

## POSTINTUBATION TRACHEAL INJURIES – CASE SERIES AND LITERATURE REVIEW

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**SUMMARY** – Post-intubation tracheal injury is a rare and potentially fatal complication. The most common causes are overinflation of endotracheal tube cuffs and multiple intubation attempts in emergency cases. The diagnosis is based on clinical and radiological suspicion of tracheal injury confirmed by fiberoptic bronchoscopy. Decision between conservative and surgical management of the injury depends on clinical presentation (respiratory instability, concomitant diseases), lesion characteristics (lesion site, size, and number), and time elapsed from injury to diagnosis. We present three cases of post-intubation tracheal injury. In two cases, the patients were treated conservatively; in the third case, the patient died from asphyxia caused by thrombus occlusion of the trachea after a longitudinal tracheal lesion. Pre-anesthetic examination did not indicate any possibility of difficult intubation in any of the patients; however, in one of the patients admitted through the emergency department, emergency intubation was performed.

**Key words:** *Asphyxia; Intubation, intratracheal; Lacerations; Wounds and injuries*

### Introduction

Tracheal injury after orotracheal intubation is a rare and potentially fatal complication. The trachea is a cartilaginous and membranous tube extending directly from the larynx, from the level of the sixth cervical vertebra to the level of the fifth thoracic vertebra. It consists of 16-20 cartilaginous rings linked by ligaments. In adults, the trachea is approximately 10-12 cm long and 11-12.5 mm wide. The tracheal lumen is not round. The posterior wall is flat, whereas the lateral and anterior walls are curved. The upper part is narrower than the middle one. The cervical segment is positioned medially, whereas the thoracic part is

positioned slightly laterally to the right. The posterior tracheal wall is very delicate and thus the most common site of injury due to endotracheal intubation. Endotracheal intubation complications may occur due to multiple intubation attempts; protrusion of the stylet beyond the endotracheal tube tip; inadequate tube size; overinflation, rapid inflation or rupture of the endotracheal tube cuff; sudden movement of the tube; excessive coughing; sudden movement of the patient; or inexperience of the clinician<sup>1</sup>. The rupture of the trachea may also be favored by corticosteroid therapy and any of the known anatomical factors, which may not be necessarily accessible to visualization during the intubation. These factors include congenital abnormalities of the trachea; a large mediastinal mass; lymph nodes or neoplasm causing tracheal distortion; congenital laxity of the membranous part of the trachea (women, the elderly, and patients who underwent esophagus surgery); and inflammatory diseases of the tracheobronchial tree.

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## Case Reports

### Case 1

A female patient aged 53, with American Society of Anesthesiologists (ASA) status I and unremarkable medical history except for a previous knee surgery under regional anesthesia, was admitted for elective surgical excision of a lipoma on her back. After the intubation with a flexible tracheal tube, the surgery was performed under general anesthesia with the patient in prone position. After the surgery, which lasted 40 minutes, the patient's breathing was adequate and she was transferred to the ward. Immediately after admission to the ward, the patient began complaining of throat pain and difficult breathing. The symptoms intensified during the night and the anesthesiologist on call at the hospital was consulted. Subcutaneous emphysema was found in the neck area. The chest and neck x-rays revealed linear transparencies around the trachea (with an uneven dorsal contour). The transparencies were consistent with subcutaneous emphysema, which extended up to the subclavicular region. The retropharyngeal space was widened (approx. 7 mm), with a linear gas accumulation along the entire neck area. Intrathoracic status was within the normal range. Oxygen saturation was 94%. Flexible bronchoscopy showed a large tear in the membranous part of the middle third of the trachea. After consultation with a thoracic surgeon, antimicrobial therapy and liquid food were introduced, and the patient was closely monitored. A fiber bronchoscopic examination in four days was recommended. The treatment remained conservative.

### Case 2

A male patient aged 23 was admitted through the Emergency Department for perforating injury of the right eye. The patient was ASA I, a smoker, and he had his last meal 3–4 hours before admission. An emergency eye surgery was performed under general anesthesia, with rapid intubation using a rubber tube. The surgery lasted 35 minutes, and oxygen saturation during surgery was 99%. After the extubation, the patient developed severe cough with blood-tinged sputum. Oxygen saturation dropped to 80% with an oxygen mask. The patient complained of retrosternal pain. He was transferred to the intensive care unit,

where flexible bronchoscopy was immediately performed, revealing a 15-mm erosion of the mucous membrane of the anterior tracheal wall, immediately below the vocal cords. The tracheobronchial tree was flushed with saline solution and adrenaline was applied to the erosion site. Chest x-ray revealed a shadow in the right middle and lower lobes and left perihilar area. Chest x-ray repeated 4 hours later showed worsening intrathoracic status: the shadow in the right lung was more pronounced, mostly in the perihilar area, while the mediastinum was normal. Ten hours later, the shadow in the right perihilar area regressed, whereas the mediastinum status remained unchanged. Oxygen saturation was 95%–100% with the oxygen mask, and 91% without the oxygen mask. The patient was treated conservatively.

