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CASE REPORTS / CASE SERIES

Post-intubation tracheal rupture: poor healing of the tracheal wall

Rupture trachéale après une intubation : rétablissement médiocre de la paroi trachéale

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Abstract

Purpose *To describe tracheal rupture after orotracheal intubation assisted by a tracheal tube introducer.*

Clinical features *A 73-yr-old morbidly obese female patient with a history of hypertension underwent a total knee replacement. There were no anticipated signs of difficult intubation. Orotracheal intubation was attempted twice by direct laryngoscopy, and a Boussignac bougie was used as a tube exchanger for the second attempt. Seven hours after tracheal extubation, the patient became dyspneic and showed a large subcutaneous emphysema. A chest x-ray and computerized tomography scan revealed rupture of the posterior tracheal wall. The distal part of the injury was 26.5 cm from the patient's teeth and 0.5 cm from the carina (i.e., beyond the normal location of the tracheal tube tip) and extended to the origin of the right main bronchus, where the tip of the Boussignac bougie was probably pushed. Formation of an endotracheal sac occurred during the first two weeks after intubation, accompanied by dyspnea and alveolar hypoventilation, but symptoms resolved favourably with conservative management.*

Conclusion *The tracheal rupture was attributed to airway manipulations, and the distal location of the lesion suggests that the cause was the Boussignac bougie rather than the tracheal tube. Long-term healing of the injury was satisfactory, although the patient continued to complain of dyspnea one year after the rupture.*

Résumé

Objectif *Décrire une rupture trachéale après une intubation idée d'un mandrin semi-rigide.*

Éléments cliniques *Une patiente de 73 ans présentant une obésité morbide et des antécédents d'hypertension a été opérée d'une arthroplastie totale du genou. Aucun signe ne laissait présager une intubation difficile. L'intubation orotrachéale a nécessité l'aide d'une bougie de Boussignac lors de la deuxième laryngoscopie directe. Sept heures après l'extubation, la patiente présentait une dyspnée et un important emphysème sous-cutané. Une radiographie des poumons et une tomodensitométrie ont montré une rupture de la paroi trachéale postérieure. La portion distale de la lésion était située à 26,5 cm de l'arcade dentaire et à 0,5 cm de la carène (soit au-delà de la position normale de l'extrémité de la sonde trachéale) et allait jusqu'à la base de la bronche souche droite, où l'extrémité de la bougie Boussignac a pu être poussée. L'évolution a été marquée par la dyspnée et la survenue d'une hypoventilation alvéolaire, conséquences de la formation d'un sac cicatriciel endotrachéal. Un traitement conservateur a permis une cicatrisation de la*

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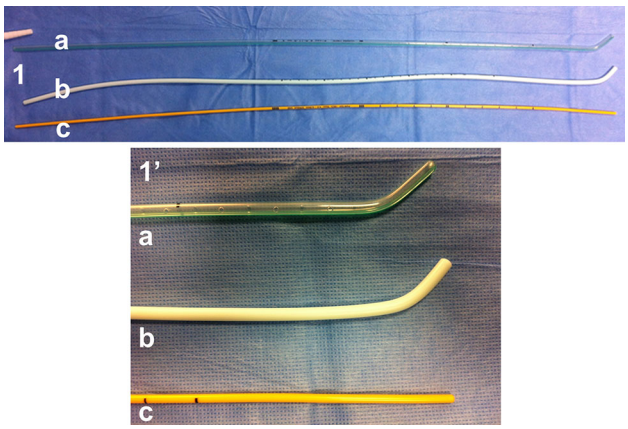

Fig. 1 Single-use tracheal tube introducers. (a) Boussignac bougie (Vygon™, Ecouen, France), (b) Eschmann® bougie (Portex™ Single-use Bougie Coudé Tip, Smiths Medical International Ltd, UK), (c) Gum elastic bougie (Portex™, Tracheal Tube Guide, Smiths Medical International Ltd, UK)

trachée ainsi qu'une résolution presque complète des symptômes.

Conclusion *Le siège distal de la rupture trachéale suggère que la bougie Boussignac a pu favoriser la rupture trachéale. Le rétablissement à long terme de la lésion était satisfaisant, bien que la patiente ait continué à se plaindre de dyspnée un an après la rupture trachéale.*

Post-intubation tracheal rupture is a rare complication of tracheal intubation that can be life threatening. Its incidence ranges from 0.005-0.03%.[1,2] Known risk factors are female sex, older age, chronic obstructive pulmonary disease, long-term corticosteroid use, a tracheal disorder, use of a double-lumen tube, and emergency intubation.[3,4]

We report a case of tracheal rupture after intubation using a Boussignac bougie (Vygon™, Ecouen, France). The Boussignac bougie is a single-use semi-rigid graduated hollow-core introducer which is 70 cm in length and features a bend and lateral perforations near the tip; the perforations allow insufflation of oxygen (Fig. 1). Like the Eschmann tracheal tube introducer (incorrectly called a "gum elastic bougie"), the Boussignac bougie is used in cases of unexpectedly difficult intubation.[5]

Case description

The patient accepted publication of this clinical case and signed a patient consent form.

