

**RESEARCH ARTICLE**

## **Iatrogenic tracheobronchial rupture after emergency intubation**

### **Authors**

Holger Rupprecht, Harald Dormann\*, Katharina Gaab\*

Holger Rupprecht, Prof., Dr. med.

Surgical Department, Leader of the Section Thoracic Surgery

Clinics of the district Neumarkt i.d. Oberpfalz

Neumarkt i.d. Oberpfalz, Bavaria, Germany 92318

Harald Dormann, Prof., Dr. med.

Head physician of the Emergency Department

Clinical Center Fürth

Fürth, Bavaria, Germany 90766

Katharina Gaab, Dr. med.

Emergency Department

Clinical Center Fürth

Fürth, Bavaria, Germany 90766

\*Corresponding author:

Dr.med. Katharina Gaab, geb. Rubach

Jakob-Henle-Straße 1

90766 Fürth

Phone: 0049/911/7580 1201

Fax: 0049/911/7580 1890

Email: [katharina@gaab-web.de](mailto:katharina@gaab-web.de)

**Abstract**

Tracheal rupture is a rare but serious complication after endotracheal intubation.

We report the case of an 85-years-old female patient presenting a massive skin emphysema after endotracheal emergency intubation. A CT-scan of the thorax showed a massive mediastinal emphysema and a dislocated tube cuff in the pleural cavity. The implemented bronchoscopy also showed the suspicion for tracheal rupture.

A double-lumen-tube-intubation failed due to a trapped tube cuff, which could not be extracted. In the following emergency surgery, the transthoracic intubation of the left main bronchus was the lifesaving procedure. Afterwards a successful tracheal reconstruction was made.

When tracheal rupture occurs early detection and an accurate treatment is necessary.

**Keywords:** Emergency intubation – cardiopulmonary resuscitation – tracheobronchial rupture – transthoracic bronchial intubation

**Introduction**

Tracheal injuries occur in cases of trauma or they are caused iatrogenic through invasive measures, for example bronchoscopy or endotracheal intubation. Post-intubation tracheobronchial rupture is a relatively rare complication. The incidences in the literature vary between less than 0.01% [1] as well as between 0.05 and 0.37% [2,3] of all oral intubation.

Post-intubation tracheobronchial rupture usually presents as a linear lesion in the membranous wall of the trachea, and is more prevalent in women and patients older than 50 years. The clinical manifestations of tracheal injury include subcutaneous emphysema and respiratory distress [4].

In 2016 Xu et al. performed a literature review and detected two hundred and eight studies that reported cases or case series about

tracheal rupture related to endotracheal intubation. If suspected by clinical examination or chest radiograph, a computed tomography scan can confirm the diagnosis, but the criterion standard is a bronchoscopy.

Emergency intubation is a risk factor that leads to a threefold increase in the risk of death in comparison with elective intubation [5].

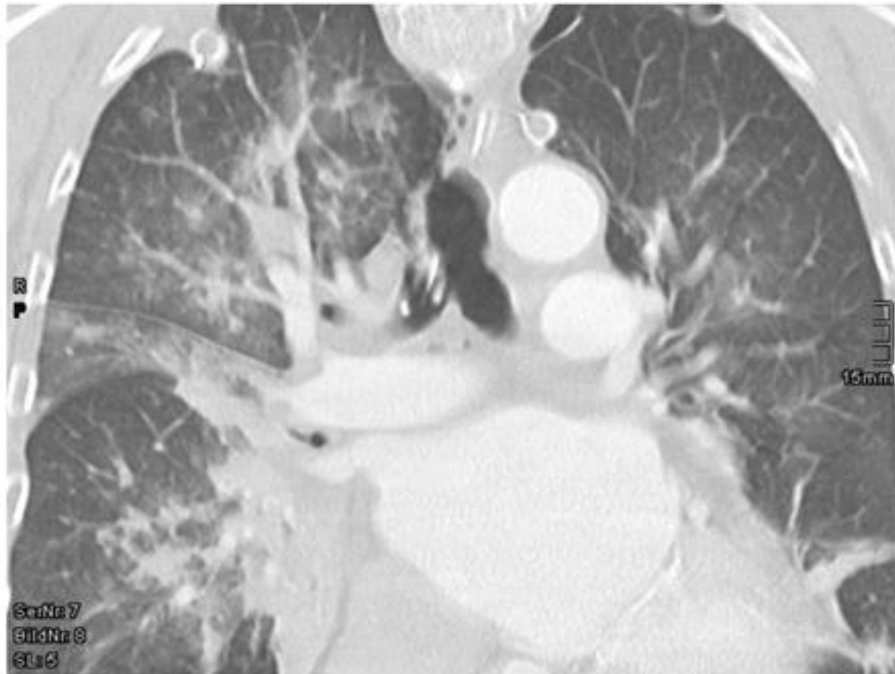
The frequency of the occurrence of iatrogenic tracheal injuries is in relation to both objective conditions of instrumentation (emergency intubation, morphology of the patient) and experience and skills of the physician. The therapeutic management has evolved from surgical treatment for all cases to selective non-operative options, applicable to small tears without mediastinitis in patients breathing spontaneously, but also in serious cases with multiple associated illnesses in patients still ventilated. The selection criteria

