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Running head: Traumatic hemothorax of corrected TOF

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ABSTRACT

An 18-year-old Japanese youth was transferred to our emergency room because of a traffic accident. He had a past history of total correction for tetralogy of Fallot as an infant. Chest computed tomography revealed hemomediastinum and hemothorax. In an emergency operation, massive bleeding from the mediastinum was observed. Bleeding arose from the torn Blalock-Taussig (BT) shunt and right subclavian artery. Hemostasis was achieved by clipping the shunt and suturing the subclavian artery. This is a rare case of a patient with hemomediastinum caused by torn BT shunt after a high-impact accident who survived it by surgery.
Tetralogy of Fallot (TOF) is a rare congenital heart defect characterized by four specific cardiac defects, namely, pulmonary stenosis, a ventricular septal defect, right ventricular hypertrophy, and an overriding aorta, which expands the aortic valve to allow blood from both ventricles to enter. If the patient has a decrease in oxygenation, surgical placement of a Blalock–Taussig (BT) shunt is first planned to secure passage of blood to the pulmonary artery. If the degree of cyanosis becomes relatively mild, radical surgery is performed by approximately 1 year old. Here, we present a patient with totally corrected TOF in infancy who underwent emergency surgery for traumatic hemomediastinum and hemothorax. Notably, the cause of bleeding was the BT shunt torn by a high-impact traffic accident, which led to massive bleeding from the pulmonary and subclavian arteries.

An 18-year-old Japanese youth was transferred to our emergency room (ER) because of high-impact trauma due to a traffic accident. He had a history of total correction of TOF in infancy and had been physically healthy when visiting our outpatient clinic 6 months before the injury (Figure 1). On arrival at the ER, he was conscious with relatively stable vital signs (Glasgow Coma Scale, E3V5M6; heart rate, 136 bpm; blood pressure, 124/104 mmHg; oxygen saturation, unmeasurable because of coldness). His blood counts and biochemical tests did not show any severe abnormalities. Enhanced chest computed tomography (CT) revealed hemomediastinum and hemothorax (Figure 2). Although extravasation of contrast agent could not be detected, an emergency operation was performed because the vital signs were becoming unstable owing to massive bleeding.
Under right open thoracotomy, 500 mL of blood clot was pooled in the thoracic cavity, and retraction of the lung uncovered massive bleeding from the mediastinum onto which the right upper lobe was severely adhered (Figure 3 and supplemental video). While dissecting the adhesion and compressing the mediastinum with the whole lung for hemostasis, bleeding from a tear in the BT shunt and right subclavian artery was discovered. After 20 min of compression achieved hemostasis, the subclavian artery was closed by suturing, and the torn BT shunt was clipped and covered with fractionated plasma products. Total blood loss was 10,020 mL, of which 3500 mL was returned by Cell Saver Elite (Haemonetics, Braintree, MA, USA). Transfusion comprised 1680 mL of packed red blood cells and 2880 mL of fresh frozen plasma. During the operation, the patient’s vital signs and oxygenation were generally stable (Supplemental figure). He was extubated on the day after surgery, and postoperative rehemorrhage was not observed. He was discharged on the 13th postoperative day and has since been in good health when visiting our outpatient clinic.

**COMMENT**

TOF is a rare congenital heart defect mainly characterized by pulmonary artery stenosis. If the patient has decreased oxygen saturation, BT-shunt surgery is initially performed to secure blood passage from the aorta to the pulmonary artery. Total correction is thereafter performed at approximately 1 year of age. The present patient had undergone BT-shunt surgery as a newborn and total correction of TOF as an infant; 17 years later the BT shunt was torn following a traffic accident, causing hemomediastinum.
Although there are many suggestive points for discussion regarding the patient's clinical course, the most interesting question is why he was able to survive the interval until the operation (about 2 hours) despite the fact that massive bleeding from the right subclavian artery and pulmonary artery arising from the torn BT shunt must have been present. Moreover, no extravasation of contrast agent was observed on chest CT scans. The bleeding origin was uncovered while dissecting adhesion of the right upper lobe, suggesting that this severe adhesion led to high internal pressure and closed the mediastinum, aiding hemostasis. Another question is why the BT shunt was torn into bleeding, even though the patient had no rib fractures or even apparent traumatic incised wounds except seat-belt marks. These facts indicate that the BT shunt was not damaged by simple external pressure, but the tear may have been caused by shearing force. Overtwist by the high-energy impact possibly overloaded the anastomosis of the BT shunt which was then torn apart. During the operation we discussed the indication of extracorporeal life support (ECLS) with cardiac surgeons, although ECLS is essentially contraindicated when uncontrollably massive bleeding is observed from great vessels.\textsuperscript{4,5} If ECLS had been applied when bleeding from great vessels still existed, it might have become more uncontrollable because of anticoagulation and high blood flow to the vessels.

We found no reports of bleeding from a BT shunt more than 10 years after total correction of TOF, with only one report of bleeding from the anastomosis just after construction of a BT shunt for TOF.\textsuperscript{6} Therefore, in this case there was no expectation of torn BT shunt before the operation. In addition, we lacked knowledge of the details of the original surgery for TOF, including even the existence of the BT shunt, which also made it more difficult to detect the origin of bleeding. Nevertheless, for future similar cases,
reviewing the preoperative images provides us the following findings implying bleeding from a BT shunt. First, there is discontinuity of the BT shunt on CT scans, even though it can be tracked on previous follow-up CT. Second, hemomediastinum is observed around the edge of the torn BT shunt. Therefore, if we could have recognized the presence of the BT shunt and closely examined the CT scans, we might have predicted bleeding from the BT shunt before surgery. In conclusion, we experienced an extremely rare case of traumatic hemomediastinum and hemothorax in a patient with totally corrected TOF 18 years previously. The cause of bleeding was the BT shunt torn by the high-impact accident, which led to massive bleeding from the pulmonary and subclavian arteries.

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REFERENCES


FIGURE LEGENDS

Figure 1. Radiological images before the current trauma. (A) Chest X-ray 6 months before the injury had no apparent abnormality. (B–D) Chest CT scans at 9 years old. Arrowhead indicates BT shunt. SVC, superior vena cava.

Figure 2. Radiological images at admission. (A) Chest X-ray revealed no transparency in right chest, which implied hemothorax. (B–D) On chest CT scans, subclavian artery side of BT shunt (arrowhead) was disrupted, and fluid collection around it and right pleural effusion were observed.

Figure 3. Intraoperative images. (A and B) Dissection of severe adhesion of right upper lobe (RUL) discovered massive bleeding from BT shunt or right subclavian artery. (C and D) Bleeding from the torn BT shunt stopped by compression. Injury of the subclavian artery was repaired by suture. (E and F) The torn BT shunt was clipped with a surgical clip.
Declaration of interests

☒ The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

☐ The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: