

## Successful Treatment of Blunt Musculophrenic Artery Injury by Transcatheter Arterial Embolization: A Case Report

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**An 86-year-old woman was transported by ambulance after jumping from the second floor of a building. Upon arrival, the blood pressure was stable; however, computed tomography indicated the presence of an anterior mediastinal hematoma. Eight hours after arrival, the patient exhibited shock. The blood pressure increased with rapid infusion. Emergency angiography was performed. Extravasation from the musculophrenic artery, which branches off from the left internal mammary artery, was observed. Transcatheter arterial embolization was performed and bleeding was controlled.**

**This is the first report of musculophrenic artery injury caused by blunt trauma to the best of our knowledge. Findings suggested that if an anterior mediastinal hematoma develops, bleeding must be rapidly controlled. If the patient responds to rapid infusion and injury of the internal mammary artery or one of its branches is suspected, transcatheter arterial embolization is considered appropriate.**

**Key words:** anterior mediastinal hematoma, blunt trauma, internal mammary artery, musculophrenic artery, transcatheter arterial embolization

### INTRODUCTION

The musculophrenic artery is one of the branches of the internal mammary artery that runs over the costal margin of the lower ribs, which is attached to the front of the diaphragm. Internal mammary artery injury due to blunt trauma of the chest region is rare, and it has been reported that some cases develop an anterior mediastinal hematoma or massive hemothorax due to injury of the main trunk of the internal mammary artery [1]. We hereby report on our experience using transcatheter arterial embolization (TAE) to successfully treat a case of falling injury in which hemothorax from a hematoma on the diaphragm and hemorrhagic shock developed because of injury of the musculophrenic artery, a branch of the internal mammary artery.

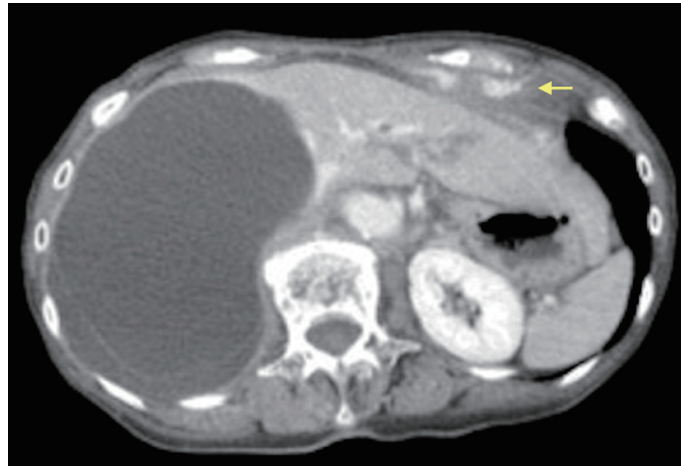
### CASE REPORT

An 86-year-old woman was transported by ambulance to the hospital with the chief complaints of disturbance of consciousness and lower back pain after shouting, stabbing her neck with scissors, and jumping off a second floor window of her house. Her medical history revealed that she had experienced psychological symptoms, including hallucinations and persecution mania, for approximately 10 years and thus had been examined by a psychiatrist once. However, she was not undergoing regular psychiatric treatment on an outpatient basis.

Upon arrival, her vital signs were Glasgow Coma Scale: E4V4M6, blood pressure: 162/90 mmHg, heart rate: 114 beats/min, body temperature: 36.9 °C, oxygen

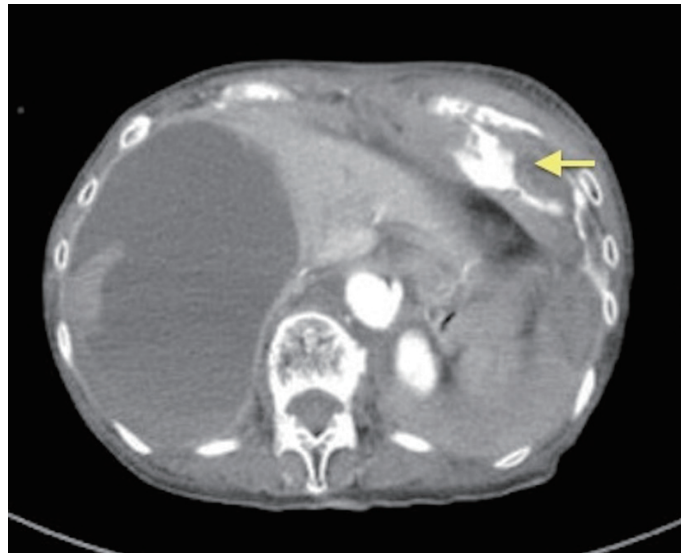
saturation: 96 % (room air). Cranial and chest computed tomography (CT) revealed hemorrhage below the cortex of the frontal lobe, fracture of the sternum, and anterior mediastinal hematoma but no clear hemothorax or rib fracture. Contrast-enhanced CT of the abdominal region showed extravasation in the left gluteus maximus. In addition, extravasation from the left inferior gluteal artery was confirmed by angiography. Therefore, the bleeding was controlled with TAE, after which the patient was admitted to the intensive care ward.