### Case 3

A female patient aged 63 was repeatedly admitted to the Nephrology Department for renovascular hypertension and initial kidney failure. Dynamic renal scintigraphy showed bilateral atherosclerotic stenoses of renal arteries. Since the patient's condition did not improve after percutaneous transluminal angioplasty, a decision was made to treat her surgically by autotransplantation of the right kidney. The patient was preoperatively assessed as ASA II and there were no indications of the possible difficult intubation. The surgery lasted 5 hours, with the patient in the left lithotomy position. After the surgery, the patient was transferred to the intensive care unit. Three hours later, she started coughing and complaining that she could not cough up the sputum. The attending physician suspected vocal cord edema due to prolonged intubation and prescribed antiedematous therapy. Despite this therapy, the patient was not able to cough up the sputum. Tracheal toilet with a thin suction catheter and laryngoscope was performed under short-term intravenous anesthesia. Sputum and a thin thrombus were obtained. The patient's condition improved subjectively and clinically, and oxygen saturation was 97%–98% all the time. Two hours after tracheal toilet, the patient started coughing again and she coughed up blood-stained, foamy sputum. Her breathing became difficult, stridor developed, and oxygen saturation decreased to 89%. The patient suddenly became pale, hypotensive and bradycardic. Emergency intu-

bation was performed, but ventilation was difficult, although oxygen saturation was 100%. A tube malposition was suspected and the patient was re-intubated without any difficulties. However, ventilation continued to be difficult and mechanical ventilation impossible due to pronouncedly increased pressure in the airways. Manual positive pressure ventilation was started again, using an Ambu bag. Despite cardiopulmonary resuscitation, the patient became asystolic, cyanosis progressed, and the patient died. The possible pulmonary embolism was suspected as a cause of heart failure. The clinical picture was later explained by a histopathologic finding of tracheal occlusion by intraluminal thrombus. Autopsy revealed a longitudinal, 4-cm long laceration of the posterolateral tracheal wall, along with a large intraluminal reddish-gray thrombus obstructing the lumen of the trachea and the right main bronchus (Fig. 1).



*Fig.1. Section of the trachea showing linear tracheal laceration with intraluminal tracheobronchial thrombus.*

## Discussion

Iatrogenic intubation injuries of the trachea are relatively rare, occurring in approximately 1:10,000–20,000 intubations<sup>2</sup>. Retrospective studies report that the incidence of tracheal injury during elective intubation performed by experienced anesthesiologists is <1%<sup>3</sup>.

The signs and symptoms of an airway injury include difficult breathing, insufficient blood oxygenation, blood-stained sputum, a feeling of retrosternal pressure, pneumomediastinum, pneumothorax, and

subcutaneous emphysema in the thoracic and neck regions<sup>4</sup>. Chest x-ray and computed tomography may explain clinical manifestations of tracheal injuries.

The time from injury to diagnosis may range from several minutes to several hours, mostly between 6 and 12 hours after extubation. Fiberoptic bronchoscopy is the method of choice to determine the severity and size of the injury and decide on the best management<sup>4</sup>. Direct laryngoscopy and re-intubation to secure the airway may cause complete tracheal dissection and result in mediastinal tube placement. Pressure-controlled ventilation may also affect the severity of the dissection; it is advisable to maintain spontaneous breathing as long as possible, depending on acid-base parameters.

Preoperative airway assessment did not predict difficult intubation in any of our patients. All three patients were intubated without any complications, and intubations were performed by experienced anesthesiologists. In two of the patients, the injuries were found on the dorsal tracheal wall; these patients underwent elective surgery. In both female patients (cases 1 and 3), Portex endotracheal tubes with internal diameter of 7.5 mm and high-volume low-pressure, Murphy eye cuff were used. In the male patient (case 2), rubber tube with internal diameter 8.0 mm was used. The tubes were selected according to the patient's age and physical constitution. The stylet was used in both female patients (type Portex, Tracheal Intubation Stylet, plastic-coated). Adequacy of cuff inflation was determined by palpation of the external balloon because a cuff pressure manometer was not available.

