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Asian Cardiovascular and Thoracic Annals 2014 22: 816 originally published online 17 January 2014
DOI: 10.1177/0218492313516777
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>> Version of Record - Aug 20, 2014
OnlineFirst Version of Record - Jan 17, 2014
What is This?
Traumatic intrathoracic tracheobronchial injuries: A study of 78 cases

Mohamed A Alassal¹,², Bedir M Ibrahim³ and Nabil Elsadeck⁴,⁵

Abstract
Background: Tracheobronchial injuries are encountered with increasing frequency because of improvements in pre-hospital care. We reviewed our experience of these injuries to determine how to better recognize them and facilitate their correct management.

Methods: Patients with traumatic non-iatrogenic intrathoracic tracheobronchial injuries managed in 2 tertiary centers in Saudi Arabia between 2000 and 2012, were studied. Clinical presentation, diagnostic evaluation, management, and outcome were reviewed.

Results: 78 patients with tracheobronchial injuries were included in this study. They were divided into 2 groups according to the management strategy. Forty-seven patients who were managed conservatively, and 31 underwent surgery. Surgery allowed shorter intensive care unit and hospital stays; otherwise, the results were comparable between the two groups.

Conclusions: Early recognition and expedient appropriate management are essential in these potentially lethal injuries. Operative management can be achieved with acceptable mortality, and conservative treatment should be considered as a valuable alternative to the well-established surgical treatment.

Keywords
Bronchi, Bronchoscopy, Trachea, Wounds, nonpenetrating, Wounds, penetrating

Introduction
Improvements in the techniques of transporting injured patients and in the care given outside the hospital have increased the number of patients with severe injuries who reach the emergency room alive. Many of these patients have sustained chest trauma and possible tracheobronchial injury.¹ Although early diagnosis and treatment is important, the diagnosis of tracheobronchial injuries is not always straightforward, and it can be missed initially in patients with multiple injuries.² Clinically, the diagnosis should be suspected if subcutaneous emphysema, persistent pneumothoraces, air leak from chest tubes, and associated stridor and hemoptysis are present. Radiologic signs are mostly nonspecific, with pneumothorax and pneumomediastinum being the most common.³ A high level of suspicion and liberal use of bronchoscopy are important in the diagnosis of tracheobronchial injury. In 80% of these injuries, the lesion involves the distal trachea within 2.5 cm of the carina. Bilateral lesions are rare, and lesions may or may not communicate with the pleural cavity.⁴

Virtual bronchoscopy produces a 3-dimensional fly-through view of the tracheobronchial tree from computed tomography data. It takes advantage of the natural contrast between the air-containing lumen and the surrounding tissues. The specific advantage of using virtual bronchoscopy to grade tears is that the perspective of the endoluminal view stays within the axis of the airway, allowing reliable semiquantitative assessment of tracheobronchial tears.⁵ These injuries must be suspected in any penetrating or blunt trauma to the neck.
and chest. They require early diagnosis, skillful airway management, and prompt treatment to improve the outcome. The treatment decision is still controversial. Although nonoperative treatment may be effective in some cases with uncomplicated ventilation, superficial or sufficiently covered tears, and moderate and nonprogressive emphysema, surgical repair is unavoidable in many others. The increasing frequency led us to retrospectively review our experience in the management of tracheobronchial injuries, and to compare it with the literature to determine how to better recognize such lesions and facilitate their correct management.

**Patients and methods**

Between January 2000 and December 2012, 78 traumatic non-iatrogenic intrathoracic tracheobronchial injuries were diagnosed in 2 tertiary centers in Saudi Arabia. Twenty-one (27%) patients were female, 57 (73%) were male, and the mean age was 52.6 ± 19.7 years (range 17 to 88 years). Twenty-one patients had a penetrating injury (3 stab wounds and 18 gunshot wounds) and 57 had suffered blunt trauma (45 due to motor vehicle accidents and 12 caused by falling from a height). Nineteen patients arrived from the scene of the incident, and 59 were transferred from another facility. A retrospective review of clinical records was carried out. Collected data included patients characteristics, clinical features, methods of diagnosis, radiographic and bronchoscopic findings, associated injuries, early airway management, mechanism of injury, time until diagnosis, anatomic location of the injury, type of treatment, duration of follow-up, and outcome. Time until diagnosis and time until treatment were defined as the reported time from injury until the diagnosis was clearly established or until definitive treatment occurred. We limited the study to patients with traumatic intrathoracic tracheal or bronchial injury, excluding those with iatrogenic and/or cervical injuries.

