Case Report

Delayed diagnosis of traumatic ventricular septal perforation in penetrating chest injury: hematoma formation in the ventricular septum in CT suggests perforation

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Background: Ventricular septal perforation (VSP) can be caused by a penetrating cardiac injury. Diagnosis of VSP tends to be delayed because a shunt might not be detected by color flow Doppler at an early stage following injury.

Case presentation: A 60-year-old man with depression was admitted to the emergency center after a knife injury in the chest. A focused assessment with sonography for trauma revealed cardiac tamponade. Shortly after an open cardiac massage and a pericardiotomy, his spontaneous circulation returned. At a later stage, follow-up computed tomography, echocardiography, and left ventriculography showed traumatic ventricular septal perforation. Conservative therapy was chosen because the pulmonary blood flow/systemic blood flow ratio was 1.42.

Conclusion: The initial contrast computed tomography shows a septal hematoma. Its presence could be perceived as a perforation site in the interventricular septum.

Key words: Heart injury, penetrating, perforation, shunt, ventricular septum

INTRODUCTION

MOST PENETRATING CARDIAC injuries involve the ventricle walls, and only a minority of cases are reported to include injury to the interventricular septum.[1] Diagnosis of ventricular septal perforation (VSP) could be delayed until the patient's clinical status improves.[1–6] It is important to repeat an echocardiography; however, computed tomography (CT) is also useful for anatomical detection.[1,4] We present a case of VSP with hematoma formation in the perforation site on an initial contrast CT. The perforation site in the muscular part of the interventricular septum can be predicted by the presence of hematoma instead of shunt flow.

CASE

A 60-YEAR-OLD MAN who had been suffering from depression stabbed himself in the left anterior chest with a kitchen knife with a blade length of 15 cm. He was transported to our hospital by ambulance. On arrival at the emergency department, he was slightly drowsy but could talk. He had a stab wound with a length of approximately 3 cm in the left anterior chest in the third intercostal space (Fig. 1). His vital signs were as follows: blood pressure, 136/79 mmHg; heart rate, 99 b.p.m.; respiratory rate, 28 breaths/min; body temperature, 36.6°C. Oxygen saturation was 99% under the oxygen rate of 10 L/min using a high concentration oxygen mask. At the physical examination, his breath sounds were diminished on the left side, but his cardiac murmur was not audible. A focused assessment sonography for trauma revealed fluid in the pericardial sac. He was prepared to undergo thoracotomy in the operating

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room; however, immediate transportation into the operating room was not allowed due to congestion. In an initial contrast CT (Fig. 2A–C), we found pericardial effusion and hemothorax on his left side. His blood pressure dropped gradually by cardiac tamponade. Approximately 190 mL blood was aspirated by pericardiocentesis, however, he suffered cardiopulmonary arrest. He underwent an emergent left anterior thoracotomy and a pericardiotomy with removal of a large amount of the hematoma. A stab wound in the anterior surface of the right ventricle was observed and was primarily repaired with 4-0 Prolene sutures reinforced with Teflon pledgets. The injury was remote from the left anterior descending coronary artery, which appeared uninjured on inspection. Shortly after we undertook resuscitation with an open chest cardiac massage, his spontaneous circulation resumed. Circulation dynamics of the patient then stabilized. On day 22 of his stay in the hospital, he did not have chest discomfort at rest; however, he felt shortness of breath when walking. A cardiac catheterization was carried out to obtain a more accurate shunt fraction, and coronary angiography indicated 90% stenosis in the middle portion of the left anterior descending artery (#7) during right ventricular wall repair. A left ventricle angiogram showed that the pulmonary blood flow/systemic blood flow ratio (Qp/Qs) was 1.42. On hospital day 24, a contrast CT showed traumatic ventricular septal perforation measuring 23 mm (Fig. 2D–F). Follow-up transthoracic echocardiography indicated a 4.1–5.6 mm septal defect with a left-to-right shunt; however, it also showed normal left ventricular wall motion. We chose conservative therapy on the premise of switching to surgical treatment depending on the severity of the cardiac symptoms. On hospital day 36, he was transferred to another psychiatric hospital. Six months after admission, echocardiography indicated no specific abnormal findings, the VSP was 4.9 mm, and Qp/Qs was 1.17. Our patient had no symptoms of heart failure, and his Qp/Qs was also reduced, so we considered the possibility of recurrence of VSP was not high.

DISCUSSION

PATIENTS SUSTAINING PENETRATING cardiac injury usually present with either cardiac tamponade or hemothorax and hypotension.[7] Cardiac tamponade provides an early opportunity for survival, and therefore, an urgent release of tamponade seems to be crucial.[2] We could recognize cardiac tamponade relatively easily; however, we could not detect VSP with echocardiography. The initial contrast CT showed an absence of a shunt flow in the interventricular septum but an imaged hematoma at the site. Therefore, hematoma formation in the muscular part of the interventricular septum suggested the presence of a perforation.

