width 100 mm, craniocaudal extent 75 mm, anterior extent

35 mm. The tumor embraced more than 50 % of the circumference of the aorta, but without certain signs of infiltration of the vessel wall. CT-guided core biopsy

revealed a chondrosarcoma grade 2. Further tumor staging showed no further pathological findings. A three-level resection including the aorta was planned together with the cardiothoracic surgeons. It was performed in two stages. First, an aorto-aortic bypass was implanted. The

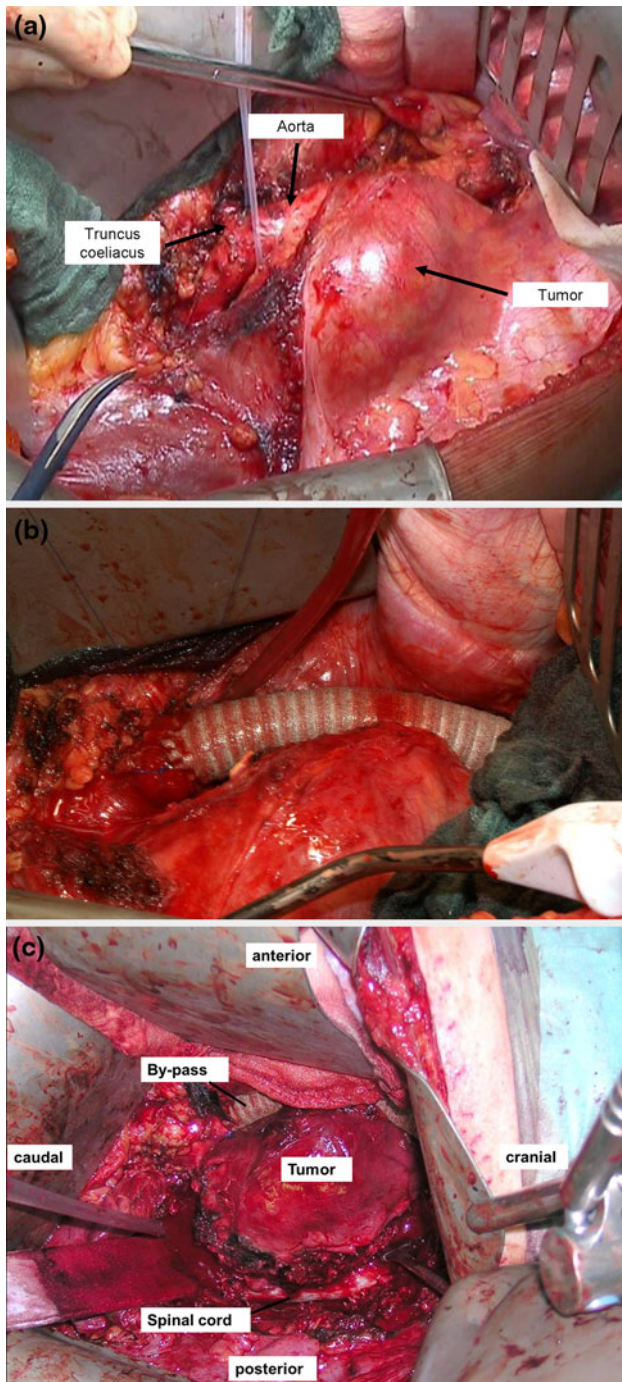


Fig. 2 Intraoperative pictures of the aorto-aortic bypass procedure via left-sided standard lateral thoracoabdominal approach with detachment and splitting of the diaphragm. **a** Mobilization of the proximal and distal aorta before clamping. **b** Aorto-aortic bypass. **c** Intraoperative picture of the anterior resection of the tumor