In all cases, there was one or more of the classic signs and symptoms such as subcutaneous emphysema, mediastinal emphysema, pneumothorax, hemoptysis, dyspnea, or difficulty with mechanical ventilation. On arrival at the hospital with clinically suspected bronchial rupture and respiratory failure or shock, a patent upper airway and vascular access were established quickly. In approximately half of our patients, immediate oral or nasal intubation or tracheostomy was performed. Chest radiography was rapidly carried out. Closed-tube thoracostomy was undertaken for treatment of hemothorax and/or pneumothorax. Following diagnosis, all patients were commenced on broad-spectrum intravenous antibiotics.

In patients who needed mechanical ventilation, an endotracheal tube was passed over a flexible bronchoscope. The cuff of the single-lumen tube was placed distal to the tracheal laceration, with sufficient reserve to the carina. If the laceration affected the tracheal bifurcation or the right or left main stem bronchus, the opposite bronchus was intubated with a corresponding double-lumen tube. The ventilation regimen was directed towards early extubation. When a continuous air leak was detected with ineffective thoracic drainage (inability of the lung to expand), hemoptysis, increasing surgical emphysema, acute suffocation, and increasing mediastinal emphysema on subsequent radiographs, the patient was transported to operating room without further diagnostic examinations, and rigid bronchoscopy was carried out. If a long tear or avulsed bronchus was observed, the patient was immediately prepared for a thoracotomy. In stable patients, a computed tomographic scan of the chest was obtained to detect mediastinal fluid collections and quick progression of mediastinal emphysema, and to perform virtual bronchoscopy. Because more than half of these patients had a patent airway on arrival in the trauma center, the first indications of tracheobronchial injuries were often clinical and radiographic findings (surgical emphysema, pneumomediastinum, abrupt termination of a bronchus, or obstruction of a bronchus as seen in Figures 1–3).

Conservative treatment was chosen in patients who refused an operation, patients in poor physical condition (severely ill), those who did not require mechanical ventilation or in whom mechanical ventilation was possible without any loss of tidal volume, and the emphysema was only mild and did not progress during ventilation. Surgery was indicated in cases of progressive subcutaneous or mediastinal emphysema, severe dyspnea requiring intubation, difficulty with mechanical ventilation, tension pneumothorax with a considerable air leak through the chest drains (open perforation into the pleural cavity), or a transmural tear longer...
than 2 cm. In no case did we decide on surgery secondary to an attempt at conservative therapy.

For conservative treatment, the patients were carefully monitored in the intensive care unit. If mechanical ventilation was needed, orotracheal intubation was performed under bronchoscopic guidance with a well-matched endotracheal tube and varying ventilation modes depending on the individual situation of each patient. Endoscopic examinations were carried out at least on day 1, 3, and 7, depending on the healing process, to clean up the situs and to assess the state of granulation tissue formation. Blood and serum analyses were performed daily to assess the patients’ clinical situation and progress.

For surgical treatment, the incision was a right posterolateral thoracotomy in the 4th intercostal space for large defects of the thoracic trachea. Defects of major bronchi were usually approached through a lateral thoracotomy with an incision in the 5th interspace on the side of the trauma. Most patients underwent surgical debridement and primary repair. After opening the mediastinal pleura with limited dissection to retain an adequate blood supply to the suture lines, longitudinal tears were closed by continuous running suture, and transverse abruptions by interrupted suture in the cartilaginous part and running suture in the membranous part, using 3/0 or 4/0 polyglactin (Vicryl) or polypropylene (Prolene) suture. Two patients had fractures of some tracheal rings that required resection followed by end-to-end anastomosis using monofilament suture. The suture line was covered with mediastinal pleura when possible, and after testing the suture line, the chest wall was closed, leaving 2 chest tubes for drainage. Three patients required pulmonary lobe resections for irreparable pulmonary vascular injuries. The rate of technical success, defined as establishment of airway continuity and control of bleeding, was 100%. All patients were evaluated by chest radiography and flexible bronchoscopy on postoperative days 2, 3, and 4, to evaluate the surgical line and remove secretions. Flexible bronchoscopy was also performed one and two weeks after the operation to detect stenotic scarring.

