Late fatal bleeding after percutaneous dilatational tracheostomy

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Abstract - We present two cases of late fatal bleeding after percutaneous dilatational tracheostomy placement. The first case describes a patient who suffered fatal bleeding after percutaneous dilatational tracheostomy due to a tracheo-innominate fistula. In this patient the percutaneous dilatational tracheostomy was sited too low down. The second case describes a patient who died following venous bleeding after percutaneous dilatational tracheostomy. This patient had had previous neck surgery. We use these two cases to focus attention on two pitfalls of percutaneous dilatational tracheostomy placement in ICU patients, namely: low tracheostomy placement may lead to tracheo-innominate fistula, and patients with previous neck surgery may have aberrant vasculature.

Keywords - Percutaneous dilatational tracheostomy, complications, tracheo-innominate fistula

Introduction
Bedside percutaneous dilatational tracheostomy (PDT) placement has become a common procedure in the intensive care unit. Major complications have been described, but are relatively uncommon. The most frequent complication is bleeding, although fatalities have rarely been reported. We report two cases of late fatal, massive bleeding after tracheostomy placement using the PDT technique.

Case 1
A 61-year-old male was admitted to the intensive care unit after a clipping procedure of an intracerebral aneurysm. Two days after admission he developed intracranial hypertension due to an obstructive hydrocephalus and an external ventricular drain was placed. Neurological deficits persisted and on day 10 a PDT procedure was performed using the Ciaglia Blue Rhino percutaneous tracheostomy introducer set. Lidocaine 2% with epinephrine 1:100,000 was used as local anaesthetic, according to protocol. The procedure was performed following the method described by Ciaglia while verifying placement endotracheally using fibreoptic bronchoscopy [10]. The first attempt to cannulate the trachea failed. No air, blood or fluid was aspirated. The second attempt was successful. Air was aspirated and a cuffed, unfenestrated 8.0 mm internal diameter tracheostomy tube was inserted under bronchoscopy. The rest of the procedure was uneventful.

The patient was subsequently weaned from ventilatory support and discharged on day 15. On day 6 after discharge (day 11 after tracheostomy) the patient was readmitted to the intensive care unit with massive haematemesis. The cuff was re-inflated and blood was aspirated through the tracheostomy tube. Bleeding ceased and the patient was stabilized haemodynamically using colloids and packed red cell infusions.

Since upper gastrointestinal bleeding was suspected, oesophago-gastro-duodenoscopy was performed which revealed large blood clots in the stomach, but no bleeding focus.

Before bronchoscopy or ENT evaluation could be performed, torrential bleeding recurred. There was massive oral and tracheal bleeding as well as blood loss around the tube from the stoma.

The patient was endotracheally intubated and transferred to the operating theatre for exploratory surgery by the ENT specialist. Blood was continuously aspirated from the endotracheal tube and bleeding continued from around the stomal opening.

The patient went into hypovolaemic shock and suffered refractory hypoxaemia with desaturations to below 50% leading to asystole. Cardiopulmonary resuscitation was initiated but was unsuccessful.

An autopsy was performed. At autopsy, destruction of the 4th, 5th and 6th tracheal rings due to the tracheostomy tube placement was seen. The stomal opening was directly adjacent to the thyroid isthmus caudally, with no microscopic evidence of perforation.

More importantly, in the innominate artery, four millimetres proximal to the origin of the right carotid artery, a two millimetre transmural lesion was found (Figure 1,2). There appeared to be a short fistula spanning the three millimetres to the most caudal part of the tracheostomy opening on the luminal side of the trachea. When looking at the trachea externally, this distance was much longer, about eighteen millimetres.

No other bleeding sites were found.

Case 2
A 73-year-old female with a medical history of a hemithyroidectomy, was transferred to our hospital with suspected meningitis. A lumbar puncture was performed and showed a marked raised white blood cell count. Treatment for suspected bacterial meningitis was initiated. Cultures remained sterile. A further
lumbar puncture was performed and revealed large monoclonal CD20 negative lymphocytes, consistent with a central nervous system localization of a diffuse large B-cell lymphoma. Treatment commenced but due to persistent neurological deficits a PDT procedure was performed using the technique described above. During the procedure, a pulsating vessel was palpated in the sternal notch. The incision was made 1.5 centimetres cranially from this vessel. The procedure was performed in accordance with protocol and was uneventful.

