Thoracic aortic endografting facilitates the resection of tumors infiltrating the aorta

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Objectives: We and others have reported the early experience with off-label use of thoracic aortic endografts to facilitate the resection of tumors infiltrating the aorta. We describe our extended experience and long-term outcome using this innovative approach.

Methods: Patients with preoperative suspected thoracic aortic infiltration who underwent endografting followed by en bloc tumor resection including the aortic wall were retrospectively reviewed and data were analyzed.

Results: Between 2008 and 2012, 5 patients (4 female) with a median age of 52 years (34-63 years) were included. Tumors infiltrating the aorta were non–small cell lung carcinomas (n = 3) and sarcomas (n = 2). Both patients with sarcoma had neoadjuvant radiation, whereas patients with non–small cell lung carcinomas had neoadjuvant (n = 2) or adjuvant chemoradiation (n = 1). Aortic endografting was performed 1 to 17 days before resection of the tumor. The proximal end of the stent-graft was deployed in the aortic arch (n = 2) or the descending aorta (n = 3). The tumor was resected en bloc in all patients and combined with chest wall and 2 to 3 levels of spinal resection in 4 of the 5 patients. Two patients with full-thickness aortic wall resection had additional buttressing of the defect. Cardiopulmonary bypass was never required. One patient had an empyema requiring debridements and thoracic window. After a median follow-up of 39 months (range, 9-62 months), all patients were alive and disease-free. None of them had overt endograft-related complications.

Conclusions: Thoracic aortic endografting allowed safe en bloc resection of tumors invading the aortic wall. Therefore, the indication for thoracic aortic endografts could be extended to specific oncologic cases. (J Thorac Cardiovasc Surg 2014;147:1178-82)

Surgical resection of tumors invading the aorta is a challenging procedure. It usually implies cardiopulmonary bypass with or without hypothermia and circulatory arrest.[1] The use of a passive shunt to avoid extracorporeal circulation also has been described.[2] More recently, we and others reported the use of thoracic aortic endografts to facilitate en bloc resection of tumors invading the aortic wall.[3-5] We describe our updated surgical experience and long-term outcome using this innovative approach.

MATERIALS AND METHODS

This is a retrospective single-center study. Patients with preoperative suspected tumoral infiltration of the thoracic aorta who underwent endografting followed by en bloc resection of the tumor and aortic wall were included. Data were retrospectively retrieved from patients' electronic charts. The study was approved by the institutional research ethics board at University Health Network. Patient informed consent was obtained.

Preoperative Staging

In case of non–small cell lung cancer, preoperative evaluation comprised computed tomography (CT) of the chest and abdomen, CT or magnetic resonance imaging (MRI) of the brain, bone scan, or integrated positron emission tomography with CT. MRI of the spine was performed when its infiltration was suspected. The mediastinum was systematically assessed by cervical mediastinoscopy or endobronchial ultrasound-guided fine-needle aspiration. Induction therapy consisted of concurrent chemoradiation with 2 cycles of cisplatin-etoposide and 45 Gy to the primary tumor. Restaging was performed with CT of the chest/abdomen, brain MRI or CT, and spine MRI if necessary. Tumors were classified according to the 7th edition of the TNM classification of malignant tumors.[6]

In case of sarcoma, preoperative radiotherapy with 50 Gy in 25 fractions was administered to the tumor. Pre- and post-radiotherapy imaging was performed with CT or MRI of the chest.

Surgical Technique

Surgical procedures were performed in 2 or 3 stages. Insertion of the thoracic aortic endograft was performed before en bloc tumor resection. Endografting was indicated if the preoperative CT showed evidence of aortic compression or encircling on more than 180°. Tumor resection

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Abbreviations and Acronyms
CT = computed tomography
MRI = magnetic resonance imaging

was performed en bloc in a second stage, typically a few days after the aortic endograft insertion. If the tumor involvement implied 3 vertebral levels or more, a 2-stage procedure was performed for the spine resection as previously described.[7]

Before thoracic aortic endografting, CT angiography from the supra-aortic vessels to the common femoral arteries was performed to assess for vessel size and anatomy. In instances of planned coverage of aortic arch arteries, sealing of artery take-off followed by appropriate arterial bypass or endovascular in situ fenestration via ipsilateral brachial artery was performed during the same stage. In cases of inadequately sized external iliac vessels, retroperitoneal access was used. An activated clotting time of 300 seconds or more was targeted for the whole procedure. Endografts (Talent and Valiant from Medtronic Inc, Minneapolis, Minn) were upsized by 10% or less compared with the native aorta. A proximal and distal landing zone of 4 cm of healthy aorta was targeted for sufficient endograft stability. Postprocedure CT angiogram was performed to rule out endoleak.