The patients were divided into 2 groups according to the management strategy: 47 were managed conservatively (group A) and 31 underwent surgery (group B). The further management in both strategies included vigorous bronchoscopy-guided frequent tracheobronchial toilet, broad-spectrum antibiotics, and prevention of high intrabronchial pressures by keeping the patients from coughing. Patients who had undergone surgery were extubated as soon as possible, preferably in the operating theater, to minimize the local trauma of intubation. Follow-up through outpatient clinic visits was carried out at approximately 1, 2, and 3 months, and then yearly for 5 years after hospital discharge, if no other incidences were detected.

The collected data were organized, tabulated, and statistically analyzed using SPSS version 13 software (SPSS, Inc., Chicago, IL, USA). For quantitative data, the range, mean and standard deviation were calculated. For qualitative data, comparisons between two groups and more were performed using the chi-square test. The correlation between variables was evaluated. Significance was adopted at $p < 0.05$ for interpretation of results of tests of significance.
Results

Thirty-eight (49%) patients were seen in the emergency department with some degree of respiratory compromise, and required prompt control of the airway. In 7 patients, a continuous air leak was detected with ineffective thoracic drainage (inability of the lung to expand), hemoptysis, increasing surgical emphysema, and/or mediastinal emphysema on subsequent radiographs; these patients were transported to operating room and rigid bronchoscopy was carried out. In stable patients, computed tomography of the chest was obtained to detect mediastinal fluid collections and quick progression of mediastinal emphysema, and to perform virtual bronchoscopy. Early in this study, we proceeded to flexible bronchoscopy, and later, after studies by our radiology team concluded that virtual bronchoscopy was a reliable noninvasive method for endoluminal assessment of central airway tears, we took the decision not to proceed to bronchoscopy but to decide the management according to the results of virtual bronchoscopy. The mean size of the injury measured by bronchoscopic vision was 2.89 ± 1.04 cm (range 1–4 cm). Two patients had transections of the right bronchi from blunt trauma. The mean delay to diagnosis was 25.7 ± 22.9 h (range 3 to 72 h). Group B patients were diagnosed significantly earlier, and the injured part was longer than in group A patients.

Table 1. Characteristics, mechanism of injury, and diagnostic findings in 78 patients with traumatic tracheobronchial injuries.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group A (conservative)</th>
<th>Group B (surgery)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age (years) [range]</td>
<td>58 ± 13.7 [34–88]</td>
<td>46 ± 9.6 [17–69]</td>
<td>0.787</td>
</tr>
<tr>
<td>Male</td>
<td>34 (72.3%)</td>
<td>23 (74.2%)</td>
<td>0.046</td>
</tr>
<tr>
<td>Female</td>
<td>13 (27.7%)</td>
<td>8 (25.8%)</td>
<td></td>
</tr>
<tr>
<td>Mechanism of injury</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blunt trauma</td>
<td>39 (83%)</td>
<td>18 (58.1%)</td>
<td>0.546</td>
</tr>
<tr>
<td>Penetrating injury</td>
<td>8 (17%)</td>
<td>13 (41.9%)</td>
<td></td>
</tr>
<tr>
<td>Method of confirmation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intraoperative rigid bronchoscopy</td>
<td>0</td>
<td>7 (22.6%)</td>
<td></td>
</tr>
<tr>
<td>Flexible bronchoscopy</td>
<td>21 (44.7%)</td>
<td>8 (25.8%)</td>
<td>0.123</td>
</tr>
<tr>
<td>Virtual bronchoscopy</td>
<td>26 (55.3%)</td>
<td>16 (51.6%)</td>
<td></td>
</tr>
<tr>
<td>Airway injury</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tracheal injury</td>
<td>14 (29.8%)</td>
<td>8 (25.8%)</td>
<td></td>
</tr>
<tr>
<td>Right bronchial injury</td>
<td>30 (63.8%)</td>
<td>18 (58.1%)</td>
<td>0.236</td>
</tr>
<tr>
<td>Left bronchial injury</td>
<td>3 (6.4%)</td>
<td>5 (16.1%)</td>
<td></td>
</tr>
<tr>
<td>Endoscopic length (cm)</td>
<td>1.6 ± 1.2</td>
<td>3.7 ± 2.4</td>
<td>0.026</td>
</tr>
<tr>
<td>Delay to diagnosis (h)</td>
<td>31.7 ± 9.7</td>
<td>23.1 ± 6.4</td>
<td>0.038</td>
</tr>
</tbody>
</table>

