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An Unusual Presentation of an Airway Tear

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Serious injury resulting from endotracheal intubation is uncommon and usually immediately apparent. Among the more serious injuries are those causing disruption of the airway. A significant airway injury is described that was not evident until 24 h postoperatively. The emergent management of this injury may have worsened the original damage, resulting in near fatal respiratory problems.

REPORT OF A CASE

An 82-year-old, 60-kg, non-English-speaking woman was admitted following 2 weeks of epigastric pain secondary to an obstructing lesion of the colon. She took no medications other than 1 g thyroid extract per day orally for long-standing thyroid insufficiency. She did not smoke. Because colonoscopy was unable to decompresse her markedly dilated colon, an exploratory laparotomy was scheduled. The day prior to surgery, multiple attempts at insertion of a nasogastric tube were unsuccessful and reportedly caused minor trauma to the nasopharynx. Following administration of 100% oxygen and application of cricoid pressure, anesthesia was induced with 350 mg thiopental and 100 mg of succinylcholine iv. The larynx was visualized easily with a #3 Macintosh blade. The trachea was intubated with a soft cuff #7.5 endotracheal tube with the aid of soft copper stylet with a blunt tip. The stylet did not protrude beyond the endotracheal tube, and the anesthesiologist reported no difficulty with any aspect of the intubation. A total of 6 ml air was added to the cuff to cause a seal, and breath sounds were heard bilaterally. An esophageal stethoscope, oral temperature probe, and a nasogastric tube subsequently were inserted without difficulty. Anesthesia proceeded with 2 mg morphine iv and the inhalation of enflurane and 66% nitrous oxide. Additional intermittent succinylcholine was given in an iv drip. A transverse loop colostomy for an obstructing adenocarcinoma with multiple distant metastasis was performed in a routine fashion. The endotracheal tube cuff was not deflated periodically intraoperatively.

The procedure lasted 8 h, and the patient was taken to the recovery room, breathing spontaneously but still anesthetized deeply. The trachea remained intubated. Chest roentgenogram exhibited low lung volumes but was otherwise normal. With an Fio2 of 0.4: PacO2 was 81 mmHg, PacO2 was 43 mmHg, and pH was 7.37. The patient appeared very drowsy but comfortable, with a respiratory rate of 16 breaths·min−1, a blood pressure of 160/90 mmHg, and a heart rate of 80 beats/min. Copious secretions were noted from the posterior pharynx and nasogastric tube, but no significant respiratory distress was seen. The trachea was extubated 90 min later with the patient awake but mildly agitated and requiring arm restraints. Two and one-half hours later, she was transferred to the ward. Moist crackles at the lung bases, a temperature of 37.5° C, and a "puffy appearance" to the face were noted prior to transfer. She remained disoriented, agitated, and continued to require passive restraints to keep her from pulling out her catheters. Five hours later, she was unable to cough effectively and exhibited coarse rhonchi on auscultation. Chest physical therapy was administered with little improvement.

No mention of subcutaneous emphysema was made until several hours later (15 h after discharge from the recovery room, 19 h after induction of anesthesia), when crepitus from the face to the sternum notch, bloody sputum, and ineffective cough were noted. Chest roentgenogram revealed marked subcutaneous emphysema and a small left pleural effusion. An esophageal tear from traumatic nasogastric tube insertion was suspected, and a normal gastrograffin swallow was obtained. Agitation, secretions, and respiratory distress worsened. A large right pleural effusion was diagnosed by subsequent chest roentgenogram, and because of worsening respiratory distress, the trachea was reintubated with a 7.0 soft cuff, high-volume, low-pressure endotracheal tube. Following intubation, a seal could not be obtained with the endotracheal tube cuff. Ventilation was inadequate with little chest expansion due to a large air leak. The respiratory distress worsened further, and another roentgenogram was obtained. The endotracheal tube tip was 23 cm from the incisors to the right mainstem bronchus (fig. 1). The cuff pressure was a measured 60 cmH2O. A consulting physician removed the original endotracheal tube and replaced it with a similar 8.0 low-pressure cuff tube under direct vision with no difficulty. A total of 20 ml of air inserted into the cuff still was insufficient for a good seal or adequate ventilation. Ventilation was maintained by institution of a low-tidal volume and rapid respiratory rate, which allowed for transport to the operating room.

Upon arrival in the operating room, the patient was extremely agitated with discoordinate respiration. She intermittently exhibited cyanosis and had bradycardia (heart rate 50 beats/min). Systolic blood pressure was palpable at 100 mmHg. A brief trial of anesthesia with oxygen and halothane was unsuccessful due to both inadequate ven...
FIG. 1. Chest roentgenogram taken following intubation for respiratory distress. Cuff diameter is indicated by arrows. Note the low position of the tube and the large amount of air in cuff.

