



Case Report

Segmental pulmonary artery transection after blunt trauma

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Abstract

We herein describe a patient with segmental pulmonary artery transection after blunt trauma, which was diagnosed preoperatively by computed tomography. Bolus tracking contrast-enhanced computed tomography clearly depicted both aortic and pulmonary vasculatures. A one-step examination quickly disclosed aortic damage and injury to significant visceral organs. To the best of our knowledge, our patient appeared to be a unique case of pulmonary segmental artery transection after blunt injury, which was preoperatively diagnosed by computed tomography. Ultimately, successful surgical repair of the pulmonary artery was performed.

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1. Introduction

A 23-year-old man was brought to our hospital following a traffic accident. After imaging studies promptly confirmed the preoperative diagnosis of segmental pulmonary artery transection and other multiple organ injuries, the patient underwent surgery. According to a literature review, contrast medium-enhanced computed tomography (CT) with dynamic phase is the best one-stop imaging modality in the setting of major trauma. Complex vascular injury and solid organ damage can be well depicted by a dynamic contrast medium-enhanced CT scan.

2. Case report

A 23-year-old man had a high-speed motorcycle collision after drinking. He was lying unconscious on the traffic island, and no brake marks were found at the scene. The patient was hypoxic and intubated after arrival at a hospital. Bilateral chest tubes were placed for hemopneumothorax. However, persistent gushing of fresh blood was observed from the left-side chest tube. He was then transferred to our hospital in a critical condition.

The patient was hemodynamically stable in our emergency room. Subsequent physical examination revealed decreased breath sounds in the left chest, with paradoxical movement of the chest wall. A chest roentgenogram (Fig. 1) revealed bilateral pulmonary contusion, left clavicle fracture, multiple left rib fractures, and bilateral hemopneumothorax with bilateral chest tubes in place. The mediastinum was normal in size. The chest CT revealed bilateral hemopneumothorax, multiple rib and clavicle fractures on the left side, bilateral pulmonary contusion, Grade III liver laceration, a small

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Fig. 1. Chest roentgenogram reveals bilateral pulmonary contusions, left clavicle fracture, multiple left rib fractures, and bilateral hemopneumothorax with bilateral chest tubes in place and endotracheal tube intubation.

pseudoaneurysm at the aortic isthmus, and pneumopericardium. A large intrapulmonary hematoma with a central low-density area was found in the consolidated left lung (Fig. 2A). After the administration of a contrast medium,

active extravasation from a segmental pulmonary artery into the low-density area was found (Fig. 2B).

The patient was immediately transferred to the operating room to control active pulmonary arterial bleeding. During the operation, a 3 cm deep pulmonary laceration and transection of two segmental pulmonary arteries were found in the superior segment of the left lower lung. There was an erected bone chip from the broken posterior portion of the left sixth rib that was suspected to have contributed to the major deep pulmonary laceration (Fig. 2C). This was well demonstrated by the CT scan with a series of coronal reformation images (Fig. 3). One pericardium tear was noted at the left hilum with exposure of the intrapericardium pulmonary veins. The surgeon ligated the bleeding segmental pulmonary arteries, resected the major torn pulmonary segment, and repaired the other minor pulmonary lacerations.

However, the condition of the patient deteriorated after surgery due to multiple organ failure and disseminated intravascular coagulopathy. He died 10 days later despite ventilator, extracorporeal membrane oxygenation, and continuous venous–venous hemofiltration supportive care.

3. Discussion

Most victims with pulmonary artery transection after blunt trauma die at the scene of their injuries. For those who survive and are able to obtain medical assistance, pulmonary artery injury is underdiagnosed and can rarely be detected directly by imaging modalities. Segmental pulmonary artery transection after blunt trauma, which was preoperatively diagnosed by CT, has not been previously reported in the literature. In the past,



Fig. 2. (A) Chest computed tomography scan without contrast medium shows a hyperdense ovoid mass at the consolidated pulmonary parenchyma with hematoma. There are some ovoid hypodense areas within the intrapulmonary hematoma. (B) After the administration of a contrast medium, contrast medium extravasation is found in the central hypodense region. (C) The erected bony clip (arrow) at the broken posterior aspect of the left sixth rib, which is adjacent to the major pulmonary laceration, contributed to the pulmonary laceration. (D) A small pseudoaneurysm is seen at the aortic isthmus without hematoma formation at the mediastinum.