Table 2. Postoperative course in 78 patients with traumatic tracheobronchial injuries.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group A (conservative)</th>
<th>Group B (surgery)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intensive care unit stay (days)</td>
<td>13.6 ± 9.17</td>
<td>7.55 ± 6.7</td>
<td>0.028</td>
</tr>
<tr>
<td>Hospital stay (days)</td>
<td>18.17 ± 14.7</td>
<td>11.15 ± 9.8</td>
<td>0.046</td>
</tr>
<tr>
<td>Bronchoscopy at 2 months</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Granulomas scar/stenosis</td>
<td>12 (25.5%)</td>
<td>8 (25.8%)</td>
<td>0.457</td>
</tr>
<tr>
<td>Normal tracheobronchial diameter</td>
<td>35 (74.5%)</td>
<td>23 (74.2%)</td>
<td>0.243</td>
</tr>
<tr>
<td>Outcome</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uneventful recovery</td>
<td>42 (89.4%)</td>
<td>27 (87.1%)</td>
<td>0.376</td>
</tr>
<tr>
<td>Complications</td>
<td>5 (10.6%)</td>
<td>4 (12.9%)</td>
<td>0.531</td>
</tr>
</tbody>
</table>
We studied 78 patients with traumatic intrathoracic injuries: 27% were female and 73% male. We found no significant differences between group A and group B in terms of age, sex, mechanism or anatomic location of the injury. All surgical procedures were effective in restoring adequate airway continuity. Mechanical ventilation was required in 38 (49%) patients on admission, and all surgical patients were mechanically ventilated at the time of operation. Fifteen patients were extubated at the end of the surgical procedure. The mean intensive care unit and hospital stays were significantly longer in group A patients. Flexible bronchoscopy was performed in all patients to inspect the tracheobronchial tree and provide pulmonary toilet. This revealed no significant difference between the 2 groups. All patients survived (no mortality) and were discharged healed. Nine patients sustained complications (overall morbidity 11.5%) with no significant difference between the 2 groups. The complications included pneumonia in 2 cases, sepsis in 2, acute respiratory distress syndrome in 2, bronchopleural fistula in 1, persistent pneumothorax after pulmonary resection in 1, and wound infection in 1. All patients recovered and were discharged in good general condition with patent airways. After discharge from the hospital, all patients were followed up in the outpatient clinic. All of them returned to their previous levels of activity, and endoscopic follow-up showed a perfect primary healing process of the lesions during the period of follow-up.

**Discussion**

Tracheobronchial injury was considered rare until the last 3 decades. These lesions are now becoming far more common or are being recognized more often, probably because of the increasing incidence of motor vehicle accidents and the rapid transportation system that allows more patients to reach the hospital alive.8 We studied 78 patients with traumatic intrathoracic tracheobronchial injuries: 27% were female and 73% male, with a mean age of 52.6 ± 19.7 years (range 17–88 years). Mean age was 22.3 years (range 4–53 years) in other study.9 The strong prevalence of women in some reports is easily explained by the fact that female airways are smaller in size;10 whereas the prevalence of men in our study can be explained by the fact that females are not allowed to drive in this area so motor vehicle accidents are more common in males. Penetrating injuries are also more common in males in this area, which coincides with other results.11

