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Case Report

Direct cardiac rupture associated with sternal fracture following blunt trauma: A report of two case

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ABSTRACT

Traumatic cardiac injury is not rare. Especially cardiac contusion with sternal fracture due to blunt trauma in common. But cardiac rupture due to direct injury from fractured sternum in very rare. There were two case of cardiac injury supposed to be due to direct injury from fractured sternum. We operated immediately, so we could save these patients. Our cases show that it's rare but blunt trauma could make sternum fracture with direct injury to right side heart.

Introduction

Bony thorax has some roles for maintain of the chest wall and respiratory function, but another important role is protection of internal organs, such as heart, lung and great vessels. Sternum is anterior part of bony thorax. In most blunt trauma, sternum fracture is due to powerful force to anterior chest wall. So, sternum fracture is associated with cardiac contusion in most cases [1]. Cardiac contusion due to blunt trauma has wide range from insignificant bruises of the myocardium to cardiac rupture [1,2]. Otherwise, cardiac rupture due to blunt trauma is very rare comparing with cardiac contusion [3]. Here, we report two cases of sternum fracture with direct cardiac injury after blunt trauma and were successfully managed after emergency surgery.

Case report

Case 1

A 42-year-old male complained anterior chest pain and dyspnea after being stuck between the wall and falling container. He had hypertension, but he did not take regular medication. Initial systolic blood pressure was 90 mmHg, heart rates were 104 beats/min, respiratory rates were 48 beats/min. In trauma bay, he complained severe dyspnea and paradoxical movement of anterior chest wall was observed. After endotracheal intubation, computed tomography (CT) was taken. His chest CT showed bilateral lung contusion, bilateral hemothorax, sternal body fracture and ruptured pericardium with hemopericardium (Fig. 1-A, B). Under suspicion of cardiac rupture, emergency anterior thoracotomy was performed. Because the sternum was fractured transversely, a low transverse incision on sternal fracture area was made by means of surgical approach for heart injury. Bilateral internal mammary arteries and left internal mammary vein was transected at fractured sternum level. Anterior pericardium was opened about 4 cm and two break points of right ventricular outflow tract (RVOT) was detected. The break points of RVOT were located just posterior to the sternal fracture,

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and were repaired with two pledged sutures. The break point of RVOT was seen due to direct injury of fractured sternum. Transected bilateral internal mammary arteries and vein were ligated and the sternal fracture was fixed with SternaLock® H-plate (Biomet Microfixation Inc., Jacksonville, FL). Post-operatively, the patient recovered without any events. Extubation was done at post-operatively day 4. Post-operative CT showed no extravasation at RVOT (Fig. 2). He was discharged at post-operative day 21. He had no injuries other than his RVOT and sternum, his injury severity score was nine.

Case 2

A 71-year-old male with history of diabetes mellitus and hypertension complained anterior chest pain after driver traffic accident. Initial blood pressure was 100/76 mmHg, heart rates were 113 beats/min, respiratory rates were 22 beats/min. In trauma bay extended focused assessment with sonography for trauma showed some amount of pericardial effusion. After resuscitation, CT showed sternal body fracture and moderate amount of hemopericardium (Fig. 3). The sternal fracture seemed due to steering wheel of car. Exploration was planned for increased amount of hemopericardium. While preparing for exploration, the patient's condition started deteriorating. Heart rates was 100 beats/min and systolic blood pressure was below 50 mmHg. While cardiopulmonary resuscitation including external cardiac massage, the median sternotomy was made. The bleeding focus was anterior wall of right ventricle (RV), which was just posterior to the sternal fracture. Primary closure without establishment of cardiopulmonary bypass was performed first rather than under establishment of cardiopulmonary bypass. Primary closure using pledged sutures was done with finger compression. Fortunately, blood pressure of the patient restored after cardiorrhapy. But arrhythmias such as atrial fibrillation and ventricular tachycardia was developed. The next day, the patient's cardiac rhythm resumed to sinus tachycardia, and the patient could be weaned from ventilator and extubated. The patient was discharged without complications 17 days postoperatively. He had no injuries other than right ventricle and sternum, his injury severity score was 25.

Discussion

We report two very rare cases of right side heart injury associated fractured sternum after blunt trauma. We could save these patients for precise diagnosis, proper surgery plan and management. In first case, sternum was fractured due to powerful force and RVOT rupture was caused by this fractured sternal end. In second case, direct force to the RV would be cause of the RV rupture. Upon arrival at the hospital, if the patient has no sign of life, none of these patients who was diagnosed cardiac rupture could survive [3]. Fortunately, these patients arrived to our hospital alive after injury and both of them was discharged any complications. These patients had a grade IV cardiac injury according to the Organ Injury Scaling committee of the American Association for the Surgery of Trauma [4]. This Organ Injury Scaling committee of the American Association for the Surgery of Trauma could measure the severity of injury and help predict the prognosis of the patients [5,6].

