**Title:** Successful Lung Lobectomy for a Lung Cancer Following Thoracic Endovascular Aortic Repair for a Thoracic Aortic Aneurysm: Report of a Case

**Authors:** Takashi Eguchi[1,3], Daisuke Fukui[2], Keiichiro Takasuna[1], Yuko Wada[2], Jun Amano[2], and Kazuo Yoshida[3]

**Institutions:** [1]Department of Thoracic Surgery, Ina Central Hospital, Ina, Japan

Departments of [2]Cardiovascular Surgery and [3]Thoracic Surgery, Shinshu University School of Medicine, Matsumoto, Japan

**Running head:** Lung Lobectomy following TEVAR

**Article type**: case report

**Corresponding author:** Takashi Eguchi,

Department of Thoracic Surgery, Shinshu University School of Medicine,

Asahi 3-1-1, Matsumoto, Japan,

Telephone: 81-263-37-2657

Fax: 81-263-37-2721

E-mail: tks1976@shinshu-u.ac.jp

## Abstract

Lung cancer and a thoracic aortic aneurysm were detected simultaneously in a 79-year-old male patient with diabetes. The aneurysm was first treated by thoracic endovascular aortic repair. A right lower lobectomy was subsequently performed after the blood flow of the bronchial and intercostal arteries was confirmed by computed tomographic angiography. The bronchial stump was covered with an intercostal muscle flap. The patient's postoperative course was uneventful. Thoracic endovascular aortic repair is a useful and less invasive treatment for such cases, but a blood flow evaluation of the aortic branches should be done following this procedure before a lung resection is considered.

**Key words:** bronchial artery; intercostal artery; lung lobectomy; thoracic endovascular aortic repair.

## Introduction

The coexistence of cardiovascular disease with lung cancer is considered to significantly impact the survival and morbidity in patients undergoing pulmonary resection. In some of these cases, cardiovascular treatment should precede the lung cancer operation in order to reduce the perioperative risk. A coincidental diagnosis of a thoracic aortic aneurysm (TAA) and lung cancer is relatively rare, and devising an effective treatment is challenging. We herein present such a case, in which a lung lobectomy following a thoracic endovascular aortic repair (TEVAR) was successfully performed.

## Case report

A 79-year-old male patient with a medical history of diabetes was referred to our department due to the simultaneous detection of a right lung tumor and a TAA by chest computed tomography (CT). The chest CT revealed an irregular mass of 3.2 cm in diameter in the right lower lobe (Figure 1a) and a swollen lymph node in the right hilum. This was strongly suggestive of a stage cT2aN1M0 primary lung cancer. In addition, a saccular aortic arch aneurysm of 6 cm in diameter was revealed during this screening (Figure

1b).

To avoid a rupture of the aneurysm in our patient, the TAA was treated first using a TEVAR procedure. A previous case was reported in which, subsequent to performing TEVAR to treat a TAA, a bronchial fistula occurred after a right lower lobectomy for a primary lung cancer; loss of blood flow to the bronchial stump and the pedicled intercostal muscle flap from the aorta due to the TEVAR procedure was stated as a possible reason for the complication [1]. In response to this article, we evaluated the blood flow of the branches of the descending aorta using CT angiography before undertaking the lung resection, and confirmed that the blood supply was preserved for both the right bronchial artery and the fifth intercostal artery (Figure 2).

A right lower lobectomy was performed 53 days after the TEVAR procedure. The bronchial stump was covered with a pedicle flap of the right fifth intercostal muscle. The patient's postoperative course was uneventful. The definitive lung tumor diagnosis in this case was a moderately differentiated squamous cell carcinoma with a hilar lymph node metastasis (pT2aN1M0).

## Comment

The need to manage TAA cases is increasing due to the aging of the population. The standard treatment for these patients is open aortic replacement using synthetic vascular grafts, but this approach carries a significant risk of early morbidity and mortality [2]. In contrast, TEVAR is a minimally invasive procedure that has become more widespread. It has been reported that this procedure can reduce early mortality, shorten the hospital stay, and deliver similar late results compared with open repair methods, even for elderly patients [2], and can provide therapeutic benefits to high-risk patients [3]. Considering the lower invasiveness of TEVAR, this approach was considered to be a potentially useful option for the treatment of a TAA associated with a lung cancer that required surgical resection.

It is noteworthy, however, that Hino et al. [1] reported the occurrence of a bronchial fistula after a post-TEVAR lung lobectomy. In this case study, impairment of the arterial supply to the bronchial stump and the intercostal muscle flap was stated to be a possible cause of the complication. Spinal cord ischemia, which is a potentially devastating complication of the TEVAR

procedure, is considered to be induced via a loss of perfusion of the intercostal arteries due to stent coverage of the thoracic aorta; the extent and distal location of the aortic coverage were reported to be associated with an increased risk of spinal cord ischemia [4]. Recently, the collateral network of small arteries in the spinal cord has been better described, and the spinal cord protection during treatment of aortic aneurysms has been improved on the basis of the collateral network concept [5]. However, the bronchial wall perfusion after lung resection remains to be elucidated, and it is still unknown how much impact the aortic coverage has on bronchial stump perfusion.

