LEFT SUBCLAVIAN ARTERY RUPTURE DUE TO BLUNT THORACIC TRAUMA: A CASE REPORT

1Yopie Afriandi Habibie, 2Ign Wuryantoro

1Division of Thoracic and Cardiovascular Surgery, Departement of Surgery, Zainoel Abidin Hospital, Medical Faculty of Syiah Kuala University, Banda Aceh
2Division of Thoracic and Cardiovascular Surgery, Departement of Surgery, Cipto Mangunkusumo General Hospital, Medical Faculty of Indonesia University, Jakarta

Abstract. Blunt thoracic trauma highest incidence is in adult, 20% to 50 % of the trauma cause death. Injuries to the vascular structures of the thoracic outlet, especially left subclavian artery, are rare and typically accompanied by massive hemorrhage. Close observation of vital sign and serial chest x-ray are very important. We describe an unusual presentation of a patient who suffered traumatic rupture off left subclavian artery. No clinical presentation of supraclavicular hematoma, unilateral absence of radial artery pulse and mediastinal widening in chest x-ray was found, but there is a massive hemothorax. Left posterolateral thoracotomy was performed, the source of bleeding was found in the apex of the lung, suspected a rupture of the left subclavian artery. The procedure continued with median sternotomy extended to left supraclavicular incision, a rupture was found in the left subclavian artery, 1,5 cm proximal to aortic arch. Primary repair was done with a good result.

Key Words: Blunt thoracic trauma, massive hemothorax, left subclavian artery rupture

Introduction
Blunt thoracic trauma is seen frequently and it is one of the major injuries resulting in death in young people. The most frequent cause of trauma is motor vehicle accident. If thoracic injury is suspected, treatment of potentially fatal injuries must be prioritized. Approximately 20% to 25% of traumatic deaths at the scene of accident are caused by isolated thoracic trauma. Twenty-five of every 100,000 trauma victims die following the trauma. Deaths are often due to airway obstruction, hemorrhage, flail chest, tension pneumothorax, cardiac tamponade, and associated intra-abdominal skeletal injuries. Injuries to the vascular structures of the thoracic outlet, especially left subclavian artery, are rare, accounting for only 1% to 2% of all vascular trauma and are typically accompanied by massive hemorrhage.1,2,3,4,5,6

Associated organ injuries raise mortality. Involvement of heart, lung and great vessels will increase mortality. Closed observation of vital signs and serial chest radiographs are essential in monitoring such patients. Sometimes tube thoracostomy maybe needed for effective treatment. Hemodynamically unstable patients with cardiac and great vessel injuries, massive intrathoracic haemorrhage, tracheobronchial or diaphragmatic rupture may need urgent surgical Emergency Thoracotomy (ET).3,7,8

This procedure (ET) is adopted from the Advanced Trauma Life Support (ATLS) management of penetrating chest injuries and selected cases of blunt thoracic trauma. The objectives of ET are to release pericardial tamponade, prevent air embolism, control massive intrathoracic or intrabdominal haemorrhage, and provide access for open cardiac massage and descending thoracic aortic cross-clamping. Majority of the cases are hemodynamically stable on the scene, or are resuscitated using the ATLS protocol. Emergency thoracotomy is a life saving procedure in critically injured patients who presents with no detectable pulse or blood pressure following chest trauma.8

We present a case of 35 year-old-man with blunt chest trauma, resulting in left traumatic subclavian artery rupture with an unusual clinical
presentation, whom underwent successful primary repair.

**Case Report**

A 35-year-old man came to our emergency department unit, had a bajaj collision with a bus coming from the left opposite direction. The patient was conscious and well orientated on admission, with a normal Glasgow coma scale. On primary survey, shortness of breath, asymmetrical movement of hemithorax, decreased left fremitus, and hypersonor percussion was found, tension pneumothorax was suspected. Needle thoracosintesis was performed, a large bore needle was inserted at the 2nd intercostal space midclavicular line, followed by insertion of chest tube with initial drainage of 200 ml blood and minor air leak. Despite these injuries, the patient respiratory status and blood pressure was remained stable. On secondary survey, no bruise or supraclavicular hematoma on anterior chest and unilateral absence of radial artery pulse was found. The patient complaint to felt pain on his left hip joint, there is adduction, flexion, endorotation, no shortening and neurovascular distal disturbance. Closed reduction and skin traction was done due to anterior hip joint displacement.

