



## Case reports: Iatrogenic bronchial rupture following the use of endotracheal tube introducers

### Compte rendu de cas: rupture bronchique iatrogène après utilisation d'introducteurs de tubes endotrachéaux

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#### Abstract

**Purpose** Endotracheal tube introducers are often used in difficult tracheal intubations, but they are rarely deemed responsible for airway injuries. There have been only a few reports of severe complications, such as pharyngeal perforation, mainstem bronchus bleeding, perforation of the tracheal mucosa, and tracheal abrasion associated with hemopneumothorax. Using a computed tomography (CT) scan, we illustrate two cases of non-severe airway injuries related to endotracheal tube introducers.

**Clinical features** We present two cases of distal bronchial lacerations caused by introducers. The first occurrence was caused by a Muallem ET Tube Stylet (METTS) in a patient who underwent surgery for a total thyroidectomy and presented hemoptysis at suction after tracheal intubation. The second occurrence was caused by an Eschmann® Tracheal Tube Introducer (gum elastic bougie) in a patient whose trachea was intubated before a

radiofrequency ablation of a single lung metastasis. There was evidence of blood on the tip of the bougie after withdrawal. In both cases, a CT scan showed a post-traumatic bronchial laceration with an acquired bronchial ectasia surrounded by ground-glass opacity due to alveolar hemorrhage. The patients had no other clinical complications, and bronchial lesions resolved spontaneously at control CT scan.

**Conclusion** These two cases show that airway damage related to endotracheal tube introducers may not be exceptional. It is not unusual to have some blood on an airway management device, and the rate and severity of these lesions are unknown. However, damage to the airway can be avoided by adapting preventive techniques during tracheal intubation.

#### Résumé

**Objectif** Les introducteurs de tubes endotrachéaux sont souvent utilisés dans les cas d'intubation trachéale difficile, mais ils sont rarement jugés responsables de blessures des voies aériennes. Il n'y a eu que quelques cas rapportés de complications sévères, telles qu'une perforation pharyngée, une hémorragie dans une bronche souche, la perforation de la muqueuse trachéale, et une abrasion trachéale associée à un hémopneumothorax. À l'aide de la tomodensitométrie thoracique (TDM), nous illustrons deux cas de lésions non-graves des voies aériennes liées à des introducteurs de tubes endotrachéaux.

**Caractéristiques cliniques** Nous présentons deux cas de lacérations bronchiques distales provoquées par les introducteurs. Le premier cas a été causé par un Muallem ET Tube Stylet (METTS) chez un patient qui subissait une chirurgie pour thyroïdectomie totale et qui a présenté une hémoptysie à l'aspiration après l'intubation trachéale. Le deuxième cas a été provoqué par un introducteur de tube

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trachéal Eschmann® (mandrin souple) chez un patient dont la trachée a été intubée avant l'ablation par radiofréquence d'une métastase pulmonaire unique. Il y avait des traces de sang sur l'extrémité du mandrin après son retrait. Dans les deux cas, une TDM a montré une lacération bronchique post-traumatique avec une ectasie bronchique acquise entourée d'une opacité en verre dépoli due à l'hémorragie alvéolaire. Les patients ne présentaient pas d'autres complications cliniques et les lésions bronchiques avaient disparu spontanément sur la TDM de contrôle.

**Conclusion** Ces deux cas montrent que des lésions des voies aériennes liées aux introducteurs de tubes endotrachéaux peuvent ne pas être exceptionnelles. Il n'est pas rare de trouver un peu de sang sur un dispositif de prise en charge des voies aériennes, mais l'incidence et la gravité de ces lésions sont inconnues. Il est toutefois possible d'éviter des lésions des voies aériennes en adoptant des techniques préventives lors de l'intubation trachéale.

An endotracheal tube introducers, whether a stiff plastic guide, an Eschmann® Tracheal Tube Introducer (gum elastic bougie), or a woven stylet, are used regularly for tracheal intubation.<sup>1</sup> They are generally considered safe, but they have occasionally been implicated in iatrogenic airway injury.<sup>2,3</sup> Clinical manifestations of these injuries are minimal, usually blood on the tip at withdrawal or at later tracheal suction.<sup>4</sup> Using computed tomography (CT) imaging, we show two cases of subsegmental bronchial rupture occurring during tracheal intubation using such introducers. The patients provided written consent to publish these unusual complications.

