

# Tracheal Bronchus Detected During General Anesthesia: A Case Report

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A tracheal bronchus is a congenital abnormality of the tracheobronchial tree in which a displaced or accessory bronchus arises from the trachea superior to its bifurcation. We herein report a case in which a tracheal bronchus was incidentally found after induction of general anesthesia, and we discuss the potential airway management problems that may have ensued. An 80-year-old man was scheduled for buccal mucosa resection and abdominal skin grafting for treatment of squamous cell carcinoma of the left buccal mucosa. Because of trismus and anticipated airway difficulty, an awake intubation was performed under sedation. A 3-branched structure was incidentally observed at the first branching site that was supposed to be the carina. The tip of the endotracheal tube was repositioned 3 cm above the tracheal trifurcation, and the rest of the procedure proceeded uneventfully. A flexible fiberoptic scope is not used in many anesthesia cases, making the identification of such tracheal or bronchial abnormalities more difficult. Therefore, it is important to carefully check the bronchial morphology on any available chest radiographs before surgery, listen to lung sounds after intubation, and assess thoracic lung compliance without neglecting routine safety checks.

**Key Words:** Anomalous bronchus; Tracheal bronchus; Trifurcate carina; Atelectasis; Hypoxia.

A tracheal bronchus is a congenital abnormality of the tracheobronchial tree in which a displaced or accessory bronchus arises from the trachea superior to the normal bifurcation at the carina. The main clinical implication of a tracheal bronchus arises during endotracheal intubation.<sup>1</sup> An endotracheal tube (ETT) can obstruct or migrate into a tracheal bronchus, causing pulmonary atelectasis and/or hypoxia.<sup>2–5</sup> We herein report a case of a tracheal bronchus that was incidentally found after induction of general anesthesia and discuss the potential risks associated with such a finding. Written consent was obtained from the patient for the purposes of publishing this case report.

## CASE PRESENTATION

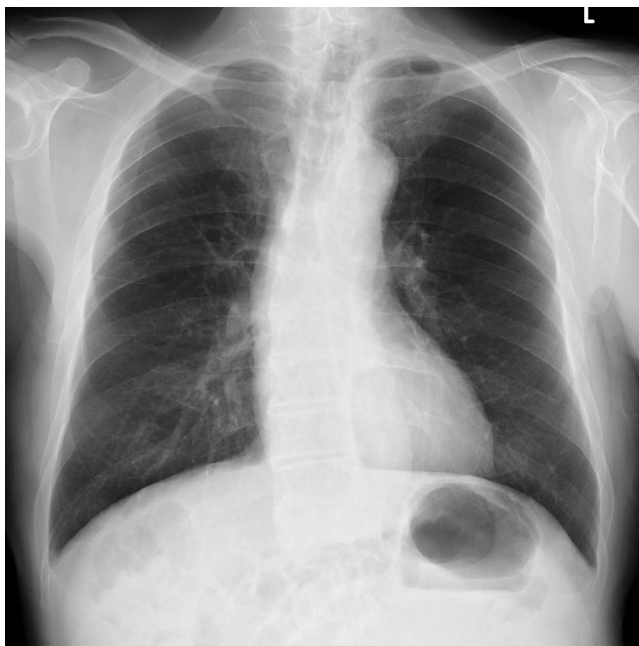
An 80-year-old man (height 160.3 cm [63 in]; weight 58 kg; body mass index 22.6 kg/m<sup>2</sup>) was scheduled for resection of squamous cell carcinoma (T4N3M0) of the left buccal mucosa and skin grafting from the abdomen under general anesthesia. The patient had no relevant family history, but he was being followed for lower abdominal aneurysms of the renal artery and bilateral common iliac arteries, which were stable. He also reported a history of a cardiac arrhythmia. The patient had no known allergies and was taking rebamipide, a mucoprotective medication used for gastritis and gastric ulcer therapy. His past surgical history included surgery for oral cancer, cervical lymph node dissection, and radiotherapy, resulting in a limited mouth opening of 15 mm. Because of his significant trismus, the developed anesthetic plan included awake intubation. The patient was deemed an American Society of Anesthesiologists physical classification 3 status.

