Successful Resuscitation of a Cardiac Arrest Patient with Ruptured Acute Ascending Aortic Dissection after Pericardial Tamponade

WUN-FU TSAI¹, KWAN-MING CHIU², SHU-HSUN CHU²

Acute pericardial tamponade is one of the common causes of pulseless electrical activity and has a low survival rate as either in-hospital or out-of-hospital cardiac arrest. We present a 50-year-old male with sudden consciousness loss. On arrival at the Emergency Department, he was in a state of out-of-hospital cardiac arrest. Electrocardiogram monitoring(ECG) showed sinus tachycardia. Cardio-pulmonary-cerebral resuscitation was performed and a portable sonogram revealed pericardial effusion. Pericardiocentesis was performed, but this failed to drain the pericardial fluid and clot. Subsequently, subxiphoid pericardiotomy was performed. Heart beat and blood pressure returned and then emergency open-heart surgery was carried out involving graft repair of the ruptured dissecting ascending aortic aneurysm. The patient was discharged in good condition.

Key words: acute aortic dissection, pericardial tamponade, pericardiotomy

Introduction

Among the four common causes of cardiac arrest, ventricular fibrillation (VF), ventricular tachycardia (VT), pulseless electrical activity (PEA) and asystole, PEA has a very low rate of successful resuscitation compared to VT/VF. The term PEA implies rhythm on the monitor without detectable pulse except for VF/VT. People with PEA can be resuscitated if a reversible cause for the PEA is identified and treated properly within a limited time¹,².

The emergency physician needs to find the correctable cause of the PEA in the Emergency Department and attempt to correct it immediately. Acute pericardial tamponade is one cause of PEA. Accumulation of pericardial fluid with an elevation of pressure in the pericardial sac results in impairment of ventricular filling and decreased cardiac output. When the pericardial pressure rises to a level greater than the normal filling pressure of the right heart chambers, this results in cardiac tamponade and there is no cardiac output. The accumulation of fluid may be gradual in most non-traumatic medical cases such as malignancy, infectious diseases, and renal insufficiency, but a sudden large accumulation can occur due to post-myocardial infarct cardiac rupture, with various types of cardiovascular trauma and due to oozing or rupture of the ascending aorta dissection.

Most of the cases have non-specific clinical presentations. Beck’s triad, first described in 1935 (distended neck veins, distant heart sounds and low blood pressure), may be the presenting features³. Pulsus paradoxus is also a non-specific feature. Low voltage and short PR intervals are ECG signs that are suggestive of acute tamponade, but not diagnostic for cardiac tamponade. About 90% of cases show...
sinus rhythm. Most of the patients have an enlarged cardio-pericardial silhouette on a chest X-ray. Right ventricular or atrial diastolic collapse on an echocardiogram is the characteristic finding of the pericardial tamponade. Treatment should start with all general resuscitation measures including cardiopulmonary resuscitation and this should be followed by basic life support procedures, intubation with assisted ventilation, intravenous or intra-osseous access, repeated doses of epinephrine, one dose of vasopressin and intravenous atropine according to the PEA treatment algorithm. If the condition of the patient is unstable, emergency pericardiocentesis with catheter insertion for continuous drainage or pericardiectomy is mandatory. The definitive treatment is the treatment of the underlying cause\textsuperscript{(3-6)}. Here we report a case of PEA due to rupture of the ascending aortic dissection and describe the course of management carried out by us.

**Case Report**

A 50-year-old male was brought to our Emergency Department by an ambulance due to sudden onset of chest pain and collapse while he was smoking after a dinner party. On arrival at our hospital, he had no spontaneous respiration and no palpable pulse. We noted cyanosis of face and neck with cold extremities. No accessible vital signs were noted and both pupils were 4mm in diameter with no light reflexes. ECG revealed short QRS sinus tachycardia, but there was no detectable pulse; based of this, PEA was diagnosed. Our team immediately started to resuscitate him according to the Advanced Cardiovascular Life Support (ACLS) guideline. Immediate cardiopulmonary resuscitation was performed. No tracheal deviation and no asymmetric breathing sounds were detected after endotracheal intubation with mechanical ventilation. A portable sonogram revealed pericardial effusion (Fig. 1). Therefore, we immedi-