## Case descriptions

### Case 1

A 67-yr-old woman (American Society of Anesthesiologists' [ASA] physical status class I) with a multinodular goiter presented for a total thyroidectomy. She had no remarkable medical history and was a non-smoker. On airway examination before anesthesia, the patient had no predictive sign of difficult tracheal intubation. Her mouth opening was > 4 cm; her dentition status and thyromental distance were normal, and her Mallampati score was 1. After establishing routine monitoring, anesthesia was induced using propofol (2.5 mg·kg<sup>-1</sup>) and sufentanil (0.3 µg·kg<sup>-1</sup>). At laryngoscopy, she had a Cormack-Lehane grade I view (glottis completely seen). Her trachea was intubated using a NIM® EMG endotracheal tube

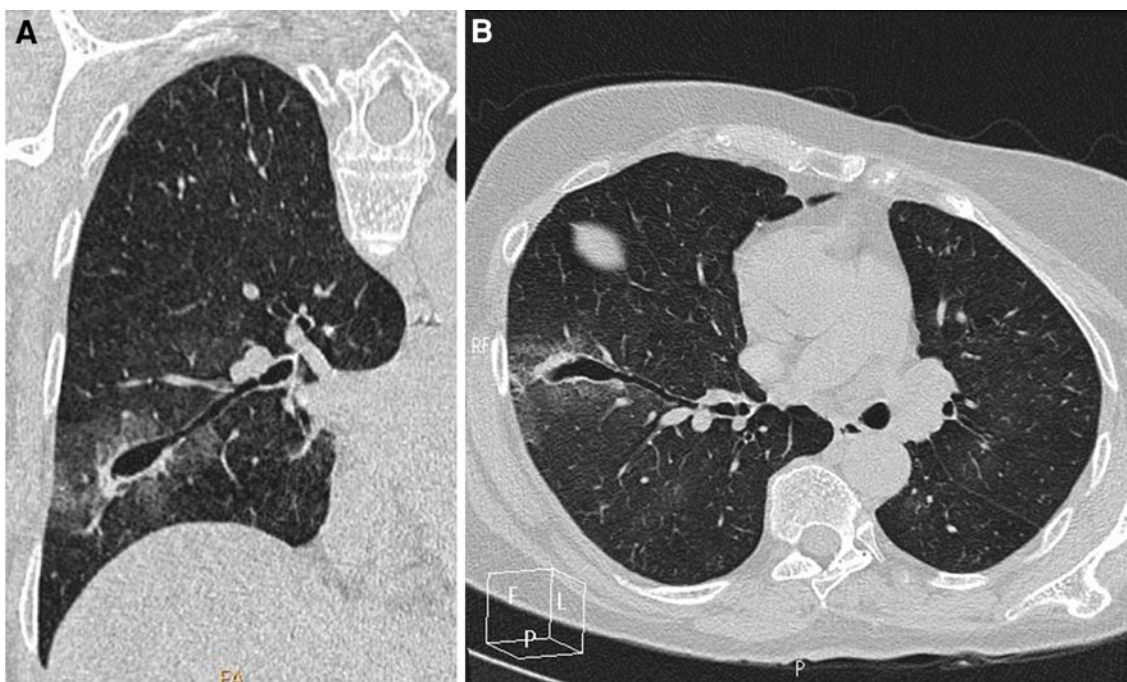
(size 7.0) (Medtronic, USA), which is fitted with electrodes that enable electromyographic monitoring of the vocal cords during surgery. As this tube is made from flexible silicone elastomer, a 4-mm internal diameter tracheal tube introducer with a malleable metal core (Muallem ET Tube Stylet [METTS], 12CH, 65 cm VBM Medizintechnik, Sulz, Germany) was first inserted 30 cm into the airway with no resistance. An assistant was asked to stabilize the introducer and the endotracheal tube was railroaded easily up to the trachea, and the stylet was then removed. After connecting the patient to the breathing system with 17 mbar airway pressure, blood came out from the endotracheal tube. Correct placement of the tube was checked, and the patient's transcutaneous oxygen saturation (SpO<sub>2</sub>) remained > 95% with normal auscultation. Endotracheal suction was performed repeatedly, and the bleeding gradually ended without ventilation problems during surgery. When surgery was completed, the patient recovered uneventfully, and her postoperative chest radiograph was considered unremarkable. A fiberoptic bronchoscopy was performed the next day and did not show any injury of the central airway.