The patient intubated in the emergency department had a laceration of the anterior tracheal wall. Since a rubber tube was used for intubation, we suspect that the tube was the reason why the laceration occurred. Today, the use of rubber tubes is mostly avoided. Also, every movement of the tube may lead to tracheal wall injury. In our opinion, this was the reason in case 1. Today, most tubes have a large-volume, low-pressure cuff, which is less traumatic because the resulting ischemia is milder than the ischemia produced by a small-volume, high-pressure cuff<sup>5</sup>.

Two of the patients with 7–15 mm long longitudinal injuries were treated conservatively and surgical management was not required. In stable patients with

a small injury or in patients with secured airway, the injury may heal with conservative therapy (antibiotics, thoracic drainage, frequent bronchoscopies) without the resulting stenosis or mediastinitis<sup>6,7</sup>. In patients undergoing conservative treatment who require mechanical ventilation support, the cuff should be inflated distally from the laceration site. Mechanical ventilation is performed using low respiratory volume and low positive end-expiratory pressure under careful monitoring of the signs of volume loss<sup>8</sup>. Surgical treatment is required in patients with unstable cardiorespiratory system, patients with tracheal laceration longer than 2 cm, and patients unable to breathe spontaneously.

Schneider *et al.*<sup>8</sup> describe a conservative treatment algorithm, based on the experience of many authors, which includes non-complicating mechanical ventilation without the respiratory volume loss, laceration satisfactorily covered by the esophagus, and only mild emphysema without progression during ventilation. Accordingly, the criteria for surgical treatment include insufficient mechanical ventilation, open perforation into the pleural space, or progressive subcutaneous or mediastinal emphysema<sup>8</sup>.

In case 3, the patient's symptoms were not typical of tracheal laceration. Irritating cough and inability to cough up the sputum indicated vocal cord edema due to intubation. Dyspnea, chest pain, blood-stained sputum, and cardiorespiratory collapse indicated possible pulmonary embolism. Due to rapid deterioration in her clinical condition and development of cardiorespiratory arrest, fiber bronchoscopy was not performed. Difficult ventilation after repeated intubations was explained by 4-cm long longitudinal laceration on the posterolateral tracheal wall found on autopsy, along with a large intraluminal reddish-gray thrombus obstructing the trachea and the right main bronchus<sup>9</sup>. Our hypothesis was that the lesion occurred due to cuff overinflation, which may have led to dissection and laceration of the posterior, membranous tracheal wall<sup>10,11</sup>. Literature search identified only two cases of asphyxia caused by the occlusive thrombus in the trachea after prolonged 10- to 12-day intubation<sup>12</sup>. To the best of our knowledge, our patient is the first reported case of acute asphyxia caused by tracheal laceration and consequent intratracheal bleeding<sup>9</sup>.

## Conclusion

The knowledge of the airway anatomy, intubation skills, and fiber bronchoscopic technique are the basic competencies that every anesthesiologist should master. Tracheal lacerations are rare, but potentially fatal intubation complications. This should be kept in mind if the patient coughs up blood-stained sputum and has difficult breathing. Early diagnosis and evaluation of the injury are the basis for further successful treatment. Conservative treatment is a safe option in patients with adequate breathing, superficial or well-covered injury, and moderate non-progressive emphysema.

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### Sažetak

#### POSILIJEINTUBACIJSKE OZLJEDE TRAHEJE: PRIKAZI SLUČAJEVA I PREGLED LITERATURE

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Poslijeintubacijska ozljeda traheje je rijetka i potencijalno fatalna komplikacija. Najčešći uzroci ozljeda su prenapuhnuti balončić tubusa i višekratni pokušaji intubacije u hitnim slučajevima. Dijagnoza se temelji na kliničkoj i radiološkoj sumnji koja se potvrđuje fiberoptičkom bronhoskopijom. Odluka o konzervativnom ili kirurškom zbrinjavanju ozljede ovisi o kliničkoj slici bolesnika (respiracijskoj nestabilnosti, pratećim bolestima), značajkama ozljede (mjestu, duljini i broju oštećenja) i vremenu koje je proteklo između trenutka oštećenja i postavljanja dijagnoze. Prikazujemo troje bolesnika s poslijeintubacijskom ozljedom traheje, dvoje od njih liječeni su konzervativno, a jedna je bolesnica preminula zbog asfiksije izazvane začepljenjem traheje ugruškom nastalim nakon longitudinalne lezije. Niti u jednog od njih u prijeoperacijskom anesteziološkom pregledu ništa nije ukazivalo na moguću otežanu intubaciju, osim što je jedan bolesnik zaprimljen i operiran kao hitan slučaj.

Ključne riječi: *Ozljeda traheje; Intubacija; Laceracija; Asfiksija*

