Isolated Right Atrial Tear Following Blunt Chest Trauma

Report of Three Cases

Ber-Ren Fang, MD, Li-Tang Kuo, MD, Chiung-Tsung Li, ¹ MD, and Jen-Ping Chang,² MD

SUMMARY
Blunt chest trauma causing isolated right atrial tear and cardiac tamponade in three patients is reported. All three patients presented with hypotension, elevated central venous pressure and altered consciousness. Echocardiographic examination demonstrated pericardial effusion in all three cases. All three patients underwent operation with a median sternotomy approach without using cardiopulmonary bypass. At operation, two patients had one tear in the right atrium, the other had two tears in the right atrium. All three patients recovered uneventfully. Early use of echocardiography to detect the presence of hemo-pericardium and cardiac tamponade in patients with suspected atrial rupture following blunt chest trauma is advocated. (Jpn Heart J 2000; 41: 535-540)

Key words: Blunt cardiac injury, Atrial tear, Cardiac tamponade

BLUNT chest trauma causing cardiac chamber rupture is rare and carries a high mortality rate. It is estimated that cardiac chamber rupture occurs in 10 to 15% of victims of fatal vehicular accidents.¹ Blunt traumatic ventricular rupture tends to be rapidly fatal and few patients survive. In contrast, blunt traumatic atrial tear tends to have a better prognosis than ventricular tear.²,³ However, the clinical manifestations of blunt traumatic cardiac chamber rupture are usually subtle, and unless the physician has a high index of suspicion, the diagnosis can be missed, resulting in delayed treatment and increased mortality. Herein, we present three cases with blunt traumatic right atrial tear that were successfully treated with cardiorrhaphy.
CASE REPORT

CASE 1: A 26-year-old Chinese female was involved in a vehicle accident with impact of the steering wheel on the anterior chest. She became unconscious immediately. Two hours later, she was transferred to our hospital’s emergency department. On clinical examination, her blood pressure was 56 / 30 mmHg. Neither a pericardial friction rub nor cardiac murmur was heard. Distended neck veins and peripheral cyanosis were noted. Abdominal tapping was attempted but no blood was drawn. Chest x-ray showed normal cardiac size and no evidence of rib or sternum fracture. Electrocardiogram showed sinus tachycardia, with a heart rate of 110 per minute. Central venous pressure measured 25 cm H2O. Hemoglobin was 13.6 g / dl. Blood gas revealed metabolic acidosis (pH = 7.082). Two-dimensional echo-cardiogram (Figure) demonstrated pericardial effusion and a band-like blood clot in the posterior inferior aspect of the heart. Twelve hours after the accident, the patient underwent an operation with a diagnosis of hemopericardium and cardiac tamponade. A median sterno-

Figure. Apical long axis view of case 1 showing pericardial effusion and a band-like blood clot (arrow heads) within the pericardial sac. C=clot; LV=left ventricle; PE=pericardial effusion.
tomy was performed with cardiopulmonary bypass standby. A large amount of hemopericardium was noted and a large blood clot was discovered in the posterior inferior aspect of the heart. A tear in the right atrium near the junction with the superior vena cava was discovered. The tear was controlled with a clamp and was repaired with interrupted sutures. After the operation, the patient's blood pressure elevated to 130 / 90 mmHg and her consciousness became clear. She recovered uneventfully and was discharged on the 8th hospital day.

**Case 2:** A 24-year-old Chinese male riding a motorcycle suffered blunt chest trauma due to a steel rod that had fallen from the trunk in front of him and hit his chest. He became drowsy immediately and was sent to our emergency department. On clinical examination, his blood pressure was 60 / 30 mmHg. Neither pericardial friction rub nor cardiac murmur was heard. Engorged neck veins were noted. Chest x-ray showed normal cardiac size and no evidence of rib or sternum fracture. Electrocardiogram revealed sinus tachycardia, with a heart rate of 120 per minute. Abdominal tapping was attempted but no blood was drawn. Central venous pressure measured 26 cm H$_2$O. Hemoglobin was 13.5 g / dl. Arterial blood gas revealed metabolic acidosis (pH = 7.221). Two-dimensional echocardiogram demonstrated pericardial effusion. Eight hours after the accident, he underwent an operation with the diagnosis of hemopericardium and cardiac tamponade. A median sternotomy was performed. A large amount of hemopericardium was found. A tear in the right atrium near the junction with the superior vena cava was discovered. The tear was repaired with interrupted sutures. After the operation, the patient's blood pressure elevated to 140 / 90 mmHg and his consciousness became clear. He recovered uneventfully and was discharged on the 8th hospital day.

