

Bilateral Pneumothorax, Subcutaneous Emphysema and Pneumomediastinum under Anesthesia

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There are many reports on complication of tracheal intubation, but the development of acute respiratory distress associated with subcutaneous emphysema, pneumomediastinum and bilateral pneumothorax is a rare complication during general anesthesia. It has also been reported that tracheal perforation may be predisposed to such complication¹⁻⁵. This is a report of an unexpected and dramatic experience we had of a case under anesthesia.

Case Report

A 7-year-old female weighing 30 kg was scheduled for skin ablation of nevus. She had had no history of cardiopulmonary problems. The preoperative X-ray of the chest was normal and the electrocardiogram was within normal limits. All laboratory values were within normal limits. She was premedicated with hydroxyzine 30 mg and atropine 0.3 mg intramuscularly 30 min before the operation. Anesthesia was induced with enflurane, nitrous oxide, and oxygen with mask and intubation was performed uneventfully with a 5.0 mm internal diameter, uncuffed endotracheal tube without a stylet. The patient was then positioned laterally for the operation. Anesthesia was maintained with a mixture of enflurane, nitrous oxide, and oxygen. During the operation, ventilation was spontaneous and assisted gently avoiding ex-

cessive pressures, in a semi-closed system. Her intraoperative course was uneventful. The operation lasted about 2 hours and then the drapes were removed and the patient was moved to a supine position. Then, bucking occurred and within minutes, subcutaneous emphysema was noted in the face, neck and anterior chest wall. The skin and mucous membranes were cyanosed and auscultation of the chest disclosed diminished air entry in the left lung, but no respiratory murmur. The blood gas analysis at that time revealed that pH was 7.34, P_{aCO_2} 46 torr, P_{aO_2} 114 torr, and base excess -1 mEq/l on an inspired oxygen fraction of 1.0. A chest X-ray showed bilateral pneumothorax of about 30% in the left and 5% in right lung, severe subcutaneous emphysema and pneumomediastinum. There were no changes in vital signs or in the electrocardiogram during this time.

A chest tube was inserted promptly into the left pleural cavity for suction drainage of air. Respiratory failure was not progressive and the patient's color improved. The follow-up chest X-ray taken after insertion of the chest revealed re-expansion of the left lung.

The patient was fully conscious and the endotracheal tube was extubated. She was then transferred to the intensive care unit and was given 40% humidified oxygen with mask. After 5 hours, the subcutaneous emphysema had almost disappeared. By the 2nd postoperative day, as the left lung had re-expanded completely, the left chest tube was removed. The patient's respiratory status remained stable, and by the 5th postoperative day, chest X-rays revealed a normal field.

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Discussion

In this case, the sequence of events developed very suddenly. Cyanosis, distention of the neck veins, and extensive spread of subcutaneous emphysema to the face and trunk developed within minutes after bucking. At the same time, bilateral pneumothorax occurred. Therefore, damage to the respiratory mucosa by the tip of the endotracheal tube caused by bucking is one of the first possibilities which can be considered under these circumstances. The posterior membranous part of the trachea is very frail and susceptible to tearing in the elderly and infant. Perforation or rent of such a part is most apt to occur by abrupt head and neck movement in intubated patients and may be predisposed to such complications⁶. The other factors of perforation may have been enhanced by rigidity of the tracheal tube, overinflation or rupture of the cuff, use of metal stylets, skill of the intubation and presence of anatomical abnormalities of trachea and larynx. The course of events in this case exclude these possibilities. Air leaking from such perforated or rent trachea may penetrate the weaker layer of the mediastinal pleura and pass into the pleural cavity thus causing pneumothorax. Air might also produce subcutaneous emphysema which can then spread upward to the face and down wards over the chest wall⁷.

Other possible cause is the inadvertent application of excessive pressure to the airways⁸. There have been many reports of serious and fatal accidents arising from the inadvertent application of excessive pressure to the airway during general anesthesia^{9,10}. Sudden application of much greater pressures to the alveoli results in overdistention of the alveoli with subsequent leakage of gas into the surrounding tissues producing pulmonary interstitial emphysema. Marginal alveoli in the lung, which lie adjacent to blood vessels, are more prone to rupture. Air leaking from such ruptured alveoli can travel along the perivascular sheaths to the mediastinum. Finally, air passes into the pleural cavity thus causing pneumothorax⁷. We can rule out this mechanism, because no application of excessive pressure to the airways was evident during anesthesia or bucking. Pneumothorax

has been reported to occur upon application of relatively excessive pressure in patients with chronic obstructive pulmonary disease and subpleural bleb¹¹. The presence of a normal pre-operative chest X-ray and the course of events exclude this possibility.

If tracheal perforation is suspected, immediate treatment is necessary. The diagnosis must be considered if difficulty with ventilation, the rapid development of subcutaneous emphysema, pneumothorax and the appearance of the dilated cuff on chest X-ray^{3,4}. Once a pneumothorax has occurred, the tension of the pleural cavity should be removed. Nitrous oxide should be discontinued because pleural gas space expands rapidly, because nitrous oxide has already been reported to be dangerous in a closed space such as pneumothorax. If the increased intrathoracic pressure is not alleviated immediately, it can lead to cardiac arrest. Mediastinal emphysema and subcutaneous emphysema usually resolve spontaneously when the continued positive pressure is stopped and the intrathoracic pressure is relieved. If such a condition distends, withdrawal of the tube and placement of the tip below the level of the defect or insertion of a cuffed tube in an effort to seal over the perforation are advisable⁴. If not necessary to repair surgically, extubation of the endotracheal tube should be performed as rapidly as is feasible⁵. It should be repaired surgically in large tracheal air leaks.

We have presented a case of bilateral pneumothorax with pneumomediastinum and subcutaneous emphysema. Bucking is one of the certain risk factors of tracheal perforation.

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