

Combined modified en bloc corpectomy with replacement of the aorta in curative interdisciplinary treatment of a large osteosarcoma infiltrating the aorta

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Abstract

Purpose We report a case of a large three-level spinal osteosarcoma infiltrating the adjacent aorta. This is the first case in which a combined modified three-level en bloc corpectomy with resection and replacement of the adjacent aorta was successful as a part of interdisciplinary curative treatment.

Methods Case report.

Results The surgical procedure was performed as a two-step treatment. A heart lung machine (HLM) was not used, in order to avoid cerebral and spinal ischemia and to decrease the risk of hematogenous tumor metastases. Instead, a bypass from the left subclavian artery the distal descending aorta was used. We modified the en bloc corpectomy procedure, leaving a dorsal segment of the vertebral bodies to enable rapid surgery. The procedure was successful and the en bloc resection of the vertebral body with aortal resection could be achieved. Except for

pallhypesthesia in the left dermatomes Th7–Th10, the patient does not have any postoperative neurologic deficits. **Conclusion** Combined corpectomy with aortic replacement should be considered as a reasonable option in the curative treatment of osteosarcoma with consideration of the immense surgical risks. The use of an HLM is not necessary, especially considering the inherent risk of hematogenous tumor metastases. Modified corpectomy leaving a dorsal vertebral body segment was considered a reasonable variation since tumor-free margins could still be expected.

Keywords Resection of the aorta · Aortic prosthesis · Spinal osteosarcoma · En bloc corpectomy · Spinal tumor

Introduction

The osteosarcoma is the most common primary bone tumor with a worldwide incidence of 10–16 per million; incidence peaks in the second, sixth, and seventh decades of life [1–3]. The 5-year survival rate of a high-grade malignant tumor entity is about 60 % in the case of no metastases as opposed to 25–30 % if metastases have already been detected [4, 5]. Standard treatment for non-metastasized tumors consists of neoadjuvant and adjuvant chemotherapy as well as surgical resection of the osteosarcoma, sometimes combined with local radiotherapy. The surgical procedure aims at complete tumor resection with the largest possible safety margins [6]. Only 0.85–3 % of all osteosarcomas are located in the spine [7]. Because of the low incidence and the immediate proximity to vital anatomical structures, the treatment of spinal osteosarcomas remains a major challenge [8]. Surgical therapy consists of en bloc resection of the tumor, i.e.,

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resection in a single piece with a capsula of healthy tissue. In cases of successful resection, survival rates are significantly higher than in cases treated with conservative measures only [9, 10]. Today, multilevel corpectomy is an established procedure and many cases have been described in the literature [11, 12]. However, to our knowledge, there is only one report of a combined corpectomy and resection of the adjacent aorta in the case of a chondrosarcoma [13].

Case report

In December 2012, a 61-year-old physically fit patient in a generally good state of health reported to his GP about an acute exacerbation of pain with a stabbing character in the area of the thoracic vertebral column. He had had pain in the same area for a year. An X-ray of the thorax showed a broadened mediastinum. The MRI detected a suspect space-consuming lesion adjacent to the thoracic descending aorta. In a subsequent CT scan, the lesion was classified as a calcified hematoma, supposedly caused by a pseudoaneurysm of the aorta (Fig. 1). The patient was sent to a vascular surgical department for stenting of the thoracic descending aorta in a planned intervention. During the procedure, a paravertebral tumor at the height of thoracic vertebral bodies 7–10 was discovered and a CT-guided biopsy of the suspected area was performed.

The obtained tissue was further analyzed at two specialized pathology institutes. An osteonectin-positive osteosarcoma was diagnosed by both institutes. The tumor was located paravertebrally at the height of thoracic vertebral bodies 7–9; it literally immured the adjacent aorta.

On a PET/CT scan, no metastases could be detected, thus curative surgical treatment was indicated. Treatment was planned according to the EURO-BOSS protocol, and neoadjuvant chemotherapy was initiated.

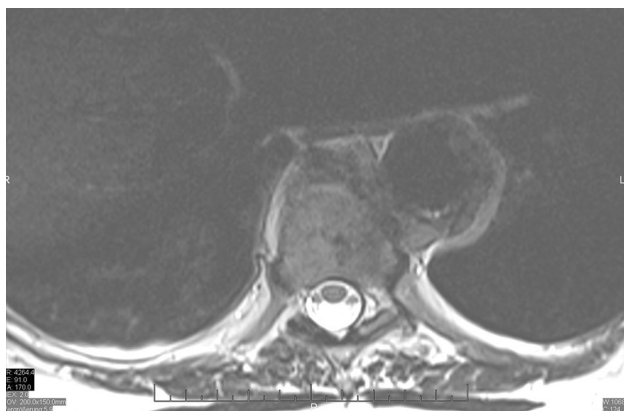


Fig. 1 The tumor, preoperative (CT scan with contrast medium, transversal plane)

Since surgical resection of the tumor had to include the affected aorta and three vertebral bodies, it was critically discussed in an interdisciplinary tumor conference and rated as highly complicated. Curative treatment was offered to the patient along with a detailed explanation of the procedure and the risks.

