


## CASE REPORT

# Thoracoscopic lobectomy using indocyanine green fluorescence to detect the interlobar fissure in a patient with displaced B3 and absence of fissure: A case report

Keita Nakanishi<sup>1</sup>, Hiroaki Kuroda<sup>1</sup> , Takeo Nakada<sup>1,2</sup>, Harushi Ueno<sup>1</sup> & Noriaki Sakakura<sup>1</sup>

<sup>1</sup> Department of Thoracic Surgery, Aichi Cancer Center Hospital, Nagoya, Japan

<sup>2</sup> Department of Surgery, Jikei University School of Medicine, Tokyo, Japan

## Keywords

Displaced bronchus; indocyanine green; lung cancer; surgery; thoracoscopic surgery.

## Correspondence

Hiroaki Kuroda, Department of Thoracic Surgery, Aichi Cancer Center Hospital, 1-1 Kanokoden, Chikusa-ku, Nagoya, 464-8681, Japan.

Tel: +81 52 762 6111

Fax: +81 52 764 2963

Email: h-kuroda@aichi-cc.jp

Received: 23 March 2019;

Accepted: 10 May 2019.

doi: 10.1111/1759-7714.13104

Thoracic Cancer **10** (2019) 1654–1656

## Introduction

Advances in computed tomography (CT) have led to an increase in reports of bronchial abnormalities. There have been several reports of a displaced bronchus associated with the incomplete interlobar fissure and pulmonary vessel anomalies.<sup>1,2</sup> Identifying such anomalies prior to lung resection can help to avoid intraoperative complications during lobectomy or segmentectomy, especially when using a thoracoscopic approach. There have been a small but not infrequent number of surgical cases reporting bronchial abnormalities, such as tracheal bronchi or displaced apical and posterior segmental bronchus (B1 and B2)<sup>3,4</sup> however, there have been few reports of anterior segmental bronchus (B3) in the right upper lobe (RUL).<sup>5,6</sup>

Several authors have reported the frequency of displaced bronchi accompanied by the absence of an interlobar fissure.<sup>1,2</sup> The correct approach in fissureless cases is essential in order to reduce prolonged air leakage after thoracoscopic resection. The procedure should be guided not only by the surgical findings but also by preoperative

## Abstract

A 90-year-old woman was admitted to our hospital with suspected lung adenocarcinoma. Preoperative three-dimensional reconstructed computed tomography revealed displacement of the anterior segmental bronchus (B3) arising from the right middle lobe bronchus with absence of the fissure between the right upper and middle lobes. A complete thoracoscopic right upper lobectomy was successfully performed. It is crucial to identify such anomalies prior to lung resection to avoid intraoperative complications during thoracoscopic lobectomy or segmentectomy. Additionally, intravenous indocyanine green with a fluorescence system was useful to identify the proper interlobar fissure boundary intraoperatively. To the best of our knowledge, this is the first reported case of thoracoscopic lobectomy for lung cancer with displaced B3 and absence of the interlobar fissure to be performed by applying the intravenous indocyanine green method.

anatomical perception. In addition, an intravenous injection of indocyanine green (ICG) with fluorescence imaging plays an important role in identifying the proper interlobar fissure boundary for a thoracoscopic technique.<sup>7,8</sup>

Herein we report a case of thoracoscopic right upper lobectomy for lung cancer with displaced B3 and absence of the interlobar fissure between the RUL and right middle lobe (RML) in which ICG with a fluorescence system was used to identify the proper interlobar fissure boundary.

## Case report

A 90-year-old woman who had never smoked was admitted to our hospital after an abnormal shadow was detected on a screening chest X-ray. Multiplanar and three-dimensional reconstructed CT revealed a pure solid mass in the RUL measuring 41 mm at its maximum diameter, with structural anomalies including displaced B3 arising from RML bronchus and absence of the interlobar fissure between the RUL and RML (Fig 1a–d). Each anterior

subsegmental artery (A3a and A3b) supplying the segment 3 area in the RUL was also detected, along with displaced B3 (Fig 1c,d). We suspected clinical stage T2aN0M0 stage IB non-small cell lung cancer and decided to perform a thoracoscopic right upper lobectomy.

Thoracoscopic lobectomy via confronting upside-down monitor setting was performed.<sup>9</sup> During the procedure, we found a major fissure but no interlobar fissure between the RUL and RML, as predicted preoperatively. Therefore, we performed the “hilum first, fissure last” technique.<sup>1</sup> We exfoliated and sequentially transected the pulmonary vein in the RUL, the superior arterial truncus branching the apical segmental and posterior subsegmental arteries (A1 + A2a), the bronchus comprising B1 + B2, and the ascending arteries (A2b and A3b) (Fig 2a). Before transecting B1 + B2, we carefully dissected the #11LN using a dorsal approach to avoid causing any damage. We then exposed the displaced B3 ascending between the medial segmental artery and lower lobe pulmonary artery (A5 and A6-10) (Fig 2a). After confirmation of B4 + B5 by bronchoscopy, we transected the displaced B3 using a powered vascular stapler, as described in our previous report.<sup>10</sup> We then exfoliated and transected the remaining anterior subsegmental artery (A3a). Finally, we confirmed the interlobar fissure using the intravenous ICG method and divided the minor fissure (Fig 2b,c), as previously described.<sup>7,8</sup> The surgical duration was 188 minutes, with a small amount of blood loss.

