

# Outcomes of surgical management of tracheobronchial injuries—a case series from a developing country

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**【Abstract】 Objective:** Tracheobronchial injuries are defined as injuries involving the trachea and/or bronchi from the level of the cricoid cartilage extending up to the division of the bronchi. We present a case series with most of the tracheobronchial injuries found to be sustained after penetrating trauma.

**Methods:** A retrospective review was performed at the Aga Khan University, Karachi, Pakistan. From January 2004 to December 2009, 168 patients with thoracic trauma were treated, of whom 15 were recognized to have major tracheobronchial and pulmonary injuries.

**Results:** The average age was 31 years with most of the patients being male (14:1). Among them, 11 patients had penetrating trauma as the main cause of injury, 3 patients had blunt trauma from road traffic accidents, only 1 patient had combined trauma (blunt and penetrating trauma). Eight

patients were diagnosed based on radiological findings. All the patients were treated surgically. Lobectomy was the most common intervention performed in 7 patients. The mortality rate was 7% (1 patient). Most patients survived with no sequelae (10 patients) while 5 survived with disability. We found that penetrating trauma was the leading cause of injury in our series. The severity of injury depends upon the weapon causing the trauma. Patients in our series had multiple injuries and required surgical management.

**Conclusions:** Tracheobronchial injuries are rare but potentially life threatening. They require quick diagnosis and management. Diagnosis tends to be difficult since there are no specialised diagnostic modalities available at present.

**Key words:** *Bronchi; Trachea; Thoracic injuries*

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**T**racheobronchial injuries are defined as injuries involving the trachea and/or bronchi from the level of the cricoid cartilage possibly extending up to the division of the lobar bronchi. A post-mortem review of 1 178 patients dying due to blunt chest trauma in Denmark found that only 2.8% had tracheobronchial injuries.<sup>1</sup> However, prompt diagnosis and treatment is mandated since they can be potentially life threatening. Nearly, 80% of patients with such injuries die before reaching the hospital.<sup>2</sup>

Blunt trauma causing tracheobronchial injuries usually occur because of high-speed vehicular accidents

and increasingly due to iatrogenic injuries.<sup>3-6</sup> Iatrogenic injury usually results from intubations and other airway maintenance procedures. The risk of tracheobronchial injuries as a complication of intubation is relatively low, estimated to be 0.005% for orotracheal intubations.<sup>7</sup>

Following blunt trauma, three different types of injuries are known to occur: transverse disruptions, which occur between tracheal rings; longitudinal, which occur along the membranous segment; complex, which involve either a combination of transverse or longitudinal injuries or injuries at multiple sites.<sup>8</sup> Injuries are also classified on the basis whether there is disruption of the pleura. Chances of developing pneumothorax are greater if disruption of the pleura is present.<sup>9</sup>

Penetrating trauma causing such injuries usually results from either stab wounds or gunshot wounds.

Tracheobronchial injuries usually present with an array of non-specific symptoms like stridor, subcutaneous emphysema, pneumo-mediastinum, hemoptysis and pneumothorax.<sup>10</sup> However, the most common

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association is found between pneumomediastinum and subcutaneous emphysema.<sup>11</sup> Diagnosis tends to be difficult since the patient usually has other associated injuries and management of those may interfere with diagnosis. Bronchoscopy remains the diagnostic modality of choice in most cases but is highly operator dependent.<sup>12,13</sup> Reports on the use of CT scans are infrequent.<sup>14,15</sup> A study reported that 3D reconstruction using CT scans may be considered a suitable screening test in trauma patients until head-to-head trials comparing bronchoscopy and CT scans could be conducted.<sup>16,17</sup>

In recent years, Pakistan has seen a rise in gunshot wounds and the same is true for traffic control. Lack of adherence to traffic laws results in significant morbidity and mortality. There are several causes for the higher morbidity and mortality associated in this part of the world, most significantly being lack of emergency support for the injured and deficiency of ambulances and trained paramedical staff available at the scene of such accidents. Delay in procuring transport to a medical centre is the cause for many on the scene deaths and severe complications for those who do manage to reach the hospital.

We performed a retrospective audit of all major tracheobronchial and pulmonary trauma presentations to the emergency room of Aga Khan University Hospital, Karachi, Pakistan, over the past 5 years and their subsequent outcomes.

## METHODS

From January 2004 to December 2009, 168 patients with thoracic trauma were treated, of whom 15 had major tracheobronchial and pulmonary injuries.

Age, sex, time between injury and presentation, diagnostic modality used, time between presentation and beginning of surgery, surgical interventions performed, other associated injuries and outcomes were seen in this retrospective audit.

The Ethics Review Committee of the Aga Khan University Hospital approved this retrospective study.

## RESULTS

The average age of the patients was 31 years with

the range being 13-48 years. The patients were predominantly male with only one patient who was female (14:1).

Most studies report that the most common cause of tracheobronchial injuries is blunt trauma. However, we found that 11 patients had penetrating trauma as the main cause of injury. Gunshot wounds were the most common mode of injury. Three patients had blunt trauma from road traffic accidents while only 1 had combined trauma (blunt and penetrating trauma).