At the routine preoperative evaluation, blood tests showed no abnormal values that would be expected to cause major problems with general anesthesia. An anterior-posterior (AP) radiograph of the chest showed slight scoliosis (Figure 1), and a 12-lead electrocardio-

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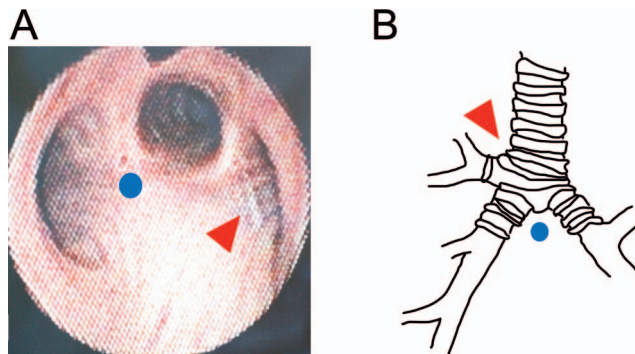
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**Figure 1.** Preoperative Anterior-Posterior Chest Radiograph

gram (ECG) showed a first-degree atrioventricular block and complete right bundle branch block with negative T waves in the precordial leads. Because of the ECG findings, a transthoracic echocardiogram was ordered, which revealed left atrial enlargement, decreased apical left ventricular wall motion, trivial mitral regurgitation, and an ejection fraction of 62.4%.

The day of the surgery the patient took his regular oral medication, the rebamipide, more than 2 hours before the induction of general anesthesia. Otherwise, he had appropriately fasted, and no premedication was given. After the patient entered the operating room (OR), a 22-gauge cannula was inserted into a vein on the dorsum of the left hand, and an infusion of Ringer acetate solution was initiated. After adequate preoxygenation and administration of topical anesthetics using 4% oral lidocaine (4 mL; 160mg) and 2% lidocaine intranasal spray (2 mL; 40 mg), an awake nasal intubation was performed via the right nares using a flexible fiberoptic scope and a size 7.0 preformed nasotracheal tube (Parker Flex-Tip, Parker Medical) under moderate sedation by intravenous (IV) boluses of midazolam 2 mg and fentanyl 50 µg.

After the initial successful intubation, general anesthesia was maintained with sevoflurane 3%, oxygen 1 L/min, and air 3 L/min. The approximate depth of the ETT at the right naris was 30 cm, and we attempted to visualize the carina using the fiberoptic scope. However, a 3-branched structure (Figure 2) was observed which led us to believe that the scope might have already

**Figure 2.** Tracheal Bronchus

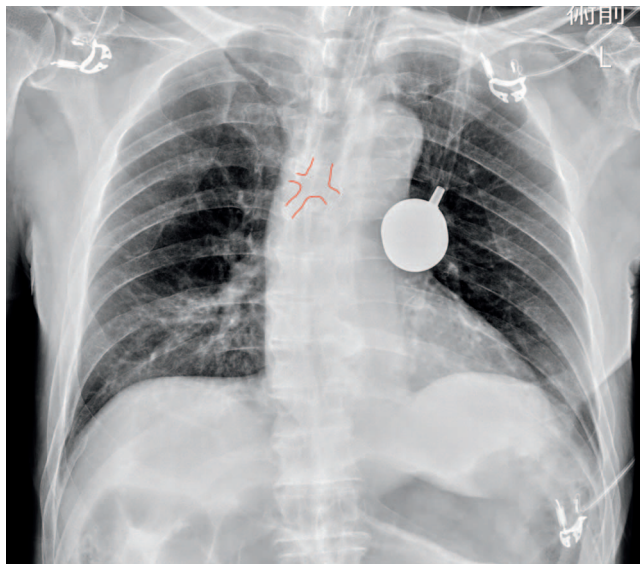
A, Fiberoptic view of the anomalous bronchus in the present case. Note that the orifice of the tracheal bronchus is positioned immediately to the right of the right main bronchus. B, Drawing of the bronchial anatomy showing the right upper lobe tracheal bronchus. • indicates carina; ▲, tracheal bronchus orifice.

reached the right middle lobe. As this would have resulted in 1-lung intubation because of overinsertion of the ETT, we withdrew the ETT by approximately 10 cm and reconfirmed continued ventilation and oxygenation (saturation of percutaneous oxygen 99%). However, the normal structure of the carina, the tracheal bifurcation into the right and left primary bronchi, still could not be observed. To avoid accidental extubation, we needed to verify the position of the ETT tip. A portable AP chest radiograph was obtained in the OR that indicated that the tip of the ETT was located approximately 3 cm superior to the trifurcate site (Figure 3); thus, we were confident that the ETT's position was appropriate. The final insertion depth of the ETT at right naris was 26 cm. Auscultation with the ETT at that depth revealed clear bilateral breath sounds in all lobes with no obvious differences.

