Aberrant mediastinal mediobasal segmental pulmonary artery in a patient with lung cancer undergoing right lower lobectomy: a case report

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Abstract
Background: A mediastinal mediobasal segmental pulmonary artery (A7) from the right main pulmonary artery is extremely rare.

Case presentation: We report the case of a 71-year-old woman with an aberrant mediastinal A7 who underwent right lower lobectomy for lung cancer (cT1bN0M0, stage IA2). Preoperative three-dimensional computed tomography (CT) angiography revealed an aberrant mediastinal A7 in the right main pulmonary artery. Right lower lobectomy and mediastinal lymph node dissection were performed. Intraoperatively, A7 was observed between the superior and inferior pulmonary veins and in the front of the lower bronchus near the anterior hilum. The artery was carefully dissected from the caudal side after inferior pulmonary vein dissection. The lung parenchyma, which was within the fissure due to poor lobulation between the middle and lower lobes, was safely divided.

Conclusions: Thoracic surgeons need to carefully evaluate CT angiography or enhanced multidetector CT findings at preoperative conferences and always keep this anomaly in mind.

Keywords: Right aberrant mediastinal pulmonary artery, Lung cancer, Right lower lobectomy

Background
The branching of the pulmonary artery, vein, and bronchus varies among individuals [1]. For thoracic surgeons, it is very important to preoperatively analyze the anatomic variations to perform safe lung resection. Here, we report an extremely rare case of a patient with lung cancer with a right mediastinal mediobasal pulmonary artery (A7) who underwent right lower lobectomy.

Case presentation
A 71-year-old woman presented to our department with a slow-growing semi-solid ground-glass nodule in the right lower lobe (S6) (Fig. 1) identified on follow-up computed tomography (CT) for oropharyngeal cancer after chemoradiotherapy. No lymph nodes or distant metastases were detected on positron emission tomography/CT. Thus, she was suspected to have primary lung cancer (cT1bN0M0, stage IA2). Preoperative three-dimensional (3D) CT angiography revealed an aberrant mediastinal A7 arising directly from the right main pulmonary artery, running between the superior and inferior pulmonary veins and entering the right lower lobe (Fig. 2). Lung function tests...
revealed a vital capacity of 2.80 L (115.2% predicted), a forced expiratory volume in 1 s (FEV₁) of 2.25 L (113.6% predicted FEV₁), and a diffusing capacity for carbon monoxide of 13.36 ml/min/mmHg (87.3% predicted). Video-assisted posterolateral fifth intercostal thoracotomy was performed with a small 8-cm incision. During surgery, the interlobular fissure between the middle and lower lobes was found to be incomplete, without effusion or adhesion. A hard, elastic tumor measuring 2 cm with slight pleural change was found on the interlobar side in S6a. Aspiration cytology of the tumor revealed a class V adenocarcinoma. As A7 was located at the anterior hilum on preoperative CT, the operative procedure was performed on the dorsal and caudal sides. First, the interlobular main pulmonary artery was exfoliated. Then, A6 and A8–10 were dissected with ligation and autosuture, respectively, after interlobular incision between the upper and lower lobes. Subsequently, the inferior pulmonary vein was dissected after the division of the pulmonary ligament. A7 was identified at the anterior hilum, running between the middle lobe pulmonary vein and the inferior bronchus (Fig. 3). Finally, an interlobar incision between the middle and lower lobes was safely made after A7 dissection with autosuture. The operative time was 153 min, and the total amount of blood loss was 25 g.

The patient received pleurodesis therapy with OK-432 for prolonged air leakage on postoperative day 8. The chest drain was removed on postoperative day 10, and the patient was discharged on postoperative day 13. The final pathological diagnosis was lung papillary adenocarcinoma, pT1b (invasive diameter, 12 mm) N0M0 pStage IA2. There was no evidence of recurrence 6 months postoperatively.

Discussion and conclusions
Thoracic surgeons often encounter anomalies of the pulmonary arteries, veins, and bronchi. It is highly possible to experience unexpected bleeding from the abnormal pulmonary arteries. This commonly results from the left mediastinal lingular artery, which is the first branch of the left main pulmonary artery. Mediastinal lingular arteries, including the A4+5 type and A4 or A5 type, have been reported in 27.3% of cases [2]. In contrast, Hong et al. reported that the incidence of a mediastinal basal pulmonary artery was 0.05% on both sides [3]. Moreover, in other anatomical pulmonary artery studies, the A7a type (which branches off in front of the inferior pulmonary vein) was observed in 74.8% of cases, A7ab (which branches off on both sides) was in 14.8%, and A7b (which was behind it) was in 4.8% [2, 4]. However, the right mediastinal basal artery has not been reported.