**Case 3:** A 44-year-old Chinese male suffered blunt chest trauma caused by the impact of the steering wheel on his anterior chest. He soon became confused, and was sent to our emergency department. On clinical examination, his blood pressure was 58 / 28 mmHg. Neither pericardial friction rub nor cardiac murmur was heard. Abdominal tapping was attempted but no blood was drawn. Chest x-ray showed normal cardiac size and no evidence of rib or sternum fracture. Electrocardiogram revealed sinus tachycardia, with a heart rate of 110 per minute. Central venous pressure measured 28 cm H$_2$O. Hemoglobin was 13.5 g / dl. Arterial blood gas showed metabolic acidosis (pH = 7.241). Two-dimensional echocardiogram demonstrated pericardial effusion. Four hours after the accident, the patient underwent operation with a diagnosis of hemopericardium and cardiac tamponade. At first, a subxiphoid approach was performed in order
to drain pericardial fluid, but continuous bleeding was noted from the
draining tube, so cardiac chamber rupture was suspected and a median
esternotomy performed immediately. Two tears in the right atrium were
noted, one in the right atrial auricle and the other in the right atrium near
the junction with the superior vena cava. Both tears were repaired with
interrupted sutures. After the operation, the patient's blood pressure ele-
vated to 140 / 80 mmHg and his consciousness became clear. He recovered
uneventfully and was discharged on the 8th hospital day.

**DISCUSSION**

Blunt chest trauma can cause a variety of cardiac injuries, including minor contusion, ventricular septal rupture, papillary muscle rupture, acute myocardial infarction, and rupture of the pericardium or cardiac chamber. Isolated atrial rupture following blunt chest trauma is rare and carries a high mortality rate. In the series of Fulda, twenty-six patients sustained atrial ruptures, 17 cases occurred in the right atrium (65%) and 8 in the left atrium. One patient sustained a bialtrial tear. Two patients had associated ventricular ruptures. The survival rate of 23 patients with isolated atrial tear following blunt chest trauma was 26% (6 of 23 patients). In the series of Martin, fourteen cases sustained cardiac chamber rupture following blunt chest trauma and isolated atrial rupture occurred in 6 cases. Of the 6 cases with atrial rupture, left atrial rupture occurred in 1 (this patient survived) and right atrial rupture occurred in the other 5 cases. Of the 5 cases with right atrial rupture, 3 survived. Perchinsky, et al. reported their experience with 27 patients who sustained blunt cardiac rupture. The ruptured chamber was the right atrium in nine patients (33%), right ventricle in nine patients (33%), left atrium in four patients (15%), left ventricle in two patients (7%), and bichamber rupture (right atrium and ventricle, left atrium and right ventricle, and left atrium and ventricle) in three patients (11%). Four (44%) of nine patients with a right atrial tear and two (50%) of four with a left atrial tear survived. In contrast, a traumatic ventricular tear tends to be rapidly fatal and fewer patients sur-
vive. In Fulda's series of eighteen cases with ventricular tear, none sur-
vived. In the series of Martin of 6 cases with ventricular tear, 3 survived. In the series of Perchinsky, three (33%) of nine patients with right ven-
tricle rupture and both patients (100%) with left ventricle rupture survived. The primary manifestations of cardiac chamber rupture are hypotension and elevated central venous pressure secondary to hemopericardium and cardiac tamponade. However, if there is associated injury elsewhere with
blood loss, the central venous pressure will not elevate. All of our three cases also presented with cardiac tamponade. The value of two-dimensional echocardiogram in the detection of pericardial fluid is well established. Yet, blood clot in the pericardial sac noted by echocardiogram following blunt chest trauma, as presented in case 1, has rarely been reported. Since echocardiography is quickly available and can be performed at bedside, it is considered the best diagnostic tool in the evaluation of patients suspected to have suffered such injuries. The lapsed time from occurrence of the accident to operation in the present three cases was 12 hours, 8 hours and 4 hours, respectively. The data for the three patients are summarized in the Table. The delayed time in treatment in these 3 cases was partly due to delayed transport from the scene of the accident to our hospital and partly because the physician who first saw the patient was unaware. So a high index of suspicion is essential for the diagnosis.

Prompt surgical intervention is recommended in patients with such injuries. Extracorporeal circulation is usually not needed for this kind of operation. None of our three cases needed extracorporeal circulation during the operation. All three patients survived after the operation. The reason for this good result may be due to the fact that the hemodynamic status of these three patients was not severely compromised before the operation.

We conclude that the diagnosis of atrial rupture should be entertained in patients presenting with a history of blunt chest trauma, hypotension and elevated central venous pressure. Early use of echocardiography to

<table>
<thead>
<tr>
<th>Patient No.</th>
<th>Mode of trauma</th>
<th>Rupture site</th>
<th>Lapsed time from trauma to operation</th>
<th>Operative approach</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Impact against a steering wheel</td>
<td>RA, SVC junction</td>
<td>12 hours</td>
<td>Sternotomy</td>
<td>Survived</td>
</tr>
<tr>
<td>2</td>
<td>Hit by a falling steel rod</td>
<td>RA, SVC junction</td>
<td>8 hours</td>
<td>Sternotomy</td>
<td>Survived</td>
</tr>
<tr>
<td>3</td>
<td>Impact against a steering wheel and RA auricle</td>
<td>RA, SVC junction and RA auricle</td>
<td>4 hours</td>
<td>Pericardial window, then Sternotomy</td>
<td>Survived</td>
</tr>
</tbody>
</table>

RA=right atrium; SVC=superior vena cava.
detect the presence of hemopericardium and cardiac tamponade is advocated. Rapid transport of patients from the scene of an accident to the hospital should increase the number of patients with these injuries who can be treated successfully.

REFERENCES