

## Traumatic Tracheobronchial Injury: Delayed Diagnosis and Treatment Outcome

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**Background:** Most traumatic tracheobronchial injuries are fatal and result in death. Some milder cases are not life threatening and are often missed at the initial presentation. Tracheobronchial rupture is difficult to diagnose in the evaluation of severe multiple trauma patients. We reviewed the traumatic tracheobronchial injuries at Konyang University and Eulji University Hospital and analyzed the clinical results. **Materials and Methods:** From January 2001 to December 2011, 23 consecutive cases of traumatic tracheobronchial injury after blunt trauma were reviewed retrospectively. We divided them into two groups by the time to diagnosis: group I was defined as the patients who were diagnosed within 48 hours from trauma and group II was the patients who diagnosed 48 hours after trauma. We compared the clinical parameters of the two groups. **Results:** There was no difference in the age and gender between the two groups. The most common cause was traffic accidents (56.5%). The Injury Severity Score (ISS) was 19.6 in group I and 27.5 in group II ( $p=0.06$ ), respectively. Although the difference in the ISS was not statistically significant, group II tended toward more severe injuries than group I. Computed tomography was performed in 22 cases and tracheobronchial injury was diagnosed in 5 in group I and 6 in group II, respectively ( $p=0.09$ ). Eighteen patients underwent surgical treatment and all four cases of lung resection were exclusively performed in group II ( $p=0.03$ ). There were two mortality cases, and the cause of death was shock and sepsis. **Conclusion:** We believe that close clinical observation with suspicion and rigorous bronchoscopic evaluation are necessary to perform diagnosis earlier and preserve lung parenchyma in tracheobronchial injuries from blunt trauma.

Key words: 1. Trachea  
2. Trauma

### INTRODUCTION

Tracheobronchial rupture (TBR) is defined as any injury to the trachea or bronchi localized between the level of the cricoid cartilage and the lobar bronchi. Ruptures of the tracheobronchial tree are rare but potentially life threatening, usually resulting from blunt/penetrating chest or neck trauma. TBR has various clinical presentations from dramatic and fatal sit-

uations, such as tension pneumothorax and mediastinal emphysema or esophageal rupture into the tracheal lumen, to a less eventful course with only minor signs of perforation [1-4]. Most traumatic tracheobronchial injuries are fatal and result in death at the site of the accident. However, some milder cases are not life threatening and very often missed at the initial presentation. Moreover, tracheobronchial rupture is difficult to diagnose in the evaluation of severe multiple trau-

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ma patients. We performed an extensive review of 23 patients who had major airway disruption after blunt thoracic trauma, aiming to define the time to diagnosis, mechanism of trauma, severity of injury, type of treatment, and clinical outcomes.

## MATERIALS AND METHODS

From January 2001 to December 2011, 23 patients with traumatic TBR have been diagnosed and treated at Konyang University Hospital and Eulji University Hospital, and their medical records were reviewed. We analyzed the patient demographics, mechanism of injury, concomitant injuries, severity of injury, method of diagnosis, anatomic location of injury, type of treatment, and outcomes. Iatrogenic tracheobronchial injuries due to intubation and diagnostic or therapeutic endobronchial interventions were excluded in this study to determine risk factors related to the trauma. Penetrating tracheobronchial injuries were also excluded from this study to reveal the time factor in the same type of trauma. We divided traumatic TBR into two groups according to the time until diagnosis and compared the clinical parameters to determine the influence of time delay on management issues. We defined to the threshold between the two groups as 48 hours because it took about 1 or 2 days to diagnose tracheobronchial injury using bronchoscopy in suspected patients and primary repair of tracheobronchial injury was usually possible within 48 hours.

Data was entered in a Microsoft Excel 2007 spreadsheet (Microsoft Co., Redmond, WA, USA) and transferred to SPSS ver. 18.0 (SPSS Inc., Chicago, IL, USA) for data description and analysis. The characteristics are presented as a percentage or mean±standard deviation. Continuous variables are presented as means and standard deviations and compared between groups by the Student t-test. The chi-square test was used for comparison between groups. Values were considered to be statistically significant if p-values were less than 0.05 (p<0.05).

