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Massive Hemorrhage From the Aorta on Removal of an Anterior Mediastinal Tumor in Spite of Using an Endovascular Stent Graft: A Case Report

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A 68-year-old man was scheduled for mediastinal tumor resection. Aortic invasion was unclear on preoperative computed tomography. Transesophageal echocardiography showed a smooth endothelial border, but the tumor was contiguous with the distal arch, and the adventitial border was unclear. After median sternotomy, the tumor was found to be adherent to the aorta. An endovascular stent graft was placed in the distal arch to protect the aorta, but excessive bleeding occurred from the aortic defect on tumor removal. This case shows that massive hemorrhage can occur during the resection of an aorta-invading tumor despite the use of an endovascular stent graft. (A&A Practice. 2019;12:82–4.)

Surgical resection of tumors invading the aorta is a challenging procedure that usually requires cardiopulmonary bypass with or without hypothermia and circulatory arrest, and is associated with significant morbidity and mortality. Moreover, it is sometimes difficult to determine the extent and degree of tumor invasion preoperatively, which affects surgical planning. Recently, some reports have described the use of thoracic aortic endografts in facilitating the resection of tumors invading the aortic wall. Here, we report a case of surgical resection of a tumor invading the aorta, after the placement of a thoracic aortic endograft that could not prevent massive hemorrhage from the aortic defect.

Written consent has been obtained from the patient.

CASE

A 68-year-old man with well-controlled hypertension and diabetes mellitus was diagnosed with a mediastinal tumor. Preoperatively, computed tomography showed an anterior mediastinal tumor (Figure 1) with a maximum diameter of about 80 mm. The tumor extended to the left upper lobe of the lung, involving the left phrenic nerve, and was contiguous with the distal arch and left pulmonary artery. It was unclear if the tumor had invaded the aorta and pulmonary artery.

The planned 1-stage surgery included median sternotomy, tumor resection, left upper lobectomy with or without endovascular stent graft placement in the distal arch, and pulmonary artery resection and reconstruction, depending on the extent of the tumor invasion. General anesthesia was induced uneventfully. We used a 37-French left-sided double-lumen endobronchial tube and a left radial arterial line as well as a central venous catheter and sheath introducer in the right internal jugular vein. Transesophageal echocardiography (TEE) was used to clarify the presence or absence of tumor invasion. TEE showed a smooth endothelial border, but the tumor was contiguous with the distal arch and the adventitial border was not clear (Figure 2). The final decision on the tumor invasion and surgical plan was delayed until findings were obtained from surgical exposure.

The surgery was initiated by performing median sternotomy. After resection of the left upper lobe of the lung, the tumor was visualized in the left side of the mediastinum. The tumor was adherent to the aorta and pulmonary artery, and involved the left phrenic and vagus nerves. Therefore, the surgeon decided to perform endovascular stent graft placement in the distal arch to protect the aorta before

Figure 1. Preoperative computed tomography showing a tumor in contact with the aorta and suspected aortic invasion.

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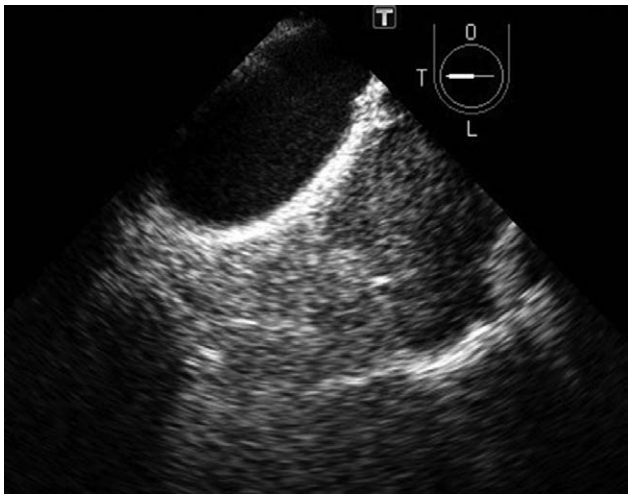

Figure 2. Intraoperative transesophageal echocardiography showing a preserved endothelial border and an unclear adventitia border.

tumor resection. A bypass from the left common carotid artery to the left subclavian artery was performed, after which a straight, externally supported, 8 × 80 mm endovascular stent graft (Maquet FUSION Bioline Vascular Graft; Maquet Japan Inc, Tokyo. Japan) was deployed in the aorta (Figure 3). It covered the distal arch and proximal descending aorta with safe proximal and distal margins. No endoleak was observed. However, when the tumor was peeled off the aorta, bleeding at the aortic defect occurred and coverage of the bleeding point with a vascular graft was required. Approximately 6000 mL of bleeding occurred within 30 minutes, which resulted in severe hypotension: systolic blood pressure (SBP) was around 50 mm Hg. Approximately 1500 mL of fluids and 4000 mL of blood products were administered. Simultaneously, multiple boluses of phenylephrine and continuous IV norepinephrine administration (up to 0.61 $\mu g \cdot kg^{-1} \cdot minute^{-1}$) were required. This situation continued for about 45 minutes. Subsequently, his SBP increased to 80 mm Hg, but his hemodynamics remained unstable. Therefore, blood products were transfused until the procedure was completed.

