Case Report

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The Great Role of Ventilator Parameters in Diagnosis of Right Main Bronchus Rupture Due to Blunt Chest Trauma

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ABSTRACT

Bronchial rupture following major blunt chest trauma should be suspected in any case of massive and persistent air leak through the intercostal drain tube. Chest radiographs and chest computed tomography scans (CT scans) are highly suggestive of this extremely rare tracheobronchial injury. The present study reported a patient who was a 15-year-old boy. He was a case of a motor-car accident and was brought to the emergency room (ER) of Rajaie Hospital (Shiraz, Iran) due to dyspnea and chest pain. The physical examination revealed a few crash injuries on his upper extremities, as well as subcutaneous emphysema in his neck. The chest X-ray revealed a right clavicular fracture, multiple rib fractures, a right pneumothorax (but no complete collapse or fallen lung), and also pneumo-mediastinum and subcutaneous emphysema. The chest CT revealed severe pulmonary contusion, severe right-sided pneumothorax, significant pneumo-mediastinum, subcutaneous emphysema, multiple right-side rib fractures, and mild displacement of the right main bronchus. Furthermore, no definitive signs of bronchial rupture were detected. Using a mechanical ventilator, the following parameters were revealed. The maximum pressure (Pmax)=7cm, H_2o (was very low), plateau pressure (P. Plateau), and expiratory tidal volume (TV) were not detected due to insufficient amounts. Additionally, increasing TV did not change those values. Bronchial rupture is one of the most important and serious differential diagnoses in forceful chest traumas when the mechanical ventilator reveals low Pmax, very low P.platue, and expiratory TV, with no change in those values with increasing TV.

Keywords: Tracheobronchial ruptures, Motor-car accident, CT scan, Trauma, Mechanical ventilation.

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Introduction

Tracheobronchial ruptures are most frequently caused by forceful trauma, such as motor vehicle accidents. They are rather uncommon and have a high prehospital mortality [1-3]. It appears to occur in approximately 1-2 % of individuals sustaining blunt injury [3-5]. Bronchial rupture following major blunt chest trauma should be suspected in every case of massive and persistent air leak through the intercostal drain tube [1, 3, 4, 6]. A chest radiograph provides indirect signs, while a chest computed tomography scan (CT scan) demonstrates specific signs highly suggestive of this extremely rare tracheobronchial injury [5, 7, 8].

Delays in diagnosis increase the rate of complications, mainly infectious (empyema, hilar abscesses, mediastinitis, pneumonia, etc.) [1]. Bronchoscopy is one of the diagnostic procedures that can detect tube wall rupture and is helpful for diagnosing minor injuries. This approach can detect bronchus injury with no visible symptoms [9].

A case of right main bronchus rupture caused by a motor-car accident was treated with a thoracotomy and repaired in Rajaee Hospital (Shiraz, Iran) Due to the rarity of the present case and the difficulty of its diagnosis, as well as the rule of mechanical ventilator parameter values in early diagnosis, the present study described the clinical course of this patient.

Case Presentation

The patient was a 15-year-old boy, a case of a motor-car accident, and was brought to the emergency department (ER) of Rajaee Hospital (Shiraz, Iran) with dyspnea and chest pain. At the time of admission and the first examination, the pulse rate (PR) was 121, blood pressure (BP) was 134/66, respiratory rate (RR) was 22, and So_2 was 96%. The Glasgow's Coma Score was estimated as 14.

During the physical examination, a few crash injuries on his upper extremities and subcutaneous emphysema in his neck were detected.

The chest X-ray (Figure 1) revealed a right clavicular fracture, multiple rib fractures, and right pneumothorax (but no complete collapse or fallen lung). Besides, pneumo-mediastinum and subcutaneous emphysema were detected.

The right chest tube was inserted for him and a massive air leak was detected. However, he still complained of dyspnea.