## RESULTS

A total of 23 patients diagnosed with traumatic TBR were divided into two groups: group I (early diagnosis: n=11, diag-

**Table 1.** Demographics of patients

Characteristic	Group I <sup>a)</sup> (n=11)	Group II <sup>b)</sup> (n=12)	p-value <sup>c)</sup>
Age (yr)	41.5±22.5	39.4±24.0	0.49 <sup>d)</sup>
Gender (male:female)	9:2	9:3	
Mechanism of injury			0.02 <sup>e)</sup>
Traffic accident	3 (27.2)	10 (83.4)	
Fall down	4 (36.4)	1 (8.3)	
Others	4 (36.4)	1 (8.3)	
Concomitant injury			
Head and neck	3	4	
Face	0	0	
Chest	4	9	
Abdomen	1	5	
Extremity	3	8	
Injury Severity Score	19.6	27.5	0.06 <sup>d)</sup>
Revised Trauma Score	7.1	6.8	0.66 <sup>d)</sup>
Method of diagnosis			
Computed tomography	6 (66.7)	5 (41.7)	0.09 <sup>d)</sup>
Bronchoscopy	10 (90.9)	12 (100.0)	
Anatomic location of injury			0.18 <sup>e)</sup>
Cervical trachea	3 (27.7)	1 (8.3)	
Intrathoracic trachea	6 (54.5)	6 (50.0)	
Bronchus	2 (18.2)	5 (41.7)	
Type of treatment			0.03 <sup>e)</sup>
Primary repair	7 (63.7)	6 (50.0)	
Lung resection	0 (0.0)	5 (41.7)	
Observation	4 (36.4)	1 (8.3)	

Values are presented as mean±standard deviation or number (%).

<sup>a)</sup>Early diagnosis group within 48 hours.

<sup>b)</sup>Delayed diagnosis group 48 hours after trauma.

<sup>c)</sup>Statistical significances were considered if p-values were less than 0.05 (p<0.05).

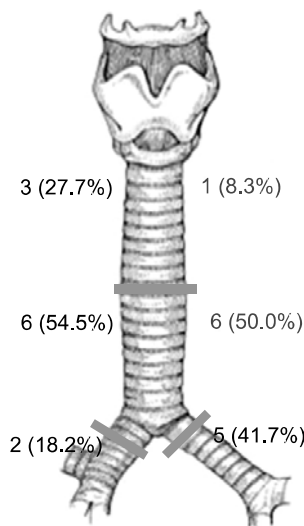
<sup>d)</sup>Student t-test.

<sup>e)</sup>Chi-square test.

nosed within 48 hours after injury) and group II (delayed diagnosis: n=12, diagnosed more than 48 hours after injury). The demographics and clinical characteristics of patients are presented in Table 1. There were 9 men (75%) and 2 women (25%) with a mean age of 41.5±22.5 years (range, 5 to 75 years) in group I (early diagnosis). In group II (delayed diagnosis), 9 (81.8%) were men and 2 were women with a mean age of 39.4±24.0 years ranging from 9 to 77. Eighteen out of the 23 patients (78.3%) underwent surgical treatment and 5 were managed non-operatively. Among the 23 patients, 11 of the injuries (47.8%) were diagnosed early and 12 (52.2%)

were diagnosed after 48 hours from injury. The causes of blunt TBR revealed that traffic accidents accounted for the majority of patients (n=13, 56.5%), followed by falls (n=5, 21.7%). The most common presenting signs of traumatic TBR were subcutaneous emphysema (43.5%) and followed by pneumomediastinum (17.4%). Of the 23 patients, 22 underwent bronchoscopy with the view of disrupted or lacerated tracheobronchial tree. In all of the patients who underwent bronchoscopy, a diagnosis was established. Computed tomography (CT) was performed and the diagnosis was clearly established in 11 patients (6 [66.7%] in group I and 5 [41.7%] in group II).

The most frequent site of injury was the intrathoracic trachea (n=6, 54.5%) followed by the cervical trachea (n=3,



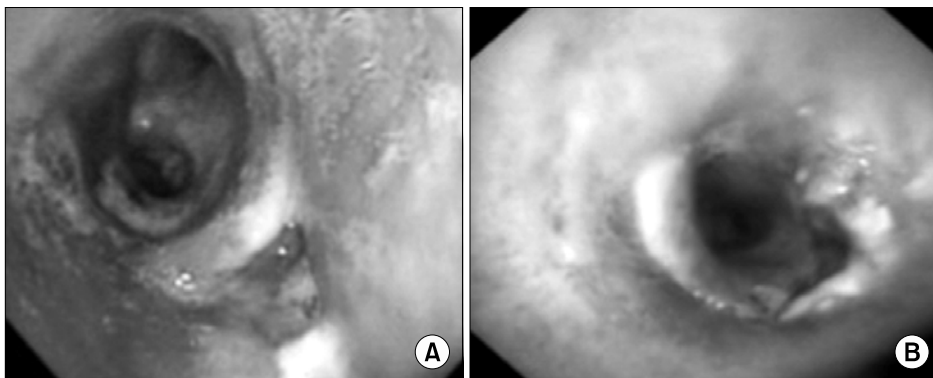
**Fig. 1.** Comparison of injury site between early diagnosis group (left) and late diagnosis group (right) (n=23).