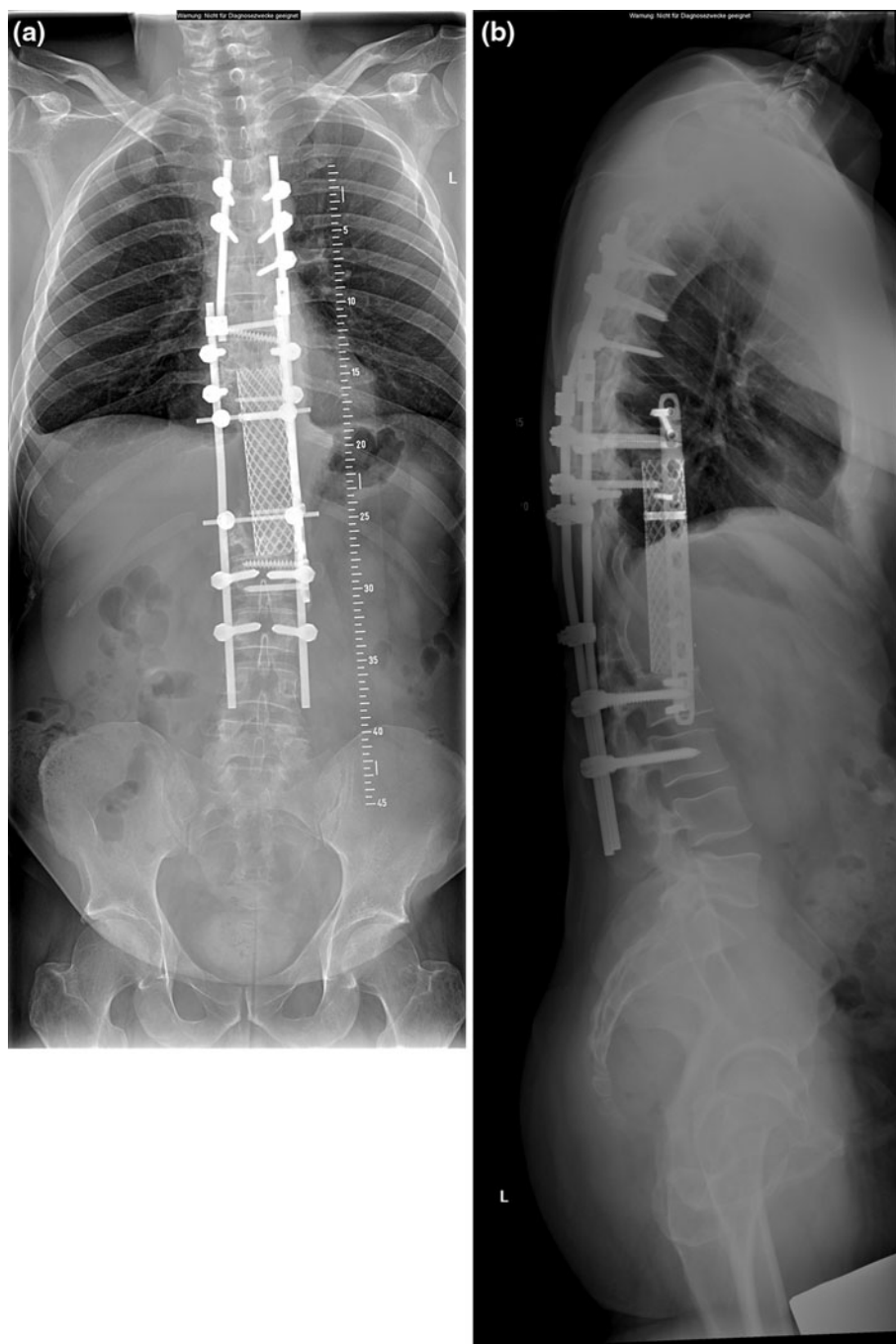
transpleural-retroperitoneal left-sided thoracoabdominal approach of Hodgson with radial detachment of the diaphragm was used to expose the tumor [8]. The distance between the caudal part of the tumor and the celiac trunk was 2.5 cm (Fig. 2a). Detachment of the esophagus from the tumor mass proved less problematic than expected. Distal perfusion using the heart–lung machine was established via the left femoral vessels following systemic heparinization. The aorta was clamped above and below the tumor, transected at both locations and sewn toward the tumor mass. A silver-coated Dacron graft (16 mm) was implanted end to end to bypass the excluded aortic segment (Fig. 2b). Cross clamp time was 27 min and bypass time 37 min. The operation lasted 135 min. Five packs of RBC and three packs of FFP were given. The patient recovered well. The postoperative neurologic status was unchanged—ASIA E, Strength Grading Scale 5/5. En bloc resection of the tumor followed 3 days after the bypass procedure. Preoperative laboratory values: hemoglobin 11.3 g/dl, thrombocytes 97,000/ μ l, aPTT 42s, INR 1.17. Surgery started with a bilateral posterolateral procedure followed by anterior surgery using the given thoraco-abdominal approach again with detachment of the diaphragm (Fig. 2c). The operation time was 700 min. Intraoperative blood substitution was: 31pks of RBC, 22pks of FFP and 5pks of platelet concentration. Postoperative laboratory values: hemoglobin 11.6 g/dl, thrombocytes 76,000/ μ l, aPTT 38s and INR 1.34. Another 6pks of RBC was given within the next 24 h. The vertebrae Th11 and Th12 were completely resected, while Th10 and L1 were resected partially. We chose a non-biological reconstruction with posterior transpedicular instrumentation and anterior cage implantation with cement augmentation and additional plate fixation. The postoperative CT scan showed a lateral pedicle penetration in Th9, and so we extended the cranial construction secondarily (see Fig. 3).

