

## CASE REPORT

### Post-intubation tracheal rupture (PITR) following uncomplicated endotracheal intubation

S. Lobaz<sup>1</sup>, M. Damodara<sup>2</sup>, C. Pani<sup>3</sup>, C. Watson<sup>4</sup>

<sup>1</sup>ST4 Anaesthesia Freeman Hospital, Newcastle upon Tyne

<sup>2</sup>ENT Specialty Doctor

<sup>3</sup>Consultant Anaesthetist <sup>4</sup>Consultant ENT surgeon,

Darlington Memorial Hospital

[stevelobaz@doctors.org.uk](mailto:stevelobaz@doctors.org.uk)

#### Summary

We report the case of a 70-year-old woman who experienced extensive subcutaneous emphysema of the face and neck without respiratory compromise following posterior vitrectomy surgery. After further investigation, the diagnosis was highly suggestive of a posterior tracheal tear secondary to uncomplicated endotracheal intubation. Conservative management was undertaken with full resolution of symptoms at one month follow-up.

Although rare, post-intubation tracheal rupture (PITR) is a real and significant complication that carries a high morbidity and mortality. Increased awareness of PITR following endotracheal intubation amongst anaesthetists and anyone undertaking endotracheal intubation is crucial, as early suspicion and directed management is essential for a desirable outcome. Conservative management is most appropriate for small tracheal tears. Simple precautions perioperatively may help to reduce the risk of PITR development.

#### Case Report

A 70-year-old woman underwent elective posterior vitrectomy surgery under general anaesthesia. The patient suffered from hypertension controlled by ramipril and atenolol. Previous anaesthetics, where she was intubated, had been uneventful. Her height was 1.61 metres.

After intravenous access and preoxygenation, induction of anaesthesia was undertaken using propofol, remifentanyl with mivacurium for muscle paralysis. Hand ventilation was straightforward with sevoflurane maintenance. Laryngoscopy after three minutes was uneventful, with grade 1 view and easy passage of a size 8.0 standard cuffed endotracheal tube. Three

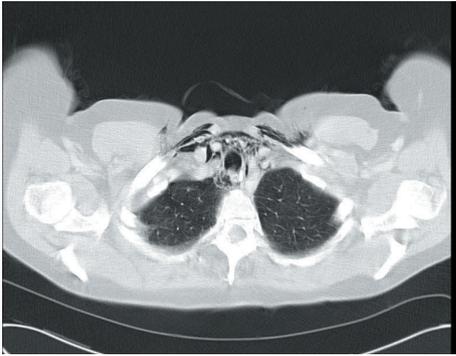
millilitres of air was used in the cuff with no audible leak. Anaesthesia for the case was maintained with sevoflurane/oxygen-air mix and remifentanyl target controlled-infusion (TCI) with glycopyrrolate and metaraminol boluses to maintain normotension.

The posterior vitrectomy surgery lasted eighty minutes and was uneventful. No coughing on the endotracheal tube by the patient was observed intraoperatively. Following suction and cuff deflation the patient was extubated deep (i.e. while still anaesthetised). A laryngeal mask size 3.0 was then inserted to allow a more gradual wake up in recovery and to reduce the potential for coughing and raised intra-ocular pressure. Morphine was given for postoperative analgesia.

Six hours post endotracheal extubation, the patient complained of swelling and tightness of her neck. Examination revealed diffuse swelling of her neck with crepitus on palpation. All clinical observations were within normal limits. The cause of her surgical emphysema at this point was unclear.

Chest X-ray showed extensive surgical emphysema in the neck. No pneumothorax was evident and a contrast swallow was normal. CT scan of the thorax confirmed significant surgical emphysema extending superiorly to the face and inferiorly into the mediastinum. (Figure 1)

Differential diagnosis included tracheal rupture or rupture of a pleural bleb or bulla. The latter was felt unlikely due lack of pneumothorax. Post-intubation tracheal rupture (PITR) or tear appeared to be the most likely explanation. The patient was taken to a high dependency care bed for observation.