Several days after the PDT procedure, a third lumbar puncture showed progressive disease. Due to this progression under treatment and the current condition of the patient, she was deemed incurable and treatment was discontinued.

The patient was taken off ventilator support and the tracheostomy tube was removed (four days after the PDT procedure). Directly after removal of the tube, the tracheostomy opening started bleeding. The patient aspirated and quickly went into respiratory arrest and died.

An autopsy was performed which revealed a perforated right anterior jugular vein (Figure 3). This vein was located directly over the tracheostomy opening. Additionally, the brachiocephalic trunk was located more cranially than normal, but had no relation to the tracheostomy opening.

**Discussion**

Percutaneous tracheostomy is a common procedure in intensive care units to establish a long-term artificial airway [8,9]. It is performed with ever-increasing frequency because of its ease, time and cost effectiveness and the uncommon occurrence of complications. We describe two cases of late fatal bleeding complications, one arterial and one venous in origin.

Late, fatal arterial and venous bleeding complications due to PDT have been described, although they are rare and therefore possibly under-reported [1].

Reported causes of these bleeding complications are tube erosion into one of the great vascular structures of the neck, for example the aorta [1], innominate vein [1] or innominate artery [2].

Possibilities to minimize bleeding complications include appropriate patient selection, knowledge of normal anatomy and recognition of potentially difficult or unusual anatomy [3,4]. In order to facilitate the latter, ultrasound techniques and fibreoptic endoscopy may be used to identify aberrant vascular anatomy and confirm correct positioning of the tracheostomy tube [3,5-7].

Another possibility is to use the Griggs technique in which the subcutaneous tissue is spread and the anatomy identified, making the identification of the midline and the preferred site of puncture

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**Figure 1.**

Anterior view of the thyroid gland and the major vessels of the lower neck. The anatomical relationship between the PDT opening (1) caudal to the isthmus of the thyroid gland (2) and the fistula opening in the brachiocephalic trunk (blue square) is shown. 3: aortic arch, 4: brachiocephalic (innominate) artery, 5: right subclavian artery, 6: right common carotid artery, 7: left common carotid artery, 8: ostium of left subclavian artery

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**Figure 2.**

a) macroscopic image of the trachea-innominate artery fistula after formaldehyde fixation (blue square depicted in b). b) microscopic image of the tracheo-innominate fistula (H&E,x12.5; blue square in a). Notice the presence of a tract (1) surrounded by granulation tissue and fibrosis connecting the ulcerated mucosa of the trachea (2) with the lumen of the innominate artery (3). The wall of the artery (4) shows destruction of the elastin fibres and accumulation of neutrophil granulocytes and necrotic debris as depicted in c (H&E,x100). 5: eighth tracheal ring.
Below the first or second tracheal rings visible. However, there is no literature available that shows the superiority of this technique.

In our first case, the tracheostomy tube was positioned too low (under the fourth tracheal ring) in spite of the use of a fibreoptic bronchoscope to confirm its position was correct. The second patient that we describe had had a hemithyroidectomy in the past, which may have lead to aberrant anatomy of the vessels. Ultrasound would have been helpful in this case to recognize the abnormal vascular structures of the neck.

There is little evidence that either fibreoptic bronchoscopy or ultrasound reduces the incidence of complications. To facilitate the procedure in our hospital we do all PDTs under fibreoptic bronchoscopy to confirm correct tube positioning. We now also use ultrasound techniques in patients with a history of neck surgery and in patients with suspected abnormal anatomy based on physical examination.

Following these complications, we suggest a standardized decision-making algorithm to minimize the risk of bleeding complications after percutaneous dilatational tracheostomy (Figure 4).

References


Figure 3.

Anterior view of the neck with the tracheostomy opening (arrow) after removal of the skin. The probe is placed in the anterior jugular vein, pointing in cranial direction. The vein was located in the midline, and perforated by the tracheostomy procedure.

Figure 4.

Standardized decision-making algorithm to minimize the risk of bleeding complications after percutaneous dilatational tracheostomy.