A Case of Deep Pulmonary Laceration Associated With Blunt Chest Trauma Treated by Emergency Room Thoracotomy

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A 30-year-old man fell from the fourth floor of a building and suffered a chest injury. He was transported to our hospital within 50 minutes. Chest roentgenography showed left hemopneumothorax and a shift of the mediastinal shadow to the right. Furthermore, most of the left upper lobe did not appear collapsed, and an infiltrative shadow and light macular shadows were noted. These findings led to a diagnosis of deep pulmonary laceration. The volume of blood in the left drainage tube reached about 1,000 mL within 1 hour. Therefore, we performed emergency room thoracotomy (ERT) and clamped the pulmonary hilum manually. We then moved him to an operating room. Upon surgery, we found extensive laceration of the whole lung, and left pneumonectomy was necessary. He was discharged on hospital day 58. ERT and pulmonary hilum clamping may improve the survival of patients with deep pulmonary laceration and uncontrollable pleural hemorrhage.

Key words: Emergency room thoracotomy, Pulmonary hilum clamp, Deep pulmonary laceration

INTRODUCTION

Deep pulmonary laceration (DPL) associated with blunt chest trauma is a serious wound; the main clinical condition is a shock state with hemorrhage and hypoxemia. Because this condition can worsen immediately and become fatal, early initiation of treatment is imperative. Treating the shock state and hypoxemia with a pulmonary hilum clamp is the most important step. If the initial treatment of DPL is based on accurate diagnosis by prompt assessment and diagnostic imaging, the patient's life can be saved. We describe a case of DPL treated successfully by emergency room thoracotomy (ERT) and a hilum clamp.

CASE REPORT

The patient was a 30-year-old man. In November 2001, he fell from the fourth floor of a building (approximately 10 meters) and suffered a chest injury. When emergency services arrived, he was lying in the dorsal position on the lawn and experiencing chest pain. He was transported to our hospital within 50 minutes from the time of injury.

On arrival

The patient's Glasgow Coma Scale score was 4-5-6; respiratory rate, 42 breaths per minute; systolic blood pressure, 80 mmHg; pulse rate, 132 beats per minute. Left breath sounds were diminished, and subcutaneous emphysema was present in the left chest. In addition, he complained of back pain, and a lumbar compression fracture was found. Blood gas analysis yielded a $PaCO_2$ of 34 torr and PaO_2 of 63 torr. Initial plain chest roentgenography revealed left pneumothorax with mild deviation of the mediastinal shadow toward the right, indicative of tension pneumothorax. The left upper lobe was mildly collapsed, and a small macular infiltrative shadow was seen in the left upper lobe. The left lower lobe showed generally decreaed radiolucency in the left thoracic cavity, suggesting mild intrathoracic hemorrhage. These findings led to a diagnosis of left DPL (Fig. 1).

10 minutes after arrival

We inserted a drainage tube in the left thoracic cavity, and 500 mL of blood was obtained. However, the patient's respiratory status worsened rapidly; we performed tracheal intubation and started artificial ventilation.

50 minutes after arrival

Although we transfused 2,000 mL of crystalloid, 20 units of concentrated red cells, and 5,250 mL of 5% albumin preparation, a shock state developed; systolic blood pressure was 40 mmHg. Meanwhile, the volume of blood from the left drainage tube reached 1,000 mL, and we clamped the tube. Plain chest roentgen-

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ography at this time showed greatly decreased radiolucency in the left thoracic cavity, suggesting severe intrathoracic hemorrhage. The left upper lobe was still mildly collapsed, but a severe infiltrative shadow was seen, suggesting severe intrapulmonary hemorrhage and edema (Fig. 2). These findings led to a diagnosis of left DPL. The above-mentioned findings suggested uncontrollable left pleural cavity hemorrhage with DPL.

77 minutes after arrival

Although we attempted to improve the patient's general condition by performing rapid fluid infusion therapy and transfusion, the hypoxemia worsened (SpO_2: 70%) and the shock state persisted (systolic blood pressure: 40 mmHg). The Glasgow Coma Scale score was 1-T-1 at this time. Therefore, we decided to perform ERT without putting him under general anesthesia and clamp the pulmonary hilum manually. When anterolateral thoracotomy was performed in the dorsal position, a large quantity of blood flowed out. The hemorrhage decreased markedly as soon as we clamped the hilum of the left lung, and the patient's blood pressure improved.

82 minutes after arrival

We moved the patient to an operating room after having performed the manual clamping because we were not able to judge the state of lung injury macroscopically.

Operative findings

We extended the thoracotomy skin incision with the patient in the dorsal position and observed the thoracic cavity. Extensive laceration of the whole lung, 7 cm long and 2 cm deep, was found. The left lung was reddish-brown and bulging due to internal pulmonary hemorrhage. Although the main DPL lesion was in the left upper lobe, we promptly performed left pneumonectomy. The operation took 90 minutes; blood loss was 376 mL.

Postoperative course

After pneumonectomy, we performed left fifth lumbar artery embolization for retroperitoneal hemorrhage associated with the lumbar vertebral compression fracture. Respiratory management was necessary for 6 days, but the postoperative course was favorable, and the patient left the hospital on day 58.

DISCUSSION

DPL is reported to account for 4.0% to 4.4% of all cases of blunt chest trauma [9, 10], and the rate at our institution, 3.1%, is comparatively low [8]. There were 678 patients with blunt chest trauma requiring hospitalization between 1988 and 2000, and ERT for DPL accounted for 0.6% of these patients. All of these patients died within 12 hours after surgery. The cause of death was uncontrollable pleural hemorrhage or disseminated intravascular coagulation with hemorrhage. The patient we describe herein was the first that we were able to save.