Histopathology showed tumor-free margins with 1 mm being the closest margin (Fig. 4). The aorta was not infiltrated by the tumor, but the distance between the adventitia and the tumor was 1.5 mm at minimum. The patient had a transient neurologic impairment (ASIA D) with strength grade 3/5 of the right leg and 5/5 of the left leg. Half a year later, he has completely recovered (5/5 of both legs) and has returned to work as a gravedigger with restricted load carrying. The latest follow-up was 48 months after the operation (Fig. 4). Local MRI and PET scan showed no signs of local recurrence or metastatic disease.

Discussion

Stener in 1971 first described the technique of spondylectomy for treating a chondrosarcoma of the spine [9]. Over

Fig. 3 Plain radiographs of the reconstruction 48 months after surgery. Note the cement-augmented, non-expandable anterior cage and the augmentation with a conventional 4.5-mm AO locking compression plate with angular stable screws



the decades, this technique has been considered as a risky and technically highly demanding procedure that was reserved for limited indications in some specialized centers [5, 10]. In 1994, Tomita, one of the pioneers in en bloc resection of the spine, published his series of 20 spondylectomies for solitary spinal metastases [11]. He presented a fairly standardized technique of a solely posterior procedure. His complication rate was low with a 100 % rate of local control. So far, several authors have reported case series or case reports about en bloc spondylectomy. The

technique is nowadays well established and considered safe in the hands of experienced surgeons and has a reasonable complication rate [12–15]. Both the stand-alone posterior and combined anterior–posterior approaches have been described [5, 7, 14]. The discussion of the pros and cons is far beyond the scope of this manuscript. Presently, even biomechanical studies with a special focus on 360° resections and implant reconstruction exist [16]. Surprisingly, no case of combined aortic replacement and spondylectomy has been reported so far, although vessel resection and