**Figure 1**

*CT scan through the upper thorax showing subcutaneous emphysema and pneumomediastinum*

On review by the ENT team, the pharynx and larynx appeared normal on flexible nasal endoscopy, however, the trachea was not visualised. Diagnostic bronchoscopy, the gold standard for tracheal tear confirmation, was not performed, as the patient was deemed stable and subjecting the patient to this procedure carried the risk of worsening the situation by extending the tear, increasing the surgical emphysema and precipitating respiratory distress.

After consultation with the regional cardiothoracic team, conservative management as an inpatient was continued on the ward, with nasogastric feeding and intravenous antibiotics for ten days.

At ten days the surgical emphysema had completely resolved and the patient was discharged home. At one month follow-up, the patient remained asymptomatic with normal neck examination.

## Discussion

Post-intubation tracheal rupture (PITR) or tear following endotracheal intubation is an uncommon complication, but carries a high morbidity and mortality.

Since the early 1950s there have been numerous case reports and a few case series of PITR in adults<sup>1-33</sup>. Estimated incidence of PITR is 0.005% for single lumen endotracheal tubes,

although this is likely to be an underestimate<sup>2,16,18,19</sup>. For double lumen tubes PITR is commoner with an estimated incidence to be between 0.05 to 0.19%<sup>1,2,34</sup>. In one systemic analysis of 50 studies, 182 cases of post intubation tracheal rupture were identified, with an overall mortality from PITR of 22%<sup>18</sup>. Advancing patient age and emergency intubation are associated with an increased risk of mortality if PITR were to occur<sup>18</sup>.

Diagnosis of PITR should be suspected in any patient developing subcutaneous emphysema following intubation for general anaesthesia with or without respiratory distress<sup>2,5,6,16,18,19,22,29,3,5</sup>. Other symptoms and signs of PITR include: haemoptysis, dyspnoea, tracheal shift, cyanosis, airway obstruction, pneumomediastinum and pneumothorax<sup>16,18,25,26</sup>. Presentation is variable with most PITR developing immediately or within five hours of extubation<sup>29</sup>. However, in some cases, presentation can be insidious, taking up to six days to present post-extubation in one reported case<sup>18</sup>.

The predominant site for PITR is the membranous portion of the distal third of the trachea at the junction between the membranous and cartilaginous portions<sup>5,18</sup>. Proximal tracheal injury is usually due to cuff overinflation. Posterior tracheal tears are more common than tracheal tears anteriorly.

Risk factors for PITR are multi-factorial. There is an increased occurrence in women with a height below 165cm, where a relative narrow airway and weak *pars membranosa* of the trachea are presumed predisposing factors. Also, endotracheal tube selection is often inappropriately large in women.

Other risk factors include<sup>18</sup> :

- Patient characteristics<sup>5,14,29</sup>
  - Female; older age; poor premorbid condition; obesity; short height

- Patient actions<sup>30</sup>
  - abrupt movements whilst intubated; excessive coughing; bucking on endotracheal tube
- Anatomic factors<sup>14</sup>
  - corticosteroid weakened membranes; chronic obstructive pulmonary disease (COPD); abnormal tracheal anatomy; tracheomalacia; short neck; difficult or narrow airway
- Intubation situation<sup>7,23</sup>
  - increased risk in emergency intubations compared to elective
- Operator error
  - multiple intubation attempts; inexperienced intubator; repositioning the endotracheal tube without completely emptying the cuff
- Equipment selection<sup>20,32,35</sup>
  - inappropriate use of stylets or bougies; cuff overinflation >32mmHg/malposition of endotracheal tube; inappropriately large endotracheal tube size; use of double lumen tubes; ruptured cuff; use of nitrous oxide which can expand cuff through diffusion
- Procedural<sup>15</sup>
  - endotracheal intubation; percutaneous tracheostomy; mediastinoscopy; jet-ventilation; excision of bronchial neoplasms

The patient in our case had a number of risk factors for PITS including: older age, frailty, female with a height below 1.65m (1.61m tall) and was intubated with a size 8.0 endotracheal tube, which may have been inappropriately large, although clinically this was not apparent.