The most important examination for a diagnosis of DPL is plain chest roentgenography upon arrival. According to Hankins and colleagues [1] and Moghissi [7], the plain chest roentgenogram of DPL is characterized by hemopneumothorax, with the extent of pneumothorax limited to within 5 cm of the apex area

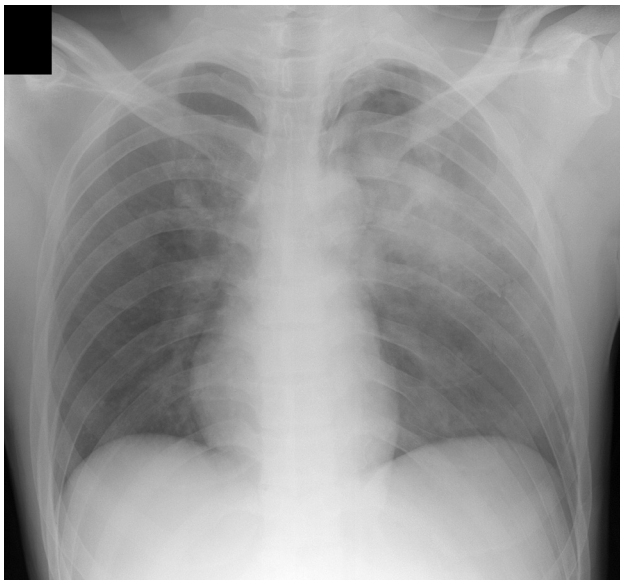

Fig. 1 Plain chest roentgenogram obtained in the supine position upon arrival. Left pneumothorax and mild deviation of the mediastinal shadow toward the right side are seen. The left upper lobe is mildly collapsed, and an intralobar small macular infiltrative shadow is seen. The left thoracic cavity is of generally decreased radiolucency. There are fractures in the left sixth and seventh ribs and subcutaneous emphysema on the left side.

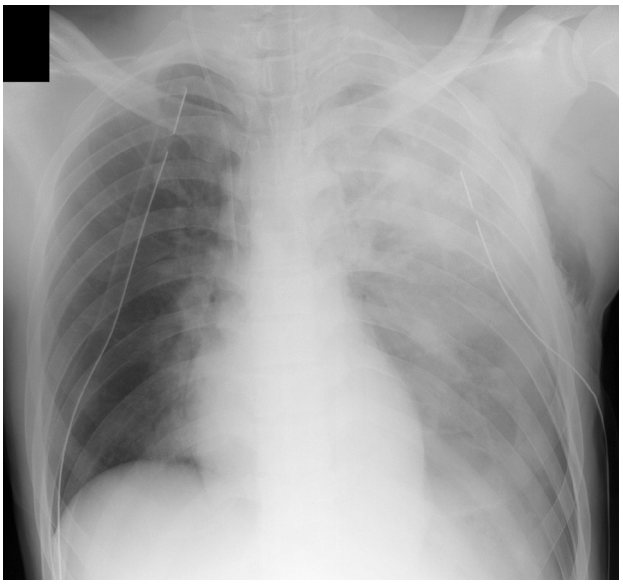

Fig. 2 Plain chest roentgenogram obtained in the supine position 50 minutes after arrival. The left upper lobe is moderately collapsed, and a severe infiltrative shadow is seen. There is decreased radiolucency in the left thoracic cavity, reflecting a large volume of intrathoracic hemorrhage. Chest tubes are inserted in both sides.

and the area of collapse never exceeding 30%. They also reported that there is no radiographic feature pathognomonic of DPL. However, the initial plain chest roentgenograms of DPL patients showed pneumothorax accompanied by moderate lung collapse, macular infiltrative shadow at the side of lung injury, and deviation of the mediastinal shadow toward the unaffected side [8]. These same findings have been reported by others [1, 5, 6, 9].

At our institution, blunt chest trauma is treated by referring to the "Classification of the Severity of Blunt Chest Trauma Based on the Therapeutic Procedure" as follows: class 1− treatable by conventional therapy; class 2− selective bronchial occlusion with the Univent is life-saving; class 3− the Univent is insufficient, and thoracotomy is required [3]. The Univent has an endotracheal tube with a moveable bronchial occlusion cuff to achieve selective exclusion of the lung or pulmonary segments [2]. This classification was made based on treatment strategy in those days. Each class, however, showed a therapeutic procedure. We determine treatment strategy according to this order now. DLP including that in our patient falls under class 3 in terms of uncontrollable intrathoracic hemorrhage despite use of the Univent (class2). In addition, the bronchoscope may facilitate the entry of blood into the unaffected lung. Therefore, bronchoscopy should be performed after bronchial occlusion [4].

DPL is characterized by the triad of intratracheal bleeding, intrapleural air leakage, and intrapleural bleeding. In particular, this intrapleural bleeding is uncontrollable, and therefore we should perform thoracotomy in a timely manner. However, there are few patients in which vital signs can be maintained until transfer to an operating room. By clamping the hilum manually after ERT, (1) we prevented aspiration of blood into the unaffected lung, thereby ensuring that the patient did not drown in his own blood. This procedure may decrease mortality from hypoxemia. (2) We reduced bronchopleural air leakage, thereby increasing the effective alveolar ventilation. This procedure prevents air embolism in the pulmonary circulation from the affected lung [10]. (3) We reduced intrapleural bleeding by clamping the pulmonary artery and the pulmonary vein, thereby maintaining the circulating blood volume. We achieved all three of these objectives with the hilum clamp and were thus able to save the patient's life.

We believe that patients with class 3 disease including DPL should be operated on as soon as their general condition permits.

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