for the therapeutic options are still under debate [6].

### **Case presentation**

An 85-years-old female patient was brought into the emergency room with severe dyspnea. Previous illnesses were chronic cardiac failure and atrial fibrillation. The necessary intubation succeeded after multiple tries. During this action a cardiac arrest occurred due to hypoxia, which made the injection of adrenalin and a cardiac massage

necessary. After return of a dopamine-supported circulation the patient was transferred to the intensive care unit. Subsequently an extensive skin emphysema occurred, especially on the areas of face and neck. The CT-scan of the thorax showed a massive mediastinal emphysema and a dislocated tube cuff in the pleural cavity, suspicious for a tracheal rupture (Fig. 1). This was verified by bronchoscopy. After inserting thoracic drainages on both sides, the patient was transferred to the operating room.



**Figure 1.** CT-scan: tracheal rupture, dislocated tube in the right pleural cavity

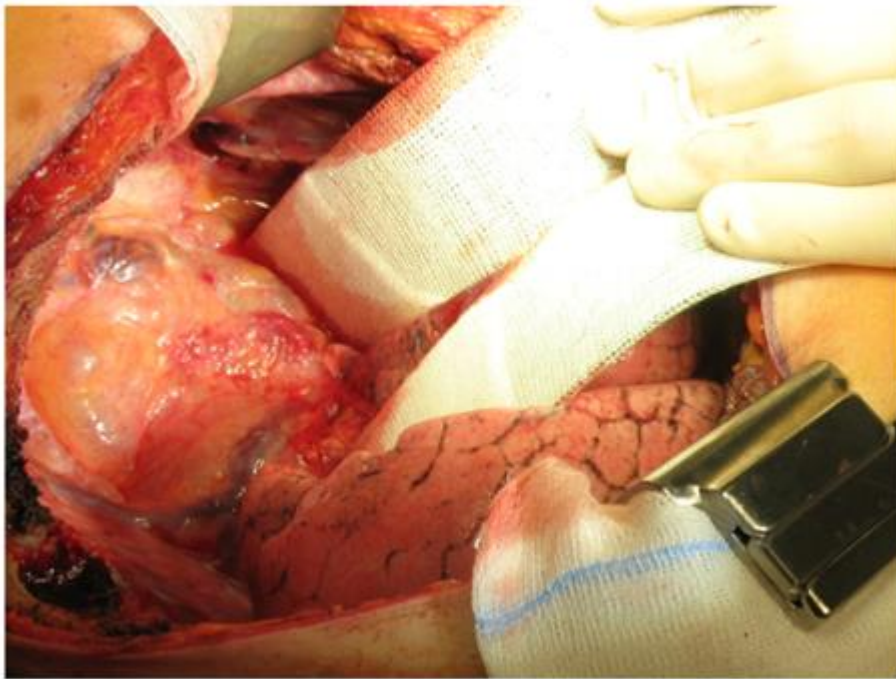
A double-lumen-tube-intubation failed due to the trapped tube cuff, which could not be extracted.