A thoracic CT scan performed 24 hr after surgery revealed a localized ectasia (9 mm in diameter, 40 mm in length) of a subsegmental bronchus (B8) 3.4 mm in diameter at its origin and surrounded by large ground-glass opacity probably due to alveolar hemorrhage in the right inferior lobe (Fig. 1a and 1b).

### Case 2

A 68-yr-old-man who had previous surgery for rectal cancer was scheduled for radiofrequency ablation of a single 14-mm lung metastasis in the posterior segment of the right upper lobe under CT guidance and general anesthesia. The patient had no history of respiratory disease, and he was a non-smoker and ASA class I. Computed tomography performed before anesthesia showed the metastasis without associated pulmonary parenchymal abnormality.

The patient had no predictive signs of difficult intubation; his mouth opening was > 4 cm; his dentition status and thyromental distance were normal, and his Mallampati score was 1. After target-controlled induction of anesthesia with propofol (target 5 µg·mL<sup>-1</sup>), remifentanyl (0.5 µg·kg<sup>-1</sup>), and suxamethonium (1 mg·kg<sup>-1</sup>), he presented a Cormack-Lehane grade 4 view (no visibility of glottis and epiglottis) at laryngoscopy. Tracheal intubation was then performed using a 5-mm internal diameter endotracheal tube introducer (Eschmann® Healthcare Tracheal Tube Introducer [gum elastic bougie], 15CH, 60 cm, SIMS Portex, Hythe Kent, UK), which was inserted easily into the airway using "distal hold-up sign" to



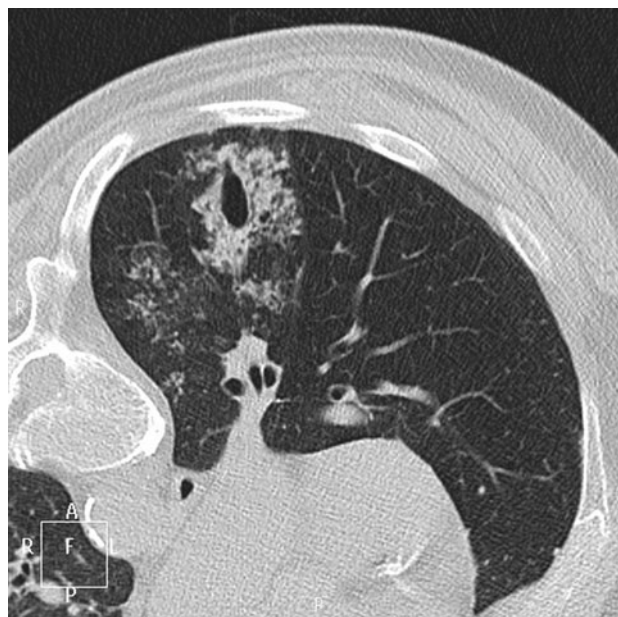
**Fig. 1** A 67-yr-old woman with a multinodular goiter who underwent surgery for a total thyroidectomy presents with blood coming out of the endotracheal tube after intubation. A) The thoracic computed tomography (CT) scan (coronal reformation) shows ectasia of the subsegmental B8 bronchus (9 mm in diameter) surrounded by

ground-glass opacity in the right inferior lobe. B) The thoracic CT scan (axial oblique reformation) shows the length (40 mm) of the acquired ectasia of the subsegmental B8 bronchus abutting the pleural surface

confirm placement. The tracheal tube (size 7.5) was railroaded over the bougie with difficulty because of resistance. This necessitated forced rotary movements to slide the tube inside the trachea. At withdrawal, blood was present on the tip of the bougie. The patient presented no symptom during the procedure. After intubation, CT revealed a relatively large localized area of ground-glass opacity centred by an acquired bronchial ectasia (10 mm in diameter, 25 mm in length) of a subsegmental bronchus (2.1 mm in diameter at its origin) of the right B6 bronchus (Fig. 2).