The etiology of tracheobronchial injury is the circumstance by which it occurs. Blunt (most often due to motor vehicle accidents) and penetrating injuries (stab or gunshot wounds that may injure major bronchi) account for the vast majority; however, iatrogenic injuries appearing after intubation, tracheotomy, or mediastinoscopy have been reported.8,12 The mechanism was 73% blunt and 27% penetrating injuries in our study; it was 36.4%–41% blunt and 63.5%–59% penetrating injuries in other reports.9,13 The predominance of blunt trauma in our series may be because we excluded cervical tracheal injuries that are more common in penetrating injuries. Accurate diagnosis of tracheobronchial injury necessitates an understanding of the mechanism of injury and mandates simultaneous evaluation of associated injuries. Blunt injuries, which seem to result from deceleration, are usually not associated with other major chest injuries and the diagnosis is difficult and frequently delayed, whereas penetrating wounds are relatively easy to diagnose.8 The typical clinical features include hemoptysis, dyspnea, and air leak, and often require a degree of clinical suspicion to make the diagnosis.14 In our series, the most frequently recognized finding was subcutaneous emphysema. No patients were asymptomatic; all had one or more of the classic signs and symptoms such as subcutaneous emphysema, mediastinal emphysema, pneumothorax, hemoptysis, dyspnea, or difficulty with mechanical ventilation. This agrees with many other studies.9 The preponderant findings on chest radiography included subcutaneous emphysema, pneumomediastinum, and pneumothorax.15 All our patients had one or more of these findings on presentation.

Prompt diagnosis and treatment generally lead to good functional recovery. The most useful diagnostic method in many series was bronchoscopy, and it was performed in all suspected patients as it is the most reliable means of establishing the site, nature, and extent of major airway disruption.3,14,16,17 Early in this study, we proceeded to flexible bronchoscopy, and later, we depended on virtual bronchoscopy for diagnosis. Bronchoscopic examination was undertaken in 46% of our patients and in 69% in other series.9 Virtual bronchoscopy proved to be reliable for semiquantitative assessment of tracheobronchial tears and was superior to other display modes because it produced more realistic images of the bronchial wall discontinuity.18 We found a right bronchial injury in 61.5% of patients and the main bronchus was involved in 72%. The higher incidence of right bronchial injuries may be due to the shorter length of the right main bronchus compared to the left. However, the right bronchus is also less protected than the trachea or the left bronchus, which are encircled by the aorta and other mediastinal tissues. The heavier right lung on the shorter right main bronchus may also play an important role in the amount of traction force experienced in deceleration injuries.19

Tracheobronchial injuries are commonly associated with persistent air leak with pneumothoraces.20,17 We had 7 patients with continuous air leak; they were
transported to the operating room and rigid bronchoscopy was carried out. Management included maintaining adequate, but not excessive, ventilation. Two different scenarios are possible: spontaneous or mechanical ventilation. In some patients with spontaneous ventilation, noninvasive positive-pressure ventilatory support can be helpful. When mechanical ventilation is needed, an endotracheal tube should be passed, if possible, over a flexible bronchoscope. The tip of the endotracheal tube should be placed distal to the tracheal rupture (bridging the lesion). If the lesion is too close to the carina or the laceration affects the right or left main stem bronchus, a double-lumen tube or even separate endobronchial intubation may be necessary. Orotracheal intubation can be accomplished in most cases. Thirty-eight (49%) of our patients required prompt control of the airway; in other series, this was 45% and the other 55% had a secure airway and were breathing comfortably on supplemental oxygen. Tube thoracostomy should be performed for evacuation of hemothorax or elimination of pneumothorax. After recognizing the airway injury and securing the airway, hemodynamic instability should be corrected, management of associated injuries should be undertaken, and antibiotics started. This was similar to our protocol of management. The diagnosis should be made as early as possible, preferably in the first 12 h. In our series, only 26% of patients were diagnosed within this time. The diagnostic delay (25.7 ± 22.9 h) was related to the fact that many patients were transferred from other hospitals with a diagnosis yet unconfirmed. Nevertheless, this delay was similar to those of other published series.