After lateral thoracotomy (5<sup>th</sup> intercostal space) an extended mediastinal emphysema (Fig. 2) was found in the still intact mediastinal pleura. After the incision of the

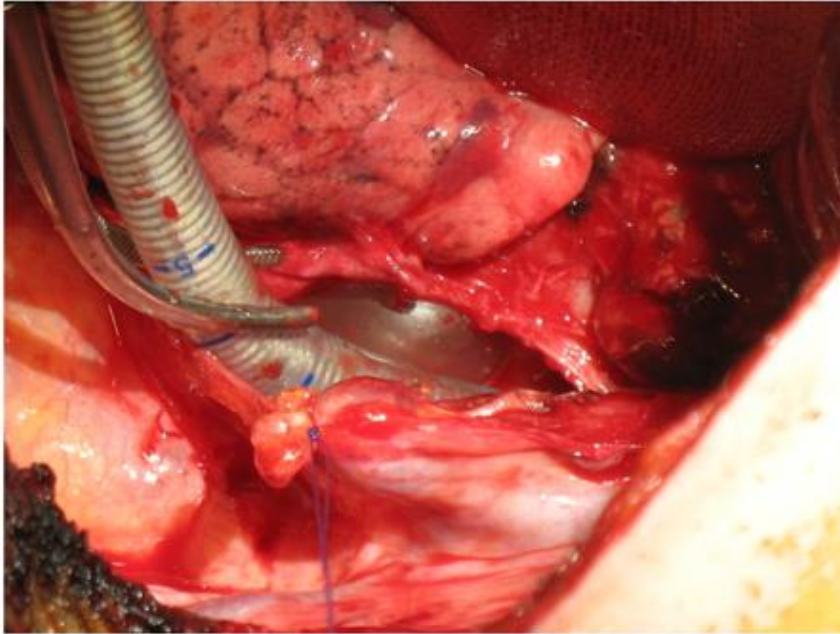
“big bulla” a massive lung fistula occurred. Due to that a sufficient ventilation over the tube cuff was not possible anymore. After the dissection of the azygos vein on the junction with the vena cava the extent of the injury became apparent: A 12 cm (4,7 inch) long laceration in the right lateral tracheal wall, which expanded to the right main bronchus.

This was aggravated by the fact, that the tube cuff was “trapped” in the tracheal wall and consequently could not be removed. The big defect was not manageable digitally. Due to that a 6-0 Woodbridge-tube was inserted into the left main bronchus over the perforation (Fig.3). After that the left lung could be ventilated with 100% oxygen. The trapped cuff was mobilized and displaced in the right main bronchus for splinting. The distal third of the rupture was closed with Teflon-

sheathed stitches (PDS 3-0). The rest of the defect was also sutured with Teflon-sheathed stitches after the removal of the Woodbridge tube. The patient was ventilated over the right sided endotracheal tube. After the closure of the defect the endotracheal tube was retracted behind the carina to ventilate both side of the lung. The stitch canals were sealed with fibrin glue and for “protection” a pedicled pleural flap as well as the distal azygos vein were sewed circularly on the defect.



**Figure 2.** mediastinal emphysema



**Figure 3.** transthoracic intubation, Woodbridge-tube in the left main bronchus

During the further stationary course no fistula occurred, the lung expanded regularly and the bronchoscopy was normal (Fig. 4).

Due to long-term-ventilation a tracheotomy became necessary, which temporarily

allowed spontaneous breathing. Unfortunately, the patient developed a left-sided bronchopneumonia as well as an anuric kidney failure and died 5 weeks later.



**Figure 4.** postoperative bronchoscopy view

## **Discussion**

Iatrogenic ruptures of the trachea are relatively rare [2,7], but life-threatening cases with a high lethality [8-11].

They happen in cases of trauma, for example in cases of incarceration [8,12-14], or they are caused iatrogenic through invasive measures like bronchoscopy or more frequently through endotracheal intubation [8,14-16]. The risk of injury through orotracheal intubation ranges from 0,01 %-0,37% [6,9,17] and increases in cases of an emergency intubation or multiple tries [6,8,9,10,13]. Especially when a guide wire (stylet) is used the risk of injuries increases threefold [6,8,9,13]. Other risk factors are coughing or motoric unrest during the intubation [14] as well as an existing medication with corticoids. Females have, in comparison to males, a significantly increased incidence of an injury risk [4,6,8,14,17,18] due to anatomic conditions, like a smaller caliber of the trachea or a weaker tracheal wall. Usually the perforation is localized in the pars membranacea (missing protection through cartilage), often through an over-inflated cuff (“Overflating”) [6,8,9,10,13,19].

In our case the laceration of the lateral tracheal wall indicates that the use of a guide wire was the cause of the injury. The cardinal symptom is a subcutaneous emphysema, which is progressive under ventilation [2,3,4,8,9,12,14,20,21], especially localized in the facial and cervical area and on the upper thoracic aperture.

