

Successful Emergency Repair of Blunt Right Atrial Rupture after a Traffic Accident

Shinji Hirai, MD, Yoshiharu Hamanaka, MD, Norimasa Mitsui, MD, Mitsuhiro Isaka, MD, and Taira Kobayashi, MD

A 53-year-old man crashed his motorcycle into a vehicle and was transported to our hospital by ambulance after about 30 min. Echocardiography revealed cardiac tamponade. Pericardiocentesis was immediately performed using a 5 Fr catheter via the subxiphoid approach and the results suggested cardiac injury. Surgery was commenced via median sternotomy about 2.5 hours after the accident. Patients with cardiac rupture who reach hospital alive can be saved by rapid transport, early detection, and early surgery. In particular, rapid echocardiography and pericardiocentesis via the subxiphoid approach under ultrasonic guidance are easy and helpful methods of making a diagnosis and achieving hemodynamic improvement prior to surgical intervention. (Ann Thorac Cardiovasc Surg 2002; 8: 228–30)

Key words: right atrial rupture, cardiac injury, echocardiography, pericardiocentesis

Introduction

Blunt chest trauma is common after motor vehicle accidents, but survival after blunt cardiac rupture is rare. Cardiac rupture after blunt chest trauma is a relatively uncommon diagnosis, and it is associated with a very high mortality. Here we report on the successful management of a patient with right atrial (RA) rupture following blunt chest trauma. We also discuss the benefits of pericardiocentesis via the subxiphoid approach under ultrasonic guidance prior to surgical repair of the cardiac injury.

Case Report

A 53-year-old man crashed his motorcycle into a vehicle on August 19, 1998, and was transported to Hiroshima Prefectural Hospital by ambulance after about 30 min. On arrival in the emergency room, he was in severe shock with a systolic pressure of 50 mmHg and a heart rate of

140 beats/min. His neck veins were distended and his extremities were severely cyanotic. He had a facial laceration on the forehead and an anterior chest contusion. Chest X-ray films showed mild cardiomegaly and fractures of the right 5th rib and right clavicle with subcutaneous emphysema. Echocardiography clearly revealed cardiac tamponade. Immediately, pericardiocentesis was performed using a 5 Fr catheter via the subxiphoid approach. Two hundred milliliters of dark venous blood was drained from the pericardial cavity and his blood pressure rose to 117/93 mmHg. Laboratory tests showed metabolic acidosis as well as elevated hepatic and cardiac enzymes (pH: 7.277, BE: -10.2 mmol/l, GOT: 173 mU/ml, GPT: 115 mU/ml, CK-MB: 219 mU/ml). Computed tomography of the head and body was also performed. Head scanning revealed no abnormalities. However, slight pulmonary contusion and right pneumothorax were observed. Since fresh dark blood continued to flow from the pericardial drain tube, cardiac injury was suspected. Surgery was commenced about 2.5 hours after injury. After tracheal intubation, a median sternotomy was performed. The pericardium was not injured, but a 1-cm tear was discovered in the free wall of the right atrium near the appendage when the pericardium was incised (Fig. 1). This tear was directly repaired with pledgeted 4-0 polypropylene monofilament sutures us-

From Department of Thoracic Surgery, Hiroshima Prefectural Hospital, Hiroshima, Japan

Received October 18, 2001; accepted for publication May 16, 2002. Address reprint requests to Shinji Hirai MD: Department of Thoracic and Cardiovascular Surgery, Hiroshima Prefectural Hospital, 1-5-54, Ujinakanda, Minami-ku, Hiroshima 734-8530, Japan.

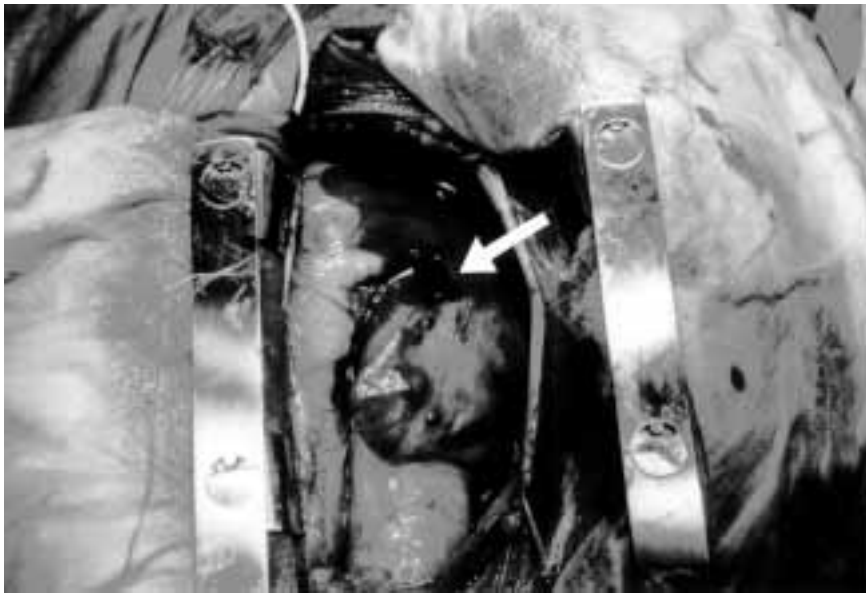


Fig. 1. A 1-cm tear was discovered in the right atrial free wall near the appendage (\Rightarrow).

ing compression. No other bleeding site was found on the cardiac surface or the great vessels. Pericardial, mediastinal, and right chest drain tubes were placed. His postoperative recovery was uneventful and the patient was discharged on the 22nd postoperative day.