The postoperative course was uneventful, and the patient was discharged two days after the operation. The pathological diagnosis was adenocarcinoma with pT2aN0M0, pStage IB (Union for International Cancer Control, 8th edition).

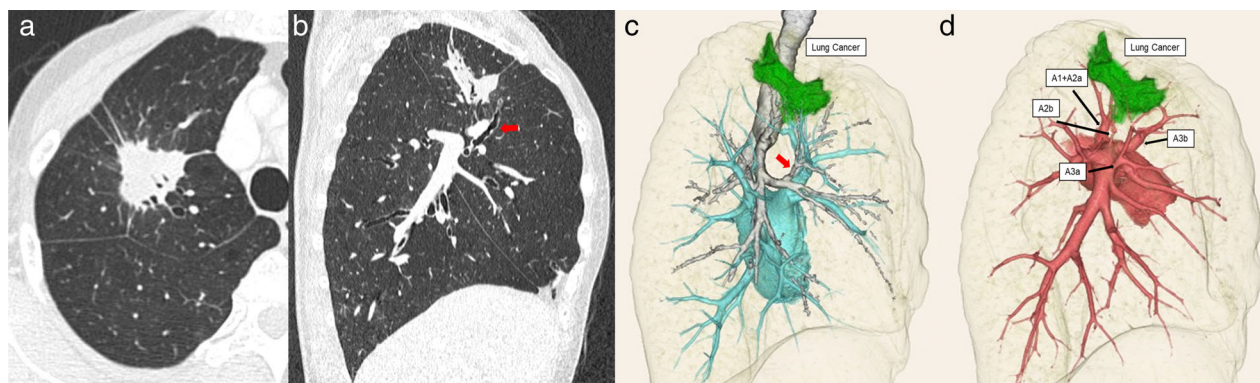
## Discussion

This case had two main features of interest: the displaced B3 arising from the RML bronchus and the creation of an interlobar fissure using the intravenous ICG method. To the best of our knowledge, this is the first surgical case report in which an absent interlobar fissure was identified using the intravenous ICG method in a patient with lung cancer and displaced B3 bronchus.

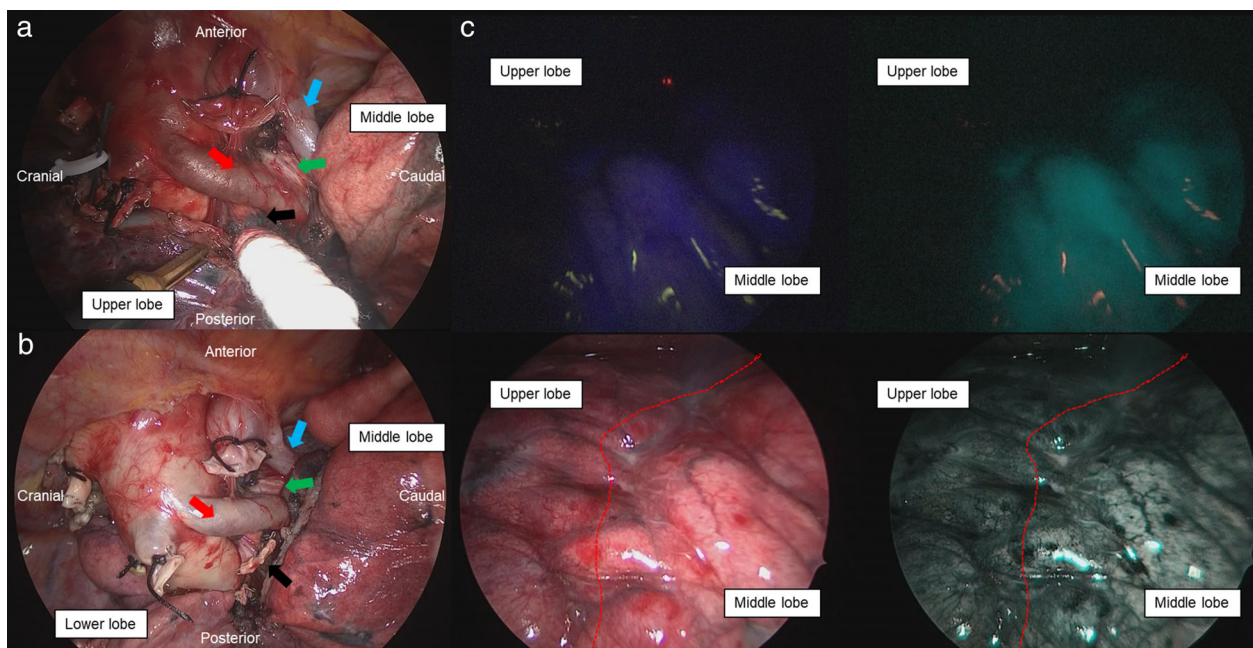
Numerous major congenital bronchial branching anomalies have been described, with a reported prevalence of 0.1%–2% in the general population.<sup>4</sup> It is well established that most bronchus abnormalities are associated with the RUL, accounting for up to 70% of reported abnormalities; however, there have been few surgical case reports of lung cancer patients with displaced B3.<sup>5,6</sup> This variant, for which Boyden proposed the description “right posteparterial bronchus,” is considered extremely rare, especially in patients with lung cancer.<sup>5</sup> In this case, three-dimensional reconstructed images, as well as multiplanar CT images, were useful to recognize and image the definitive position of the displaced B3, which was located between A5 and the lower lobe pulmonary artery (Fig 1c,d).