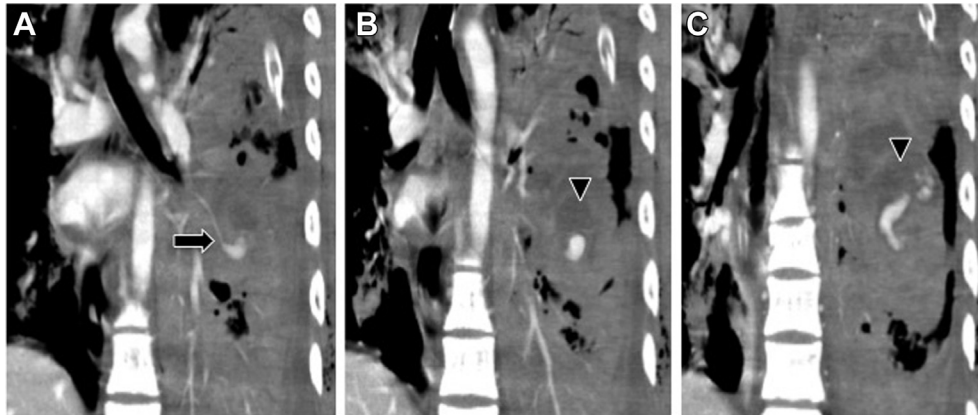


Fig. 3. (A) Contrast-enhanced chest computed tomography scan with serial coronal reformation images reveals contrast medium extravasation from a segmental pulmonary artery (arrow). (B, C) Contrast medium is extravasated into the intrapulmonary hematoma (arrowhead).

the diagnosis was made based on a doctor's clinical judgment, and immediate thoracotomy was typically performed. The history of violent trauma mechanism (falls from a building or motor vehicle accident), physical examination (flail chest and contusion wound at chest wall), and imaging studies can be crucial for timely diagnosis and early intervention. The roentgenogram showed the first rib fracture, or scapula fracture, and was also suggestive of the violent trauma mechanism. A high index of clinical suspicion and early diagnosis are essential for patient survival. As acquisition times, space, and contrast resolution of CT scan have improved, it is now widely used in the evaluation of major trauma severity. Currently, CT scan is the imaging modality of choice for a thorough, simultaneous survey of the soft tissue, lung parenchyma, and bony structures. A contrast medium is strongly recommended for the evaluation of vascular injury and can provide lifesaving time benefits. The relative contraindication to iodized contrast media in customary scenarios where a patient may otherwise have prior minor anaphylaxis-like

reaction or poor renal function should never prevent the use of a contrast medium when vascular injury is highly suspected and early diagnosis is critical to sustain life.

Fifty percent of all fatal motor vehicle accident victims had blunt chest trauma, which directly contributed to death in 12–25% of those fatalities; nonetheless, only 15% of patients with chest trauma arriving alive at the emergency department underwent early thoracotomy.¹ Proven pulmonary artery injury following blunt thoracic trauma had been reported in only nine cases, in eight case reports published since 1988 (Table 1).^{2–9} The diagnosis was made based on clinical judgment and intraoperative findings prior to Ambrose et al² reported the seminal case of main pulmonary artery laceration in 2000, which was preoperatively diagnosed by active extravasation in a CT scan.

Two cases in 1988–1997 involved preoperative CT scans, which failed to diagnose pulmonary vascular injury preoperatively.^{3,4} Daon and Gorton³ reported a case where angiography helped to diagnose the patient's pseudoaneurysm of the

Table 1
Review of nine patients with pulmonary artery injury after blunt chest trauma.