After hemostasis was obtained and his hemodynamics were stabilized, the surgeon initiated resection of the pulmonary artery, after temporarily clamping the left pulmonary artery. The tumor and left pulmonary artery were resected, and the pulmonary artery was repaired with a Gore-tex patch (W. L. Gore & Associates, Co, Ltd, Tokyo, Japan). Surgery lasted approximately 8 hours. The total blood loss was approximately 8000 mL; total blood transfusion, 3920 mL (red blood cells, 2520 mL; fresh frozen plasma, 1200 mL; platelets 200 mL); and albumin administration, 1500 mL.

After the surgery, the patient was transferred to the intensive care unit and was kept sedated and intubated. The patient was stabilized hemodynamically by administering an additional 480 mL of red blood cells and 500 mL of 5% albumin. His SBP increased up to 120 mm Hg, so that the norepinephrine could be weaned off. On postoperative day 1, his respiratory status improved (Pao_2/fraction of inspired oxygen ratio was approximately 300); therefore, he was extubated after the sedation was stopped and he had become conscious. However, he experienced deterioration

Figure 3. Postoperative chest radiography showing an endovascular stent graft covering the distal arch.

of muscle strength in the left foot. A neurologist was consulted, and magnetic resonance imaging was performed. He was diagnosed with spinal cord infarction, most likely due to hypoperfusion during the surgery. On postoperative day 4, he was moved to the general ward, and on postoperative day 21, he was referred to a rehabilitation hospital. The pathological diagnosis was adenocarcinoma invading the aortic media.

DISCUSSION

Several reports have recently described the use of thoracic aortic endografts to facilitate resection of tumors invading the aortic wall.[1–7] These reports advocate the use of endografts to reduce perioperative risks and allow complete tumor resection without aortic clamping and cardiopulmonary bypass. However, there are no experimental data that offer reliable advice on how much the covered stent area should measure at each end of the resection area, but safe proximal and distal margins of 2 or 4 cm have been proposed.[1,2] In addition, there is no consensus on the maximal possible extent of aortic wall resection in cases in which endografts were used. Collaud et al[1] encountered no complications when the partial thickness of the aortic wall and less than one-half of the circumference were resected with buttressing of the defect with a patch of bovine pericardium. Dejima et al[3] reported combined resection of the aortic wall and tumor using an endovascular stent graft patch to reinforce the aortic wall defect. In another report, using a brief aortic cross-clamp and covering the defect with a muscle flap were suggested for cases in which the removed aortic section includes the adventitia and almost the full thickness of the media.[4,5] Kanno et al[6] laced 2 thoracic endovascular grafts to reinforce the strength of the aortic adventitia via posterolateral thoracotomy. In some experimental studies, tumor resection was performed

in a second-stage procedure, typically a few days to several weeks after aortic endograft insertion.[2,7] However, the optimal delay period between thoracic aortic endograft insertion and aortic wall resection is not known.

In all the above reports, there was no case of massive bleeding despite extensive tumor invasion. In our case, there were sufficient margins and no endoleak. However, we did not know the exact depth of the tumor invasion. When the tumor was peeled off the aorta, the aortic wall was torn and the endovascular stent graft was exposed unexpectedly, resulting in massive bleeding. The possible causes of massive bleeding are as follows: the attachment of the endovascular graft to the aortic wall might have loosened when the stent graft was exposed. It might have led to leakage at the graft ends (type 1 endoleak) and/or leakage via the branch vessel (type 2 endoleak). These could have been the main reasons for massive bleeding, although no endoleak was detected on checking with contrast medium. The other sources of bleeding might have been the collateral flow around the tumor. Nonetheless, the exact reason of bleeding was not clear, and we could not predict the massive bleeding.

Knowing the extent of the tumor invasion preoperatively is important to prevent massive bleeding. Mediastinal tumors are normally evaluated preoperatively using computed tomography and magnetic resonance imaging, which provide information on the probable loci of invasion or adhesion of tumors to surrounding tissues, but complete prediction of adhesion is often difficult. TEE has also been used to evaluate the extent of tumors.[8,9] In 1 report, aortic invasion by a lung tumor was shown by the disappearance of the outer hyperechoic layer of the aorta and lack of synchronous movement of the tumor consolidation during respiration.[8] In another case report, intravascular ultrasound was used, which could show the 3-layer structure of the aortic wall and provide information on aortic tumor invasion.[10] These reports show that ultrasound images can be helpful in obtaining information on tumor invasion of the aorta. However, in our case, we were unable to identify the invasion using TEE, and the tumor invasion of the aorta was deeper than we originally thought. In addition, lack of synchronous movement of the tumor consolidation during respiration could not be used to evaluate the aortic invasion by the mediastinal tumor. Therefore, several tools are needed to evaluate tumor invasion as correctly as possible. Ultrasound images for the evaluation of tumor invasion have not been widely reported, and further accumulation of cases is needed to improve the interpretation of these images.

In conclusion, this case shows that massive hemorrhage can occur on removal of a tumor invading the aorta, and preparation for massive bleeding is necessary, even when an endovascular stent graft is used.

DISCLOSURES

Name: Yuri Hayashi, MD.
Contribution: This author helped analyze the data and write the the manuscript.
Name: Atsushi Yasuda, MD.
Contribution: This author helped with anesthetic management during the operation.
Name: Sho Adachi, MD.
Contribution: This author helped with anesthetic management during the operation.
Name: Shigehito Sawamura, MD, PhD.
Contribution: This author helped revise the manuscript.
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