Left hemopneumothorax, 1st and 2nd ribs fractures in left hemithorax was demonstrated on chest radiographs. No sign of mediastinal widening, scapular fracture and hematoma at the apex of the lung was found. Left acetabular fracture and left femoral head dislocation was seen in pelvic radiograph. Laboratory findings shows haemoglobin level of 12.8 gr/dl, hematocryte 38%, leucocyte 27,700/µl. On observation period, instability of haemodynamic happened. The patient was resuscitated with crystalloid and colloid solution, 800 ml blood was drained from chest tube. Sign of massive hemothorax and on going bleeding intra thoracic cavity was found, haemoglobin level was decreased to 5.5 gr/dl.

Emergency left posterolateral thoracotomy was performed, intra thoracic cavity was entered through 5th intercostal space. About 500 ml of blood clot was found at the basis of the lung, and was also found at the apex of the lung. Source of the bleeding was suspected in apex of the lung and rupture of the left subclavian artery. The procedure continued with median sternotomy extended to left supraclavicular incision. In exploration, aortic arch, innominate artery, right and left carotid artery was intact, but there was rupture with active bleeding from left subclavian artery, 1.5 cm proximal to aortic arch. Primary repair was done with a good result.

![Figure 1](image1.png)

**Figure 1.** Chest radiograph demonstrating left hemopneumothorax with chest tube insertion. Arrow; 1st and 2nd ribs fractures in the left hemithorax. No sign of mediastinal widening, scapular fracture and no hematoma at the apex of the lung.

![Figure 2](image2.png)

**Figure 2.** Operative picture. (A) First step we do left posterolateral thoracotomy. Found blood clot at the basis of the lung about 500 ml, also blood clot at the apex of the lung, suspected source of bleeding in the apex of the lung and rupture from left subclavian artery, (B) continued with median sternotomy extended to left supraclavicular incision.
incision. Arrow; Left subclavian artery, found rupture 1.5 cm proximal to aortic arch.

Postoperative, the patient’s condition improved dramatically. He was extubated on the 1st postoperative day in Cardiothoracic ICU, and was discharged home on the 10th postoperative day, with the chest radiograph showing good lung expansion.

Figure 3. Post operative chest radiograph demonstrating good lung expansion. Chest drain already took off.

Figure 4. Post operative clinical picture. There is no wound dehiscence.

Discussion
Trauma is the leading cause of death among people younger than 40 years of age. Blunt thoracic trauma is seen frequently in society and also one of the major injuries resulting in death in younger people. Road traffic accidents were the main cause of injury, followed by domestic falls and labour accidents. Outdoor falls and sport accidents accounted for a small number of injuries. The increasing incidence of high-speed road accidents has important repercussions on the number of thoracic injuries admitted to hospital. It is widely accepted that 25% of all traumatic deaths are due to thoracic injuries and that significant chest trauma is present in 50% of fatal traffic accidents. In a review of the management of chest trauma, Adebonojo et al all noted that 10% of patients with chest injury died at the site of the accident, and 5% died within 1 hour of arrival at the hospital. He also found a 5% rate of thoracotomy in such patients. (1,3,9,10,11)

Table 1. Type of causes of blunt thoracic trauma

| Cause                      | No. of Patients | %    |
|----------------------------|-----------------|------|
| Vehicle accident            | 143             | 8.12 |
| Occupational accident       | 12              | 0.71 |
| Cycling                    | 10              | 0.59 |
| Animal attack              | 9               | 0.51 |
| Domestic falls              | 17              | 1.03 |
| Sport accidents             | 8               | 0.48 |
| Others                      | 16              | 0.96 |
| Total                       | 1750            | 100  |

Two most common causes of death between the accident site and the casualty department are respiratory distress and irreversible hypovolemic shock. Thomas et al, describe from 896 patients who sustained blunt thoracic trauma, the most common cause of mortality and major complication is acute respiratory distress syndrome (ARDS). (1,3,9)

Table 2. Mortality and major complication of patient who suffered from blunt thoracic trauma

| Variable                                   | No. of Patients |
|--------------------------------------------|-----------------|
| Acute respiratory distress syndrome        | 5               |
| Blunt thoracic trauma                      | 5               |
| Associated trauma                          | 3               |
| Traumatic injuries                         | 2               |
| Hospital mortality                         | 1               |