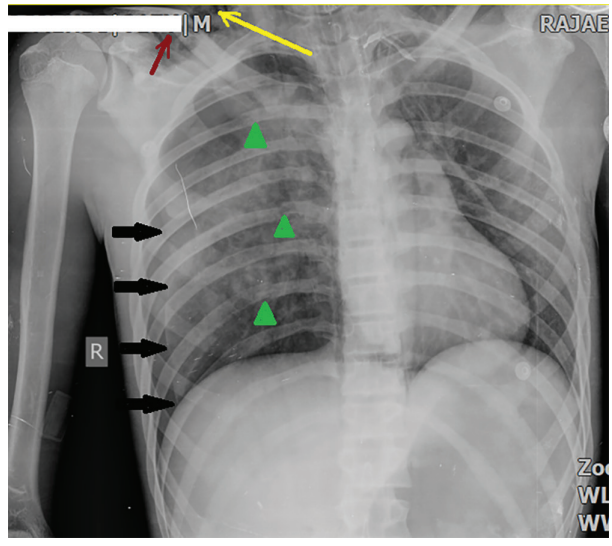

Fig. 1. First PA Chest X-ray shows right-sided pneumothorax (black arrows), rib fractures (green arrows), subcutaneous emphysema (yellow arrow), and clavicular fracture (brown arrow).

A chest CT was performed, and we found severe pulmonary contusion, severe right-sided pneumothorax, significant pneumo-mediastinum, subcutaneous emphysema, multiple right-side rib fractures, and mild displacement of the right main bronchus. However, we found no definitive sign of bronchial rupture (Figures 2 and 3).

Due to severe dyspnea and agitation, the patient received sedation and was also intubated. Mechanical ventilation was started, but the mechanical ventilator showed a "low tidal volume (TV)" signal. CXR confirmed the exact positions of ETT and chest tube (Figure 4).

As presented in Table 1, the results of the first ABG were: PH: 7.39, Po_2: 64.1, So2: 92.2, Pco2:

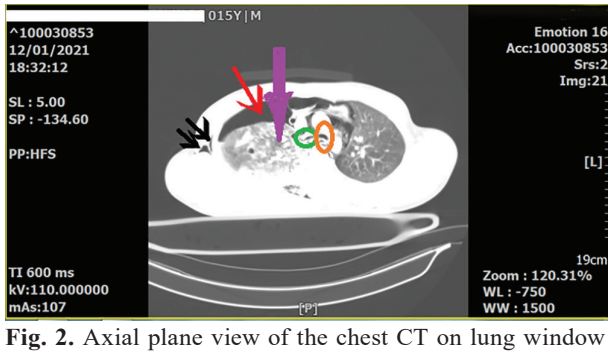

Fig. 2. Axial plane view of the chest CT on lung window shows right-sided subcutaneous emphysema (black arrows), right pneumothorax (red arrow), and lung (purple arrow). The left main bronchus silhouette is intact (brown circle), while the outline of the right main bronchus is disrupted (green circle).

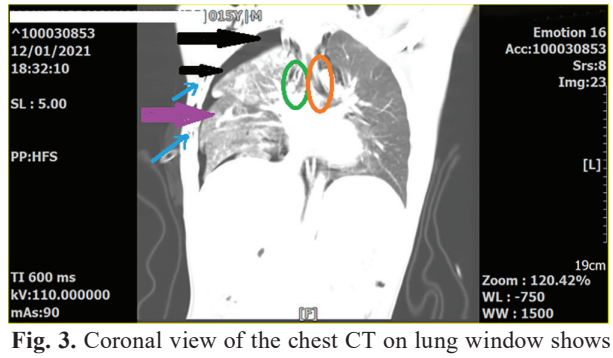

Fig. 3. Coronal view of the chest CT on lung window shows right-sided subcutaneous emphysema (blue arrows), right pneumothorax (black arrows), and partially collapsed lung (purple arrow). The left main bronchus silhouette is intact (brown circle), while the outline of the right main bronchus is disrupted, and mild displacement occurs (green circle).

