Case Report

Emergency department initiation of percutaneous cardiopulmonary support for traumatic cardiac tamponade with coagulated pericardial effusion

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ABSTRACT

Cardiac rupture following blunt trauma is associated with a high mortality rate. We present a rescued case of blunt traumatic cardiac tamponade successfully initiated with percutaneous cardiopulmonary support (PCPS) at the emergency department (ED) without pericardiocentesis.

A 27-year-old woman was transferred to our hospital after a motor vehicle accident. She presented with profound shock, and the cardiac portion of the focussed assessment of sonography for trauma (FAST) showed almost coagulated pericardial effusion. We considered that the haemodynamic collapse was caused by cardiac tamponade, and we initiated PCPS in the ED. Subsequently, her systemic perfusion was preserved by PCPS, and she was transferred to the operating room safely. A laceration of the right atrium was successfully repaired. In cardiac tamponade, blood accumulation in the pericardium may be localised and the formation of blood clots may cause difficulty with aspiration. The initiation of PCPS afforded time to surgeons prior to definitive surgical repair and enabled the patient’s transfer to the operating room securely.

This report demonstrated the case of a rare, but successful outcome of resuscitation of a patient with blunt traumatic cardiac rupture with cardiac tamponade. PCPS is considered as an important treatment option in ED for traumatic cardiac tamponade, particularly if the effusion has clotted.

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1. Introduction

Cardiac rupture following blunt thoracic trauma is associated with a high mortality rate and often results in death at the scene. To save such patients, prompt decision-making and rapid sequential treatments are required. In this case report, we present the case of a 27-year-old woman who sustained blunt trauma to the chest, resulting in cardiac tamponade because of a vehicle collision, and we explain our prompt diagnosis that was made in accordance with the cardiac portion of the focussed assessment of sonography for trauma (FAST). Furthermore, we describe successful initiation of percutaneous cardiopulmonary support (PCPS) at the emergency department (ED) as a bridge prior to emergency surgery.

2. Case report

A previously healthy 27-year-old woman was admitted to our hospital after she met with a car accident. She was the single driver of a vehicle that collided head-on with another vehicle. Following the accident, she complained of anterior chest pain, dyspnœa, and appeared pale while in the ambulance. En route to the hospital, the patient was in a state of stupor (Glasgow Coma Scale, E4V3M5), and her pulse over the radial artery was impalpable. By the time she arrived at the hospital, she was restless, her blood pressure was non-recordable and both of her external jugular veins were engorged. Primary examination of the patient only showed an anterior chest bruise and a shallow right knee wound. An immediate FAST showed the absence of intraperitoneal echo-free space in the bilateral subcostal and lower abdominal views; however, the subxiphoid view showed high echoic pericardial effusion, suggesting that the effusion was coagulated (Fig. 1). No major bleeding was observed on chest or pelvic portable radiographs.
We considered that the main cause of the haemodynamic collapse was cardiac tamponade, and the patient was in an impending cardiopulmonary arrest. Moreover, we estimated that pericardiocentesis would be ineffective because the pericardial effusion had clotted, as detected by FAST. Therefore, after orotracheal intubation and initiation of mechanical ventilation, we decided to implement emergent PCPS (CAPIOX EBS, TERUMO Corp, Tokyo, Japan) in the ED, prior to pericardiocentesis.