The pathological pattern of blunt chest trauma varies worldwide, and involvement of any thoracic organs leading to various consequences. The diagnosis of blunt chest trauma is mainly by clinical assessment supported by investigations such as chest radiography and echocardiography. Chest radiography is routine for patients presenting with chest trauma; however, beyond resuscitation in emergency situations, specific treatment depends on the pathology detected. The primary aims in the management of chest trauma are prompt restoration of normal cardiorespiratory function, control of
hemorrhage, treatment of associated injuries, and prevention of sepsis. While the outcome of chest trauma depends on early diagnosis and urgent institution of care, resuscitative measures and chest tube insertion are curative in only 80% of cases.\(^{(4,9)}\)

**Table 3.** Etiology of blunt thoracic trauma. The most common etiology is traffic accidents. The most common organ injuries are lung and chest wall.

| Pathology                  | Traffic Accidents | Others | Total |
|----------------------------|-------------------|--------|-------|
| Chest wall                 | 262               | 3      | 265 (36.5%) |
| Lung                       | 237               | 7      | 244 (32.4%) |
| Diaphragmatic              | 23                | 0.1   | 23 (3.1%) |
| Thoracic-oesophageal       | 5                 | 0.1   | 5 (0.6%) |
| Thoracic vessels injury    | 9                 | 0.1   | 9 (1.2%) |
| Total                      | 599 (8.5%)        | 17 (1.8%) | 816 (100%) |

**Table 4.** Treatment of blunt thoracic trauma in 896 patient. The most common treatment is tube thoracostomy drainage.

| Treatment                      | No. of Patients |
|--------------------------------|-----------------|
| Conservative                   | 68 (9.8%)       |
| Closed tube thoracostomy drainage | 218 (27.4%)     |
| Open Thoracostomy              | 353 (47.3%)     |
| Sternotomy                     | 5 (0.6%)        |

The chest wall and the soft tissues are the locations most commonly affected by blunt traumas. Although most of the fractures of bony thorax are benign entities and can be treated without hospitalization, trauma limited to the thoracic cage itself may cause profound pathophysiological alterations, which may be fatal if not promptly treated. On the other hand, the accurate identification of patient at high risk for major chest trauma is essential for regulation of over and under triage within atrauma system. *Chest pain* and *dyspnea* were the most common symptoms at presentation whereas sensitivity over the chest wall, *bone crepitation* and *subcutaneous emphysema* were the most common findings on physical examination. *Soft tissue trauma* and *rib fractures* were the most common problems observed following blunt thoracic traumas. Non-penetrating chest injuries are seen frequently in civil populations. Rib fractures are reported as the most common pathologies associated with chest trauma (35–40%).\(^{(11)}\)

The presence of 1st or 2nd ribs, or more than two rib fractures is a marker of severe injury and is the most common type of injury in blunt chest trauma, and intrapleural collection is the most frequently associated pathology. Chest tube insertion has significant role as the single most important treatment modality for chest trauma. Mortality rate was 0.2% in patients with no rib fractures versus 4.7% in patients with more than two rib fractures. Lee reported that mortality doubles (1.8% vs 3.9%) for patients with three or more rib fractures and those with no rib fractures. Poole reviewed all series of fractures of first and second ribs and found a 3% risk for aortic injury and a 4.5% risk for injury of brachiocephalic and subclavian vessels. Hospital mortality rate for isolated chest injuries were reported to range from 4-8%, and increased to 13–15% when another organ system was involved, and to 30–35% when more than one organ system was involved. Lee et al reported the mortality rate as 1.8% in all patients with blunt chest trauma. An ISS of 16 or more has been taken as the cut-off value defining major trauma. Death was also occurred due to associated head injury.\(^{(9,11,12,13)}\)

**Table 5.** Pathologies of bony thorax in blunt thoracic trauma

- Associated organ injuries such as heart injuries or rupture of great vessel increase mortality. Although nothing can be done for these patients, many other arrive at hospital alive and can be saved if errors of evaluation and management can be avoided. Closed observation of vital signs and serial chest radiographs are essential in monitoring such patients. Effective and urgent intervention were lifesaving, such as in hemodynamically unstable patients with cardiac and great vessel injuries, massive intrathoracic haemorrhage, tracheobronchial or diaphragmatic rupture patients whom may need urgent surgical ET.\(^{(1,3)}\)
ET in blunt thoracic trauma is still a controversial issue. Surgical indications for thoracotomy, such as immediate or resuscitative thoracotomy, and early or late operations, are also well defined. Mortality in chest trauma was more related to the clinical state of the patients and the type of injuries than to the form of treatment. Urgent left thoracotomy is indicated for all patients who are not responsive to effective resuscitation. Those with no vital signs on monitoring or after the first 30 minutes following the trauma may not require resuscitation. The most frequent findings in blunt thoracic trauma were pneumothorax and hemothorax. These complications can be treated successfully by tube thoracostomy.