Table 1. The ABG findings

Value	First ABG	Second ABG	Third ABG
PH	7.39	7.29	7.21
PO_2	64.1	135.7	81.9
SO_2	92.2	98.2	93.1
PCO_2	38.00	55.2	74.9
HCO_3	23	27.3	29.6
BE	-1.1	-0.4	-0.4

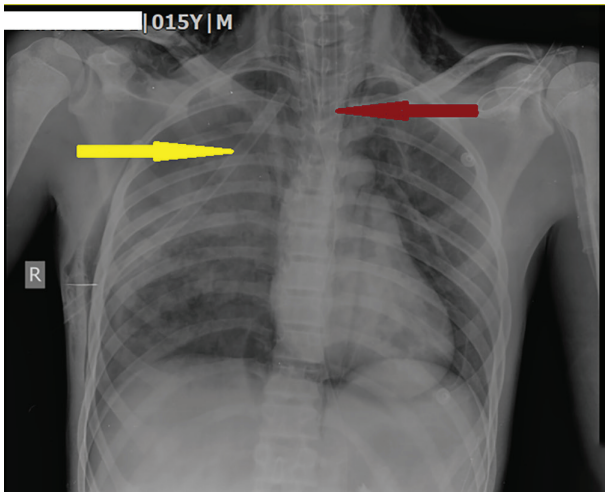

Fig. 4. The second chest X-ray shows the exact positions of ETT (brown arrow) and chest tube (yellow arrow).

38.00, Hco3: 23, BE:-1.1 and the second ABG were as follows: PH: 7.29, Po_2: 135.7, So_2:98.2, Pco_2:55.2, Hco_3:27.3, BE:-0.4. Therefore, the mechanical ventilator was replaced, considering the possibility of device errors. However; the new device likewise reported a "low TV" alarm. The third ABG showed PH: 7.21, Po_2: 81.9, So_2: 93.1, Pco_2: 74.9, Hco_3: 29.6, BE: -0.4.

We considered that the maximum pressure (Pmax)=7 cm, H_2o (was very low), plateau pressure (P. Plateau), and expiratory tidal volume (TV) were not detected due to low amounts. Besides, there was no change in those values as TV increased.

Therefore, according to the data and the lack of bronchoscopy at that moment, and considering the point that a massive "broncho-pleural fistula has disturbed the patient's ventilation", the patient was promptly transferred to the operation room.

Thoracotomy was performed, and an injury to the right inferior-medial part of the trachea and right main bronchus, with an intact posterior part, was detected and repaired. In addition, the left main bronchus injury in the medial proximal section following bifurcation was detected and repaired. (Figures 5 and 6).

Partial lung collapse occurred only as a result of bronchial cartilage injury with barely partial injury of its mucosa.

He developed pneumonia 48 hours after the procedure with Enterobacter confirmed by pleural effusion culture. Therefore, antibiotic therapy with meropenem and linezolid was commenced.

After 45 days, he was finally discharged from the hospital in good health condition. Bronchial rupture caused by blunt thoracic trauma was rarely seen. It might present with non-specific signs and symptoms, making a prompt diagnosis difficult. Difficulties in the diagnosis would cause delays in the treatment and increase the likelihood of complications.

Discussion

In general, dyspnea is the most prevalent symptom, and the main findings on chest X-ray are pneumothorax, pneumomediastinum, subcutaneous emphysema, and atelectasis [5, 7, 8].