Eight hours after being admitted to the hospital, her systolic blood pressure dropped to 70 mmHg; thus, rapid infusion was performed. Her blood pressure subsequently increased to 110/89 mmHg. We reviewed CT on arrival, and found contrast medium extravasation near the left diaphragm (Fig. 1). When contrast-enhanced CT of the abdominal region was performed again, contrast medium extravasation near the left diaphragm expanded (Fig. 2, 3). We judged that the cause of the shock was bleeding from the region around the left diaphragm. Selective left internal mammary artery arteriography was performed using microcatheter advanced into the main trunk of left mammary artery, and this revealed extravasation from the left musculophrenic artery (Fig. 4). Embolization was performed with 6 micro coils and gelatin sponge pledgets (Fig. 5). Because chest CT following TAE revealed left hemothorax, a left thoracic drain was inserted. As a result, 670 ml of bloody fluid was drained. The patient's general condition then stabilized, and she was transferred to a psychiatric hospital on hospital day 63.

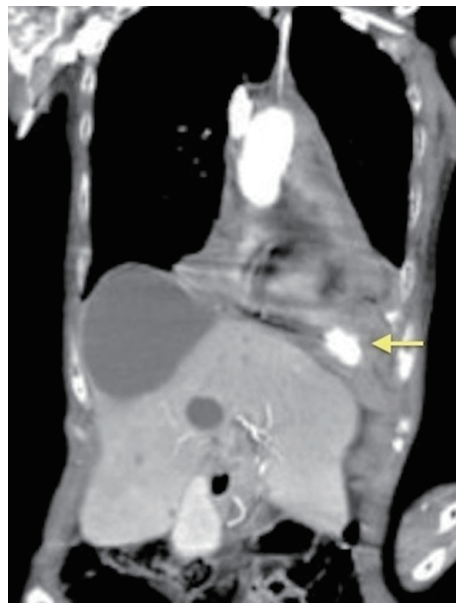


**Fig. 1** Contrast-enhanced CT at arrival, which there was the contrast medium extravasation around the left diaphragm that we could not detect at first.

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**Fig. 2, 3** Contrast-enhanced CT taken 8 h after arrival at the hospital revealed a hematoma on the left diaphragm, and extravasation.



**Fig. 4** Extravasation from the musculophrenic artery, the terminal branch of the left internal mammary artery, was observed.



**Fig. 5** The bleeding was stopped by performing TAE against the main trunk of the internal mammary artery using a gelatin sponge and 6 platinum micro coils of which diameter is 2mm (Cook, Hilal Embolization Microcoils™)

## DISCUSSION

The internal mammary artery branches off from the subclavian artery and descends perpendicularly to the deep part of the intercostal muscle along the lateral margin of the sternum. It then bifurcates into the musculophrenic artery and the superior epigastric artery near the sixth intercostal space. The musculophrenic artery extends into the diaphragm, lower pericardium, and abdominal wall. It also sends out anterior costal branches to the seventh, eighth, and ninth intercostal spaces [2].

Internal mammary artery injury due to blunt trauma is rare. Chen *et al.* reported that of 166 patients who underwent aortography for blunt trauma of the chest region, there was only one case of internal mammary artery injury [3]. Furthermore, there have only been 49 cases of internal mammary artery injury reported over the past 37 years (1997–2014) [1]. A search of PubMed with musculophrenic artery injury as a keyword revealed reports of two cases of musculophrenic artery injury [4, 5], both of which were due to penetrating trauma rather than blunt trauma. Thus, musculophrenic artery injury due to blunt trauma is considered rare, and we believe that this is the first report of such a case.

Incorrect diagnosis of internal mammary artery injury can lead to cardiac compression due to anterior mediastinal hematoma or massive hemothorax, thereby resulting in fatal consequences [6]. Successful surgery for internal mammary artery injury, involving median sternotomy and ligation of the injured vessel to stop the bleeding, has been reported [7]. Currently, internal mammary artery injury has not been established as an indication for TAE. However, Kawamura *et al.* reported that TAE was appropriate for cases in which

the patient is responsive to infusion when anterior mediastinal hematoma develops and shock is exhibited [8]. In addition, Whigham *et al.* performed TAE on 12 of 18 cases of internal mammary artery injury and reported that hemorrhage resolved with TAE alone in 11 cases, although one case required additional surgery [9]. In our case, injury of the musculophrenic artery, a branch of the internal mammary artery, caused a hematoma near the diaphragm and extravasation. Eight hours after the injury, massive hemothorax and shock were exhibited. We considered a thoracotomy procedure; however, because blood pressure rose with the rapid infusion and contrast-enhanced CT revealed extravasation on the diaphragm, angiography was performed to clarify the site of bleeding. Because angiography findings revealed extravasation from the musculophrenic artery, a branch of the internal mammary artery, TAE was performed and subsequently bleeding was controlled.

As a result, we missed the extravasation of contrast medium on the arrival CT scan, and the result should be reflected. We think that one of the causes of missing the extravasation around the left diaphragm on the arrival CT scan was the peculiarity of the bleeding site, which was the transition region between chest and abdomen, and was located in between parietal pleura and diaphragm. The border between parietal pleura and diaphragm is not cavity. Therefore, the bleeding from the musculophrenic artery was not spreading to the pleural cavity and not developing into hemothorax early after the injury. Eight hours after being admitted to the hospital, the bleeding from the musculophrenic artery expanded and developing into massive hemothorax. Though there was no rib fracture, the left massive hemothorax appeared by the left musculophrenic artery injury. Therefore we think that one of the mech-

anism of musculophrenic artery injury was due to vertical shearing force in falling injury.

When a hematoma accompanied by extravasation on the anterior mediastinum and diaphragm is observed because of blunt chest trauma and the patient goes into shock, taking into account the possibility of a fatal outcome due to cardiac compression or hemothorax, bleeding should be rapidly controlled.

We believe that it is appropriate to quickly perform TAE on cases in which injury of the internal mammary artery and its branches is suspected and the patient responds to rapid infusion.

#### CONFLICT OF INTEREST

There were no conflicts of interest.

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