**Table 6. Intra thoracic complication in blunt thoracic trauma’s**

| Complication                      | No. of Patients | %   |
|----------------------------------|-----------------|-----|
| Hemorrhax                       | 667             | 38.55|
| Pneumothorax                     | 1053            | 60.57|
| Pneumonia contusion              | 81              | 4.86 |
| Cardiac contusion                | 2               | 0.12 |
| Diaphragmatic rupture            | 22              | 1.36 |
| Pleuritis contusion              | 2               | 0.12 |
| Pneumothorax contusion           | 21              | 1.21 |
| Pneumonia contusion              | 1               | 0.06 |
| Thoracic injury                  | 1               | 0.06 |
| Thoracostomy                     | 1               | 0.06 |

Blunt thoracic trauma can lead to cardiac and great vessel injuries, frequently unsuspected in patients with multiple systems injuries. The absence of physical signs of thoracic trauma, such as mediastinal widening in chest radiograph, doesn’t mean that there is no internal thoracic injury. Pulmonary parenchymal injury following blunt thoracic trauma have several mechanisms; (1) deceleration effects on the unfixed structures in the chest; (2) bidirectional compression between the sternum and vertebral bodies; (3) indirect force from the abdomen which increases intrathoracic pressure and produces rupture; (4) laceration by fractured ribs and (5) blast forces. Mechanisms of vascular injury of blunt thoracic trauma can include avulsion or traction injury from stretch or rotational stress, compression, or contusion from a direct blow, and laceration from fractures of adjacent ribs or clavicle.

Most traumatic great vessel disruptions that present for repair occur at the aortic isthmus near the ligamentum arteriosum and just distal to the left subclavian artery. These injuries are best approached through a posterolateral thoracotomy in the 4th intercostal space.

The patient in this case report had traffic accident, was conscious and well oriented in admission, sustained bidirectional compression on his chest. The patient had shortness of breath, was confirmed as tension pneumothorax. Large bore needle was inserted, continued with insertion of chest tube to drain blood. This management was based on ATLS protocols. First and second rib fractures was found in chest radiograph, but no mediastinal widening was found. Respiratory status and blood pressure maintained stable. The mechanism of the trauma was the same as in the literature mentioned above.

This lethal injuries is due to combination of direct compression, indirect compression and deceleration forces, which typically cause a transverse disruption of all three layers of the great vessel wall and its branch, especially left subclavian artery. The aortic isthmus (limited in its mobility by the ligamentum arteriosum, the paired intercostal arteries, and the left main stem bronchus) is the site of disruption in 93% to 95% of all blunt great vessel injuries who was survived. In contrast, survival after disruption of the aortic arch is extremely rare. The majority of patients sustaining aortic great vessel injuries die at the scene of accident. Of approximately 15% of the patients who survive the initial injury, the leading cause of in-hospital mortality is exsanguinating great vessel rupture occurring in 20% of these patients. Survival depends upon prompt diagnosis and repair.

Blunt injuries to branches of the great vessels, which is subclavian artery, may be suspected clinically, are not unusual and must be considered in any patient surviving deceleration or crush injury. Hemodynamically stable patients should undergo a high resolution contrast computed tomography (CT) of the chest which is the initial method of choice. Clinical presentation for
 patient with suspected of subclavian artery injuries are listed below (18):

- Bruising over anterior chest
- Limb ischemia
- Thoracic outlet hematoma
- Discrepancies in pulses and blood pressure between the two arms

Sign of subclavian artery injuries or great vessel injuries in blunt thoracic trauma that can be found in chest radiographs are also listed below (18):

- Abnormal thoracic contour/size
- “Widening” mediastinum
- First or second rib fractures
- Scapular fracture
- Unstable sternum
- Opacification of aortopulmonary window
- Depression of left main stem bronchus
- Tracheal shift to the right
- Deviation of NGT to the right
- Widening of the right paratracheal stripe
- Presence of apical cap
- Widening of paraspinal line
- Hemothorax

Clinical presentation in our patient was not usual like stated in literature. The patient did not have bruising on anterior chest, limb ischemia, discrepancies in pulses and blood pressure between the two arms, or widening of the mediastinum on chest radiograph, but fractures of the first and second ribs on chest radiograph was found, presented with massive hemopneumothorax and was hemodynamically unstable. ET was performed without any suspicious of great vessel injury. Large amount of blood clot at the basis and at the apex of the lung was found, suspected left subclavian artery ruptured, continued with median sternotomy extended to left supraclavicular incision.