The mean tracheobronchial injury length in our patients, as seen in bronchoscopy, was 2.89 ± 1.04 cm, while it was 4.5 ± 1.5 cm in another series. There is still controversy regarding the management strategy for tracheobronchial injuries. Many surgeons advocate early surgical treatment, ensuring rapid relief from a life-threatening situation with an excellent operative outcome, and nonoperative therapy only in exceptional cases based on strict clinical and endoscopic criteria: stable vital signs, effective ventilation, no esophageal injuries or signs of sepsis, and no evidence of major communication with the mediastinal space. Others believe that surgical treatment is not mandatory in patients with small to moderate ruptures, and such aggressive treatment may even have adverse effects, especially in patients with multiple injuries. We operated on 31 (40%) patients and the other 47 (60%) were managed conservatively. Our strategy was similar to that of others who suggested that treatment can be conservative or aggressive, depending on the extension of the lesion and the patient’s clinical condition. Usually, conservative treatment is preferred for stable patients with small uncomplicated tracheobronchial lesions. Surgical treatment is reserved for patients requiring mechanical ventilatory support, unstable patients with pneumomediastinum, and for emphysema involving the chest, neck, and face. Some reports concluded that surgery offers prompt repair, avoids complications (descending mediastinitis) and sequelae (tracheal stenosis), and allows a relatively short recovery time. Others advocated that conservative treatment should be considered as a valuable alternative to the well-established operative treatment because the results are comparable. In our series, surgery allowed shorter intensive care unit and hospital stays. There was no significant difference in morbidity between our two groups of patients. Morbidity occurred in 11.5% of our patients; it was 25.8% in another series. Stricture formation is one of the complications of tracheobronchial injury, which occurs with or without repair. This occurred in 12.8% of our patients and 9.3% in another series. Tracheobronchial injuries were previously thought to be universally fatal. Recently, management can be performed with acceptable mortality. We had no mortality in our study; it was 16.6%–19.3% in other studies.

Selection criteria for conservative management are a matter of debate: some stress the fact that there should be no evidence of respiratory or hemodynamic instability, others consider the length or depth of the laceration as important criteria. Some reports limited it to small tears < 2 cm in length, or unstable clinical situation. Others recommend it in patients who have spontaneous ventilation or when extubation is scheduled within 24 h of diagnosis. In our series, conservative treatment was chosen in patients who refused the operation, severely ill patients, and those who did not require mechanical ventilation or in whom mechanical ventilation was possible without any loss of tidal volume and the emphysema was only mild and did not progress during ventilation. Surgical treatment was reserved for patients requiring mechanical ventilatory support. The purposes of surgery are to obtain closure of the defect to restore effective ventilation, to prevent mediastinitis secondary to contamination from the airways, and to reduce the risk of subsequent healing complications or long-term tracheal stenosis. The surgical approach to repair of these tracheobronchial injuries is dictated primarily by the location of the injury. Exposure of the mediastinal trachea, carina, and right main bronchus is best achieved through a right posterolateral thoracotomy through the 4th intercostal space. The proximal left main bronchus can be dealt with through a right thoracotomy; however, complete transection of the left main bronchus is best exposed through a standard left thoracotomy. Management includes repair of the bronchus or pulmonary resection. If there is irreparable damage to a major bronchus or massive pulmonary vascular injury, lobectomy may be the only surgical...
option, as was the case in 3 of our patients. Pneumonectomy is not recommended because of a 100% mortality rate. Most injuries can be repaired by simple techniques. Some surgeons concluded that meticulous repair can be achieved with nonabsorbable monofilament sutures that is less likely to be associated with suture line infection. Other groups prefer repair using interrupted absorbable suture that is less likely to cause granulation. Our surgical treatment consisted of local debridement followed by repair with interrupted or running 3/0 or 4/0 polyglactin (Vicryl) or polypropylene (Prolene) suture (longitudinal tears were closed by continuous running suture and transverse abruptions by interrupted suture in the cartilaginous and by running suture in the membranous part). Extubation should occur in the operating room or as soon as respiratory physiology allows. We aimed to extubate patients who had undergone surgery as soon as possible, preferably in the operating theater, to minimize the local trauma of intubation. Fiberoptic bronchoscopy permits direct visualization to monitor the healing process, and also has the advantage of allowing bronchial toilet without danger to the repaired area. Follow-up to detect stenosis or anastomotic technique is important, as is attention to pulmonary toilet. During their intensive care unit stay and also during follow-up through outpatient clinic visits, our patients underwent careful tracheobronchial toilet and observation of the reconstructed bronchus by fiberoptic bronchoscopy.

From this study we can conclude that early surgical treatment ensures rapid relief with an excellent operative outcome, and allows a relatively short recovery time. Thus we recommend it for patients requiring mechanical ventilatory support if the patient and relatives agree and the general condition can tolerate operation. Nonoperative conservative management of tracheobronchial injuries is a safe and valuable option in patients with uncomplicated ventilation, those who refuse the operation, and patients in poor physical condition.

Funding
This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Conflict of interest statement
None declared.

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18. Polverosi R, Vigo M, Baron S and Rossi G. Evaluation of tracheobronchial lesions with spiral CT: comparison...