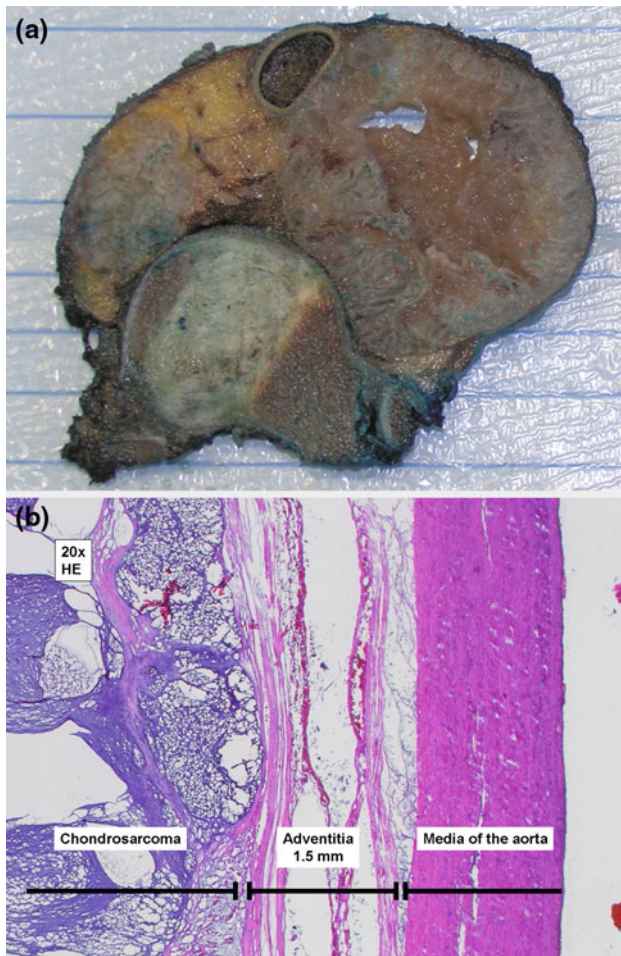


Fig. 4 **a** Macroscopic sections of the specimen. **b** Microscopy of the tumor (HE strain). Note the close relationship of the tumor to the aorta

replacement are not uncommon in the treatment of sarcomas of the extremities [17].

A major issue that warrants thorough discussion is the indication for surgery in this case. A study of the Bologna group has clearly shown the superiority of a wide or at least marginal resection in chondrosarcoma of the spine compared to intralesional resection [3]. The question arises whether a free margin could be expected without sacrificing the aorta and without a high risk of aortic bleeding. Although the MRI did not show clear infiltration of the media, we were not convinced that a safe resection could be performed because of the very thin layer between the aorta and the tumor and the circumferential growth pattern around the aorta. The postoperative specimen showed a margin of 1.5 mm between the tumor and the aorta, which may be taken as confirmation of the preoperative concerns. Preoperative stent implantation and intramural dissection could have been an alternative to our chosen procedure. However, the long-term outcome, especially if the aortic

wall is partially resected, remains questionable and a secondary aortic procedure may become necessary later. Thus, en bloc resection including the aorta following bypass, which traditionally has a very good long-term prognosis, seemed to be justified.

The second issue for discussion is the timing and sequence of the surgical procedures. To our knowledge, only one case report on the concomitant use of a heart–lung machine in extensive spinal surgery exists. The indication was a restricted, intraoperative ventilation in a 3-year-old child undergoing anterior surgery for a severe scoliotic deformity [18]. The use of the heart–lung machine to reduce the risk of ischemic spinal cord injury during clamping necessitates an intraoperative anticoagulant therapy with high doses of heparin. Thus, an activated clotting time (ACT) of at least 300 s is required. Due to the resections of the pedicles and the opened epidural space, we anticipated a problem with venous and osseous bleeding. Therefore, to minimize the risk of heparin-induced bleeding, we decided to separate the bypass procedure from the tumor resection over time and agreed on a 3-day delay.

The en bloc resection strategy and the reconstruction have to be discussed further. We chose a posterior procedure followed by an anterior procedure. Due to the huge tumor mass on the anterior side, we felt safer to mobilize it from the anterior under direct view of the main tumor mass. We chose a non-biologic reconstruction that might be problematic in the long run. Huge autografts or allografts would however have been necessary to fill the large defect. Good long-term results are described for anterior femoral allografts [19]. Fibular or rib struts might have been another option [20]. Their integration as a non-vascularized graft is however questionable with a higher risk of postoperative infection. The vascularized graft on the other hand is time consuming in this already very prolonged surgery. One further argument against biologic reconstruction was the uncertain prognosis of the patient. For 4 years, the patient has now been free of any adverse events. He remains completely rehabilitated with little restrictions in his daily heavy work. It is hard to convince the patient now to undergo biologic reconstruction. We agreed on regular radiologic follow-up visits. In case of screw loosening, early reinstrumentation with biologic augmentation should be performed.

Conclusion

En bloc spondylectomy in combination with aortic resection is feasible and might expand the possibility of producing tumor-free margins in special situations. The separation into a primary bypass procedure and secondary resection procedure seems to be reasonable.

Conflict of interest No conflict of interest exists.

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