Cardiac tamponade reportedly occurs in 55–69% of patients with stab wounds.[2] Although the most common chamber involved in cardiac injuries is the right ventricle, it is clearly due to its anatomical location.[8] Approximately 1–5% of patients present with traumatic ventricular septal defects.[1] Table 1 shows that the time to reach a diagnosis of VSP ranges from 1 day to 10 years.[1–6] It has been postulated that the reason for the delay of VSP is due to a muscle spasm or a blood clot sealing the defect.[9]

Predictors for death include exsanguination, left ventricular or intrapericardial great vessel injury, multiple-chamber injury, or a cardiac injury of 2 cm or more.[7] Conservative management is advocated in asymptomatic muscular VSPs, where in the absence of pulmonary hypertension, ventricular

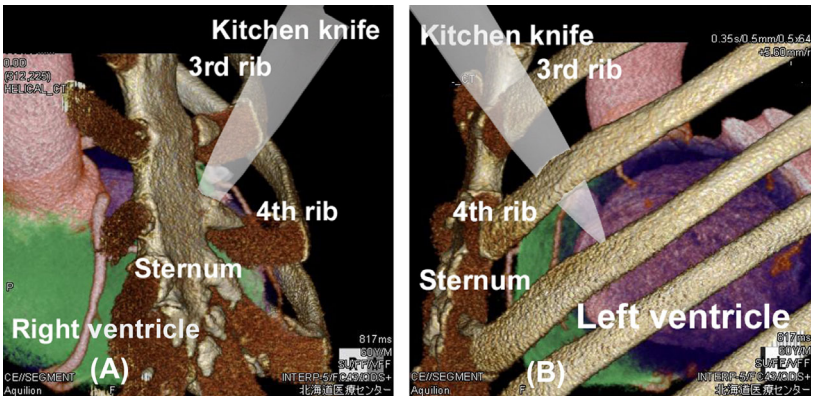

Fig. 1. Entry pathway of a kitchen knife (indicated by a white triangle) into the chest of a 60-year-old man is estimated from the position of ventricular septal perforation, as shown by computed tomography. The patient grabbed the knife with the right hand and stabbed himself in the third intercostal space.