An IV bolus of rocuronium 40 mg was administered after we confirmed the ETT depth with a radiograph and secured the tube's position. The anesthesia monitor indicated a thoracic lung compliance of 60 mL/cm H<sub>2</sub>O, and subsequent arterial blood gas analysis taken from the femoral artery showed acceptable oxygenation (partial pressure of oxygen of 142.3 mm Hg) and oxygen saturation (saturation of oxygen 99% at a fraction of inspiratory oxygen 40%). Therefore, we considered the tip of the ETT adequately located to provide oxygen-mixed gases to all the lung lobes.

Anesthesia throughout the surgery was maintained with sevoflurane 1% to 1.5%, oxygen 2 L/min, air 2 L/min, and a continuous infusion of remifentanyl 0.25 µg/kg/min. The patient's hemodynamics, respiratory status, and other vital sign parameters were stable, and the durations of the surgery and anesthesia were 109 and

**Figure 3.** Portable AP Chest Radiograph Taken in OR After Intubation



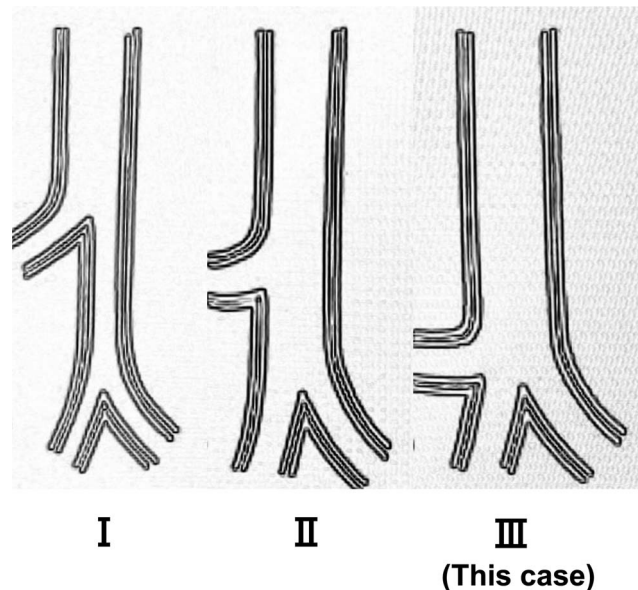
Note that the right upper lobe begins directly from the trachea and that the tube tip is located above all 3 apertures (red outline). AP indicates anterior-posterior; OR, operating room.

240 minutes, respectively. The patient was extubated after recovery of neuromuscular blockade following IV sugammadex 200 mg and adequate spontaneous breathing with airway patency. The patient's hospital stay was prolonged for 30 days postoperatively because of the buccal mucosa squamous cell carcinoma, which required extended time for rehabilitation because of difficulty eating after surgery, but he was discharged home with no other complications.

## DISCUSSION

A 3-branched intratracheal structure, or tracheal bronchus, was unexpectedly found in the present case during visualization of the carina with the fiberoptic scope. A tracheal bronchus reportedly occurs with a frequency of 2% (0.1-5%). The right upper lobe bronchus is the most likely to develop such an abnormality because the bronchial germ is formed in the proximity of the main bronchus during embryonic development.<sup>6-8</sup> Although the frequency of each variant listed below is not clear, several variants of a tracheal bronchus have been reported: type I, displaced right upper lobe tracheal bronchus; type II, supernumerary right upper lobe tracheal bronchus; and type III, displaced right upper lobe tracheal bronchus as a tracheal trifurcation.<sup>9</sup> In the present case, we encountered a tracheal bronchus type III as classified using the previously discussed system (Figure 4).