27.7%) and main bronchus (n=2, 18.2%) in group I (early diagnosis), and the intrathoracic trachea (n=6, 50.0%) was most frequently injured in group II (delayed diagnosis), followed by the main bronchus (n=5, 41.7%) and cervical trachea (n=1, 8.3%) (Fig. 1). For the surgical management of tracheobronchial rupture, 13 patients of 18 surgical patients (72.2%) were treated by primary repair (Fig. 2). The median times from trauma until diagnosis were 2 days (early diagnosis group) and 3 days (delayed diagnosis group), respectively.

When we compared group I (early diagnosis) and group II (delayed diagnosis), there was no difference in the age and gender of the two groups. The Injury Severity Score (ISS): anatomical scoring system was 19.6 in group I and 27.5 in group II (p=0.06), The Revised Trauma Score: physiologic scoring system was 7.1 in group I and 6.8 in group II (p=0.66), respectively. Although the ISS was not statistically significant, group II likely had more severe injuries compared to group I. A CT scan was done in 11 cases and tracheobronchial injury was diagnosed in 66.7% in group I and 41.7% in group II (p=0.09). We performed surgical intervention in 18 patients (7 in group I, 11 in group II) and all four cases of lung resection were performed in group II (p=0.03). There were two mortality cases, and the causes of death were shock (n=1) and sepsis (n=1).

## DISCUSSION

The incidence of traumatic TBR is very low, but these injuries are often fatal. The mandible, sternum, and vertebral column can protect the tracheobronchial tree from injuries, which explains the infrequency of TBR. It is difficult to de-



**Fig. 2.** (A) The left main bronchus was ruptured and separated pre-operatively in patient with blunt chest trauma. (B) The repaired site of left main bronchus was healed well and patency was maintained 4 weeks after primary repair.

termine the actual number of cases of traumatic TBR that occur since most of them die just after trauma and few patients are transported to the emergency room. Kirsh et al. [5] reported that 33 (2.8%) were injured at the tracheobronchial tree, and 81% of them expired before arrival at the emergency department, when 1,178 patients autopsied due to blunt trauma were evaluated. Kemmerer et al. [6] reported that only 5 patients were identified as having tracheobronchial injuries when they autopsied 585 traffic accident fatalities over the course of 10 years [5,7]. It is estimated that 2.5% to 3.2% of deaths as a result of trauma were due to airway injuries on the basis of autopsy reports [8,9]. Although traumatic TBRs are often life-threatening because of their influence on respiration, an improved transport system and emergency services has enabled increasing numbers of these patients to reach trauma centers [2,10]. However, the diagnosis of traumatic TBR has often been delayed due to the occult clinical findings [11]. The large case series (more than 10 patients) have shown that the rate of delayed diagnosis of tracheobronchial injuries during the first 24 to 48 hours after blunt trauma varies from 5.0% to 80.6%, assuming these patients survived the initial trauma [3,12-16]. These data demonstrate the difficulty in diagnosis of airway injuries and traumatic TBR requires a high index of suspicion for timely diagnosis [17]. Furthermore, blunt tracheobronchial injuries have a significant diagnostic challenge. In our study, the delayed diagnosis and treatment group had more multiple trauma due to traffic accidents than the early diagnosis group. The reasons for delayed diagnosis in blunt trauma are nonspecific chest wall trauma with rib fractures that may be presumed to be the source of pneumothorax and/or pneumomediastinum and involvement of multiple other organ injuries. Therefore, severe multiple trauma patients require more rigorous evaluation for tracheobronchial injury. A review of the literature on tracheobronchial injuries shows that cases of delayed or missed diagnosis are often likely to require lung parenchymal resection and are associated with long-term complications [18]. We found that the patients who presented with a delayed diagnosis of TBR more frequently underwent lung parenchymal resection compared to the early diagnosis and treatment group. In our experience, the delayed diagnosis group had more severe injuries compared to the early diagnosis group. Furthermore,

bronchial injuries with delayed diagnosis made it difficult to save the lung parenchyma.

## CONCLUSION

In our experience, group II (delayed diagnosis) tended toward more severe injuries than group I (early diagnosis). Furthermore, bronchial injuries with delayed diagnosis made it difficult to save lung parenchyma and lung resection often had to be performed. In conclusion, we believe that close clinical observation with suspect and rigorous bronchoscopic evaluation are necessary to perform diagnosis earlier and preserve the lung parenchyma in tracheobronchial injuries from blunt trauma.

## CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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