![Fig. 1 Pericardial effusion](image-url)
Cardiac arrest with acute aortic dissection

...consulted with a cardiovascular surgeon and performed pericardiocentesis using a long 16-gauge needle; however, this failed. Therefore, we then performed a bedside sub-xiphoid pericardiotomy. An about seven cm long longitudinal midline incision was made and blunt finger dissection under the xiphoid process was used to open the pericardium. About 50ml of blood suddenly rushed out and it was then possible to detect by feel the pumping heart using the tip of a finger. This was the “feeling of saving his life”. We then obtained measurable blood pressure and there was a dramatic improvement in the pupils’ reaction reflecting the possibility of a good neurological outcome. His pulse became palpable and the initial blood pressure after the pericardiotomy was 180/100 mmHg. His cyanosis began to disappear and pupil reactions recovered. The total time for resuscitation at the Emergency Department was 20 minutes from arrival of the patient. We explained the patient’s critical condition to his family by phone from the Emergency Department. The family stated that he was a healthy person except for a history of hypertension. We therefore considered that the possible cause of his acute cardiac tamponade to be cardiovascular in origin. An urgent operation was performed after permission from the family by telephone instead of normal signed paper permission. The operative findings were a 2 cm intimal tear at about 2 cm above from aortic annulus near the lesser curvature and the presence of a large amount of clotted blood in pericardium. A successful resection of the dissected ascending aorta was carried out and replacement with a 30mm Hemashield artificial vascular graft was performed under cardiopulmonary bypass. The patient recovered consciousness two hours after the operation. After a total admission to hospital of 20 days, he was discharged in a well condition and resumed his normal life without any neurological deficit. There have been no complications after 3 years follow up at out patient department.

Discussion

Differential diagnosis of PEA includes the five Hs (Hypovolemia, Hypoxia, Hydrogen ions (acidosis), Hyperkalemia/hypokalemia and metabolic disorders, Hypothermia/ hyperthermia) and the five Ts (Tension pneumothorax, Cardiac tamponade, Thrombosis [coronary], Thrombosis [pulmonary], Toxins/tablets). In cardiac arrest, the diagnosis of acute cardiac tamponade is very difficult because of a lack of specific clinical presentations. Suspicions arise from evidence of PEA and a history including male gender, hypertension, cigarette smoking, cardiac trauma and other previous cardiovascular disorders. Recently, FAST (focus assessment sonography in trauma) has been introduced into emergency medicine and many Emergency Departments possess their own ultrasound devices. Rapid and accurate diagnosis of intra-peritoneal fluid and pericardial effusion in traumatic and non-traumatic cases can be obtained using a sonogram. Sonography is a non-invasive and cost effective procedure in an Emergency Department. In Taiwan, the Taiwan Society of Emergency Medicine and The Society of Ultrasound in Medicine, ROC, provide ultrasound training programs. When the patient is unstable, there is not enough time to obtain a chest x-ray or a CT. Though a transthoracic echocardiogram (TEE) is very sensitive for thoracic aortic dissection, it requires time-consuming preparation for the procedure and has limited availability. In this case, we obtained a diagnosis in a short time using our portable ultrasound system. The accurate diagnosis was based on the evidence of PEA on arrival to Emergency Department, the confining of the cyanosis to the face and neck, short QRS complex sinus tachycardia, middle age male gender with history of cigarette smoking and pericardial effusion on the ultrasound image.