A 73-yr-old morbidly obese female patient (body mass index = 40 $kg.m^{-2}$) with a history of hypertension underwent a total knee replacement because of advanced osteoarthritis of the left knee. There were no anticipated signs of difficult intubation (Mallampati score, class 2; mouth opening, 3.5 cm; thyromental distance, 8 cm) and no restrictions of cervical spine mobility.

Anesthesia was induced using a target-controlled infusion (TCI) of propofol (5 $\mu g \cdot mL^{-1}$), ketamine 0.2 $mg \cdot kg^{-1}$, etomidate 0.2 $mg \cdot kg^{-1}$, and a TCI of remifentanil (2.5 $ng \cdot mL^{-1}$), intravenously. Orotracheal intubation was attempted using direct laryngoscopy with a McCoy laryngoscope blade (Penlon Limited, Abingdon, UK), a Portex® 7.0 mm internal diameter tracheal tube (Soft Seal® Cuff Tracheal Tubes, Smith Medical, London, UK), and a Rüsch Flexi-slip™ (Teleflex Medical SAS, Le Faget, France) stiffening tracheal tube stylet. A Cormack-Lehane score of 3 was recorded. The first attempt at tracheal intubation failed because the patient's glottis was too anterior, even on activation of the McCoy blade. The second attempt was made using the same laryngoscope but with a Boussignac bougie. The bougie was inserted into the patient's trachea without difficulty, but its advance could not be viewed. It was advanced 24 cm from the patient's teeth without any "clicks" (usually felt when the bougie abuts the tracheal rings) or distal "hold up" (when the bougie's progression is stopped in a smaller airway). The tracheal tube was slid into position 22 cm from the patient's teeth, and the bougie was removed without incident. Oxygen support through the Boussignac bougie was not necessary during intubation. The tracheal tube cuff was inflated to a pressure of 24 mmHg. Both lungs were clear to auscultation, and the shape of the carbon dioxide curve and end-tidal levels were normal. Controlled mechanical ventilation was instituted; peak pressure was normal (< 30 cm H_2O). No foreign body was visible in the patient's mouth or airway tract during laryngoscopy, and no tooth loss or damage occurred.

There were no incidents, either surgical or anesthetic, during the two-hour procedure. Hemodynamic and respiratory parameters were stable, and airway pressures remained unchanged. After surgery, the patient was transferred to the recovery room with her tracheal tube still in place and mechanical ventilation was continued. Her trachea was extubated 60 min later without incident. After three hours in the recovery room, the patient was transferred to the Orthopedic Department where, four hours later (i.e., seven hours after tracheal extubation), she coughed and complained of acute dyspnea. This was followed by a large subcutaneous emphysema. An emergency chest *x-ray* and computerized tomography scan revealed a rupture of the posterior tracheal wall with a right-sided pneumothorax, pneumomediastinum, and extensive subcutaneous emphysema (Fig. 2a and 2b).

Insertion of a right-sided chest tube improved ventilation but did not reduce the subcutaneous

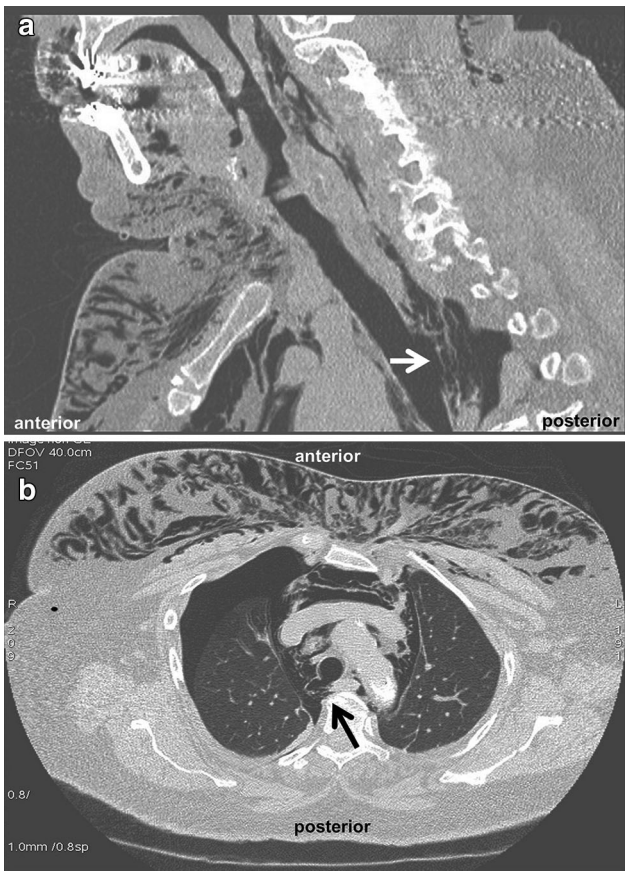

Fig. 2 Chest computerized tomography (CT) scans (a) sagittal view: rupture of the posterior tracheal wall (white arrow), 2.5 cm in length at 24 cm from the teeth; (b) axial view: rupture of the right posterolateral tracheal wall (black arrow)

