

Subcutaneous Emphysema and Pneumomediastinum after Endotracheal Anaesthesia

C L Chiu,*^{FRCA}, G S Y Ong,**^{FANZCA}

Abstract

Introduction: We report a case of subcutaneous emphysema and pneumomediastinum that presented postoperatively after tracheal extubation. **Clinical Picture:** A 51-year-old man had an uneventful anaesthesia lasting about 6.5 hours. Intubation was performed by a very junior medical officer and was considered difficult. He developed sore throat, chest pain, numbness of both hands and palpable crepitus around the neck postoperatively. Chest X-ray revealed diffuse subcutaneous emphysema, pneumomediastinum and possible pneumopericardium. **Treatment:** He was treated conservatively with bed rest, oxygen, analgesia, antibiotic prophylaxis, reassurance and close monitoring. **Outcome:** The patient made an uneventful recovery. **Conclusions:** We discussed the possible causes.

Ann Acad Med Singapore 2000; 29:256-8

Key words: Anaesthetic technique, Complications, Pneumomediastinum, Subcutaneous emphysema, Tracheal intubation

Introduction

Pneumomediastinum is a well-recognised clinical entity. It may present either intraoperatively or postoperatively from a number of possible causes. We present a case in which an apparent difficult tracheal intubation may have led to pneumomediastinum and subcutaneous emphysema developing in the postoperative period, after the patient's trachea was extubated.

Case Report

A 51-year-old, 80 kg healthy man with degenerative joint disease was scheduled for bilateral total hip replacement. His past medical history was unremarkable. He had been taking a variety of non-steroidal anti-inflammatory drugs (NSAIDs) for osteoarthritis, together with ranitidine for the last two years. He was not a smoker and had no previous surgery. Physical examination including an assessment of the airway was normal. Laboratory investigations and preoperative electrocardiography (ECG) showed no abnormalities. No preoperative chest X-ray (CXR) was performed.

A combined general and epidural anaesthesia was planned. Epidural catheter was inserted with the patient in a lateral position and under aseptic condition. Epidural space was identified at 5 cm with loss of resistance to saline

at L2-3. Catheter was threaded easily and left at 9 cm. A test dose of 3 mL of 0.5% bupivacaine was given to exclude intrathecal injection. Thereafter general anaesthesia was induced with fentanyl, thiopentone and atracurium. Three minutes later laryngoscopy was performed using a Macintosh size 3 blade. This was done by a junior anaesthetic medical officer with less than three months experience, under full supervision. The larynx could not be visualised initially. Assisted ventilation of the lung via facemask was re-instituted. The head was repositioned, and a second attempt at laryngoscopy, with some anterior pressure on the thyroid cartilage, reviewed a grade II larynx. Oral intubation was performed using a disposable polyvinyl chloride tube (Mallinckrodt medical, internal diameter 8.5 mm) without the stylet. The patient did not cough during or after the intubation. After tracheal intubation, breath sounds were heard equally in both lung fields and capnography confirmed the correct position of the tracheal tube.

Anaesthesia was maintained for the 6.5-hour surgical procedure using enflurane, nitrous oxide, oxygen and bupivacaine infusion. The patient's lung was mechanically ventilated with a delivered tidal volume of 500 mL and a respiratory rate of 8 to 10 breaths per minute. The peak airway pressure remained less than 25 cm H₂O and breath sounds were normal throughout the procedure. No

* Lecturer

** Professor and Head of Department
Department of Anaesthesia
Faculty of Medicine
University of Malaya, Malaysia

Address for Reprints: Dr C L Chiu, Department of Anaesthesia, Faculty of Medicine, University of Malaya, Lembah Pantai, Kuala Lumpur 59100, Malaysia.

unexpected events occurred and surgery was performed without difficulty.

After completion of the operation, anaesthesia was discontinued and the residual neuromuscular block was reversed with neostigmine 2.5 mg and atropine 1.2 mg. Patient awoke and his trachea was extubated without difficulty. He was taken to the post anaesthesia and surgery care unit (PASCU) where he was noted to be awake, communicative and in no distress. Epidural bupivacaine infusion was continued for postoperative pain relief.