## Discussion

Difficult tracheal intubation is a frequent occurrence during anesthesia. It arises in 1-4% of patients who have seemingly normal airways,<sup>4</sup> and it is usually associated with traumatic complications that have been extensively described.<sup>5</sup> Reported complication rates during emergency tracheal intubations range from 4.1-28% (esophageal intubation, 1.6-9%; aspiration, 2-4%; and trauma, 0.5-7%), reflecting variations in practice patterns, outcome definitions, and data collection methods.<sup>6</sup>



**Fig. 2** A 68-yr-old man had general anesthesia for radiofrequency ablation of a single lung metastasis of rectal cancer. The thoracic computed tomography scan with the patient in the prone position after tracheal intubation and before performing radiofrequency shows an acquired bronchial ectasia (10 mm in diameter) of the right subsegmental B6 bronchus and associated ground-glass opacity due to local hemorrhage in the B6 segment

Difficult airway management guidelines advise the use of a tracheal tube introducer in cases of unanticipated difficulty, most often a poor view of the vocal cords on laryngoscopy (Cormack-Lehane grade 3 or 4 view).<sup>1</sup> Use of an introducer (guide, stylet, or bougie) for tracheal intubation ensures a > 90% success rate.<sup>4</sup> They are inexpensive, result in few complications, and are easy to use.<sup>7</sup> Introducers are positioned into the trachea by direct view using the Seldinger's technique or blinded using the "tracheal clicks" sign or the "distal hold-up sign" to confirm placement.<sup>7</sup> The endotracheal tube is threaded over the introducer and railroaded into the trachea, and the introducer is then withdrawn.

Trauma related to tube introducers is rare and may occur without difficult intubation.<sup>3</sup> Most bougie placement complications are related to perforation caused by aggressive placement or from railroading, i.e., pushing the endotracheal tube over the bougie against resistance.<sup>7</sup> Only a few injuries related to the use of introducers have been reported in the proximal airways. These include pharyngeal perforation in a patient needing tracheal reintubation,<sup>8</sup> bleeding and clotting in the right mainstem bronchus,<sup>9</sup> perforation of the posterior tracheal mucosa just under the glottis (creating a false lumen dissecting the wall of the posterior trachea),<sup>10</sup> and tracheal abrasion associated with hemothorax shown on chest *x-ray*.<sup>11</sup>

Most often, trauma related to tube introducers is evoked when hemoptysis is observed after intubation, when blood is present on the introducer tip at withdrawal, or later at tracheal suction. The most probable explanation for trauma in our cases is a direct rupture of a small subsegmental bronchus caused by inserting the introducer tips too distally in the airway. This resulted in the bronchial wall being mechanically enlarged and torn and creating distal bronchial ectasia associated with localized pulmonary hemorrhage.

In the first case, a 4-mm diameter stylet caused the rupture of a 3.4-mm diameter subsegmental bronchus. As the patient had no symptoms, she received no specific treatment and was discharged from the unit after three days. A CT scan performed one month later showed complete resolution of the bronchial injury and the pulmonary hemorrhage.

In the second case, a 4-mm diameter bougie injured a 2.1-mm diameter subsegmental bronchus. Radiofrequency ablation of the single lung metastasis was performed successfully without any complication. The patient presented a slight hemoptysis on day one and was discharged after hospitalization for 48 hr. A CT scan one month later showed a complete resolution of the bronchial injury.

Fortunately, in our cases these complications resolved spontaneously, but they could have been associated with severe pulmonary hemorrhage, pneumothorax, and hemothorax as reported earlier by Smith.<sup>11</sup> Using the "distal

hold-up sign" may favour lung trauma since railroading the endotracheal tube is sometimes difficult and necessitates placing force on the introducer which already abuts against the bronchial wall.

The following approaches can be used to circumvent these complications: gently advance the tracheal tube introducer and endotracheal tube; avoid the "hold-up sign"<sup>12</sup> or, if used, retract the tracheal introducer a few cm after the "distal hold-up sign" before railroading the tracheal tube over the introducer; improve the tracheal tube's angle of insertion over the introducer by moving soft tissues out of the way with the laryngoscope; minimize the risk of introducer migration by having an assistant "stabilize" the introducer while advancing the endotracheal tube into the trachea<sup>7</sup>; limit the number of tracheal intubation attempts<sup>9-13</sup>; and use evaluated standard devices,<sup>14</sup> i.e., avoid introducers that can be more harmful for tracheobronchial mucosa (e.g. those with a metal core). If an injury is suspected after the intubation process and imaging is not a contributory factor, a diagnosis can be made with a chest CT scan or bronchoscopy.

In conclusion, these two cases show that airway damage related to endotracheal tube introducers may not be exceptional. It is not unusual to have some blood on an airway management device, and the rate and severity of these lesions are unknown. However, damage to the airway can be avoided by adapting preventive techniques during tracheal intubation.

**Competing interests** None declared.

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