According to the case presented in this study, we found that attention to dynamic measurements of mechanical ventilators is a very sensitive guide for

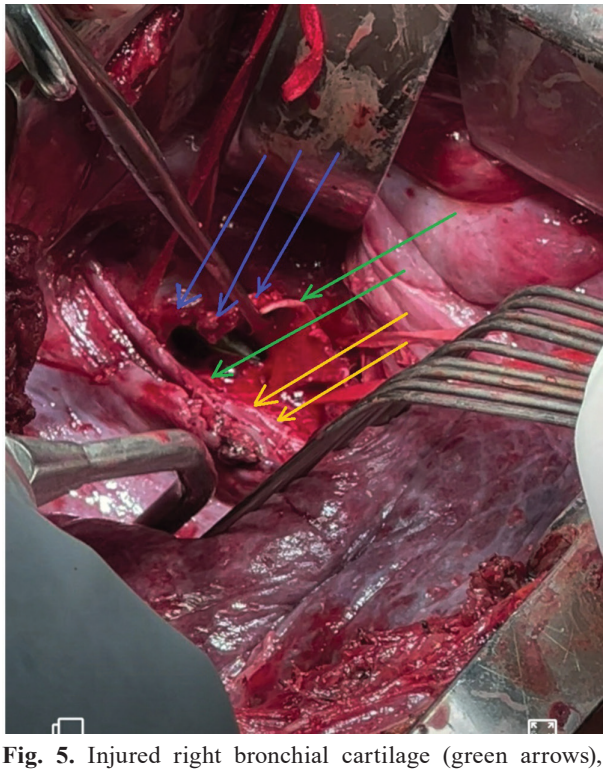

Fig. 5. Injured right bronchial cartilage (green arrows), uninjured right bronchial mucosa (yellow arrows), and anterior lateral wall of trachea (blue arrows)

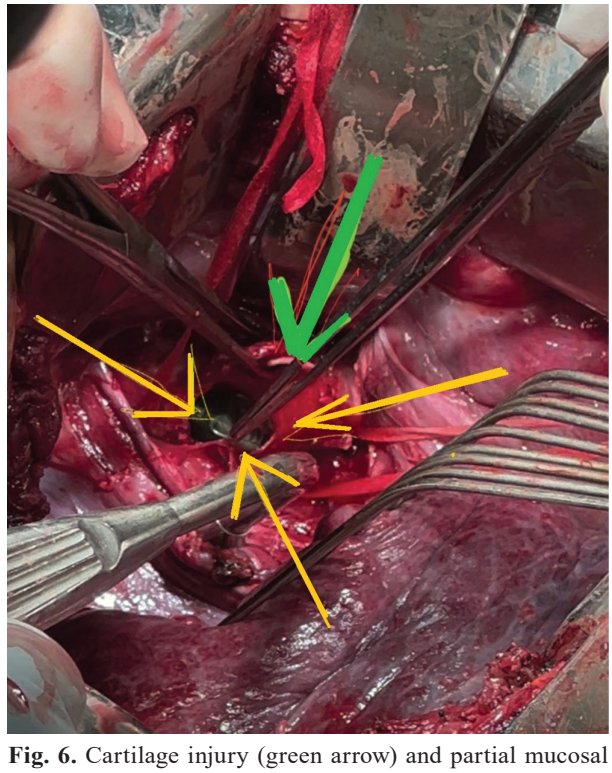

Fig. 6. Cartilage injury (green arrow) and partial mucosal injury (yellow arrows)

early diagnosis of bronchial rupture. Early diagnosis and rapid repair of the bronchial injury can preserve the complete function of the lung tissue and the healthy life of the patient.

As a result, in a forceful chest trauma, when the mechanical ventilator revealed low Pmax and very low P.platue and expiratory TV, and no change occurred in those values with increased TV, bronchial rupture became one of the important and serious differential diagnoses. Consequently, early diagnosis and rapid repair of the bronchus injury could preserve the complete function of the lung tissue and the patient's healthy life.

Declaration

Ethics approval and consent to participate: Due ethical approval and consent has been taken.

Consent for publication: All authors have read and given their consent for publication of this manuscript.

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Authors' Contribution: RT: Chose the case, made useful comments and corrections, and wrote the article. GS: Made useful comments and corrections. HA: Surgeon of the patient. All the authors have read and approved the final version for publication.

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