Tumor resection was performed en bloc and included resection of the involved aortic wall, lung, chest wall, and spine when necessary. Typical 2-stage procedure consisted of a posterior midline incision, posterior tumor release, and multilevel spine instrumentation for the first stage. In the second stage, en bloc tumor resection with completion of the spine instrumentation was performed through a posterolateral thoracotomy with or without reopening of the posterior midline incision. The chest wall was reconstructed with a polypropylene (Marlex; C. R. Bard Inc, Cranston, NJ) or polytetrafluoroethylene (Gore-Tex; WL Gore & Associates, Flagstaff, Ariz) mesh.

RESULTS

Between 2008 and 2012, 5 patients underwent insertion of a thoracic aortic endograft to facilitate en bloc resection of a tumor infiltrating the aortic wall. Patient characteristics are described in Table 1. After a median follow-up of 39 months (range, 9-62 months), all patients were alive and disease-free.

All 5 patients underwent aortic wall resection without aortic clamping and cardiopulmonary bypass. Table 2 summarizes the different types of combined surgical procedures performed. R0 resection was achieved in all patients. The median hospital length of stay for the sum of the 2- or 3-stage procedure was 16 days (range, 7-29 days). None of the 5 patients had endograft-related complications, such as paraplegia, stroke, endoleak, and graft migration. Only 1 patient had major postoperative complications.

The early outcome of patients 1 and 2 have been described in detail by Roche-Nagle and associates.[3] Patient 1 had a history of multiple local recurrences of a low-grade chest chondosarcoma. She presented with a new recurrence at the level of the 8th thoracic vertebra (T8) and indenting the posterior aspect of the aorta. The first surgical procedure consisted of a posterior midline incision with posterior spinal instrumentation T3-T12 and bilateral laminectomy for resection of spinous processes T7-9. Four days later, she underwent a straightforward insertion of a thoracic endovascular graft above the artery of Adamkiewicz. The third stage occurred 2 days later through a thoracotomy and reopening of the posterior midline incision (Figure 1). Complete resection of the tumor required resection of the whole aortic wall over 5 × 3 mm exposing the endograft. The aortic defect was covered with pleura. Six weeks after discharge, she underwent a thoracic window for empyema secondary to parenchymal bronchopleural fistula, and an omental flap was brought to cover the area of the involved spine and aorta. After multiple wound and instrumentation revisions for debridement and nonunion, the patient remains disease-free at more than 5 years and is receiving intermittent antibiotic therapy for minor hemoptysis. Clear evidence of graft infection has not been established.

Patient 2 had a lung adenocarcinoma of the left upper lobe involving the dome of the aortic arch. After a crossover bypass from the right to the left common carotid artery was performed (end-to-side anastomosis, 7-mm Dacron graft), an endograft was deployed proximally up to the take-off of the innominate artery with rapid ventricular pacing. The endovascular graft covered the left common carotid and subclavian arteries. To minimize the risk of endoleak, the origin of the left carotid was ligated and an endovascular plug was placed in the left proximal subclavian artery. Five days later, the patient underwent en bloc tumor resection via a left hemi-clamshell incision, including the media of the aorta on one quarter of the aortic circumference and a width of 3 cm (Table 2). Adjuvant chemoradiotherapy with 4 cycles of cisplatin-vinorelbine and 60 Gy was administered. The patient is alive without recurrence 53 months after the surgery.

Patient 3 had multiple metachronous lung metastasis from a femur osteosarcoma. After repeated resections, recurrence was apparent as a pleural mass located behind the aorta at the level of the carina on the left side (Figure 2). A straightforward endograft insertion allowed a partial aortic wall resection of 3 cm^2, en bloc with the tumor on the following day. Tumor recurred in a different location along the pleura 13 months later requiring another chest wall resection, and the patient is currently disease-free at 39 months.

Patient 4 underwent a 3-stage procedure for a left lower lobe adenocarcinoma invading the neural foramen of T6-7. The endovascular graft was deployed 2 cm below the left subclavian artery. Six days later, she underwent posterior tumor release and instrumentation/stabilization from T2-10. Finally, the tumor could be resected en bloc with an area of 5 cm^2 of aortic adventitium 11 days later.

Patient 5 had a squamous cell carcinoma of the left lower lobe abutting the descending aorta over 180° and infiltrated T6 vertebral body. The stent-graft was deployed at the distal edge of the origin of the left common carotid artery, covering the subclavian artery origin. Therefore, in situ fenestration of the subclavian artery with balloon dilation

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