In the first stage surgical session, dorsal instrumentation Th5–Th11 was performed. Afterward, the patient was monitored on an intermediate care ward for 24 h as planned, and no complications were reported.

The patient recovered in a timely fashion. The second step intervention was scheduled 3 days later. Tumor resection and implantation of an aortic prosthesis were performed as well as a three-level vertebral body replacement.

A double thoracotomy was performed on the left side to allow for sufficient access to the subclavian artery, the proximal descending aorta, and the distal descending aorta. A 10 mm Dacron bypass was implanted from the left subclavian artery to the distal descending aorta to shorten the period of ischemia in visceral organs and peripheral organs during aortic disconnection. Consequently, we were able to avoid the use of a heart lung machine (HLM).

Orthopedic spine surgeons separated the tumor tissue from the surrounding structures. The infiltrated segment of the aorta was then disconnected and reconstructed with a 22 mm Dacron prosthesis, while the infiltrated aorta was left in situ. The temporary bypass between the subclavian artery and the descending aorta was then removed. Then,

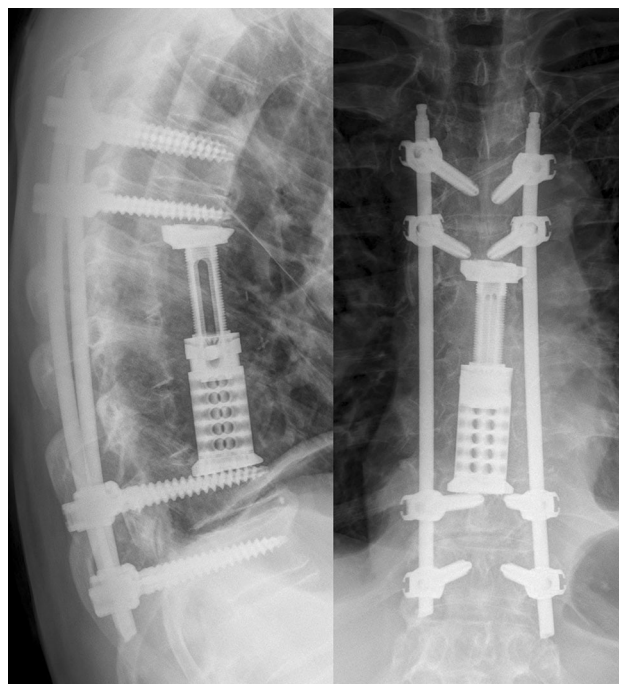


Fig. 2 Postoperative X-ray: vertebral body replacement and instrumentation (lateral and a.p. plane)

en bloc resection of the tumor was performed, which included the vertebral bodies Th7–Th9 and the affected segment of the aorta. Adjacent to the spinal canal, the dorsal fragment of the vertebral bodies (about 0.5 cm in diameter) was left in order to ensure osseous protection of the spinal canal. This shortened the surgical procedure and prevented any damage to the spinal cord due to manipulation.

After resection of the en bloc compound, a three-level vertebral replacement was implanted. The aortic Dacron prosthesis was separated from the neighboring lung by sewing on a bovine pericardial patch. Mass transfusion of

blood components (19 red cell concentrates, 18 fresh frozen plasma, and two thrombocyte concentrates) was required.

Postoperatively, the patient was monitored on an ICU ward without any complications. He was able to get out of bed after 4 days. From a neurological point of view, he reported paresthesia in dermatomes Th7–Th10 on the left side, which was unchanged upon clinical examination 3 and 12 months, postoperatively. Apart from this, no sensory or motor deficits were documented. The instrumentation and vertebral body replacements were found to be correctly positioned in the postoperative X-rays and CT

