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## Bivona<sup>®</sup> Hyperflex tracheostomy tube occlusion causing spurious tachypnoea and tracheal ulceration

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### EDITOR:

Tracheostomy tube placement may lead to erosive ulceration and bleeding of the posterior trachea in addition to ventilatory difficulties with tube abutment against the tracheal wall. We report the occurrence of spurious tachypnoea and a posterolateral tracheal wall ulceration using a Bivona<sup>®</sup> Hyperflex tracheostomy tube (Smiths Medical International Ltd, Hythe, Kent, UK).

### Case report

A 38 yr old, 178 cm tall, 130 kg male was admitted to our institution with diabetic ketoacidosis secondary to acute pancreatitis. His past history was significant for type II diabetes mellitus, hypertension, morbid obesity, renal insufficiency, reactive airway disease, tobacco use and allergy to penicillin. He took no medications at home. While in hospital, he developed systemic inflammatory response syndrome and became hypotensive. He subsequently needed an exploratory laparotomy for a small bowel perforation that occurred secondary to the hypotension and hypoperfusion. This resulted in a prolonged and complicated course of treatment in the intensive care unit. He developed respiratory failure due to pancreatitis-associated acute lung injury [1], necessitating controlled ventilation and the place-

ment of a tracheostomy tube (Bivona<sup>®</sup> Hyperflex size 7.0).

Ten days after tracheostomy tube placement, he had an episode of aspiration in conjunction with a report of increasingly bloody tracheal aspirates upon suctioning. He had bilateral coarse breath sounds and the chest X-ray revealed bilateral pleural effusions with increased pulmonary markings in both lung fields. He was observed to have a respiratory rate of 48 breaths min<sup>-1</sup> with bilevel mode of ventilation; however, the ventilator indicated a respiratory rate of only 16 breaths min<sup>-1</sup>. He was receiving 50% oxygen and a positive end expiratory pressure (PEEP) of 10 cm H<sub>2</sub>O. At this time, his blood pressure was 142/88 mmHg, pulse 104 beats min<sup>-1</sup> and oxygen saturation (pulse oximeter) 97%. The ventilator setting was changed to the assist control mode with the F<sub>i</sub>O<sub>2</sub> and PEEP remaining unchanged, but this changed neither the respiratory rate difference observed between the ventilator and the physical examination, nor his vital signs.

Fibreoptic bronchoscopy was performed to evaluate his bronchial tree regarding aspiration and bleeding, and to ascertain a potential cause for the discrepancy between the respiratory rate observed on physical examination and that indicated on the ventilator. Upon successfully traversing the tracheostomy tube with the fibreoptic bronchoscope, the carina was not initially seen; instead a bloody, erosive, ulcerative lesion was immediately evident. The lesion was located above and lateral to the right mainstem bronchus. The tracheostomy tube was readjusted outward and rotated counter-clockwise to relieve the pressure on the tracheal mucosa.

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The patient was then able to synchronize his respiratory pattern with the ventilator and was not tachypnoeic. This improvement in the breathing pattern indicated that our finding of tachypnoea was spurious, yet the patient's respiratory efforts were appropriate.

The internal tracheostomy tube opening had been pressing against the right posterolateral side of the trachea. Under these conditions, the patient would be prevented from taking full spontaneous breaths because his ability to generate a negative pressure would have brought the tracheal mucosal surface into the tube, causing an occlusion. Thus, the patient would appear to move his thorax as if he were taking a breath, but he would be unsuccessful until the ventilator gave him the required mandatory positive pressure breath.

This patient was attempting 48 breaths  $\text{min}^{-1}$ , of which 32 were against an artificial airway probably occluded by tracheal tissue. These spontaneous negative pressure efforts may have caused his tracheal ulceration. The other 16 breaths he received were positive pressure breaths that easily passed into his airway, successfully ventilating him and thus allowing his vital signs to remain normal. This hypothesis was supported by a computed tomography report of the chest from the previous day, indicating that in 'sagittal reconstructions it appears that the distal end of the tracheostomy tube touches the posterior wall of the trachea and may have a small opening for exhalation'. Re-examination of the patient's trachea 24, 48 and 72 h later showed healing of the ulcer. The patient was discharged from hospital 14 days later.

## Discussion

Tracheostomy tubes may have complications, including tube occlusion, tube dislodgement, tracheal stenosis, descending mediastinitis, tracheo-oesophageal fistula and tracheo-innominate artery fistula (TIAF) [2–5]. Although a TIAF is rare (0.3%), it has a mortality rate of up to 80% [2]. It can occur anywhere from 2 days to 2 months after tracheostomy placement. If such a bleed is suspected, the patient should have a fiberoptic examination performed in an operating room [2].

It must be noted that the Bivona<sup>®</sup> Hyperflex tracheostomy tube has a terminal portion that extends approximately 9 mm beyond the balloon, and although the last 3 mm are soft and pliable,

it has a very rigid, non-flexible, wire reinforced portion that extends the initial 6 mm beyond the balloon; this may have contributed to the ulceration and bleeding observed in this report. Furthermore, it has been suggested that this type of tracheostomy tube has a tendency to straighten and apply pressure on the posterior wall of the trachea [6].

Through this first report of tracheal mucosal ulceration and erosive bleeding using a Bivona<sup>®</sup> Hyperflex tracheostomy tube, we would like to caution our colleagues who care for patients with such a tracheostomy tube that if the patient's respiratory rate/effort exceeds that recorded on the ventilator display and/or the inspiratory pressure delivered to the patient produces an inappropriately low tidal volume [6], they must consider tube occlusion and be vigilant as to the potential for erosive bleeding.

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