Studies	Type of injury	Treatment	Method of diagnosis	Outcome
Vendrell and Gahide ⁵	Right main pulmonary artery pseudoaneurysm	Watchful observation	CT	Alive
Pereira and Narrod ⁶	Right main pulmonary artery pseudoaneurysm, which was lacerated on the operation table	End-to-end repair with bypass	CT, angiography	Alive
Ambrose et al ²	Main pulmonary artery laceration	Repair without bypass	CT	Alive
Daon and Gorton ³	Right main pulmonary artery laceration; pseudoaneurysm of the proximal innominate artery	Repair with bypass	Indirect sign: irregularity of the pulmonary arterial wall in CT	Alive
Ohta et al ⁷	Main pulmonary artery laceration	Repair without bypass	Tube thoracostomy with massive continuous blood drainage	Alive
Katz and Groskin ⁸	Pulmonary artery laceration	Repair without bypass	Tube thoracostomy with massive continuous blood drainage	Alive
Nishimoto et al ⁴	Main pulmonary artery laceration	Repair without bypass	Tube thoracostomy with massive continuous blood drainage; CT: no finding	Alive
Hawkins et al ^{9,a}	Left main pulmonary artery laceration Right main pulmonary artery laceration	Repair without bypass Repair without bypass	Tube thoracostomy with massive continuous blood drainage	Alive Died in operating room

CT = computed tomography.

^a Hawkins et al reported two cases and one died after surgery.

proximal innominate artery. CT scan revealed an “irregularity” of the anterior wall of the right pulmonary artery without hematoma formation or active extravasation. Pulmonary artery injury was not suspected preoperatively, and the patient underwent surgery with the diagnosis of innominate artery pseudoaneurysm. A 0.5 cm transverse laceration was noted intraoperatively on the anterior surface of the right pulmonary artery. Nishimoto et al⁴ reported a case of main pulmonary artery laceration found intraoperatively. In these two cases, the CT scan failed to support a diagnosis of pulmonary artery injury preoperatively.

Several possible reasons that might explain the underdiagnosis by CT scan of pulmonary vascular injury are the suboptimal spatial resolution in older CT scanner models and the additional time necessary for contrast delivery into pulmonary circulation to detect subtle vascular lesions. Other possible reasons are that the disease process is ongoing and there was only a weakened pulmonary vascular wall during the CT scan. The pulmonary vascular full-thickness laceration occurred after the CT scan.

Including our case, nine out of 10 patients received surgical repair for pulmonary artery injury, and two died. Vendrell and Gahide⁵ reported a 42-year-old woman with right pulmonary artery pseudoaneurysm and hemodynamic stability. Watchful observation and CT scan performed 14 days later revealed a stable clinical condition and spontaneous reduction in the size of the pseudoaneurysm. The patient was discharged uneventfully 1 month later.

In our case, the young man had pulmonary and aortic vascular injuries, liver laceration, left pulmonary laceration, bilateral pulmonary contusion, and tension pneumothorax. Although rare, active bleeding from the transected segmental pulmonary artery was observed in the chest CT scan. This type of injury left the patient with little chance of survival at the scene due to simultaneous cardiovascular collapse and oxygen exchange failure of the lungs. He had persistent gushing of massive blood from the left chest tube. A CT scan was warranted to exclude thoracic vascular injury.

Our CT scan protocol was intended to create an arterial phase to opacify both the pulmonary arteries and the aorta. In

our patient, the pseudoaneurysm at the aortic arch and active bleeding of segmental pulmonary artery were clearly demonstrated in the CT scan preoperatively. Power injection of 120 mL contrast medium at a flow rate of 2.5–3 mL/second was suggested. We used the bolus-tracking technique and placed region of interest (ROI) at the aortic arch. The scan is triggered when the contrast medium flows to the aortic arch and has met the Hounsfield unit threshold (120 HU). It is critical to administer a sufficient amount of contrast medium to enhance well both the pulmonary and the aortic vasculatures during scanning. However, determining the correct contrast medium amount can be challenging, as this amount is highly variable due to low cardiac output and shock status in trauma patients.

In conclusion, subtle vascular lesions at the pulmonary artery or aorta can be well evaluated at the same time if we use an optimized CT protocol. Correspondingly, clinicians should have a high index of clinical suspicion for potential pulmonary vascular injury in major trauma patients, and an optimized chest CT protocol can be lifesaving.

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