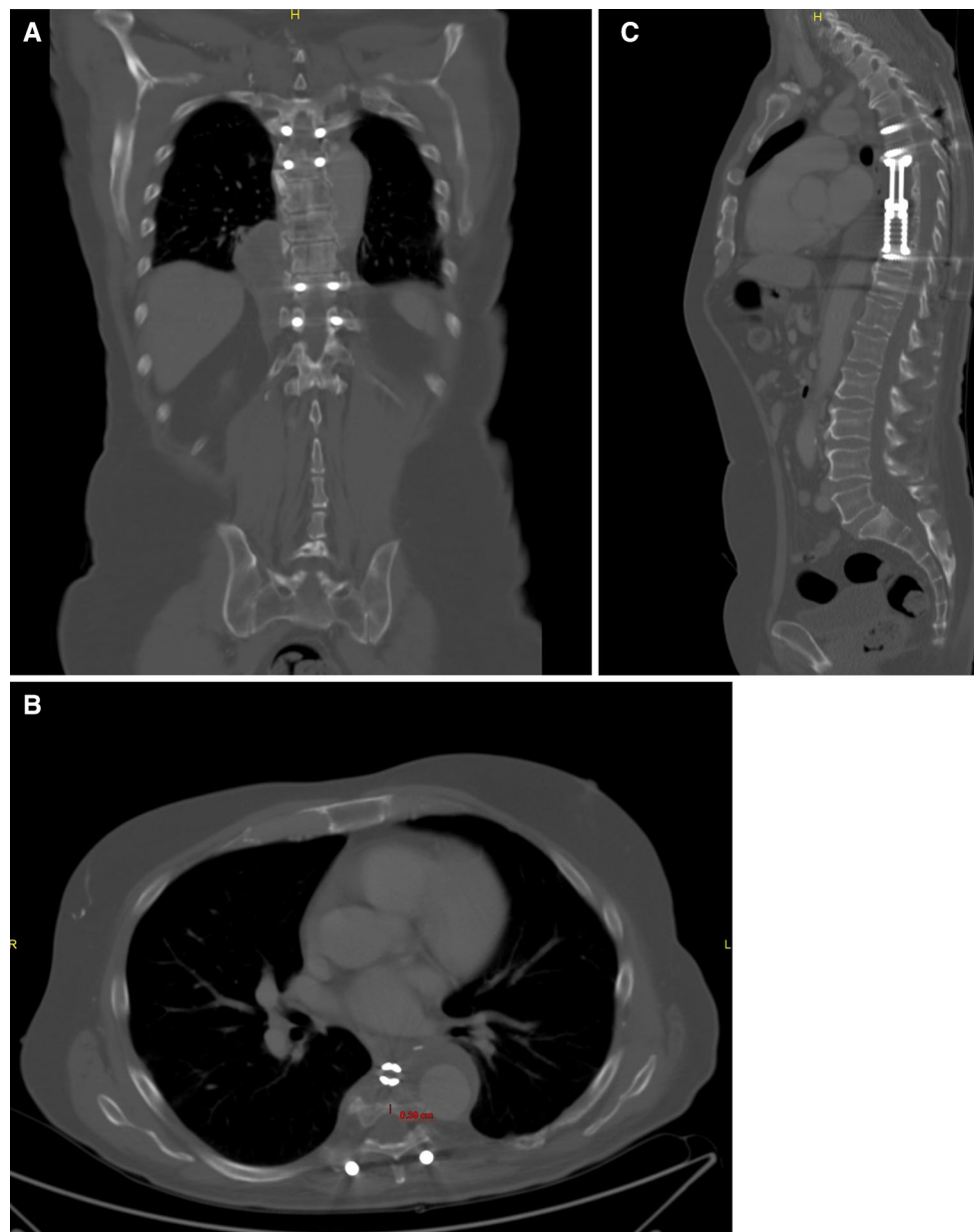


Fig. 3 Postoperative CT scan. Coronal plane (a), transverse plane (b), and sagittal plane (c)

scan with no relevant dislocation of the implanted material (Figs. 2, 3a–c). Three weeks after the operation, the patient was discharged to a rehabilitation clinic in a good general state of health and was autonomously mobile with the help of a rollator. Three months later, he could ride his bike and work out despite adjuvant chemotherapeutic treatment.

The $15 \times 8 \times 4$ cm en bloc preparation (Fig. 4) was preserved in formalin and histologically analyzed in our pathology institute. In the intraoperative frozen section analysis of the neighboring lung, no signs of tumor infiltration were detected. The vertebral bodies with soft tissue and aortic segment were horizontally sectioned and examined macroscopically and by contact radiography.



Fig. 4 Resected en bloc tumor, macroscopic aspect

Extraosseous beige-gray tumor masses between the aorta and vertebral bodies with a maximum diameter of 5.4 cm were detected; these tumors featured a small intraosseous segment and a solid segment in the aortic tissue. In the aortic clearing, a thin lining membrane was seen (Fig. 5a, c). In the histological examination, atypical fusiform cell infiltrates with multifocal tumorous osteoid formations and numerous atypical mitotic figures (Fig. 5c) were visible. These infiltrated the aorta, including the intima. In addition, numerous vital tumor infiltrates could be detected microscopically in vertebral body Th8. The final histopathological diagnosis was a highly malignant osteosarcoma of the osteoblastic type.