In the present case, the origin of the right bronchial artery was the right fourth intercostal artery, which, beginning from the aorta, was covered with the stent graft. However, contrast enhancement was visualized by CT angiography, and we concluded that the blood flow to the right bronchial artery was preserved due to collateral circulation. In addition, the beginning of the fifth intercostal artery was not covered with the stent graft. Therefore, we decided to perform a right lower lobectomy and bronchial stump buttressing with the fifth intercostal muscle flap.

There are many collaterals of the bronchial artery. Moreover, the artery is frequently divided during mediastinal lymph node dissection, and no problems occur in the majority of cases. Therefore, we speculated that a single obstruction of the bronchial artery would not induce perfusion impairment of the bronchial stump. However, if a stent graft extensively covered the thoracic aorta, it is possible that the blood supply of the collateral vessels could also be impaired, and temporary perfusion impairment of the bronchial circulation might occur.

Bronchial stump buttressing with an intercostal muscle flap is routinely performed in our institute during lower lobectomies or pneumonectomies in diabetic patients [6]. The dominant blood supply to the intercostal muscle is via the posterior intercostal artery, and the muscle flap is usually transected anteriorly [7]. From the third to sixth intercostal spaces, there are anastomoses located between the anterior and posterior intercostal arteries [8]. Hence, if the origin of the posterior intercostal artery of the targeted muscle flap is covered by a stent graft, the blood supply to the muscle would come from the internal thoracic artery. In such cases, the use of other material, including pleural, pericardial and fat pad grafts, should be

considered as an alternative treatment approach. On the other hand, during a pre-lung surgery TEVAR procedure, the extent of aortic coverage should be decided by taking into account not only sufficient aortic fixation, but also the risk of impaired perfusion after lung surgery.

In conclusion, we have successfully performed a lung lobectomy following a TEVAR to treat a lung cancer patient with a concomitant TAA. TEVAR is a minimally invasive procedure, and is therefore a useful treatment approach for TAA cases associated with lung cancer. However, care should be taken, as extensive aortic coverage may induce perfusion impairment of the bronchial stump following lung surgery. It may be useful to evaluate the bronchial circulation using CT angiography during the TEVAR procedure.

## Conflict of interest

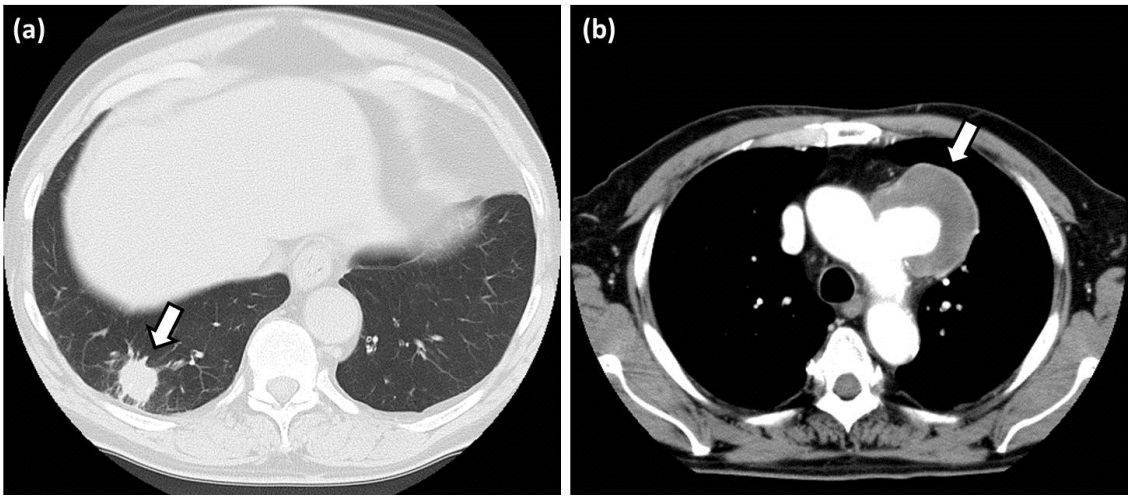
None declared.