The time between injury and presentation was divided into three categories: immediate (less than 6 hours after injury), late (6-24 hours) and delayed (greater than 24 hours). Most of the patients fell into the immediate category (11 patients), 2 into late category and 2 delayed.

Eight patients were diagnosed based on radiological findings while the rest 7 were diagnosed based on clinical features. Chest X-rays were performed for all patients while chest CT scans were performed for 3 patients.

All the patients were treated surgically. Lobectomy was the most common intervention performed in 7 patients. Tracheal repair was attempted and successfully performed in 3 patients while pneumonectomy in 2 patients. Hematoma removal was performed in 2 patients while only 1 patient underwent concomitant bronchus repair and lobectomy.

All patients had coexisting injuries. Abdominal injuries were present in 4 patients while orthopedic injuries were also present in 4 patients. The more sinister great vessel injuries and spinal injuries were found in 2 patients each. Esophageal injury was present in only one of the patients presenting with tracheobronchial trauma.

The morbidity was low (20%). Two patients had a prolonged hospital stay because of the need for ventilator support and 1 patient had to undergo re-exploration for hemorrhage.

The outcomes were divided into three categories: alive and well, alive with disabilities and dead. One patient died. Most patients survived with no sequelae (10 patients) while 4 survived with disability.

## DISCUSSION

One of the first published cases of tracheobronchial injuries appeared in the year of 1873 where on autopsy a 74-year-old woman was seen to have a right main stem bronchus avulsion.<sup>17</sup> Tracheobronchial injuries were thought to be always fatal. It was in 1927 that Krinitzki reported the case of a survivor.<sup>18</sup> In 1931, a girl who had a post-traumatic stricture of the left main bronchus underwent a successful pneumonectomy.<sup>17</sup> Survival rates have been improving over the years with rapid diagnosis and early repair of such injuries.

There are many theories regarding the mechanism of blunt tracheobronchial injury. However, there are three theories that are commonly accepted. Rapid deceleration as seen in road traffic accidents causes a shearing force that in turn leads to rupture of the trachea and bronchi since the lungs are only fixed at the carina and free within the pleural space. The second hypothesis involves the development of traction forces at the carina. Blunt trauma to the chest increases the transverse diameter of the chest while decreasing the antero-posterior diameter of the chest and the lungs are adherent to the chest wall because of negative intrapleural pressure. Stretching of the lungs produces the traction force in question. The third theory also involves blunt impact to the chest. The impact causes rise in the airway pressure against a closed glottis. If the force developed exceeds the elasticity of the airways, rupture of tissues occurs.<sup>19, 20</sup>

The severity of the injury depends on the weapon involved in cases of penetrating trauma and the deceleration produced in road traffic accidents. Knife wounds behave like uncontrolled surgical events and the probability of associated injuries is high. Common associated injuries include hemothorax, pneumothorax, hemoptysis and direct injury to other mediastinal structures. Small caliber hand guns produce less tissue damage during the trajectory of the bullet compared with military/hunting weapons.<sup>21</sup>

Most authors agree that conservative management either medically or surgically achieves good outcomes. Caro et al<sup>22</sup> reported a favorable outcome in 84.8% of patients managed conservatively. However, it is important to note that this is only possible if there is absence of major symptoms like esophageal injuries, subcutane-

ous emphysema or severe dyspnea requiring ventilation. Most of the patients in our series underwent aggressive surgical treatment (lobectomy/pneumonectomy). This could be attributed to the presence of other injuries. While patients in other series presented quite late from days to weeks after injury. The majority of patients (11/15) in our series presented within 6 hours after trauma.

The most popular surgical procedure to manage these injuries is thoracotomy. The percentage in civilian hospitals is reported to be quite low. In a study of 2 455 Canadian patients, 183 (7.4%) underwent thoracotomy.<sup>23</sup> The rates of major resections like lobectomy and pneumonectomy reported in the literature are even lower. They are usually attempted as a last resort when all other measures have failed. A multicenter study from North America reported major resections in 25% of patients.<sup>24</sup> While a study in South Africa reported major resections in 13% of patients.<sup>25</sup> In our series, the number is different from the usual trend. Lobectomy was the most commonly performed procedure (46.67%) while pneumonectomy was done in 13.33% of patients. These procedures are associated with increased morbidity and mortality. The South African series reported a 100% mortality rate for pneumonectomy patients while lobectomy patients fared better (20%).<sup>25</sup> The outcomes in our series were quite favorable considering that such aggressive surgical treatment was mandated. The mortality rate was 7% while 27% survived with disability.

In conclusion, tracheobronchial injuries are rare but potentially life threatening. They require quick diagnosis and management. Diagnosis tends to be difficult for two reasons. First, the patient usually has many other injuries that warrant quick management and second, modalities available for diagnosis are not up to the mark. CT scans show promise but sufficient data is not available. Bronchoscopy is the gold standard but is highly operator dependent. A highly trained pulmonologist may not be available at every trauma center to perform bronchoscopies especially after hours. The index of suspicion for such injuries needs to be high in trauma care settings since they can be fatal before they are recognized.

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