Carinal injury: An airway challenge for anesthesiologists

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ABSTRACT

Tracheobronchial disruption is a potentially life-threatening airway challenge for all the anesthesiologists. Carinal rents, although rare, if not timely managed can be catastrophic. We describe a patient with carinal rent being managed successfully by prompt diagnosis, use of low-pressure ventilation, and bronchoscopic sealing using tissue glue.

Key words: Airway challenge, bronchoscopic sealing, carinal injury, tissue glue, tracheobronchial disruption

INTRODUCTION

Tracheobronchial disruption is a potentially life-threatening airway challenge for all the anesthesiologists. The varied clinical presentations and delayed diagnosis may lead to clinical catastrophe if not timely managed. We describe a patient with carinal rent being managed successfully by prompt diagnosis, use of low-pressure ventilation, and bronchoscopic sealing using tissue glue.

CASE REPORT

A 30-year-old man after sustaining a high-speed motor vehicle accident was referred to our tertiary level trauma center on second day postinjury. He had blunt trauma chest and fracture shaft of right femur. He was intubated in the emergency department for respiratory distress and a previously placed right intercostal drain (ICD) was repositioned prior to shifting the patient to intensive care unit (ICU).

He had decreased air entry in the right side of the chest with coarse crepitations. There was large continuous air leak from the right ICD and subcutaneous emphysema suggesting the possibility of tracheobronchial disruption. Despite a well-placed chest tube, chest radiograph showed persistent right pneumothorax and collapsed right lung. Fiberoptic bronchoscopy done by anesthesiologist revealed the presence of a large rent of 1 cm at the level of carina. The endotracheal tube was withdrawn under fiberoptic guidance, which showed no upward extension of the rent and finally the tube was left in situ just below the vocal cords. Computed tomography (CT) chest revealed fracture right 1st–3rd ribs with gross pneumomediastinum, right lung contusion, massive subcutaneous emphysema, and possibility of tracheal bronchus. A second ICD was placed in 2nd intercostal space on the right side and connected to negative pressure suction. He was ventilated by assist-control mode ventilation with a tidal volume of 5 mL/kg, positive end-expiratory pressure (PEEP) of 3 cm (maximum PEEP at which there was no continuous air leak and prevented atelectasis) and the respiratory rate was adjusted according to the PaCO$_2$ and pH. Peak inspiratory pressure, compliance, airway pressure, and resistance were monitored. Adequate pain relief was ensured with 0.125% bupivacaine and 2 μg/mL fentanyl combination being administered through thoracic epidural positioned at D8–D9 level at rate of 4-7 mL/h. On third day postinjury, bronchoscopic sealing of the tracheopleural fistula was...
Table 1: Effect of fibrin glue on airway parameters and arterial blood gas analysis

| Parameters                  | Pretreatment with fibrin glue | Posttreatment with fibrin glue |
|-----------------------------|-------------------------------|-------------------------------|
| Airway pressures p plateau  | 29                            | 27                            |
| (cm of water)               |                               |                               |
| Mode of ventilation         | Synchronized intermittent mandatory ventilation | Pressure support ventilation |
| (FiO₂ = 0.4)               |                               |                               |
| Static compliance           | 14.5                          | 12.5                          |
| pH                          | 7.45                          | 7.44                          |
| PaO₂                        | 72                            | 120                           |
| SaO₂                        | 95                            | 99                            |
| PaCO₂                       | 36                            | 40                            |

done using N-butyl-2-methyl cyanoacrylate (tissue glue). The flexible adult fiberoptic (size 4.9) scope was passed through endotracheal tube and the carinal rent was localized. A 5-French angiography catheter was passed through the working channel of the bronchoscope and 1 mL of the tissue glue along with lipoidol was instilled into the carinal rent. The continuous air leak in the ICD stopped at the end of procedure, lung expanded and pneumothorax relieved following the procedure and did not recur. Subsequently, the patient was extubated under fiberoptic guidance after 12 days of mechanical ventilation. Before and after the repair when the patient was on mechanical ventilation blind suctioning of the tracheal tube was avoided as it could further damage the injured carina.