There have been frequent reports of displaced bronchi accompanied by the absence of an interlobar fissure.<sup>1,2</sup> A “hilum first, fissure last” or “no-touch fissure” technique using staplers was proposed as a useful technique for patients with the absence of an interlobar fissure to reduce air leakage.<sup>1</sup> In this case, we formatted the proper fissure for the absence of fissure accompanied by displaced B3 by applying the intravenous ICG method according to previous reports on the formation of the segmental plane.<sup>7,8</sup>

Intraoperatively, the displaced B3 and hilar RML structures were positioned behind the absent fissure from a visceral mediastinal view, and behind the ascending arteries



**Figure 1** Preoperative multiplanar computed tomographic images (a: axial, b: sagittal) showing a mass in the right upper lobe with displaced B3 arising from the right middle lobe bronchus (red arrow) and no interlobar fissure between the right upper and middle lobes. (c) Three-dimensional reconstructed images according to pulmonary veins and bronchi showing displaced B3 (red arrow) arising from the right middle lobe bronchus. (d) The distribution and running style of the pulmonary arteries supplying the right upper lobe.



**Figure 2** Intraoperative views: (a) before transection of displaced B3 (black arrow); and (b) after removal of the right upper lobe. Displaced medial segmental artery (A5, red arrow), right middle lobe bronchus (B4 + 5, green arrow), and right middle lobe vein (V4 + 5, blue arrow). (c) Intraoperative identification of interlobar boundaries by intravenous indocyanine green injection using conventional mode (left top) and Spectra-A mode (right top), and corresponding surgical view (bottom). Red dot line: the visualized boundaries between the right upper and middle lobes.

(A2b and A3b) from a dorsal view. As shown in Figure 2a, b, transection of B1 + B2 without damaging the interlobar lymph node made it safer and easier to perform transection of the displaced B3, as expected preoperatively. It is crucial to identify such anomalies before lung resection to ensure successful thoracoscopic surgery.

**Disclosure**

No authors report any conflict of interest.

**References**

- 1 Asakura K, Imanishi N, Matsuoka T et al. Video-assisted thoracic surgery lobectomy for lung cancer with displaced b (1+2). *Ann Thorac Cardiovasc Surg* 2014; **20**: 486–9.
- 2 Hayashi K, Motoishi M, Horimoto K, Sawai S, Hanaoka J. Left upper division segmentectomy with a simultaneous displaced bronchus and pulmonary arteriovenous anomalies: A case report. *J Cardiothorac Surg* 2018; **13**: 40.
- 3 Kuroda H, Mun M, Nakagawa K, Okumura S, Sakao Y. Thoracoscopic lung resection for lung cancers in right upper lobe with anomalous structures (displaced B2 and Uvpbi): Report of two cases. *Case Stud Surg* 2016; **2**: 37–40.

- 4 Chassaqnon G, Morel B, Carpentier E, Ducou Le Pointe H, Sirinelli D. Tracheobronchial branching abnormalities: Lobe-based classification scheme. *Radiographics* 2016; **36**: 358–73.
- 5 Boyden EA. *Segmental Anatomy of the Lungs*. McGraw-Hill, New York, NY 1955.
- 6 Akiba T, Inagaki T, Nakada T. Three-dimensional printing model of anomalous bronchi before surgery. *Ann Thorac Cardiovasc Surg* 2014; **20**: 659–62.
- 7 Kuroda H, Dejima H, Mizuno T, Sakakura N, Sakao Y. A new LigaSure technique for the formation of segmental plane by intravenous indocyanine green fluorescence during thoracoscopic anatomical segmentectomy. *J Thorac Dis* 2016; **8**: 1210–6.
- 8 Kuroda H, Yoshida T, Arimura T, Mizuno T, Sakakura N, Sakao Y. Novel development of Spectra-A using indocyanine green for segmental boundary visibility in thoracoscopic segmentectomy. *J Surg Res* 2018; **227**: 228–33.
- 9 Mun M, Ichinose J, Matsuura Y, Nakao M, Okumura S. Video-assisted thoracoscopic surgery lobectomy via confronting upside-down monitor setting. *J Vis Surg* 2017; **3**: 129.
- 10 Kuroda H, Yoshida T, Sakao Y. A powered vascular staple for the application of segmental bronchial closure in thoracoscopic anatomic segmentectomy. *J Thorac Dis* 2017; **9**: 5352–4.