emphysema, which was large enough to prevent eye opening and restrict chest expansion. Hypoventilation resulted in respiratory acidosis (arterial blood carbon dioxide tension [$PaCO_2$] = 66 mmHg on day 6) and mental confusion, which warranted transferring the patient to the intensive care unit (ICU).

On admission to the ICU, the patient was in hypovolemic shock, which was promptly corrected by administration of 1 L of colloids. Placing the patient in a 45° head-up position seemed to improve chest expansion, and oxygenation was satisfactory with use of a high-concentration oxygen mask (PaO_2 = 69 mmHg). The patient's mental confusion resolved rapidly without any specific treatment. Amoxicillin and flucanozole were initiated as prophylaxis.

Nursing care, a 45° head-up position, and repeat multifocal puncture of the subcutaneous emphysema gradually improved spontaneous ventilation. A thoracic surgeon was consulted and advised conservative management. After four days in the ICU, the emphysema had regressed, the neurological examination was

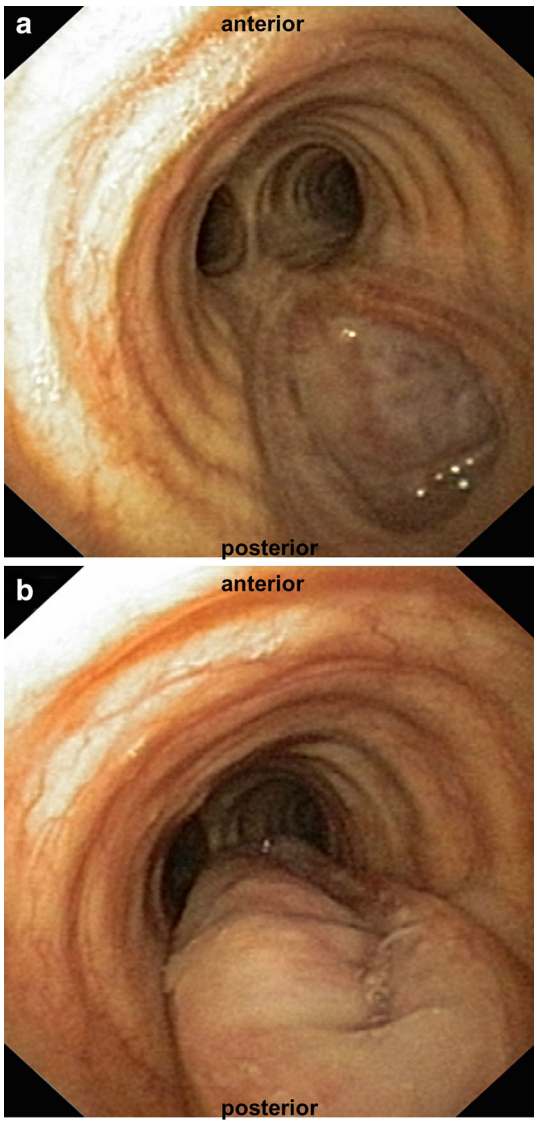

Fig. 3 Bronchial fibroscopy at 15 days post tracheal rupture. (a) At inspiration, the endotracheal sac shifts into the mediastinum; (b) At expiration, the endotracheal sac forms a hernia

satisfactory, and oxygenation improved (PaO_2 = 83 mmHg with 3 $L \cdot min^{-1}$ of nasal oxygen). There was no requirement for invasive or noninvasive orotracheal intubation or mechanical ventilation. The patient was transferred to the Pulmonology Department and progressed favourably. Bronchial fibroscopy on day 15 revealed a mobile sac whose motion was affected by the respiratory cycle and that projected into the trachea at expiration (Fig. 3a and 3b). After 21 days in hospital, the patient was breathing normally and had no fever, and there were no visible clinical or radiological signs of subcutaneous emphysema.

The patient was discharged from hospital 21 days after the surgical knee procedure with no particular problems.