Simple preventative considerations perioperatively have changed little since the

1950s, as there are few risk factors which can be modified by anaesthetists prior to intubation. Such considerations include: choosing the correct size of endotracheal tube for the patient, care during airway manoeuvres particularly when using a bougie or stylet, care with cuff inflation (keep pressure <30mmHg, although this is not routinely measured in practice), appropriate cuff deflation when repositioning or removing endotracheal tube and avoidance of nitrous oxide<sup>16,18,32</sup>. A second thought to ensure that these simple measures are done in every case may be enough to reduce PITS incidence further, although occurrence will never be completely prevented.

Investigations for PITS aid prompt diagnosis. Chest X-ray and thoracic CT scan are warranted to assess subcutaneous emphysema or pneumomediastinum and any associated mediastinal injury<sup>5,9,18,36,37</sup>.

Chest X-ray in an intubated patient with PITS is described as showing subtle migration of the balloon cuff towards the endotracheal tube tip<sup>36</sup>. CT is reported to be 85% sensitive for the diagnosis of tracheal rupture. The gold standard investigation of PITS is fiberoptic bronchoscopy for definitive confirmation<sup>18</sup>.

Consensus within the literature has not yet been reached in the management of PITS. Factors including size, location, depth of tear, associated oesophageal injury, mediastinitis and need for ventilatory support have been variously considered as criteria for deciding on surgical versus conservative management. Cardillo et al. in 2009 proposed a classification to guide non-surgical and surgical treatment of tracheal lacerations post endotracheal intubation using these factors<sup>4</sup>.

In the past, surgical management of PITS was considered the best method of treatment<sup>2,3,10,14,17-19,21,27,38,39</sup>. However more recent opinion and evidence, providing that the patient is clinically stable, is that conservative management

produces a more favourable outcome particularly when the tracheal lesion is small<sup>2,5,8,18,33,35,40,41</sup>. Conservative management encompasses treatment with antibiotics, airway humidification, and selective mechanical ventilation, which can prevent complications such as respiratory compromise, bronchial stenosis, pulmonary fibrosis, mediastinitis, sepsis and death. Surgical management of PITR in some reports is associated with a very high mortality - up to 42%<sup>18</sup>. However, for large tracheal or more complex lesions, early surgical intervention is the only option for resolution with a variety of surgical approaches reported to achieve this<sup>38,39,42</sup>. Any patient with suspected PITR should be discussed with the local cardiothoracic centre for advice over best individual management plan.

In summary, post intubation tracheal rupture (PITR) is an uncommon but serious complication of endotracheal intubation, although on reviewing the literature, PITR appears to be a more common event than first thought and the incidence is likely to be underestimated. A high index of suspicion and awareness of PITR should be suspected in any patient developing subcutaneous emphysema with or without respiratory distress, presenting hours to days following general anaesthesia.

## References

- 1 Barbetakis, N. S., G. et al.: Tracheal laceration following double lumen intubation during Ivor Lewis esophagogastrctomy. *Interactive cardiovascular and thoracic surgery* **2008**, 7, 866-868.
- 2 Borasio, P. A., F. Chiampo, G.: Post-intubation tracheal rupture. A report of ten cases. *European Journal of Cardiothoracic Surgery* **1997**, 12, 98-100.
- 3 Carbognani, P. B., A. Cattelani, L. Internullo, E. Caporale, D. Rusca, M. : Management of post intubation tracheal rupture. *Ann Thoracic Surg* **2004**, 77, 406-409.

Early diagnosis with CT scan and fiberoptic bronchoscopy - the investigations of choice - are essential to guide appropriate management depending on clinical state. Conservative management of PITR tailored to an individual patient's state and the size of lesion is associated with a better outcome, with smaller lesions doing better with conservative management than surgery in preventing complications and mortality. Regional cardiothoracic centre advice is crucial in managing PITR appropriately.

All anaesthetists, particularly trainees early in their career and anyone undertaking endotracheal intubation, particularly in the Emergency Department, should be taught and aware of PITR and its management. Preventative considerations perioperatively have changed little since the 1950s, and although simple, should be done in every patient to ensure the risk of PITR occurrence is reduced to an absolute minimum.

## Acknowledgements

We would like to thank staff at Darlington Memorial Hospital Intensive Care and ENT ward for there help in managing this case. We would also like to thank Dr Walton and Dr Roysam, Freeman Hospital, Newcastle upon Tyne for their comments and advice.