Canulae (15-Fr and 18-Fr) were percutaneously inserted using the Seldinger technique from the femoral artery and vein, respectively. PCPS in the vena-arterial mode was initiated at a flow rate of 4.0 L min⁻¹ m⁻². The PCPS system consists of a hollow fibre membrane oxygenator with a heat exchanger-pump, centrifugal pump and polyvinyl chloride extracorporeal circuits. To prevent blood coagulation in the circuit of PCPS, heparin (3000 U) was intravenously administrated. After initiation of PCPS, the patient’s systemic perfusion improved (blood pressure, 92/80 mmHg; pulse rate, 110; oxygen saturation (SpO2), 100%). Subsequently, a whole-body computed tomography (CT) scan was performed. The CT scan revealed pericardial haematoma and a small intrahepatic haematoma with a small contrast extravasation. We transported the patient to the operating room and an emergent median sternotomy was performed. A bloody pericardial effusion was obtained when the pericardium was opened. After the haematoma was removed, a 1-cm laceration was found in the right atrial appendage (Fig. 2). The laceration was oversewn using 5/0 polypropylene sutures, and PCPS was discontinued. Two drainage tubes were placed in the pericardial cavity and the anterior mediastinum. After the procedure, we managed the intrahepatic haematoma by transcatheter arterial embolisation under radiographic guidance at the catheter laboratory. The patient was then admitted to the intensive care unit. Within 24 h, 10 U of packed red blood cells, 24 U of fresh frozen plasma and 20-U of platelets were required.

After 2 days, the patient’s tracheal tube was removed, and chest tubes were removed on the fourth day. The patient was then transferred from the intensive care unit to a ward, and she was neurologically intact on the seventh day.

3. Discussion

In previous studies, the incidence of blunt traumatic cardiac rupture among hospital trauma admissions ranged from approximately 0.16% to 2%, and its mortality is reported as 59.7–100%.

Other studies describe that mortality may reach more than 80% even among patients who survive transport to level 1 trauma centre. Another retrospective study of 160 autopsy cases showed that of 40 fatalities from blunt chest trauma, approximately 5% reached the hospital alive, with the majority dying at the scene (86%) or during retrieval (approximately 8%). Most of the patients with cardiac rupture reaching medical facilities present with cardiac tamponade.

FAST’s routine coupling of abdominal and cardiac imaging has been widely instructed and accepted almost universally as a standard approach for trauma sonography. The cardiac component of FAST is aimed at identifying pericardial fluid and cardiac activity. Previous studies have shown that FAST allows for early detection of haemoperitoneum and haemopericardium and it has revolutionised the initial management of trauma patients.4 Ultrasound is a rapid non-invasive test without the risks of radiation or contrast administration, and its use is increasing steadily.

In blunt cardiac rupture, blood accumulation in the pericardium may be localised and the formation of blood clots may result in difficulties with aspiration.56 However, previous studies have raised precautions regarding complications associated with this procedure.1 Although ED thoracotomy is also an important option for traumatic cardiac tamponade, we decided to initiate PCPS because cardiac or trauma surgeons were not available in our hospital at the time, and we estimated that pericardiocentesis would be ineffective because the pericardial effusion had clotted almost completely.

Recently, venaarterial cardiopulmonary bypass, also called venaarterial extracorporeal membranous oxygenation, using the percutaneous insertion method has been widely used for patients with cardiopulmonary arrest resulting from various causes, such as acute myocardial infarction, post-cardiotomy shock, pulmonary embolism and accidental hypothermia.7,8 With trauma patients, however, bleeding complications have been a major limitation to the application to extracorporeal support because of the need for systemic anticoagulation. Recently, advances in anticoagulation management, including heparin-bonded circuits, have reduced the risk of bleeding complications, and a few clinical reports have documented successful treatment in trauma patients.9 Similarly, other studies have shown successful cases that achieved hospital discharge with full neurological recovery after arrest or near-arrest in patients who underwent venaarterial cardiopulmonary bypass initiated by an emergency physician.10

In this case, the initiation of PCPS in ED enabled us to avoid cardiac arrest, to preserve systemic perfusion, and it was possible to perform a full-body CT scan and securely transport the patient to the operating room. Previous studies have demonstrated the utility of the full-body CT scan during early trauma care.11 In this case, CT...
scan revealed liver trauma with contrast extravasation and provided useful information in deciding a treatment strategy.

4. Conclusion

In conclusion, this report demonstrated the case of a rare, but successful outcome of resuscitation of a patient with blunt traumatic cardiac rupture with cardiac tamponade. PCPS is considered an important treatment option in ED for traumatic cardiac tamponade, particularly if the effusion has clotted.

Conflict of interest

There are no conflicts of interest in connection with this article.

References