

**Clinical report**

# Isolated right atrial rupture because of external cardiac massage after coronary artery bypass grafting

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**Background:** Isolated right atrial rupture is a very rare catastrophic complication of cardiopulmonary resuscitation.

**Objective:** We described a rare case of right atrial rupture after external cardiac massage.

**Methods:** We reported the case of a 62-year-old male patient who developed excessive bleeding following external cardiac massage for sudden cardiac arrest in the intensive care unit after coronary artery bypass grafting.

**Results:** This man underwent successful emergency repair of the tear of the right atrium without using cardiopulmonary bypass.

**Conclusion:** Right atrial rupture can occur after external cardiac massage. An emergency repair is needed.

**Keywords:** Cardiac massage, complication, coronary artery bypass grafting, excessive bleeding, right atrial rupture

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Cardiac arrest is an important cause of morbidity and mortality. Cardiopulmonary resuscitation (CPR) is associated with a wide range of iatrogenic complications. Complications because of cardiac massage were first identified in autopsy cases by Baringer and associates [1].

Closed-chest cardiac massage (C-CCM) for cardiac arrest in cardiac surgical patients can be life-saving, but may cause various injuries. The most common complications of the C-CCM are fractures of the sternum and ribs. These complications may be associated with cardiac injury, pericardial tamponade, and pneumothorax [2-4]. Cardiac injuries include myocardial contusion or laceration, valve insufficiency because of rupture of the valve, interventricular septal rupture, and the rupture of cardiac chambers. If the patient has a chest tube, massive bleeding may also become evident because of the cardiac injury. Isolated right atrial rupture secondary to C-CCM is a very rare, but potentially life-threatening complication.

Herein, we report a case of isolated traumatic rupture of the right atrium following C-CCM in a patient who underwent uneventful coronary artery bypass grafting (CABG), which was successfully treated by primer suture. We also review the literature regarding the topic.

## Case report

A 62-year-old man was admitted to our hospital because of increasing chest discomfort and fatigue suggesting unstable angina for 3 months. He was diabetic and hypertensive. A coronary angiogram showed 90%, 70%, 80%, and 95% luminal narrowing of the left anterior descending, the diagonal, the first obtuse marginal, and the right coronary artery, respectively. Preoperative echocardiography revealed mild mitral regurgitation, no abnormal findings in other valves, left ventricular hypertrophy, and a left ventricular ejection fraction of 40%. The patient underwent uneventful surgery through median sternotomy. Cardiopulmonary bypass (CPB) was instituted using an ascending aortic perfusion cannula and single right atrial cannula with moderate hypothermia. Myocardial protection was accomplished initially with antegrade cold crystalloid cardioplegia via the aortic root and then continued with cold blood cardioplegia. The patient underwent quadruple CABG with connection of the left internal thoracic artery to the left anterior descending coronary artery and a saphenous vein grafts to the diagonal artery, the first obtuse marginal branch, and the posterior descending artery, respectively. The patient was weaned off CPB without inotropic support. He was transferred to our intensive care unit (ICU) and mechanically ventilated and sedated. Four hours after admission to the ICU, the patient was awake. The patient's hemodynamic parameters were stable. He was extubated following

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well-established criteria. His blood pressure was 130/65 mmHg with low-dose nitroglycerin infusion, and a central venous pressure of 8 mmHg. There were no abnormal findings during this early postoperative period. He then suffered a sudden cardiac arrest of unknown underlying cause 16 hours after surgery. C-CCM was performed by an experienced physician. Ten minutes after successful CPR, the patient had abundant bleeding from his chest tubes and bleeding persisted. After rapid intubation, the patient was transferred to the operating room to evaluate the excessive bleeding and correct sudden hemodynamic instability. When the sternum was reopened, a large amount of blood was observed in the anterior and inferior aspect of the heart. A tear at the upper lateral wall of the right atrium adjacent to the appendage was discovered. The defect was clamped and the hemorrhage was controlled. The heart collapsed, but was quickly filled with crystalloid solution and blood provided via the right atrium. During exploration, the heart fibrillated and internal cardiac massage was initiated. Electrical defibrillation was successful. Heart rhythm returned to normal and was regular. After resuscitation, high doses of inotropes were required to maintain blood pressure. The bleeding point at the right atrium was a linear tear of 1.5 cm in length. The rupture of the right atrium was repaired using continuous a polypropylene suture. Further exploration showed no sites of other bleeding, no breakage of the sternal wires, rib or sternal fracture. The bypass grafts were intact.

The patient regained hemodynamic stability before leaving the operating room and his blood pressure was 115/55 mmHg, central venous pressure 12 mmHg, and regular heart rhythm of 98 beats/min. His postoperative course was uneventful and he remained neurologically intact. He was discharged on the tenth postoperative day. At his recent follow-up, 7 years after the operation, he was doing well. Informed consent was obtained from the patient to report this case report and publication was approved by our institutional ethics review board.