- 4 Cardillo, G. e. a.: Tracheal lacerations after endotracheal intubation: a proposed classification **2009**.
- 5 Chen, E. L., ZM. Glass, PSA. Bilfinger, TV. : A case report of tracheal injury after emergent endotracheal intubation: a review of the literature and causalities. *Anaesthesia and Analgesia* **2001**, 93, 1270-1271.
- 6 Fan, C. K., PC. Tsai, KC. Chiang, WC. Chang, YC. Chen, WJ. Yuan, A.: Tracheal ruputure complicating emergent endotracheal extubation. *Am J Emerg Med* **2004**, 22, 289-93.
- 7 Gottschalk, A. B., MA. Blanc, L. Schulz, F. Standi, T.: Rupture of the trachea after emergency tracheal intubation. *Anaesthesiol Intesivmed Notfallmed Schmerzther* **2003**, 38, 59-61.

- 8 Guerra, M. M., JA., Caiado, A. Almeida, J. Moura, S, Leal, F. Vouga, L.: Iatrogenic tracheal rupture: a case report and indications for conservative management. *Rev Port Pneumol* **2006**, *12*, 71-78.
- 9 Harris, R. J., A.: Acute tracheal rupture related to endotracheal intubation: a case report. *The Journal of Emergency Medicine* **1998**, *18*, 35-39.
- 10 Hofmann, H. R., G. Radke, J. Neef, H. Silber, RE.: Iatrogenic rupture of the tracheobronchial tree. *European Journal of Cardiothoracic Surgery* **2002**, *21*, 649-652.
- 11 Jo, Y. P., WY. Choi, E. Koo, BN. Kil, HK.: Delayed detection of subcutaneous emphysema following routine endotracheal intubation. *Korean Journal of Anesthesiology* **2010**, *59*, 220-223.
- 12 Kumar, S. P., S. Cohen, P.: Tracheal laceration associated with endotracheal anaesthesia. *Anaesthesiology* **1977**, *47*, 298-299.
- 13 Lewis, R. S., M.: Hazards of endotracheal anaesthesia. *British Journal of Anaesthesia* **1964**, *36*, 504-515.
- 14 Marty-Ane, C. P., E. Jonquet, O. Mary, H.: Membranous tracheal rupture after endotracheal intubation. *Ann Thoracic Surg* **1995**, *60*, 1367-1371.
- 15 Massard, G. R., C. Dabbagh, A. Kessler, R. Hentz, JG. Roeslin, N. Wihlm, JM. Morand, G.: Tracheobronchial lacerations after intubation and tracheostomy. *Ann Thoracic Surg* **1996**, *61*, 1483-1487.
- 16 Medina, C. C., JJ. Felicetti, JC. Machuca, TN. Gomes, BM. Melo, IA.: Post-intubation tracheal injury: report of three cases and literature review. *J Bras Pneumol* **2009**, *35*, 809-813.
- 17 Meyer, M.: Iatrogenic Tracheobronchial lesions - a report of 13 cases. *Thorac Cardiovasc Surg* **2001**, *49*, 115-119.
- 18 Minambres, E. B., J. Ballesteros, MA. Llorca, J. Munoz, P. Gonzalez-Castro, A.: Tracheal rupture after endotracheal intubation: a literature systematic review. *European Journal of Cardiothoracic Surgery* **2009**, *35*, 1052-1062.
- 19 Orta, D. C., J. Yergin, B. Olsen, G.: Tracheal laceration with massive subcutaneous emphysema: a rare complication of endotracheal intubation. *Thorax* **1979**, *34*, 665-669.
- 20 Sato, H. T., T. Kasai, K. Kita, T. Tanaka, N.: Perforation of the trachea by an endotracheal tube: an autopsy case. *International Journal of Legal Medicine* **2008**, *123*, 513-516.
- 21 Sippel, M. P., C. Hirner, A. Wolff, M.: Tracheal rupture after endotracheal intubation: experience with management in 13 cases. *Thorac Cardiovasc Surg* **2006**, *54*, 51-56.
- 22 Smith, R. P., L. Volpitto, P.: Subcutaneous emphysema as a complication of endotracheal intubation. *Anesthesiology* **1959**, *20*, 714-716.
- 23 Sternfield, D. W., S.: Tracheal rupture and creation of a false passage after emergency intubation. *Ann Emerg Med* **2003**, *42*, 88-92.
- 24 Striebal, H. P., LU. Karavias, T.: Tracheal rupture caused by overinflation of endotracheal tube cuff. *Anaesthetist* **1995**, *44*, 186-188.
- 25 Thompson, D. R., RC.: Rupture of the trachea following endotracheal intubation. *Journal of American Medical Association* **1968**, *204*, 995-997.
- 26 Tornvall, S. J., KH. Oyanedel, ET.: Tracheal rupture, complication of cuffed endotracheal tube. *Chest* **1971**, *59*, 237-239.
- 27 Varela, G. J., M.: Tracheal rupture secondary to intubation or tracheostomy. *Arch Bronconeumol* **1995**, *31*, 421-423.
- 28 Watters, K. L., PD. Walsh, RM.: Massive subcutaneous emphysema following routine endotracheal intubation. *Journal of laryngo Otol.* **2003**, *117*, 899-901.
- 29 Kaloud, H. S.-J., F. Prause, G. List, W.: Iatrogenic ruptures of the tracheobronchial tree. *Chest* **1997**, *112*, 774-778.
- 30 van Klarenbosch, J. M., J. de Lange, JJ.: Tracheal rupture after tracheal intubation. *British Journal of Anaesthesia* **1994**, *73*, 550-551.
- 31 Smith, B. H., RB.: Tracheal rupture during anaesthesia. *Anaesthesia* **1984**, *39*, 894-898.
- 32 Tu, H. S., N. Leiutaud, T. Bensaid, S. Menival, V. Duvaldstein, P.: Nitrous oxide increases endotracheal cuff pressure and the incidence of tracheal lesions in anaesthetised patients. *Anaesthesia and Analgesia* **1999**, *89*, 187-190.