The bordering lung parenchyma and the osseous margins were free of tumor cells, whereas some vital tumor cells were found in the cranial margin of the aorta. Altogether, an R1 resection was achieved.

Discussion

As has been reported by Gösling and colleagues, combined en bloc spondylectomy and aortic replacement is a feasible treatment option for spinal tumors infiltrating the aorta [13]. In this case, the indication for surgical tumor resection has to be critically questioned since osteosarcomas have to be resected with a wide safety margin [6].

It had to be decided whether the immense surgical risks should be taken even if tumor-free margins could not be safely expected. In the final analysis, vital tumor cells were

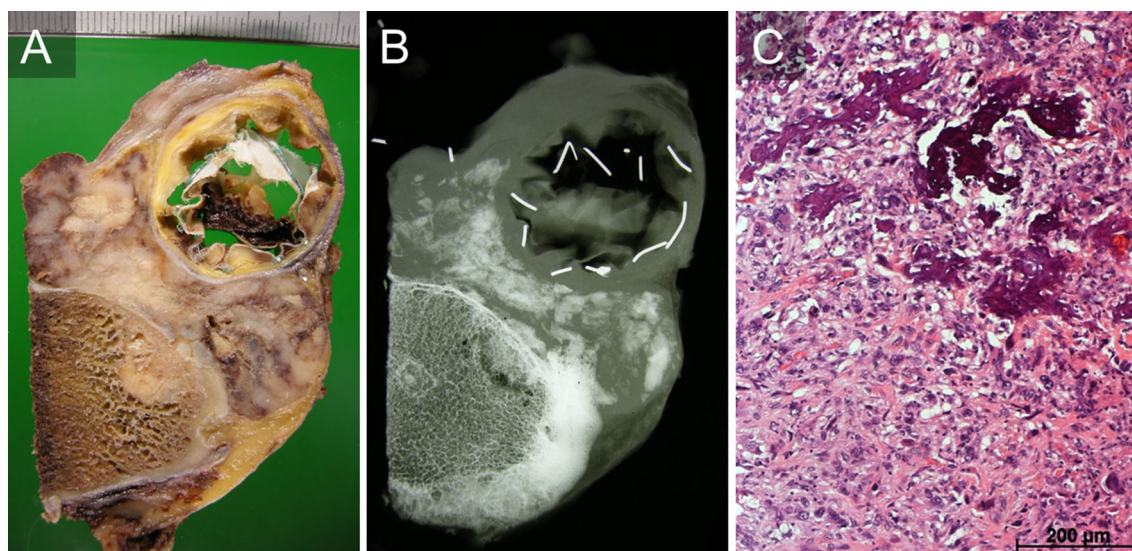


Fig. 5 Pathological findings. **a** Macroscopic aspect: predominantly beige and gray knotty extraosseous tumor tissue in between the vertebral body and the aorta with some intraosseous foci and a slim lining membrane in the aortic lumen. **b** Contact radiology: multifocal

pathologic ossification foci in the tumor tissue. **c** Microscopic aspect: atypical mesenchymal infiltrate with the formation of tumorous osteoid (*upper half*), typical of osteoblastic osteosarcoma (hematoxylin–eosin stain, $\times 100$ magnification)

found in the cranial margin of the resected aorta, thus careful discussion of the indication had certainly been justified. The patient nevertheless opted for surgical treatment because of the prospect of a significantly improved prognosis in the case of a successful operation.

We chose to leave a dorsal fragment of the vertebral bodies, about 0.5 cm in diameter, in order to improve the osseous protection of the spinal canal, shorten the surgical procedure, and avoid any damage to the spinal cord due to manipulation. When trying to achieve the widest possible safety margin, this is also a disputable measure. Considering the preoperative MRI and CT scans, it still seemed reasonable. Since no vital tumor cells could be found in the osseous margins of the resected tumor tissue, the modified procedure seems justified.

An HLM was not used, considering the inherent risk of hematogenous tumor metastases. Furthermore, the risk of spinal ischemia was not significantly higher using our method as opposed to using an HLM. Also, this method did not require systemic heparinization, which would have considerably increased the bleeding risk. By not using the HLM, the patient did not have to undergo the relative immune suppression caused by these machines.

Conclusions

Combined spondylectomy with aortic replacement is feasible and should be considered a valid option in the interdisciplinary curative treatment of spinal tumors after thorough consideration of the benefits and risks. The use of an HLM is not necessary, especially considering the inherent risk of hematogenous tumor metastases. Modified corpectomy leaving a dorsal vertebral body segment was considered a reasonable variation since tumor-free margins could still be expected.

Conflict of interest None of authors has any potential conflict of interest.

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