In PEA resulting from cardiac tamponade, effective brain perfusion cannot be achieved even with the cardiopulmonary cerebral resuscitation because...
of the restricted ventricular filling. Immediate release of the effusion is mandatory. A life-saving bedside procedure, subxiphoid pericardiocentesis, with insertion of a catheter, is recommended. A 16 or 18 gauge needle can be introduced from left sternocostal angle and directed toward the inferior tip of left scapula with negative pressure. This procedure is a blind method and has approximately 17% rate of complications including puncturing of a ventricle, damaging a heart valve and damage to a coronary vessel. Alternatively, echocardiographically guided pericardiocentesis can be performed. We failed in our attempt at pericardiocentesis and this may have been due to clotted blood in the pericardium. At that time, the patient condition was worsening (the pupils had become fully dilated with no light reaction and his cyanosis had become pronounced up to his abdomen); therefore, we decided to perform sub-xiphoid pericardiotomy. Immediate consultation with a cardiovascular surgeon is also mandatory when embarking on further resuscitation. Sub-xiphoid pericardiotomy can be performed by an incision of 6-8 cm at upper midline of the abdomen; then the operator can cut off or split the xiphoid process of the sternum to approach the pericardium. This procedure is safer and more effective than percutaneous needle pericardiocentesis. The complication rate is about 1.1%. These include bleeding, myocardial injury, post pericardiotomy syndrome and infection. For an acute onset of cardiac tamponade due to thoracic trauma, lateral thoracotomy is recommended because the surgeon can perform cross clamping of descending thoracic aorta, intra-corporal cardiac massage, and pericardiotomy visually and thus it may be possible to repair the visible lacerated heart and vessels. We did not carry out the creation of pericardial window after the pericardiectomy and so there could be only a temporary relief of the signs and symptoms of cardiac tamponade. To obtain adequate and definitive treatment, our cardiovascular surgeon immediately performed a sternotomy with exploration. He then carried out repair of the ascending thoracic aortic dissection without any time-consuming examinations such as a computed tomographic (CT) angiogram of the aorta. There was no family present at the Emergency Department and the patient was under threat of death. Therefore, we did not obtain a written informed consent for this life-saving procedure but obtained agreement using the telephone to communicate with his family.

Obtaining informed consent for any invasive treatment is the most important right of a patient. Universally, the patient has a right to refuse appropriate treatment even if his refusal is a danger to his life. Nevertheless, in some circumstances, there can be a waiver of the consent. These include: firstly, when the patient is unconscious and in need of an immediate life-saving procedure; secondly, when the patient is mentally impaired and is incapable of making the judgment; thirdly, under a mandatory Government health control program is involved and finally, when a minor is ward of court and the court decides that a specific treatment is in the child’s best interest. In the final situation, for example, parents cannot refuse to give treatment to a child who is a victim of child abuse.

Though emergency medicine and critical medicine are not a sub-speciality of surgery, the physician must perform some invasive procedures in order to save patients’ lives. These procedures include endotracheal intubation, cricothyrotomy, central venous catheterization, per-cutaneous pacemaker application, intraosseous access, venous cutdown, chest tube application, pericardiocentesis, pericardiotomy and thoracotomy with cross clamping of the aorta. Resident physicians need to obtained adequate opportunities for training in these invasive procedures. Therefore, knowledge of and practice of surgery is very important for them. In United States of America, resident training in emergency medicine at many medical centres covers these invasive procedures and educators have suggested practicing on the newly deceased after obtaining consent from the patient’s family.
References

急性主動脈剝離導致心包填塞以及心臟停止
經急救成功之案例

蔡文福1  邱冠明2  朱樹勳3

急性心包膜填塞是無脈性心電異常活動(pulseless electrical activity; PEA)的原因之一，而且不論在院內或院外的心臟停止救命率都不高。我們報告一位50歲的男性突然因昏迷而由救護車送急診室，到達時，病人沒有自然呼吸，而且摸不到脈搏，但床側心電圖顯示器顯示 VARIABLE 心搏過速，所以立刻給予心肺復甦術，攜帶式超音波顯示心包膜內積水，馬上執行心包膜穿刺術，但是失敗，因此改由胸骨剑突下方做心包膜穿刺術，引流心包膜腔積液，術後血壓和心跳馬上恢復，緊急由心血管外科接手施行開心手術，發現升主動脈剝離予以修補手術，經治療後病患恢復正常出院。

關鍵詞：急性主動脈剝離，心包膜填塞，心包膜穿刺術