Intubation secondary to agitation and unacceptably low blood pressure. Scopolamine (0.4 mg), and pancuronium (6 mg) were administered iv with FiO2 of 1.0, which allowed both successful ventilation through a rigid bronchoscope as well as preservation of acceptable hemodynamic variables. Bronchoscopy revealed a 3-cm linear tear extending from the trachea to the entrance of the right upper lobe bronchus (fig. 2A and B). The left main bronchus was intubated selectively with an 8.0 soft cuff tube and a right thoracotomy, and tracheal repair was performed. Following tracheal closure, the endotracheal tube cuff was located by bronchoscopy in the proximal trachea above the suture line (18 cm at incisors in this patient), and spontaneous respiration with halothane anesthesia and oxygen returned. The patient was transferred to the Respiratory Intensive Care Unit, and the trachea was extubated 5 h later without difficulty.

DISCUSSION

This case illustrates a delayed presentation and possible iatrogenic worsening of an airway disruption. They are uncommon and usually are associated with either thoracic surgery, bronchoscopy, or deceleration trauma.1 Airway or esophageal instrumentation, notably endotracheal intubation, is a very uncommon cause of acute airway disruption. Only 13 cases have been reported from 1966 to 1983, and a large percentage involved either high-pressure cuffs or Carlens double lumen endotracheal tubes (55%). Airway injuries resulting directly from laryngoscopy and endotracheal intubation likely are related to the skill and technique of the operator, the duration of time required to perform the intubation, and the clinical condition and history of the patient.2,3 Prolonged endotracheal intubations by inexperienced operators and the use of a stylette result in the highest percentage of injuries to the airway as well as adjacent structures.2,4 Injuries by stylettes do not have to cause an airway discontinuity to result in respiratory distress. Mucosal elevation with bleeding, fibrinous granuloma formation, and

FIG. 2A. Surgical exposure of the tracheal rupture. Note that the endotracheal tube is visible through the tracheal tear, the size of which corresponds to the cuff diameter. B. Artist’s drawing of A.
airway obstruction 72 h postoperatively have followed injury to the anterior cartilaginous portion of the trachea, presumably from the endotracheal tube stylette. 

The clinical symptoms of airway disruption were well illustrated by the above case even though the onset was more gradual than in those previously reported. Although Hood and Sloan reported that in 66% of their series of 98 cases, more than 24 h elapsed from the time of injury to the time of diagnosis. Their series only included two cases (2.2%) of surgically associated trauma. The majority of the cases in their series are out-of-hospital injuries, not related to direct airway manipulation. Airway injuries associated with anesthesia usually present acutely. In all of the tracheal intubation-related cases of airway disruption reported the injury was suspected either intraoperatively or in the immediate postoperative period. Disruption was diagnosed by either a large air leak not correctable by additional inflation of the pilot balloon, subcutaneous emphysema and respiratory distress in the recovery room, or the discovery of the endotracheal tube itself exposed during thoracotomy.

In intubation-related cases of airway disruption subcutaneous emphysema, ineffective cough, bloody sputum with difficulty clearing secretions, hypercarbia, hypoxemia, and respiratory failure are common signs. In this case the original injury probably occurred at the time of her first endotracheal intubation and was worsened by the subsequent reintubation and cuff overinflation on the floor. Inability to seal a properly placed endotracheal tube with a reasonable amount of air is ominous and very suggestive of airway discontinuity. In high volume, low-pressure cuffs, cuff pressure closely approximates tracheal wall pressure, and significant stress can be placed on the lateral tracheal wall if the cuff is overinflated. A 7.0 Millinckrodt Hi-Lo® cuffed endotracheal tube inflated with 60 ml of air to approximate the cuff size shown in the postintubation roentgenogram (fig. 1) creates an intracuff pressure of 140 mmHg. In my case, a small disruption of the airway was likely present postoperatively and the cuff overinflation after reinsertion significantly extended the injury, lead to acute respiratory insufficiency, and the need for emergency thoracotomy.

The original injury also may have occurred either intraoperatively or while her trachea was intubated in the recovery room. Abrupt head and neck movement in this elderly, non-English-speaking patient who surely was frightened as well as confused easily could have caused this injury considering the agitation that was present. Difficult insertion of a nasogastric tube also could have been the cause of the damage, although an earlier onset of her symptoms would be expected. Unreported trauma from the stylette or unvented nitrous oxide accumulation in the cuff are possible causes of the original injury as well.

Optimal management of any case of airway disruption depends on the particular circumstances of the case involved, but, in general, a spontaneous inhalation technique with a potent anesthetic and without nitrous oxide may be the safest if it is well tolerated. As in any case of tracheal repair, positive pressure ventilation should be avoided and extubation of the trachea should be performed as rapidly as is feasible. 

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