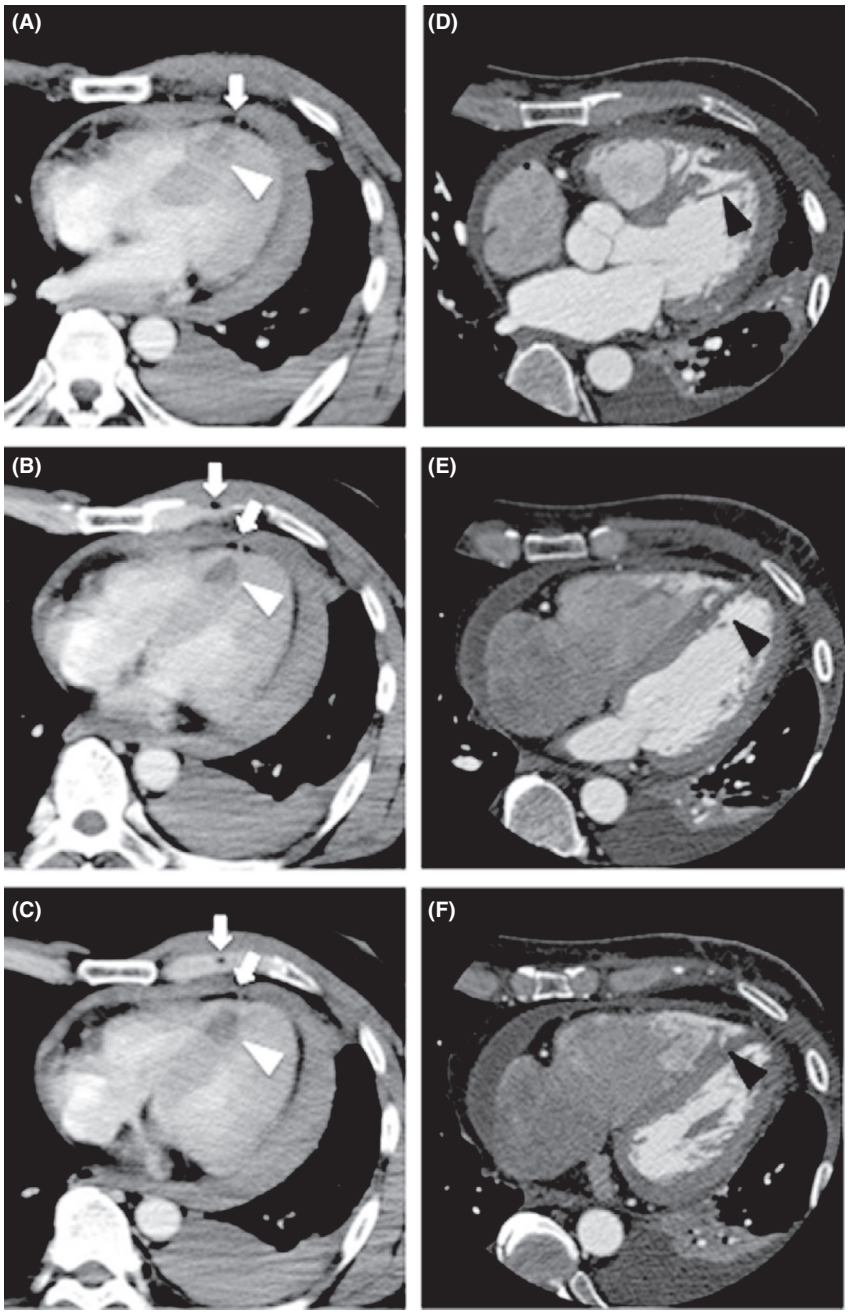

Fig. 2. A–C, Initial contrast computed tomography of a 60-year-old man with a self-inflicted knife injury to the chest reveals the extent of a low attenuation lesion (hematoma; white arrowhead) at the muscular part of the interventricular septum. The pathway of the knife is recognized in the right ventricle from the chest wall (white arrows). Hematoma (white arrowhead) of the muscular part of the interventricular septum is on the extension line. D–F, Follow-up contrast computed tomography shows the traumatic ventricular septum perforation at the right ventricular mid-anteroseptal wall (black arrowhead).

dimensions remain normal and Qp/Qs remains <2. To prevent congestive heart failure and pulmonary hypertension, VSPs should be repaired when the defect is large (Qp/Qs ≥ 2.0).[1,3] Patients with small VSPs and no evidence of heart failure can be managed conservatively with serial echocardiography,[5] and in some cases, small defects could even close spontaneously over time.[3] The decision to repair the defect depends on the patient's clinical status, as well as

Table 1. Characteristics of ventricular septum perforation (VSP) are compared with those of other published series

	Published case	Age (years)/Sex	Symptom	VSP			Qp/Qs	Outcome
				Size (mm)	Time of diagnosis	Examination		
1	Sugiyama *et al.*[1]	20/M	NR	23	7 days	TTE, CT	3.7	Surgical repair
2	Ito *et al.*[2]	51/M	SM	5	12 days	TTE	1.1	Observation
3	Ilia *et al.*[3]	45/M	SM	NR	7 months	TTE	3.0	Surgical repair
4	Jeon *et al.*[4]	20/F	Anemia	5	1 day	TTE, CT, MRI	NR	Surgical repair
5	Midell *et al.*[5]	20/M	SM	NR	11 days	AG	1.4	Observation
6	Suenaga *et al.*[6]	30/M	SM	15	10 years	AG	1.96	Surgical repair

AG, angiography; CT, computed tomography; F, female; M, male; MRI, magnetic resonance imaging; NR, not reported; Qp/Qs, pulmonary blood flow/systemic blood flow ratio; SM, systolic murmur; TTE, transthoracic echocardiography.

the findings from the cardiac catheterization.[1] In this case, we selected a conservative observation because the Qp/Qs was calculated to be 1.42 in the left ventricular angiogram.

Echocardiography is useful for providing anatomic details, and it remains the mainstay in the diagnostic management for cardiac trauma. However, it has been reported that the incidence of delayed sequela of penetrating cardiac injury is 23% using echocardiography.[1] If a pneumothorax, wound, or chest tube is at the site where the transducer should be placed, the sufficient preoperative evaluation cannot be carried out in patients with poor image quality. It is conceivable that echocardiography cannot detect shunt flow due to decreased cardiac contractility and hematoma formation at the perforation site. In these cases, additional cardiac imaging techniques, such as CT or cardiac magnetic resonance imaging, can play an important role.[4] Sugiyama *et al.* reported that high-resolution CT identified a posttraumatic VSD that was missed on transthoracic echocardiography.[1]

Even if early transthoracic echocardiography cannot evaluate shunts, hematoma formation in contrast CT suggests the presence of a traumatic ventricular septum perforation. If ventricular perforation is suspected and echocardiography shows insufficient description of the defect, it is worth considering contrast CT.

DISCLOSURE

Approval of the research protocol: N/A.
Informed consent: Informed consent was provided by the patient to present this case.
Registry and the registration no. of the study/trial: N/A.
Animal studies: N/A.
Conflict of interest: None declared.

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