## Discussion

Traumatic cardiac injuries are rare, but well described as a complication of various injuries. They appear to be an increasing trend and are associated with significant morbidity and mortality. To understand the types, mechanisms, and complications of cardiac injuries, and the roles of various diagnostic modalities

is important for early diagnosis and treatment [5]. Etiological factors include iatrogenic injuries such as CPR, percutaneous catheterizations, pacemaker implantation, and tube thoracostomy; external traumas including blunt, penetrating, and gunshot injuries; and accidental events such as horse kicks, falls, motor vehicle accidents, and explosion of a tank of compressed air [5-9]. In our case, the etiology was C-CCM.

Cardiac-related injuries are responsible for approximately 25% of traumatic deaths. Injuries to the heart may be the result of blunt or penetrating trauma [5]. The structure most commonly involved in cardiac rupture after blunt trauma is the right atrium [6, 7]. By contrast, the most common site of a penetrating cardiac injury is the right ventricle because it has the greatest anterior exposure [8]. Right ventricle injury was found in 8 of 15 patients treated for heart injury because of penetrating trauma in our clinic [9].

In a study including many high-risk surgeries such as cardiac, thoracic and neurosurgical procedures, Kyokong et al. [10] has suggested that the incidence of intraoperative and 24-h perioperative cardiac arrest was 10.3 and 21.4 per 10000 anesthetics with mortality rate of 48.1% and 74.0% respectively. They conclude that improving emergency trauma facility may increase survival rates.

Cardiac arrest after cardiac surgery may occur unexpectedly during the early postoperative period in hemodynamically stable patients [11]. In cardiac surgical patients, the causes of sudden cardiac arrest are the result of various factors such as arrhythmias, graft failures, or tamponade. These patients require an expert CPR and often reopening of the chest. This usually must include conventional C-CCM, endotracheal intubation, cannulation of peripheral and central vessels for the application of fluids and therapeutic agents, and external defibrillation [12]. Complications of CPR include sternum and rib fractures, mediastinal hemorrhage, hemopericardium, epicardial hematoma, myocardial contusion, valvular injury, lung contusion, pneumothorax, hemothorax, and other visceral organ injuries [3, 4, 13, 14].

Sternum and rib fractures are the most common complications of CPR, in particular when C-CCM is performed in cardiac surgical patients with median sternotomy [3, 13, 15]. The incidence of rib fractures because of conventional C-CCM in the treatment of cardiac arrest in adults ranges from 12.9% to 96.6% and sternal fractures are found in 1.3%–43.3% [15].

Krischer and colleagues [13] have shown cardiovascular lesions to occur in 10.6% of cases in a study of 705 deaths after CPR. Cardiac rupture or laceration may occur primarily because of rib or sternal fractures, insufficient skill of the operator, or preexisting myocardial damage such as myocarditis and acute myocardial infarction [4, 16, 17]. It also occurs secondary to a stronger compression of the heart between the anterior thoracic wall and the vertebral column. Machii and colleagues [2] reported a case of fatal right atrial ruptures and pericardial sac perforation by a fractured sternal edge. Noffsinger and colleagues [3] also reported that vigorous CPR performed on an acutely infarcted heart resulted in lethal cardiac laceration and tamponade. On the other hand, Natsuaki and colleagues [18] reported a survival case of right ventricular rupture induced by CPR in a patient with acute myocardial infarction. Even though CPR-related cardiac rupture is rare, we should be aware of this complication [2]. One mechanism of valvular injury during CPR is thought to involve an abrupt elevation of ventricular pressure from a sudden compression of the heart when the atrioventricular valve is closed [19]. The reported frequency of each type of injury is highest for chordal rupture, followed by rupture of the papillary muscle and leaflet tear. Iatrogenic cardiac injuries secondary to C-CCM are often neglected because of an inexperienced physician or because of significant other associated injuries concealing the cardiac injury [2]. In recent years, however, iatrogenic cardiac injuries have been reported with increasing frequency because of the increased awareness of the relationship between chest trauma and cardiac lesions and the wide application of echocardiography. Cardiac injury is usually diagnosed by echocardiography because overt clinical signs and symptoms maybe are absent. Sudden massive bleeding usually requires reopening of the chest to control hemorrhage and to repair the injury [11].

The case presented herein involved injury to the right atrium, which occurred immediately after C-CCM and resulted in excessive bleeding and hemodynamic instability. It may have occurred as a result of injury by sharp breaks in the sternum during CPR. To our knowledge, this is the first report of isolated right atrial rupture occurring during external cardiac massage in the early postoperative period. Early detection of the injury and exploration and repair resulted in the successful outcome.

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