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# Life Threatening Complications after Unsuccessful Attempt of the Guidewire Dilating Forceps Tracheostomy in Multi-Trauma Patient with Cervical Spine Injury

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## ABSTRACT

*Percutaneous tracheostomy (PCT) is a safe method under proper patient selection, increased technical experience and bronchoscopy- or ultrasound-guided procedure. Trauma patients with cervical spine fractures and spinal cord injury are at a high risk for respiratory failure and require a definitive airway followed by prolonged mechanical ventilation. We would like to present multiple, life-threatening complications after unsuccessful attempt of the guidewire dilating forceps tracheostomy (GWDF) in one trauma patient with a cervical spine injury. With this case report we would like to lay emphasis on the importance of continuously bronchoscopy- or ultrasound-guided PTC in trauma patients, especially with cervical spine injury, as the need to respect the steep-learning curve in its performance.*

**Key words:** percutaneous tracheostomy, cervical spine trauma, complications, critical care

## Introduction

Percutaneous tracheostomy (PCT) is a safe method under proper patient selection, increased technical experience and bronchoscopy- or ultrasound-guided procedure<sup>1-7</sup>. Early perioperative complications classified as serious (cardiorespiratory arrest, death, loss of airway, pneumothorax, pneumomediastinum), intermediate (hypoxia/hypotension, tracheal wall injury, guidewire and cannula misplacement, perforation of the esophagus, aspiration) and minor (hemorrhage, subcutaneous emphysema, false passage) are procedure-specific and well described by many authors<sup>8,16</sup>. Trauma patients with cervical spine fractures and spinal cord injury are at a high risk for respiratory failure and require a definitive airway followed by prolonged mechanical ventilation<sup>17</sup>. High cervical levels, the presence of pneumonia, a preexisting

lung disease and the patient age were identified as predisposing factors for frequent early tracheostomy placement<sup>18</sup>. Previous neck surgery and unstable cervical spine fracture were adverse conditions for PCT<sup>3,19,20</sup>. Few authors have made an extended indication (short, fat neck, previous tracheostomy, reduction or inability to perform neck extension, anti-coagulation therapy) for PCT performed by experienced surgeons<sup>21-24</sup>. Ben Nun A has found PCT to be a feasible and safe procedure with minimal short and long term morbidity in 34 multi-trauma patients with cervical spine fracture and available anatomical landmarks without neck extension<sup>25</sup>. On the other side, Massick DD has shown that 60% of all complications occurred in the course of the first 20 PCTs<sup>5</sup>. Further, the suboptimal cervical anatomy is responsible

for a significantly higher total complication incidence rate (65%), which is independent of the experience level with PCT technique described by Massick DD and Liao L<sup>3,5</sup>.

We would like to present multiple, life-threatening complications after unsuccessful attempt of the guidewire dilating forceps tracheostomy (GWDF) in one trauma patient with a cervical spine injury. The procedure was performed by a young staff, under failed anatomic selection criteria and without clear bronchoscopy detection during PCT.

## Case Report

A 72-old man was admitted to ICU after accident-related head, neck and brain injuries. CT scans confirmed a left temporal lobe contusion, fractures of the middle skull base and the right pyramid. Lamellar epidural haematoma covered the both temporal lobes. There were also fractures of the dens axis and anterior arch of the first cervical vertebra without significant dislocations. These injuries were treated non-operatively. Chronic obstructive pulmonary disease with a left-sided liquid- and partial right-sided fibrothorax were detected by chest radiography. Tracheostomy was indicated 13 days after intubation in view of prolonged ventilatory dependence, excessive mucus production and need for frequent bronchopulmonary toilet. A shorter distance between the cricoid's cartilage and the sternal angle (3 cm; it was not either less but nor longer, retrospectively) with no possibility for the appropriate cervical spine extension was noted. Under these circumstances, the PCT was performed in the operating room under bronchoscope-guided procedure. The guidewire dilating forceps technique (GWDF) was used. The procedure was performed under general anesthesia (propofol 2.5 mg kg<sup>-1</sup>, vecuronium 0.1 mg kg<sup>-1</sup>, sufentanil 0.15 µg kg<sup>-1</sup>, 50% O<sub>2</sub> air mixture, 0.8 % sevoflurane). Bronchofiberscope was placed through the tracheal tube on its top and the tube was pulled to the cuff position between the vocal cords and the immediate subglottis. A junior critical care physician provided bronchoscopic evaluation of the procedure.