Discussion

Cardiac rupture is a common cause of death after blunt chest trauma. In autopsy series, it was reported to be detected in 36-65% of deaths.^{1,2)} Survival for long enough to reach hospital after cardiac rupture is rare, being reported in 0.3-1.1% of patients.¹⁾ The first successful surgical repair of blunt myocardial rupture involved the repair of an RA injury by Desforges, et al. in 1955.³⁾ In Japan, to our knowledge, only 14 patients have undergone successful emergency repair of RA rupture after a traffic accident, including our own case (Table 1). The cause of RA injury was motor vehicle accidents in nine cases, motorcycle accidents in two cases, and injury to a pedestrian in one case. Symptoms on arrival at hospital were as follows: hypotension (75%), tachycardia (55%), associated chest injuries (50%), and coma (11%). Clinical evidence of cardiac tamponade includes hypotension, elevated central venous pressure, and muffled heart sounds (Beck's triad), but all of these clinical manifestations are not always present and clinical signs may be absent or masked by hypovolemia due to associated injuries. The diagnostic examinations used to investigate cardiac tamponade were echocardiography in 64%, chest X-ray in 55%, and computed tomography in 18%. Echocardi-

graphy in the emergency room is thought to be very helpful for diagnosis. Sixty-seven percent of patients underwent pericardiocentesis before surgery. Pericardiocentesis via the subxiphoid approach is not only useful to diagnose and release cardiac tamponade, but also to estimate the site of cardiac rupture. Dark blood draining from the pericardium suggests injury to the right atrium or ventricle, while bright red blood suggests that the left atrium or ventricle is involved. In general, the right heart is believed to be more vulnerable than the left heart, and the atrium is thought to be more frequently injured than the ventricle.¹³⁾ The anatomical location was the RA rupture in five cases, the superior vena cava (SVC)-RA junction in four cases, and the RA free wall in three cases. The appendages are most vulnerable because of their thin walls. Atrial rupture has a different mechanism from ventricular rupture. Atrial rupture can be caused by forceful compression of the thorax and heart during late systole at the time when the atrioventricular valves are closed. Another mechanism could be a sudden increase of venous pressure produced by sudden compression of the abdomen or crushing of the extremities. Conversely, ventricular rupture is caused by direct compression of the anterior chest wall against the vertebral column during end-diastole at the time when ventricular filling is maximal. The surgical approach was median sternotomy in 10 cases and left thoracotomy in 2 cases. We prefer median sternotomy because adequate exposure of the heart and great vessels is obtained and the incision is easily extended for laparotomy. RA rupture can usually be repaired by simple suture under direct compression or application of a vas-

Table 1. Review of reported successful emergency repair of right atrial blunt rupture by traffic accident in Japan

Author	Age (yr)/sex	Etiology	Location of tear	Cardiac tamponade/pericardiocentesis	Surgery	Time to operation
Okabe ⁴⁾ (1982)	–/M	–	RA appendage	Yes/yes	–	–
Okabe ⁴⁾ (1982)	–/M	–	RA appendage	Yes/yes	–	–
Kagaya ⁵⁾ (1982)	36/M	MVA	SVC-RA junction	Yes/yes	MS	6 h
Ueno ⁶⁾ (1986)	48/M	MVA	RA free wall (1 cm)	Yes/yes	MS	3 h
Mashiko ⁷⁾ (1987)	30/M	MVA	–	–	MS	–
Mashiko ⁷⁾ (1987)	44/M	PED	–	–	LT	–
Kato ¹⁾ (1988)	16/M	MC	RA free wall (4 cm)	Yes/no	LT	4 h
Sekiguchi ⁸⁾ (1988)	53/M	MVA	RA appendage (1.5 cm)	Yes/no	MS	4.5 h
Takazawa ⁹⁾ (1991)	60/M	MVA	RA appendage (1.5 cm)	Yes/no	MS	5 h
Honda ¹⁰⁾ (1996)	23/F	MVA	SVC-RA appendage	Yes/yes	MS	16 h
Sugita ¹¹⁾ (1996)	24/M	MVA	RA appendage (1.5 cm)	Yes/no	MS	3.5 h
Sugimoto ¹²⁾ (1999)	23/M	MVA	SVC-RA appendage (4 cm)	Yes/yes	MS	3.5 h
Fujiwara ²⁾ (2001)	30/F	MVA	SVC-RA junction (5 mm)	Yes/yes	MS	5.75 h
Hirai (2002)	53/M	MC	RA free wall (1 cm)	Yes/yes	MS	2.5 h

MVA: motor vehicle accident, PED: pedestrian accident, MC: motorcycle accident, RA: right atrial, SVC: superior vena cava, MS: median sternotomy, LT: left thoracotomy

cular clamp without cardiopulmonary bypass. The time from injury to operation ranged from 2.5 to 16 hours. Although delay in diagnosis and release of cardiac tamponade is the cause of death in cardiac rupture, the diagnosis may be difficult to establish because of multiple organ trauma. The patient with a delay of 16 hours was only found to have cardiac tamponade when the abdomen was explored for hemostasis of a ruptured liver.

Conclusion

We conclude that patients with cardiac rupture who reach hospital alive can be saved by rapid transport, early diagnosis, and early surgical treatment. In particular, echocardiography is an easy and helpful method for diagnosis. Rapid pericardiocentesis via the subxiphoid approach under ultrasonic guidance during the initial exploration is important for confirming the site of injury in a patient with cardiac rupture and for obtaining hemodynamic improvement prior to surgical intervention.

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