To date, five cases of right mediastinal basal pulmonary artery (Table 1) have been reported in the English literature, all of which were reported in Japan due to the prominence and availability of high-resolution CT. There were two cases of aberrant A7 and one case each of A7a, A6–10, and A7–10. To the best of our knowledge, this is the first reported case of aberrant A7 that independently branched off during right lower lobectomy. Aberrant vessels were identified in all six cases, including our case, in which preoperative multidetector CT and 3D-CT angiography were performed. Intraoperative findings identified poor lobulation in all cases. Operative procedures can be classified depending on whether the interlobular incision between the middle and lower lobes or resection of an aberrant artery was first performed. In three of four cases in which the pulmonary artery in the lower lobe was resected, an interlobular incision was first performed. In our
case, we first transected the inferior pulmonary vein with autosuture from the dorsal side for better visualization of the hilum. Then, we exfoliated the aberrant A7 and transected it with autosuture. An interlobular incision was made safely, and the lower bronchus was transected. We encountered no complications during lymph node 7 dissection. After surgery, pleurodesis was required for prolonged air leakage (same as in case 2), but the postoperative course was otherwise uneventful. At present, the formation of a thrombus in the peripheral stump of the pulmonary artery has not been detected, as in other patients.

It is important to check vessel variation using 3D-CT angiography and discuss the safe operative procedure at the preoperative conference.

In summary, we reported a case of a patient with lung cancer and a mediobasal mediastinal pulmonary artery arising from the main pulmonary artery who underwent right lower lobectomy. Our report suggests that attention should be paid to these anomalies.
Table 1  Reports of right mediastinal basal pulmonary artery: A review of literature

| Case | Journal        | Age | Sex | Diagnosis                        | Location | Size (mm) |
|------|----------------|-----|-----|----------------------------------|----------|-----------|
| 1    | GTCS/2011 [5]  | 72  | M   | Metastasis from rectal cancer    | Rt. S7   | 7         |
| 2    | Surg Case Rep/2016 [6] | 67  | M   | Lung cancer                      | NR       | NR        |
| 3    | GTCS/2017 [7]  | 76  | M   | Squamous cell carcinoma          | NR       | 65        |
| 4    | ATS/2020 [8]   | 74  | F   | Invasive mucinous adenocarcinoma  | Rt. S6-9 | 73        |
| 5    | Surg Case Rep/2021 [9] | 73  | M   | Combined small cell carcinoma    | Rt. S9   | 18        |
| 6    | Our case       | 71  | F   | Papillary adenocarcinoma         | Rt. S6   | 25        |

| Case | Preoperative exam | Aberrant | Operative procedure | Operation | Interlobular fissure |
|------|-------------------|----------|---------------------|-----------|----------------------|
| 1    | MDCT angiography  | A7       | Right basal segmentectomy | VATS     | Incomplete           |
| 2    | 3D angiography    | A7       | Right middle lobectomy | VATS     | Incomplete           |
| 3    | MDCT              | A7-10    | Right lower lobectomy | VATS     | Incomplete           |
| 4    | Enhanced TSCT     | A6-10    | Right lower lobectomy | Small thoracotomy | Incomplete |
| 5    | CT angiography    | A7a      | Right basal segmentectomy | VATS     | Incomplete           |
| 6    | 3D angiography    | A7       | Right lower lobectomy | Small thoracotomy | Incomplete |

| Case | Operative step | (1) Interlobular incision | (2) Aberrant | (3) Intersegmental incision |
|------|----------------|---------------------------|-------------|-----------------------------|
| 1    | Interlobular incision | Aberrant A7 |             |                             |
| 2    | Interlobular incision | Not resected aberrant |             |                             |
| 3    | Interlobular incision | Aberrant A7-10 |             |                             |
| 4    | Interlobular incision | Aberrant A6-10 |             |                             |
| 5    | Abasal + aberrant A7a | Bbasal + V7-10 |             | Intersegmental incision   |
| 6    | A6 + Abasal | IPV + aberrant A7 |             | Interlobular incision     |

| Case | Operation time (min) | Blood loss (ml) | Complication | Postoperative course | (1) Air leak | (2) None | (3) No rec. at 8POM |
|------|----------------------|-----------------|--------------|----------------------|-------------|----------|---------------------|
| 1    | NR                   | NR              | None         | No rec. at 8POM      |             |          |                     |
| 2    | NR                   | NR              | Air leak     | No rec. at 7POM      |             |          |                     |
| 3    | NR                   | NR              | None         | NR                   |             |          |                     |
| 4    | 80                   | 10              | None         | Adjuvant chemotherapy and no rec |             |          |                     |
| 5    | 144                  | 30              | None         | No rec. at 1POY      |             |          |                     |
| 6    | 153                  | 25              | Air leak     | No rec. at 6POM      |             |          |                     |

Abbreviations
3D: Three-dimensional, A7: Mediobasal pulmonary artery; CT: Computed tomography; FEV: Forced expiratory-volume in 1 s.

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KK drafted the manuscript. All authors participated in the treatment, contributed to the development of the methodology. All authors read and approved the final manuscript.

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Availability of data and materials
The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate
Not applicable.

Consent for publication
Informed consent of clinical detail and image publication was obtained from the patient.

Competing interests
The authors declare that they have no competing interests.

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