Angiography should have been done first before the surgery, if injuries to the great vessels is suspected based on clinical presentation in order to make a good plan for the surgery. Since the patient had unusual clinical presentation and was hemodynamically unstable, it was decided to performed ET for live saving.

Such injury should always be suspected in major trauma where there are fractures of the first, second and third ribs. An early chest radiograph (antero-posterior view) is obtained in the receiving area in all victims of either blunt chest trauma or decelerating trauma with or without evidence of chest injury. Mediastinal widening is the most frequent manifestation of great vessel injury, and is the key of diagnosis. Angiography is the next diagnostic modality to perform when any mediastinal abnormality is seen on the chest radiograph. Angiography remains the gold standard for the diagnosis of stable patients with thoracic vascular injury. Angiography provides the detailed anatomic information necessary for planning the operative approach. However, they may remain undetected until the fatal rupture of the mediastinal hematoma occur. Clinical presentation such as absent of upper extremity pulses, sudden hemotorax, left supravascular swelling and persistent hypotension are also an indication for immediate angiography. (17) Relative indications for angiography include brachial plexus palsy, apical pleural hematoma, and fracture of 1st rib. (7) The use of angiography to delineate the entire thoracic aorta; this will define the anatomy of the injury that may not always be made clear on computerised tomography. (5, 7, 13, 16, 18, 19, 20, 21)

Therapy is given based on priority when an injury appears to be life-threatening, such as in the event of airway obstruction, external or intraabdominal hemorrhage, or continuing intracranial bleeding. (7, 22) Medical therapy include intravenous infusion of vasodilator (usually nitroprusside), attempted limitation of intravenous administration of fluids once the blood pressure exceeds 90mmHg, and the administration of β-blocker where the pulse rate exceeds 85-90 beats/min. Medical management continued while diagnostic studies or other
surgical procedures performed, or until the patient with proven rupture has been placed on cardiopulmonary bypass.(22)

Successful repair was performed with autogenous saphenous vein. A high degree of clinical suspicion is necessary to detect subclavian artery transection from blunt trauma because of the location of this injury, lack of initial bleeding, and the rich collateral blood supply to the arm.(17) Although prevention and treatment of pulmonary damage have reduced the mortality of patients with severe blunt thoracic trauma, the mortality is still high when multiple severe injuries, pulmonary contusion, cardiovascular injury, diaphragmatic rupture and brain damage are present.(1)

Blunt injury of the brachiocephalic artery poses diagnostic and management problems for trauma and thoracic surgeon. Patients were stabilized and underwent repair through a median sternotomy with extension of the incision anterior to the sternocleidomastoid muscle. Median sternotomy is the best approach of choice in both controlling hemorrhage and repairing the arterial injury.(23,24) All patients had restoration of flow to the subclavian and carotid arteries utilizing bypass grafts or primary repair. All patients survived leave the hospital with no complications related to the procedure. Patients with blunt injuries of the brachiocephalic artery should be stabilized, and circulation of the subclavian and carotid arteries should be restored with graft placement or primary repair. (23)

Median sternotomy with extension of the left supraclavicular incision, anterior to the sternocleidomastoid muscle was performed on the patient in this case report, primary repair of the ruptured site is also done, as the literature mentioned above, with a good result.

Conclusion: Clinical presentation in the patient presented in this case report was unusual as what is mentioned in the literature mentioned. The patient only had fractures of the first and second ribs on chest radiograph, massive hemothorax and was hemodynamically unstable. ET was performed for live saving without any suspicion of great vessel injury. Left subclavian artery ruptured then suspected, the procedure continued with median sternotomy extended to left supraclavicular incision with good result.

The key word of diagnosis for great vessel injuries in blunt thoracic trauma is mediastinal widening in chest radiograph. Angiography should be done first before the surgery if the patient was stable and if there is a suspicious of great vessel injuries.

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