An hour later the patient complained of sore throat and left-sided chest pain with numbness of both hands. All vital signs were normal. 12-lead ECG in the PASCU showed no acute changes compared to the preoperative ECG. Patient was reassured and monitored overnight. His voice was normal and there was no dyspnoea or dysphagia. The next day he continued to have sore throat and chest pain, worse during inspiration. It was noted that subcutaneous emphysema had developed around the neck. The examination was remarkable for palpable crepitus. Breath sounds were clear and equal bilaterally. A portable CXR revealed diffuse subcutaneous emphysema, pneumomediastinum and possible pneumopericardium. There was no pneumothorax. After discussion with a cardiothoracic surgeon, the patient was treated conservatively with bed rest, oxygen, analgesia, antibiotic prophylaxis, reassurance and close monitoring. Over the next 24 hours, the patient remained stable and a further CXR on the third postoperative day showed that the gas within the mediastinum had almost entirely disappeared. The patient made an uneventful recovery and was discharged on the eighth postoperative day.

Discussion

There are several possible explanations for the origin of subcutaneous and mediastinal gas in this patient. Pleural puncture with the Touhy needle is a theoretical possibility but it is excluded by the ease and the success of the epidural block.

Air may also reach the mediastinum by tracking down the fascial planes of the neck or through any of the diaphragmatic hiatuses but as surgery was remote from these areas, it is unlikely in this case.

Central venous cannulation can cause tracheal puncture¹ and result in pneumomediastinum, but in this patient, no attempt was made to cannulate the neck vein. Alveolar rupture is another potential cause for pneumomediastinum. It may occur when a pressure gradient develops between marginal alveoli and perivascular interstitial tissue, due to either an increase in alveolar pressure or a decrease in perivascular pressure. The gas takes the line of least resistance along the fascia surrounding the bronchovascular

tree to reach the mediastinum. Patients with underlying obstructive lung disease are particularly at risk. In this patient, intermittent positive pressure ventilation was employed and that increases the intraalveolar pressure and also reduces the perivascular pressure by impeding venous return and reducing cardiac output. However, the peak inspiratory pressure was 25 cm H₂O or less, the I to E ratio remained less than 1:3 throughout the anaesthesia and the systolic arterial pressure was maintained around 100 mmHg intraoperatively, thus making this an unlikely cause in this patient. More importantly, had the extrapulmonary air occurred intraoperatively, it would have increased in size due to the administration of nitrous oxide and positive pressure ventilation during this long surgery. This would have become clinically apparent and compromised the cardiopulmonary function intraoperatively.

The presentation (pneumomediastinum and surgical emphysema without pneumothorax) was typical of trachea laceration.² Tracheal laceration, while rare, is a known complication of endotracheal intubation.³⁻⁶ It usually occurs during the act of intubation, or as a result of an immediate complication once the tube is in place. A number of factors have been thought to contribute to tracheal laceration: the use of a bevelled endotracheal tube with stylet, overinflation of the cuff, the application of cricoid pressure, the need for exaggerated manipulation of the airway with the laryngoscope to facilitate visualisation of the trachea and intubation by an inexperienced anaesthetic trainee. However, tracheal laceration can occur in apparently uneventful intubation.⁷

Although preoperative assessment of the airway did not reveal any possible difficult intubation in this patient, the intubation was achieved with some degree of difficulty by a very junior anaesthetic trainee, and it is possible that a small tracheal laceration may have occurred. However, it was not until 1 hour after extubation that the problem became apparent. The most likely explanation is the tracheal laceration occurred proximal to the endotracheal tube cuff. When the cuff was inflated, the portion of the tracheal proximal to the endotracheal tube cuff, the site of laceration would not be exposed to the increased airway pressure and therefore air could not be insufflated into the soft tissues of the neck. Only after tracheal extubation, when the patient was breathing spontaneously and creating the negative intrathoracic pressure was air entrained. The air subsequently dissected through tissue planes into mediastinum and subcutaneous tissues. If the tissue disruptions were located distal to the cuff of the endotracheal tube, as might occurred secondary to distal tracheal laceration or alveolar rupture, air would have been introduced into the tissue outside of the trachea or in the pleural space while the patient was receiving positive

pressure ventilation.