Patients with these symptoms must undergo a bronchoscopy [17,18,19,21,22] to detect the

defect and to stabilize the intact contralateral bronchus in cases of a main bronchus rupture [20]. When applicable a double-lumen-intubation can be done [4,7,15,19].

In the case of our patient this procedure was unfeasible due to the incarcerated cuff between the cartilage fragments. For “Ultima ratio” only a transthoracic intubation of the left main bronchus by “open thorax” was possible [6,12]. This technique was used by us for the first time worldwide in 1996 in the case of a polytrauma-patient with a complete avulsion of the right main bronchus [12].

A computed tomographic scan has to be performed in order to to exclude additional injuries [6,10], for example pneumothorax or a pneumo-pericardium [14,23], which can cause a life-threatening pericardial tamponade [23]. A pneumo-mediastinum [10,14] is highly suspected for a tracheal lesion. However, a nonexistent pneumothorax does not exclude a tracheal rupture [8,10]. Responsible for that is the intact mediastinal pleura, which prevents an air discharge in the free pleural cavity and accordingly prevents the tension pneumothorax [12,16]. In this constellation the air rises up along the trachea and causes a massive subcutaneous emphysema, which can impede the venous return and cause a severe hypoxia [12].

In case of a cardiovascular depression a collar incision has to be performed in order to open the anterior mediastinum for relief. This is also necessary, if after the insertion of thoracic drainages on both sides under the suspicion of a pneumothorax [17], the emphysema increases, and the patients becomes cardiovascular unstable. Especially

in a pre-clinical situation this can lead to specific problems, because of the massive skin emphysema can make classic tension pneumothorax signs, like an upper venous congestion, invisible. Moreover, breathing sounds nearly cannot be heard. Due to that a tension pneumothorax has to be assumed and the thoracic cavity has to be drained with chest tubes after a thoracic trauma or an intubation in combination with a skin emphysema.

If the mediastinal pleura is ruptured, a massive and hardly manageable air fistula occurs, which makes a sufficient oxygenation impossible [8,13,16]. The only chance for survival lays in the insertion of multiple big lumen drainages and the simultaneous increase of the breathing volume [12,13].

Usually the ruptures can be found in the distal trachea, often with an extension in the (right) main bronchus [7,13,14,18]. This location can be reached best with a right-sided posterior-lateral thoracotomy [2,8,9,12,13,18,21]. With Teflon-sheathed Single-Sutures (e.g. PDS 3-0) a perforation can mostly be sealed [6,12,13]. Only in cases of bigger defects an interposition, e.g. with pericardium [23], becomes necessary. The suture row can additionally be sealed with fibrin glue [2,8,12]. If possible biological material, e.g. pleura, pericardial fat or an intercostal muscle flaps, should be used [6,8,11,12,13,19,21]. For a conservative treatment there are diverse expert opinions: If

the defect is smaller than 2-4- cm or smaller than one third of the tracheal circumference [15] and no infection signs (mediastinitis) can be reported [6,8,9,14] a non-surgical-treatment is possible under strict monitoring. In case of slightest signs of an infection [4,6,10,17,18] or a persisting lung collapse, despite of the existing chest tubes [15], an early thoracotomy has to be performed.

### **Conclusion**

Tracheal injuries are afflicted with a high lethality [11]. The cardinal symptom is a subcutaneous emphysema [2,4,18,20,22], mainly in the facial and cervical area [7,11,12,17,18]. Preclinical, both thoracic cavities have to be drained due to a pneumothorax, which can cause a tension pneumothorax, especially after ventilation [22], and may later lead to death [14,17]. The worst-case scenario is a ruptured mediastinal pleura, due to which a none-manageable air fistula can occur, which makes a sufficient oxygenation impossible [8,16,23]. The only chance for survival is given through the insertion of multiple big lumen chest tubes [12,13] and the maximization of the breath volume [12]. In rare cases, like in our patient, in which a side separately ventilation is not possible [15,20,22] the transthoracic intubation in the contralateral main bronchus is the only possible technical alternative [6,12].