**Figure 4.** Schematic Representing the 3 Types of Tracheal Bronchus Likely to be of Significance to Anesthesiologists



Type I, displaced right upper lobe tracheal bronchus. Type II, supernumerary right upper lobe tracheal bronchus. Type III (this case), displaced right upper lobe tracheal bronchus as tracheal trifurcation.

All types of tracheal bronchus involving the upper lobe bronchus have anesthetic implications regarding risks of obstruction by an ETT.<sup>10</sup> If the ETT happens to be placed within the tracheal bronchus, only that lobe/lung section will be ventilated. If the ETT is placed beyond the tracheal bronchus, the remaining lung sections other than those fed by the tracheal bronchus will be ventilated. Either situation may lead to unexpected complications such as atelectasis and hypoxia.<sup>11-13</sup> Additionally, a tracheal bronchus is known to be associated with other congenital anomalies, such as Down syndrome. Therefore, this anomaly should be considered when performing general anesthesia for a patient with Down syndrome.<sup>14</sup>

Initially, when we detected the 3-branched structure in the present case, we incorrectly presumed that the fiberoptic scope had reached the right middle lobe. However, we could not detect the normal structure of the carina indicating the bifurcation of the trachea into the primary bronchi. Therefore, based on auscultation, AP chest radiographs, and arterial blood gas analysis, we determined that the ETT tip was in the proper position and that the patient was well oxygenated and ventilated. Upon withdrawing the fiberoptic scope and recognizing a tracheal ring, we determined that the distal end of the fiberoptic bronchoscope was still within the trachea, and we continued with the intubation maneuvers. Ideally, the tracheal anatomy moving down to the level of the carina

should have been identified early during intubation as the ETT was being advanced beyond the vocal cords, which might have prevented our initial confusion.

Anesthesiologists must remember that an unrecognized tracheal bronchus abnormality may result in serious complications during elective or emergency endotracheal intubation, because a routine intubation could result in the ETT cuff being positioned overtop the tracheal bronchus and obstructing airflow to that lobe. Moreover, in one reported case, hypoxemia and right upper lobe collapse occurred secondary to obstruction of a deeply placed anomalous tracheal bronchus.<sup>15</sup> Endotracheal intubation in a patient with a tracheal bronchus can cause obstruction of the tracheal bronchus, leading to shunting, atelectasis, and hypoxemia.<sup>16</sup> Pneumothorax or inadequate ventilation may also occur if the ETT is inadvertently advanced into the anomalous lobe.<sup>17</sup> Although in the present case hypercapnia was not caused by the presence of the tracheal bronchus and hypoxemia was not encountered, anesthesiologists remain aware of the potential risk for adverse events. One report indicated that the right upper lobe could be detected from abnormal waveforms in flow-volume loops; thus, it is important to carefully check all available anesthetic monitors for potential signs of an abnormality.<sup>18</sup>

A routine AP chest radiograph was obtained during the preoperative examination, but it was still difficult to recognize the presence of this anatomic variant before general anesthesia. Given that the incidence of an anomalous right upper lobe bronchus in adults is approximately 0.1% to 5.0%, we should have been aware of the possibility of this potential complication when inserting an ETT. If a tracheal bronchus was occluded, breath sounds would be expected to be diminished or absent in the right upper lobe. Therefore, if breath sounds are diminished in the right upper lobe, tracheal bronchus should be considered in the differential. This could be quickly and easily checked by fiberoptic bronchoscopy to visualize and diagnose the anomaly and correctly place the ETT. However, flexible fiberoptic scopes are not usually utilized for routine tracheal intubation in most cases, preventing observation of abnormalities in the bronchial branches. Therefore, it is important to carefully review the bronchial morphology if an AP chest film is available prior to surgery and induction of general anesthesia, listen to lung sounds after intubation, and verify lung compliance for safe airway management.

## CONCLUSION

This case report highlights the diagnostic procedures for managing the airway in a patient with one tracheal

bronchus variant. This case serves as a reminder of the significance of performing routine safety checks after intubation, such as auscultation of the lungs. Adequacy of ventilation should be confirmed after intubation, and further clinical and/or radiographic studies may be necessary to establish an accurate diagnosis in the event of an unexpected airway abnormality.

## Conflict of Interest

The authors have no conflicts of interest relevant to the contents of this report.

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