**DISCUSSION**

Traumatic disruptions of the trachea and bronchi are rare but life threatening. More than 80% of tracheobronchial injuries due to blunt trauma are located within 2.5 cm of the carina. This site preponderance is because of shearing forces between the fixed carina or proximal bronchus and the mobile distal bronchi/lungs.

Careful history of the mechanism of the trauma and a thorough examination helps in establishing early diagnosis of tracheobronchial injury. Shortness of breath, cyanosis, pain, cough, hoarseness, hemoptyis, pneumothorax, and
subcutaneous surgical emphysema are usual features of tracheobronchial injury.[6] Increasing dyspnea and refractory pneumothorax with continuous air leak from the chest tubes are important characteristics of a tracheobronchial lesion as was in our case. Persistent air leak from ICD may represent either disruption of tracheobronchial tree (seen early after injury) or rupture of an overdistended alveolus (seen late after injury as a complication, such as ARDS). Routine chest X-rays and bronchoscopy help in establishing diagnosis in more than 90% of the cases.[5] CT chest [Figures 3 and 4] findings might be misleading as was in our case where differential diagnosis of tracheal bronchus was kept. A tracheal bronchus is an aberrant, accessory, or ectopic bronchus, which arises from the posterior wall of the trachea just above the carina and accidental intubation of the tracheal bronchus can lead to inadequate ventilation of the rest of the lung.[6,7] However, fiberoptic visualization of the tracheobronchial tree ruled out this entity.

Establishment of adequate ventilation that minimizes flow through the fistulous tract takes precedence over all other therapeutic measures. Hence, endotracheal tube was withdrawn away from the carina minimizing the direct damage of ventilatory air inflow into the carinal rent. Ventilator strategy adopted to promote healing of the carinal rent included minimizing the PEEP, limiting the effective tidal volume, shortening the inspiratory time and reducing the respiratory rate during ventilation.[8] All these maneuvers have a goal of reducing the mean airway pressure <30 cm, and therefore, reducing fistula flow and loss of tidal volume. The use of high-frequency ventilation (HFV) has been conflicting. Many reports state that HFV did not improve exchange, so we did not use HFV.[9] In general, HFV seems to be useful in patients with normal lung parenchyma and proximal broncho-pleural-fistula (BPF), while it is of limited value in patients with distal disease and parenchymal disease.[9]

Surgical repair is regarded as the treatment of choice for traumatic tracheal injuries.[10] However, it is associated with significantly high morbidity and mortality.[11] In spontaneously breathing patients, surgery represents an additional trauma because nonsurgical management is sufficient for healing.[12] Our case encourages the consideration of conservative treatments, such as the use of bronchoscopy and different glues, coils, and sealants. Various sealants available are polyethylene glycol, ethanol, fibrin glue, cellulose, and cyanoacrylate glue.[8] We used cyanoacrylate glue in our patient, which initially seals by acting as a plug and later induces a local inflammatory process with mucosal proliferation and fibrosis creating a permanent seal. Lipoid, iodized oil is used[8] to delay its polymerization. Success of sealants depends on the size of fistula. Small rents can seal on their own, so we waited for 3 days and visualized the rent under fiberoptic guidance, which showed persistent rent. So, we opted for use of sealant glue. Those BPFs >8 mm are not suitable for endoscopic management, while those 1 mm in size have the highest success rate.[8] Use of sealants may be associated with complications, such as pain and fever, local tissue necrosis, and inflammatory reaction to foreign body (mediastinitis), thromboembolic complications, and septic complications.[13]

In conclusion, prompt recognition, low pressure mechanical ventilation, adequate pain relief, and treatment of tracheobronchial disruption by bridging the defect with tissue glue is a feasible treatment and an alternative to surgery in selected patients.

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