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Pneumomediastinum with subcutaneous emphysema during anesthesia for an infant

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Introduction

Many complications related to endotracheal intubation have been described, but pneumomediastinum, subcutaneous emphysema, and pneumothorax are rare complications during anesthesia. These may be seen in the same patients individually or in various combinations. Most of the patients who show these complications are elderly or critically ill. This report described a case of pneumomediastinum with massive subcutaneous emphysema occurring without pneumothorax during anesthesia for an infant with congenital club foot.

Case report

An 11-month-old boy (weight 8.5 kg, height 72 cm) was admitted to our hospital for elective surgery to correct congenital club foot. His laboratory data and chest X-ray findings were unremarkable (Fig. 1). Preanesthetic medication consisted of 0.1 mg of intramuscular atropine. In the operating room, the patient was monitored with an electrocardiogram, a pulse oximeter, an automated blood pressure device, precordial stethoscope, and a rectal temperature probe. Anesthesia was induced via a mask with halothane 2.5% and nitrous oxide (N_2O) in oxygen. Muscular relaxation was obtained with 1 mg of vecuronium intravenously. Endotracheal intubation was done with a noncuffed spiral endotracheal tube with an internal diameter of 4.0 mm without apparent difficulty. The endotracheal tube was inserted 2 cm beyond the vocal cord and fixed using adhesive tape. A metallic stylet was used to aid intubating the spiral endotracheal tube. After the endotracheal tube was positioned, breath sounds were auscultated equally bilaterally. Anesthesia was maintained with halothane and 66% N_2O in oxygen, and intermittent positive pressure ventilation was instituted by hand bagging. We used Jackson-Rees' circuit. The operation was done in the prone position. The oxygen saturation by pulse oximatry (Spo_2) was maintained from 98% to 99% during the operation. Breath sounds were monitored using the precordial stethoscope during anesthesia. The intraoperative anesthetic course was uneventful.

The patient was returned to supine position after finishing the operation. On emergence from anesthesia, the patient bucked and coughed on the endotracheal tube. An abrupt increase in airway pressure occurred for a second because the pop-off valve was not fully opened. Spontaneous respiration began to increase and appeared to be adequate. Then, while the endotracheal tube was being gently removed, the patient coughed and bucked again, and his neck suddenly became swollen. It was noted that the patient's neck had subcutaneous emphysema with crepitus. This spread was very rapid and the subcutaneous emphysema included the upper anterior chest wall and the face. Spo_2 decreased gradually. As pneumothorax was suspected, another endotracheal tube was introduced. A portable chest radiograph was obtained immediately and showed the evidence of a pneumomediastinum with gas dissecting into the soft tissues of the neck, but there was no evidence of pneumothorax (Fig. 2). The Spo_2 and vital signs were maintained well and the swelling of the neck slightly decreased. The endotracheal tube was reextubated carefully. Neither increase of swelling of the neck nor difficulty of respiration occurred in this time.

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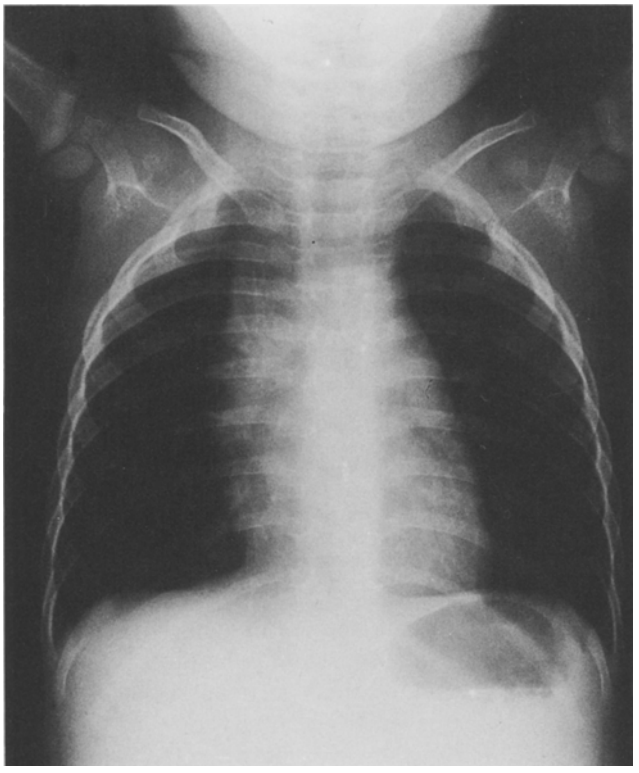