- 33 Prunet, B. L., G. Asencio, Y. Cathelinaud, O. Avaro, JP. Goutorbe, P.: Iatrogenic post-intubation tracheal rupture treated conservatively without intubation: a case report. [www.casesjournal.com/content/1/1/259](http://www.casesjournal.com/content/1/1/259) **2008**.
- 34 Spaggiari, L. R., M. Carbognani, P. Solli, P.: Tracheobronchial laceration after double lumen intubation for thoracic procedures. *Ann Thoracic Surg* **1998**, *65*, 1837-1839.
- 35 Moschini, V. L., S. Dabrowska, D. Iorno, V.: Tracheal rupture after tracheal intubation: effectiveness of conservative treatment. *Minerva Anestesiologica* **2006**, *72*, 1007-1012.
- 36 Chen, J. S., K. Mirvis, SE. Killeen, KL. Dutton, RP.: Using CT to diagnose tracheal rupture. *AJR* **2001**, *176*, 1273.
- 37 Rollins, R. T., I.: Early radiographic signs of tracheal rupture. *AJR* **1986**, *148*, 695-698.
- 38 Welter, S. K., T. Halder, R. Stamatis, G.: A new technique for complete intraluminal repair of iatrogenic posterior tracheal lacerations. *Interactive cardiovascular and thoracic surgery* **2011**, *12*, 6-9.
- 39 Janni, A. M., G. Mussi, A. Ambrogi, MC. Angeletti, CA.: Postintubation tracheal tear repair by cervicotomy and longitudinal tracheostomy. *Ann Thoracic Surg* **2000**, *69*, 243-244.
- 40 Mullan, G. G., C. Arora, A. Narula, A.: Conservative management of a major post-intubation tracheal injury and review of current management. *Eur Arch Otorhinolaryngol* **2007**, *264*, 685-688.
- 41 Berlinden, M. e. a.: Conservative treatment of tracheal injuries. *Anaesthesia and Analgesia* **2004**, *100*, 210-214.
- 42 Barbetakis, N. s., G. Paliouras, D. Lafaras, C. Bischiniotis, T. Tsilikas, C.: Intraoperative tracheal reconstruction with bovine pericardial patch following iatrogenic rupture. *Patient Safety in Surgery* **2008**, *2*, 4.