Cardiac rupture due to fractured rib end is rare [7,8]. There were hemopericardium or pneumopericardium in these reported cases. In our cases, CT showed both hemopericardium and pneumopericardium. This could lead to diagnosis of cardiac rupture. In most patients had the diagnosis of hemopericardium, few patients presented clinical sign of cardiac tamponade [3]. Cardiac tamponade depends on tearing of the pericardium and the rate of hemorrhage [9]. So suspicion of blunt cardiac rupture is essential. Sometimes aggressive fluid resuscitation would dismiss the diagnosis of pericardial tamponade [3]. In the second case, increased pericardial fluid

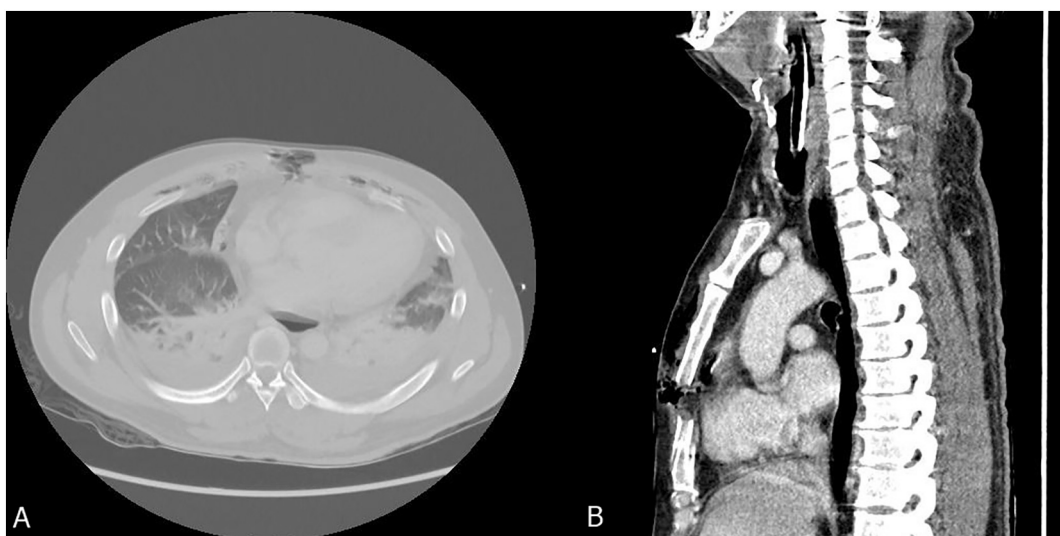


Fig. 1. His chest CT showed bilateral lung contusion, bilateral hemopneumothorax (A), sternal body fracture and ruptured pericardium with hemopericardium (B).

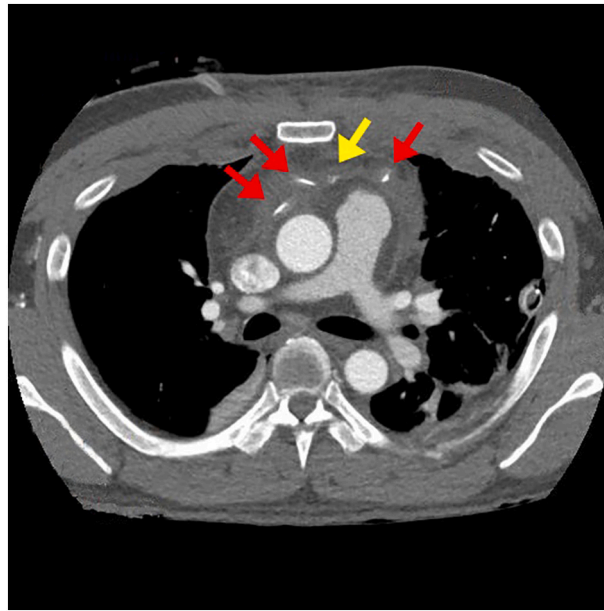


Fig. 2. Post-operative CT showed no extravasation at RVOT. There were pledged suture (yellow arrow) and JP drains (red arrow). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)



Fig. 3. Computed Tomography showed sternal body fracture and moderate amount of hemopericardium.

could lead to diagnosis of cardiac injury. Despite of every effort, cardiac arrest developed. We should take care of these patients carefully.

Treatment of these patient is cardiorrhapy. The choice of incision is debatable [3]. In first case, a low transverse incision on sternal fracture area was made for the sternum was fractured transversely. If the injured site was not seen at this incision, we planned the extension of this incision bilaterally across the sternum into a clamshell. Though this incision had limited exposure of the heart, the injured RVOT was seen directly and repaired easily. In second case, the ruptured RV was repaired thru the median sternotomy due to cardiac massage. We thought that this patient could not survive if we did not make the median sternotomy. In these two cases, median sternotomy provided better exposure of the heart comparing low transverse incision. The median sternotomy provides the most adequate exposure of the heart and easy to establishment of cardiopulmonary bypass [3,10]. On the other hand, left anterolateral thoracotomy might provide rapid access but this incision is limited view to any cardiac structure except the apex of the left ventricle

[3]. For most cardiac rupture is located at right side, left anterolateral thoracotomy might be inadequate access [3]. Thoracotomy is favorable to non-cardiac surgeons, but it also provides limited surgical exposure, which might be fatal in certain condition [10]. Cardiopulmonary bypass is recommended in these patient; massive and sudden bleeding or considerable manipulation to expose and repair the injury, which can cause deterioration in the circulation [9].

Conclusion

When a patient survives the cardiac rupture long enough to reach a hospital, immediate operation is essential. There is no report about direct penetrating injury to RVOT or RV due to fractured sternal end by blunt trauma. We could save these patients for precise diagnosis, proper surgery plan and management.

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