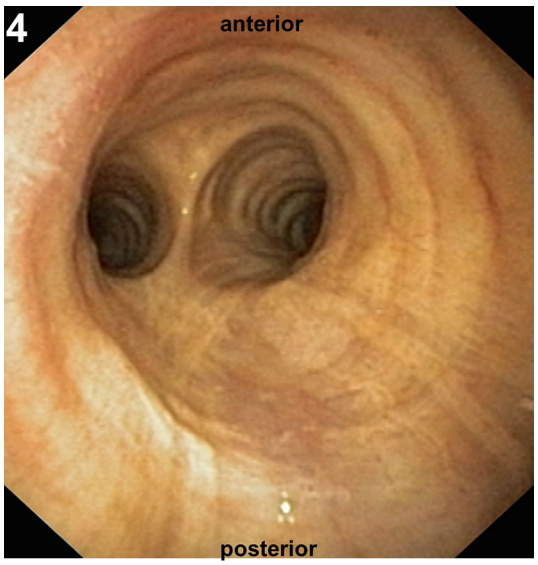

Fig. 4 Bronchial fibroscopy at 45 days post tracheal rupture. The endotracheal sac is completely closed and the trachea has recovered its initial shape

Visits to the Pulmonology Department at 45 days and one year confirmed excellent wound healing. Although the wound was considered definitively healed (Fig. 4), the patient nevertheless continued to complain of dyspnea more than one year after the initial event.

Discussion

We described a case of tracheal rupture after an unexpectedly difficult orotracheal intubation using a Boussignac bougie. The patient presented risk factors (female sex, older age), and at first attempt, tracheal intubation using a tracheal tube introducer failed. The patient's first symptoms occurred seven hours after tracheal extubation, which is consistent with the published delay for post-intubation tracheal ruptures (up to 72 hr).[4,6] Post-trauma pneumothorax, pneumomediastinum, extensive subcutaneous emphysema, and recovery without surgical intervention have previously been reported.[7,8]

The novel feature of our case is the occurrence of tracheal rupture involving a Boussignac bougie, although other tube introducers have been implicated in tracheal rupture.[9–15] The iatrogenic injury measured on bronchial fibroscopy was 2.5 cm long and 2 cm wide at its widest point, and it extended from 24-26.5 cm from the patient's teeth. The distal end was 0.5 cm from the carina. The injury extended to the origin of the right main bronchus where the Boussignac bougie usually comes to rest, which was beyond the distance usually associated with the tip of a tracheal tube, although tube curvature was not taken into account. Consequently, the tracheal tube was less likely than the bougie to be incriminated in the tracheal rupture, even if it is not possible in retrospect to ascertain whether the cause of injury was the bougie or the tracheal tube.

The injury may have been a result of the practitioner handling the device less confidently due to heightened stress after failing a first attempt at tracheal intubation. The Boussignac bougie is slightly more rigid than the Eschmann® tracheal tube introducer and has a 135° curved end (Fig. 1a). It was rotated to facilitate insertion into the trachea in order to better expose the glottis, and this maneuver might have damaged the right posterolateral wall of the trachea. Other possible causes for the tracheal rupture, e.g., injury during the first intubation attempt or spontaneous rupture can be ruled out. Neither the stylet nor the tracheal tube could be inserted at the first attempt. The patient presented none of the signs (severe coughing or vomiting) commonly associated with spontaneous tracheal rupture.[16,17] Because there were no warning signs that intubation might prove difficult, the patient, despite being obese, had not been placed in the ramped position and no muscle relaxant had been administered.

The images of tracheal healing illustrate the potential risks associated with this type of lesion. At day 15, a large sac projected into the tracheal lumen at expiration but without causing total obstruction. This endotracheal sac led to impeded breathing and alveolar hypoventilation, as evidenced by hypercapnia, which lessened as the trachea healed. By day 21, the dyspnea had nearly totally regressed and blood gases had returned to normal. It thus seems that patients with tracheal rupture need to be under continuous surveillance. Besides the major risk of mediastinitis, patients may present respiratory distress caused by anomalous healing of the tracheal wall. In our patient, this led to hypercapnia only, but greater obstruction of the trachea could have induced major and potentially life-threatening ventilation complications. Jougon *et al.* considered that conservative treatment was possible for an uncomplicated tracheal rupture smaller than 4 cm.[7] In one of the larger retrospective studies (n = 29), Schneider *et al.* recommended conservative treatment when mechanical ventilation was either not warranted or could be delivered past the tracheal lesion.[8] Our endotracheal photographs show the resolution of tracheal lesions during conservative treatment.

Conclusion

We report a case of tracheal rupture secondary to an unexpectedly difficult intubation. The cause was more likely the Boussignac bougie than the tracheal tube, but this

could not be established with any certainty. The formation of an endotracheal sac led to dyspnea and alveolar hypoventilation. Long-term healing of the injury was satisfactory, although the patient continued to complain of dyspnea one year after the tracheal rupture.

Conflicts of interest None declared.

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