## References


1. Hino H, Murakawa T, Nagayama K, Nakajima J: **Bronchopleural fistula after lower lobectomy of the right lung following thoracic endovascular aortic repair**. *Interact Cardiovasc Thorac Surg* 2012; 14:655-7.
2. Patel HJ, Williams DM, Upchurch GR, Jr., Dasika NL, Passow MC, Prager RL, et al.: **A comparison of open and endovascular descending thoracic aortic repair in patients older than 75 years of age**. *Ann Thorac Surg* 2008; **85**:1597-1603.
3. Onitsuka S, Tanaka A, Akashi H, Akaiwa K, Mikasa K, Kanaya K, et al.: **Thoracic endovascular aortic repair with homemade stent grafts: early and mid-term outcomes**. *Surg Today* 2011; **41**:1054-1061.
4. Feezor RJ, Martin TD, Hess PJ, Jr., Daniels MJ, Beaver TM, Klodell CT,et al.: **Extent of aortic coverage and incidence of spinal cord ischemia after thoracic endovascular aneurysm repair**. *Ann Thorac Surg* 2008; **86**:1809-1814.
5. Griepp RB, Griepp EB: **Spinal cord perfusion and protection during descending thoracic and thoracoabdominal aortic surgery: the collateral network concept**. *Ann Thorac Surg* 2007; **83**:865-869.
6. Sfyridis PG, Kapetanakis EI, Baltayiannis NE, Bolanos NV, Anagnostopoulos DS, Markogiannakis A, et al.: **Bronchial stump buttressing with an intercostal muscle flap in diabetic patients**. *Ann Thorac Surg* 2007; **84**:967-971.
7. Ferguson MK: **Thoracic surgery atlas**. Philadelphia, PA: W.B.Saunders, Inc. 2007; p. 290.
8. Gray H, Standring S, Ellis H, Berkovitz BKB: **Gray's anatomy : the anatomical basis of clinical practice**, 40th ed. Edinburgh ; New York: Elsevier Churchill Livingstone; 2008. p.926-927

## Figure legends

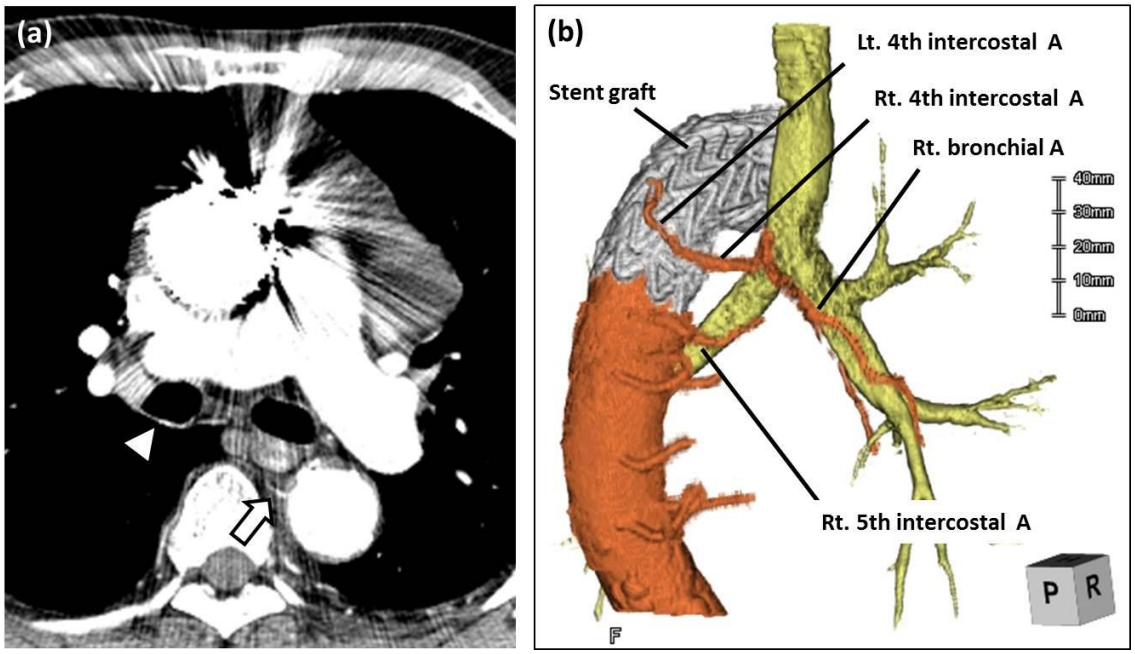
Figure 1




(a) Chest CT showed an irregular mass of 3.2 cm in diameter located in the right lower lobe of the lung (arrow).

(b) A saccular aortic arch aneurysm of 6 cm in diameter was also seen (arrow).

Figure 2




(a) CT angiography revealed contrast enhancement in the right bronchial artery (arrowhead) and the right fifth intercostal artery (arrow).

(b) A three-dimensional reconstruction image for the current case showing that the right bronchial artery originated from the right fourth intercostal artery and ran posteriorly along the right bronchus, but that the beginning of the artery was sealed by the stent graft. The origin of the right fifth intercostal artery was below the distal end of the graft.

Rt., right; Lt., left; A, artery