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Obstructive shock induced by internal thoracic artery injury with traumatic sternal fracture

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Abstract:

Internal thoracic artery (ITA) injuries associated with sternal fractures can lead to shock. Several studies have documented injuries resulting in hemorrhagic shock, yet there is limited reporting on obstructive shock. Opinions differ regarding which is superior between transcatheter arterial embolization (TAE) and open thoracotomy. We report the case of an 80-year-old female patient presented with blunt chest trauma when driving. Her vital signs were normal. However, ultrasonography revealed a hypoechoic anterior mediastinal lesion. Her blood pressure decreased immediately before undergoing a computed tomography (CT) scan. The CT scan showed a sternal fracture, anterior mediastinal extravasation, and dilation of the inferior vena cava. TAE was performed on both internal thoracic arteries, and the patient was transferred to a hospital where an open thoracotomy could be performed. The patient was treated conservatively and discharged without sequelae. Obstructive shock caused by an ITA injury with a sternal fracture can be successfully treated using TAE.

Keywords:

Internal mammary artery injury, mediastinal hematoma, sternum fractures, traffic accident

Introduction

Traumatic sternal fractures (SF) constitute approximately 3%–8% of cases involving blunt trauma, predominantly attributable to forceful impacts to the chest commonly associated with automobile collisions.^[1] Injury to the internal thoracic artery (ITA) can be associated with SF but is rare. However, reports indicate that with late detection of injury, around 45% of patients may encounter fatal shock.^[2] This prompts swift diagnosis of ITA injuries in cases of blunt trauma, thereby enabling the formulation of a treatment plan.

been reported, whereas reports of obstructive shock in such cases are rare. Treatment options for such trauma include transcatheter arterial embolization (TAE) or open thoracotomy. Nevertheless, there is no consensus on which technique is superior.

Herein, we describe a case of a traffic accident, leading to sternal fracture and ITA injury that resulted in obstructive shock due to an anterior mediastinal hematoma. The patient underwent TAE and was discharged without any sequelae.

Case Report

An 80-year-old female patient with no relevant medical history presented to our hospital with chest pain. She drove her car over a curb and crashed into a garden

Several cases of hypovolemic shock due to ITA injury with traumatic SF have

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stone, striking her chest on the steering wheel in the parking lot. The witnesses claimed there was a crack in the windshield, the airbag deployed, and the patient was wearing a seatbelt at the time of injury. She was not taking any medication, including antithrombotics and anticoagulants.

Her vital signs on arrival were as follows: heart rate - 85 beats/min (sinus rhythm); blood pressure - 127/93 mmHg; respiratory rate - 24 breaths/min; SpO₂-96% in room air; and Glasgow Coma Scale score - 15/15. Physical examination revealed bruising and tenderness in the midline of the chest, and a hypoechoic lesion was noted around the anterior mediastinum on ultrasonography. Laboratory data showed elevated high-sensitive troponin and creatine kinase-muscle/brain [Table 1]. Peripheral venous access was secured in both upper arms, and tranexamic acid was administered to prevent further bleeding. She was transferred to the computed tomography (CT) room because her vital signs were within the normal range. Immediately before undergoing a contrast-enhanced CT, her systolic blood pressure dropped to 70 mmHg. Therefore, a rapid fluid infusion was initiated. The CT revealed contrast extravasation into the mediastinum due to ITA injury and dilation of the inferior vena cava (IVC) [Figure 1]. After the CT scan, her systolic blood pressure increased to the 120s. After she returned to the ER, a blood transfusion was administered (red blood cells - 2 units; fresh-frozen plasma - 2 units), sheaths were inserted into both femoral arteries, and rapid tracheal intubation was performed under sedation.

After confirming hemodynamic stability, the patient underwent TAE. A catheter was inserted through the right femoral sheath. Embolization was performed using a coil and a gelatin sponge to stop extravasations from the branches of both ITAs [Figure 2]. Following the completion of TAE, the patient was transferred to a hospital where an open thoracotomy could be performed due to the possibility of mediastinal hematoma growth and ITA rebleeding. The patient was treated conservatively, as the mediastinal hematoma did not increase after transfer. The tracheal intubation tube was removed 2 days after transfer.

Five days later, the patient was transferred to our hospital for follow-up and observation because her general condition remained stable. After 10 days of rehabilitation at our hospital, the patient was discharged without any sequelae.

Proper written consent was obtained from the patient for the use of the data related to this case.