A horizontal incision was made between the second and third tracheal ring. Hemorrhage close to the incision field stopped after reinfiltration of lidocaine 1% with epinephrine (1:100.000). The blood loss was less than 5 mL. The trachea was punctured twice. In the first attempt, the cannulated needle was inserted vertically to the trachea, approximately at the 2.0 cm-depth with clear aspiration of air but without clearly confirmation of its top by bronchoscopy. In the second attempt, the same happened. This time the needle was placed deeper (2.5 cm) and directed something more lateral to the right side, retrospectively. Clear aspiration of air was present in syringe but the cannulated needle's top was not confirmed by bronchoscope, again. The surgeon's decision was to continue the procedure in spite of negative bronchoscopic evaluation. The guidewire passed through very easily. Retrospectively, we supposed, it was dislocated out

of the posterior tracheal wall at that time and penetrated the esophagus. The forceps dilatation of the trachea was performed without difficulty. The guidewire slip past without resistance. But the tracheostomy tube was not passing by easily. Capnography did not confirm its correct position. It was placed paratracheally as a result of the guidewire kinking, retrospectively. Profound transient hypoxemia (SaO 34%) and bradyarrhythmia occurred followed with severe hypotension and cardiac arrest. The patient was re-intubated under suspicion on unintentional draw out of tracheal tube, successfully resuscitated in one minute and kept on mechanical ventilation. Chest radiography detected a pneumomediastinum and a bilateral pneumothorax (Figure 1). CT scans have confirmed these findings but also included suspected communication between the posterior tracheal wall and the esophagus on the one site and mediastinum on the other site (Figure 2). The false route of the tracheostomy tube passed by the right paratracheal side in the anterior mediastinum. Thoracic drains were inserted into the pleural cavity on both sides. The patient stabilized and open surgical tracheostomy was done. To detect esophagus and tracheal injury, a spine and chest surgeon performed exploration of the neck and a right-sided thoracotomy. Fenestrations on the posterior tracheal and anterior esophageal wall were minimal and did not require any surgical reconstructions. A nasogastric tube was placed. Drainage of mediastinal cavity was performed in order to prevent mediastinal and subcutaneous emphysema.

After 3 days the patient developed fever with high temperature. Wound infection of the right-sided thoracotomy was detected. Antibiotics were introduced immediately according to the wound culture results. Both thoracic drains were removed on the eight-day after complete regression of pneumomediastinum and pneumothorax had been confirmed. In the following month the patient



Fig. 1. Chest radiography with detected 1- pneumomediastinum, and 2- right- and left-sided pneumothorax.



Fig. 2. CT scan of the thorax: 1-pneumomediastinum, 2-right- and left-sided pneumothorax, 3-tracheal posterior wall injury with esophagus perforation, 4-suspected communication between the posterior tracheal wall and the anterior mediastinum.

was treated in the ICU due to the presence of right and left liquidothorax, right-sided pneumonia and weaning from mechanical ventilation. One and half month after his injury, he was admitted conscious, respiratory sufficient with spontaneous breathing over the tracheal cannula to the department of neurosurgery.

## Discussion

The PCT has become, as minimally invasive technique, an alternative method to conventional surgical tracheostomy (ST) for long-term intubated patients.

Early meta-analyses showed that the PCT technique proved to be associated with a higher incidence of complications as compared to the ST: 4–10% vs. 2–3% for early perioperative complications, 0.33% vs. 0.06% for serious cardiorespiratory events and 0.44% vs. 0.03% for perioperative deaths<sup>26,27</sup>.

Delaney A and Higgiss K.M have shown in their recently meta-analysis significant higher complications of decannulation/obstruction (The pooled odds ratio, OR=2.79) during PTC to compare with ST and no significantly evidence of increased incidence of clinically significant bleeding 5.7% (OR=0.6), major perioperative 2.6% (false passage, OR=0.37, minor hemorrhage, OR=1.09) or long term complication during PCT (subglottic stenosis, OR=0.59). There were significantly less wound infection 6.6% (OR=0.28–0.37) and unfavorable scarring (OR=0.44). Their subgroup analysis of PCT pointed out that it was associated with a reduction in overall mortality (OR=0.70) to compare with ST<sup>28,29</sup>. These conclusions could not be accepted for cardiac arrest, sepsis, posterior tracheal wall

injury, pneumomediastinum, tracheo-innominate fistula, mediastinitis, pneumonia, atelectasis, aspiration and subcutaneous emphysema because of minimal events of reporting<sup>29</sup>.

Pneumothorax and pneumomediastinum are relevant but infrequent complications of PCT. Pneumothorax incidence ranges from 0.0–6.7%<sup>1,3,16</sup>. The posterior tracheal wall injury is the most often cause of pneumothorax in PCT technique. Pleural cavity extends around the lateral to the posterior tracheal wall and might be punctured by the tip of the needle even when puncturing the trachea in the middle. The short distance between dorsal tracheal wall and pleural cavity enhance the possibility of pleural puncture. The air leak through mediastinal pleura after tracheal wall injury might be the occurrence of pneumomediastinum with incidence of 0.005–0.06%<sup>3,8</sup>. The mid-line puncture of the tracheal anterior wall and reduction in potentially serious complications can only be achieved by bronchoscopic or ultrasound monitoring<sup>4,10</sup>.