## References

1. Zlotnik A, Gruenbaum SE, Gruenbaum BF, Dubilet M, Cherniavsky E. Iatrogenic tracheobronchial rupture: A case report and review of the literature. *International Journal of Case Reports and Images*. 2011;2(3):12-16.
2. Borasio P, Ardisson F, Chiampo G. Post-intubation tracheal rupture. A report on ten cases. *Eur J Cardiothorac Surg*. 1997;12(1):98-100.
3. Spaggiari L, Rusca M, Carbognani P, Solli P. Tracheobronchial laceration after double-lumen intubation for thoracic procedures. *Ann Thorac Surg*. 1998;65(6):1837-1839.
4. Lim H, Kim JH, Kim D, Lee J, Son JS, Kim DC, Ko S. Tracheal rupture after endotracheal intubation—a report of three cases. *Korean J Anesthesiol*. 2012;62(3):277–280.
5. Xu X, Xing N, Chang Y, et al. Tracheal rupture related to endotracheal intubation after thyroid surgery: a case report and systematic review. *Int Wound J*. 2016;13(2):268-271.
6. Paraschiv M. Iatrogenic tracheobronchial rupture. *J Med Life*. 2014;7(3): 343–348.
7. Conti M, Pougéoise M, Wurtz A, et al. Management of postintubation tracheobronchial ruptures. *Chest*. 2006;130(2):412-418.
8. Marty-Ané CH, Picard E, Jonquet O, Mary H. Membranous tracheal rupture after endotracheal intubation. *Ann Thorac Surg*. 1995;60(5):1367-1371.
9. Miñambres E, Burón J, Ballesteros MA, Llorca J, Muñoz P, González-Castro A. Tracheal rupture after endotracheal intubation: a literature systematic review. *Eur J Cardiothorac Surg*. 2009;35(6):1056-62
10. Deja M, Menk M, Heidenhain C, et al. Strategies for diagnosis and treatment of iatrogenic tracheal ruptures. *Minerva Anesthesiol*. 2011;77(12):1155-1166.
11. Kaloud H, Smolle-Juettner FM, Prause G, List WF. Iatrogenic ruptures of the tracheobronchial tree. *Chest*. 1997;112(3):774-778.
12. Rupprecht H, Rümnapf G, Petermann H, Günther K. Transthoracic bronchial intubation in a case of main bronchus disruption. *J Trauma* 1996;41(5):895-897.
13. Chen EH, Logman ZM, Glass PS, Bilfinger TV. A case of tracheal injury after emergent endotracheal intubation: a review of the literature and causalities. *Anesth Analg*. 2001;93(5):1270-1271.
14. Wagner A, Roeggla M, Hirschl MM, Roeggla G, Schreiber W, Stert F. Tracheal rupture after emergency intubation during cardiopulmonary resuscitation. *Resuscitation*. 1995;30(3):263-266.
15. Lampl I. Taracheobronchial injuries: Conservative treatment. *Interact Cardio Vasc Thorac Surg*. 2004;3(2):401-405
16. Schultz SC, Hammon JW, Turner CS, McGuirt WF, Nelson JM. Surgical management and follow-up of a complex tracheobronchial injury. *Ann Thorac Surg*. 1999;67:834-836
17. Elicora A, Akgül AG, Topcu S, Özbay S, Hosten T, Sezer HF, Elicora SS. Management of post-intubation tracheal membrane ruptures. *Arch Iran Med*. 2016;19(7):491-495.



18. Medina CR, Camargo J, Felicitti JC, Machuca TN, de Moraes Gomes B, Melo IA. Post-intubation tracheal injury: report of three cases and literature review. *J Bras Pneumol.* 2009;35(8):809-813
19. Hofmann HS, Rettig G, Radke J, Neef H, Silber RE. Iatrogenic ruptures of the tracheobronchial tree. *Eur J Cardiothorac Surg.* 2002;21(4):649-652.
20. Massard G, Rouge C, Dabbagh A et al. Tracheobronchial lacerations after intubation and tracheotomy. *Ann Thorac Surg.* 1996;61(5):1483-1487.
21. Gabor S, Renner H, Pinter H, Sankin O, Maier A, Tomaselli F, Smolle FM. Indications for surgery in tracheobronchial ruptures. *Eur J Cardiothorac Surg.* 2001;20(2):399-404.
22. Wallet F, Schoeffler M, Duperret S, Robert MO, Workineh S, Viale JP. Management of low tracheal rupture in patients requiring mechanical ventilation for acute respiratory distress syndrome. *Anaesthesiology* 2008; 108(1):59-62
23. Rupprecht H, Gaab K. Tension pneumopericardium in a multiply injured child. *Asian Cardiovasc Thorac Ann.* 2017 Sep-Oct;25(7-8):550-552