Tracheal laceration caused by the cuff of endotracheal tube has been reported.³⁻⁵ An overinflated endotracheal tube cuff could caused a laceration. The cuff sealed off the air leak until the patient was extubated. In our case the cuff was inflated with minimal air after intubation. The pilot balloon was monitored over the course of anaesthesia and no overinflation was detected. Furthermore our patient is young and has a normal trachea, which has been shown to withstand distension by the endotracheal cuffs. The surgery was also remote from the trachea, unlike the case described by Smith et al,³ where the membranous part of the trachea was unsupported and weakened during dissection of the neck when oesophagus is removed from the posterior aspect of the trachea.

Tracheal laceration can also be caused by a sudden increase in intrabronchial pressure, possibly at the time of extubation. This is thought to be more likely in elderly female patients,⁸ probably with trachea weakness as a predisposing factor. It has also been reported with a heavy smoker⁹ who is at risk of severe postoperative coughing and has low grade chronic tracheo-bronchial inflammation, making the trachea more vulnerable. However, this would be less likely in this patient, given his minimal risk factors and smooth anaesthetic emergence.

Therefore, the explanation most consistent with the patient's clinical course is disruption of the trachea proximal to the endotracheal tube cuff.

Although the traditional management of intubation-related tracheal laceration is operative,¹⁰ conservative management^{6,8,9,11,12} has been successfully employed. Ross et al¹³ proposed certain criteria to be used as guidelines in deciding on non-operative management of intubation related tracheal laceration: stable vital signs, no difficulty ventilating the patient while intubated or respiratory distress while extubated, no evidence of oesophageal injury, minimal mediastinal fluid collection, non-progressive pneumomediastinum or subcutaneous emphysema and no signs of sepsis. Our patient fulfilled the above criteria and was managed successfully with conservative measures.

In summary, we report an unusual case in which a patient suffered an apparent tracheal laceration proximal to the endotracheal cuff with resultant delayed onset of

pneumomediastinum and subcutaneous emphysema. The only risk factor that could be identified in this case was an inexperienced anaesthetic trainee. This condition is rare but perhaps occurs more often than is reported and may remain undetected postoperatively. In the majority of cases it is a benign condition resolving spontaneously with conservative management.

REFERENCES

1. Konichezky S, Saguib S, Soroker D. Tracheal puncture. A complication of percutaneous internal jugular vein cannulation. *Anaesthesia* 1983; 38:572-4.
2. Spencer J A, Rogers C E, Westaby S. Clinico-radiological correlates in rupture of the major airways. *Clin Radiol* 1991; 43:371-6.
3. Smith B A C, Hopkinson R B. Tracheal rupture during anaesthesia. *Anaesthesia* 1984; 39:894-8.
4. Tornvall S S, Jackson K H, Oyanedel E T. Tracheal rupture, complication of cuffed endotracheal tube. *Chest* 1971; 59:237-9.
5. Orta D A, Cousar J E, Yergin B M, Olsen G N. Tracheal laceration with massive subcutaneous emphysema: a rare complication of endotracheal intubation. *Thorax* 1979; 34:665-9.
6. D'Odemont J P, Pringot J, Goncette L, Goenen M, Rodenstein D. Spontaneous favourable outcome of tracheal laceration. *Chest* 1991; 99:1290-2.
7. Kumar S M, Pandit S K, Cohen P J. Tracheal laceration associated with endotracheal anaesthesia. *Anesthesiology* 1977; 47:298-9.
8. Regragui J A, Fagan A M, Natrajan K M. Tracheal rupture after tracheal intubation. *Br J Anaesth* 1994; 72:5-6.
9. Van Klarenbosch J, Meyer J, De Lange J J. Tracheal rupture after tracheal intubation. *Br J Anaesth* 1994; 73:550-1.
10. Massard G, Rouge C, Dabbagh A, Kessler R, Hentz J G, Roeslin N, et al. Tracheobronchial lacerations after intubation and tracheostomy. *Ann Thorac Surg* 1996; 61:1483-7.
11. Marty-Ane C, Picard E, Jonquet O, Mary H. Membranous tracheal rupture after endotracheal intubation. *Ann Thorac Surg* 1995; 60:1367-71.
12. Mollins L, Buitrago L J, Vidal G. Conservative treatment of tracheal lacerations secondary to endotracheal intubation. *Ann Thorac Surg* 1997; 64:1227-8.
13. Ross H M, Grant F J, Wilson R S, Burt M E. Non-operative management of tracheal laceration during endotracheal intubation. *Ann Thorac Surg* 1997; 63:240-2.