Esophageal perforation is a rare (0–0.6%) but serious complication of PCT<sup>20</sup>. It could be expected in presence of posterior tracheal wall injury by needle, guidewire or tip of dilator<sup>15</sup>. Early surgical reconstruction of any recognized extensive posterior tracheal wall and esophagus injury is required to avoid the life-threatening complication as tracheo-esophageal, tracheo-innominate fistula and consecutive mediastinitis. We supposed that the left-sided pneumothorax and esophageal perforation were caused in our case in the second attempt by the needle and guidewire that penetrated to deep thru the posterior tracheal wall. According to the extension of tracheal and esophageal injury measured by CT scans, we could not be able to exclude the possibility that the tip of GWFT dilator's penetrated thru this structures also.

The incidence of paratracheal insertion of tracheostomy tube, reported by various authors, ranges from 0.5 to 6.7%<sup>1,27,30–32</sup>. Despite proper placement of needle and guidewire, calcified cartilage of tracheal rings especially in elderly may deflect the dilators and bend the guidewire making a predisposition for creating a false passage of tracheostomy tube into the anterior mediastinum. In our case, we supposed that the guidewire was dislocated outside the trachea as the consequence of the needle misplacement under inappropriate bronchoscope visualization. The false passage on the right tracheal side caused pneumomediastinum and right sided pneumothorax. Our inconvenient experience has proved the statement of Polderman K that bronchoscopy-assisted PTC, in correlation with blind procedure provides the lower rate of moderate and serious complications (3.0% vs. 7.3%) and mortality (3.8% vs. 9.7%)<sup>33</sup>.

Patients with adverse conditions (short, fat neck, obesity cervical injury, coagulopathy, emergency) had a low PTC complication rate similar to patients with normal conditions by Ben Nun A<sup>21</sup>. Mayberry JC has reported about safely performed PCT in trauma patients without cervical spine clearance and neck extension, including patients with stabilized cervical spine or spinal cord injury<sup>22</sup>. PCT may be advantageous and safe in early tra-

cheotomy insertion 6–10 days after anterior cervical spine fixation, particularly in the presence of cervical cord injury and under ultrasound-guided performance as reported by O’Keeffe T<sup>23</sup>. PCT is equally safe as ST in patients with anterior cervical spine fixation as described by Šustić A<sup>24</sup>.

Following the results of a meta-analysis and randomized controlled studies, PTC appears to be a safe technique in experienced hands. Under this condition the cervical spine fracture would not be considered a contraindication for PTC<sup>10,25</sup>. In conclusion, the complication rate of PTC depends on local medical expertise and the level of experience of the person performing the proce-

dure. Initial PCT attempts should be supervised by an experienced surgeon<sup>3,18</sup>. With this case report we would like to stress the importance of continuous bronchoscopy- or ultrasound-guided PTC in trauma patients, especially with cervical spine injury, as the need to respect the steep-learning curve in its performance.

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## **ŽIVOTNO UGROŽAVAJUĆE KOMPLIKACIJE NAKON NEUSPJELA POKUŠAJA PERKUTANE TRAHEOTOMIJE KOD POLITRAUMATIZIRANOG BOLESNIKA SA OZLJEDOM VRATNE KRALJEŽNICE**

### **S A Ž E T A K**

Perkutana traheotomija (PTC) je klinički široko prihvaćena metoda osiguravanja dišnog puta u jedinicama intenzivne skrbi. Pravilna selekcija bolesnika prema opće prihvaćenim indikacijama i anatomskim markacijama uz kontinuiranu vizualizaciju postupka bronhoskopom (ili ultrazvukom) osigurava sigurno izvođenje svakog njegovog segmenta. Sveukupni porast tehničkoga iskustva u izvođenju PCT neminovno doprinosi smanjenju nastanka mogućih neželjenih komplikacija. Bolesnici sa ozljedom vratne kralježnice, sa ili bez pridružene ozljede vratnoga dijela leđne moždine čine visokorizičnu skupinu bolesnika sa pojavom produžene respiracijske insuficijencije i potrebom za mehaničkom ventilacijom kod kojih je traheotomija u većini slučajeva neizbježna. Ovim opisom kliničkog slučaja želimo prikazati nastale višestuke, po život opasne komplikacije nakon neuspješnoga pokušaja izvođenja PCT kod politraumatiziranog bolesnika sa pridruženom povredom vratnog dijela kralježnice. Njime također želimo istaći važnost kontinuirane vizualizacije cjelokupnog postupka izvođenja PTC (bronhoskopom ili ultrazvukom) kao i poštivanja graducije stjecanja tehničke i praktične vještine osobe kao i tima koje je izvodi.