Discussion

This case illustrates that even a sternal fracture with a relatively good prognosis can precipitate shock. It highlights the potential life-saving role of TAE

Table 1: Laboratory findings of the patient before and after transcatheter arterial embolization

MARKERS	UNIT	INITIAL DATA	AFTER TAE
Glucose	mg/dL	196	N/A
HS-Troponin	pg/mL	40.4	117.1
CK	U/L	134	203
CK-MB	U/L	42	10
AST(GOT)	U/L	79	N/A
ALT(GPT)	U/L	31	N/A
LDH	U/L	262	N/A
Na	mEq/L	141	N/A
K	mEq/L	3.4	N/A
Cl	mEq/L	106	N/A
BUN	mg/dL	10.7	N/A
Cre	mg/dL	0.46	N/A
CRP	mg/dL	0.01	N/A
WBC	/uL	9950	9370
RBC	10 ⁴ /uL	425	375
Plt	10 ⁴ /uL	22.1	15.7
PT-INR		0.91	0.98
APTT	sec.	24.4	40
D-Dimer	ug/mL	9.4	7.2



Figure 1: Contrast-enhanced computed tomography when signs of shock were seen. (a) Extravasation from a branch of the internal thoracic artery (white arrow), (b) Mediastinal hematoma compressing the heart, (c) Inferior vena cava dilated with a diameter of 31.7 mm × 19.9 mm (asterisk)

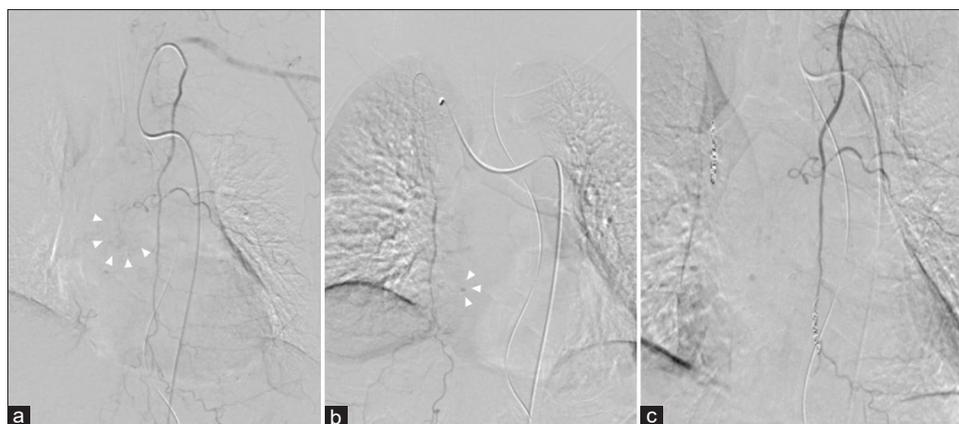


Figure 2: Internal thoracic artery angiogram. (a) Extravasation from a branch of the left internal thoracic artery, (b) Extravasation from a branch of the right internal thoracic artery, (c) Postangiographic findings

when administered alongside appropriate systemic management.

The causes of ITA injuries are mostly cardiopulmonary resuscitation and traffic accidents. ITA injury is rare in SFs. However, the average blood flow of the ITA is approximately 150 mL/min on each side, which can easily cause shock when injured.^[3] Hemorrhagic shock generally causes the collapse of the IVC. In our case, the IVC was dilated to a diameter of 31.7 mm × 19.9 mm. This led to a diagnosis of obstructive shock. While rapid infusion-induced blood pressure improvement may indicate hemorrhagic shock, it can also suggest obstructive shock arising from enhanced preload. However, if hemorrhagic shock was present, the volume of infusion during the CT scan would not have dilated the IVC. This discrepancy led us to infer that the patient's blood pressure declined due to a combination of hemorrhagic shock and obstructive shock.

TAE and open thoracotomy are intervention options for internal mammary artery injury. Opinions are divided on whether TAE or open thoracotomy should be performed as the initial treatment.^[4] Some reported cases that were treated with TAE,^[5] conversely, others performed thoracotomy in their cases.^[6-9] TAE is less invasive but is only effective against vascular injuries. Hence, if extravasation cannot be anticipated, or if the patient is hemodynamically unstable during contrast-enhanced CT, open thoracotomy might be prioritized over TAE. Nishimura *et al.* claimed that the treatment choice should be based on the source of bleeding, the presence or absence of coagulation abnormalities, and the effect of the mediastinal hematoma itself on circulation.^[7]

In the present case, blood tests showed no coagulation abnormalities, and the patient's general condition was stable under ventilator control. Therefore, TAE was performed as the initial treatment. Although the treatment was successful, considering the recurrence

of hemodynamic instability and an increase in mediastinal hematoma due to bleeding from the fracture, we decided that the patient should be transported to a facility where open thoracotomy could be performed at any time. In such cases in which the patient can be observed conservatively, open thoracotomy must always be considered, and follow-up at a facility where cardiovascular surgery can be performed is desirable.

Conclusions

We encountered a case of obstructive shock due to a traumatic sternal fracture and ITA injury. Even in such potentially life-threatening injury, if the patient's vital signs can be maintained stability, a less invasive approach such as TAE can treat a patient's life successfully.

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Author contributions statement

H.K. designed the study, the main conceptual ideas, and the proof outline and collected the data. N.W., M.M., and A.H. aided in interpreting the results and worked on the manuscript. M.N. supervised the project. H.K. wrote the manuscript with support from M.N. and N.W. All authors discussed the results and commented on the manuscript.

Conflicts of interest

None declared.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given her consent for her images and other clinical information to be reported in the journal. The patient understands that her name and initials will not be published and due efforts will be made to conceal her identity, but anonymity cannot be guaranteed.

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