Fig. 1. Chest X-ray before the operation

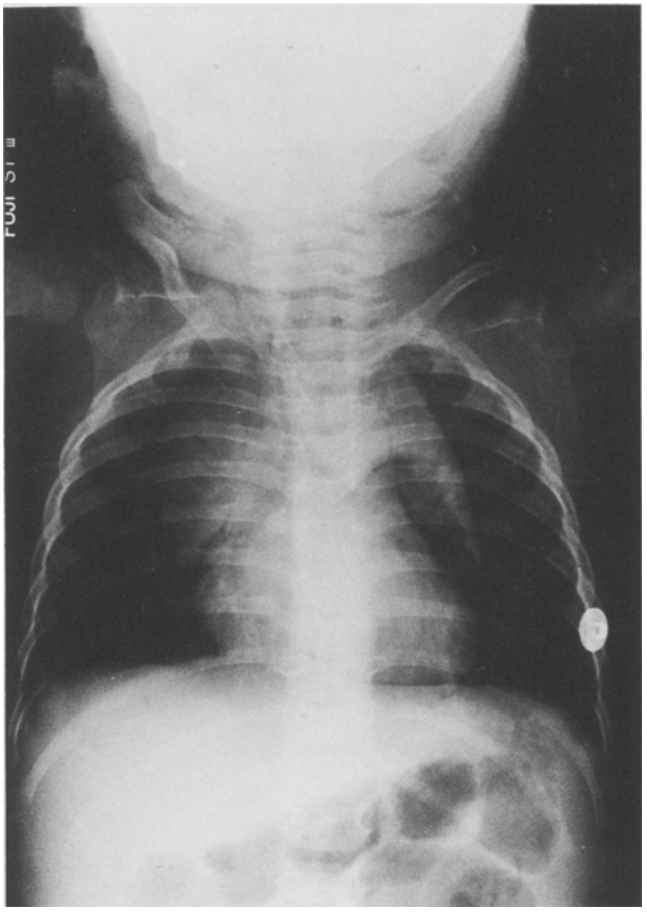

Fig. 2. Chest X-ray indicating pneumomediastinum with subcutaneous emphysema

Postoperatively, the patient was observed in the intensive care unit for 4 h. The subcutaneous emphysema of the neck decreased visibly. There was mild crepitus over the upper chest wall, neck, and face. A chest radiograph taken 4 h after the operation showed no more increase of the pneumomediastinum. A chest radiograph taken 4 days after the operation showed residual pneumomediastinum. At that time there was no crepitus in the neck and the chest wall. The postoperative course was uneventful and the patient was discharged 21 days after the operation.

Discussion

Many complications related to endotracheal intubation during anesthesia have been described, but pneumomediastinum is rare. The etiologies of pneumomediastinum are classified into five categories as follows [1]: (1) Rupture of marginal alveoli into the pulmonary interstitial tissue and then to the mediastinum, (2) rupture or perforation of the trachea, bronchus, or esophagus into the mediastinum, (3) air entering the mediastinum from the deep fascial planes of the neck, (4) air entering the mediastinum from the retroperitoneal space, and (5) trauma to the chest wall.

Rupture of marginal alveoli may present as pulmonary interstitial emphysema, pneumothorax, pneumomediastinum, retroperitoneal air dissection, pneumoperitoneum, or subcutaneous emphysema [2–4]. These may be seen in the same patients individually or in various combinations. In most cases described in the literature, these complications occurred in patients on mechanical ventilation with high inflation pressures, mostly in critically ill and elderly patients [3]. Barotrauma probably did not occur in this case because the airway pressure was maintained low enough to do adequate gas exchange by hand bagging.

Tracheobronchial rupture has been reported to occur in association with repeated, forceful attemps at a difficult intubation [5], tracheal abnormalities [6], overinflation of the endotracheal tube cuff [7], or high airway pressure during anesthesia [8]. It one reported case, tracheal laceration occurred during anesthesia without

an apparent precipitating event [9]. The tear usually occurs posteriorly in the membrane portion of the trachea that is unsupported by the cartilage [3]. Neonates, elderly people, or patients with chronic obstructive pulmonary disease are at greater risk because the vulnerable posterior trachea in these patients is thinner, more fragile, and less elastic than normal. Club foot is generally an isolated anomaly and has not been reported to be associated with weakness of the tracheal wall. The first tracheal intubation in our patient was not considered traumatic. The stylet did not protrude beyond the tube tip and was withdrawn as soon as the tube went past the vocal cords. It was, therefore, unlikely that the first intubation caused the tracheal tear.

The endotracheal tube might inadvertently have slipped too deep while in the prone position or while changing the position. Damage of the carinia or mainstem of the bronchus might have occurred at the time of the patient's coughing and bucking on emergence. It is likely that the bronchus or the tracheal wall would be damaged by a sudden rise in airway pressure caused by bucking and coughing on emergence from anesthesia.

Subcutaneous emphysema of the neck, face, and chest wall occur with pneumothorax, pneumomediastinum, or both [1]. It was supposed that subcutaneous emphysema was induced by decompression of the pneumomediastinum in this case. Signs of a tracheobrochial tear may usually appear immediately, but sometimes appear several hours after the injury [10]. Early symptoms such as dyspnea, neck or chest pain, and cough are absent in patients under anesthesia. When this complication is suspected, a chest radiograph should be obtained to diagnose or to rule out pneumomediastinum or pneumothorax. It was reported that subcutaneous emphysema could cause severe restriction of ventilation by its tension effect [9,11]. Undetected pneumomediastinum can also be life-threatening.

Most cases of pneumomediastinum associated with endotracheal intubation require only conservative treatment, because the tear is always small [3]. The N_2O should be immediately discontinued during anesthesia because its high solubility facilitates absorption and discontinuation permits rapid resolution of pneumomediastinum. Diagnostic bronchoscopy may be essential to identify the location of the tear when air leakage is continued. Postoperative bronchoscopic examination of the tracheal mucosal tear was not done in this case because we did not have a small enough bronchoscope and we were afraid that the associated positive pressure ventilation would have likely worsened the emphysema.

In summary, pneumomediastinum is a rare complication during anesthesia. The authors reported a case of an 11-month-old boy, in whom pneumomediastinum with massive subcutaneous emphysema without pneumothorax developed during anesthesia. The etiology was not known, but we considered that the it was probably multifactorial. It should be noted that bucking and coughing on emergence could cause pneumomediastinum in infants and therefore infants are in need of much more careful management during anesthesia than adult patients.

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