Case Report

Rescue Pericardial Drainage and Return Connected to ECMO for Aortic Rupture into the Pericardial Sac with Acute Type A Aortic Dissection

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Keywords

Acute type A aortic dissection · Aortic rupture · Cardiac tamponade · Pericardial drainage · Extracorporeal membrane oxygenation

Abstract

We present the first documented case of emergent pericardial drainage and return (PD-R) under extracorporeal membrane oxygenation (ECMO) for the management of aortic rupture into the pericardial sac caused by acute type A aortic dissection (AADA). An 83-year-old woman collapsed during an elective coronary intervention. ECMO was eventually required. Acute accumulation of pericardial effusion with aortic dissection was revealed by echocardiography. Percutaneous pericardial drainage was performed using a drainage line connected to the venous line of the ECMO system to maintain blood flow and blood pressure. After stabilization of the patient's hemodynamics, immediate aortic repair was successfully performed and the patient was discharged with no neurological deficit. In cases of massive amounts of

pericardial drainage and persistent hemorrhagic shock due to aortic rupture with AADA, PD-R connected to ECMO is useful while waiting for aortic repair.

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Introduction

Pericardial drainage (PD) is generally required for treatment of patients with cardiac tamponade due to aortic rupture. Controlled pericardial drainage (CPD), in which elevation of blood pressure is prevented by adjusting the amount of drained fluid, has been recognized as a favorable procedure for critical cardiac tamponade with acute type A aortic dissection (AADA) [1–3]. However, in cases of massive accumulation of pericardial effusion because of aortic rupture, CPD is not sufficient to maintain blood pressure. Here, we report that PD and return (PD-R) connected to extracorporeal membrane oxygenation (ECMO) was effective for the management of cardiac tamponade and hemorrhagic shock due to aortic rupture with AADA.

Case Presentation

An 83-year-old woman with a history of cerebral infarction was hospitalized with a diagnosis of stenosis in the left anterior descending branch. An elective percutaneous coronary intervention was started using a right radial artery approach; however, catheter engagement was difficult because of the tortuosity of the brachiocephalic artery and ascending aorta. She complained of chest pain, followed by loss of spontaneous respiration and palpable pulsations; therefore, cardiopulmonary resuscitation (CPR) was immediately initiated. Because she did not recover, despite continued CPR, ECMO via the right femoral artery and left femoral vein was started. The time from collapse to the induction of ECMO was 11 min.

Subsequently, tracheal intubation was performed, followed by the appearance of cyanosis of the face and distension of the jugular veins. Transthoracic echocardiography revealed the rapid accumulation of pericardial fluid and aortic dissection in the ascending aorta. The patient then underwent CPD for drainage of bloody fluid. However, because it decreased the circulating blood volume and worsened concomitant hemorrhagic shock, her blood pressure and the blood flow during ECMO remained unstable. Then, the drainage route was directly connected to the venous line of the ECMO system, resulting in a flow rate of 2–2.5 L/min (Fig. 1). The hemodynamic state was stabilized by adjusting the ECMO flow via control of the drainage volume of the pericardial effusion, which led to rapid improvement of the cyanosis of her face and the distension of the jugular veins.

Subsequently, computed tomography was performed, which resulted in a diagnosis of AADA with rupture of the ascending aorta (Fig. 2). The patient was transferred to the operating room, with a time from onset to operation of 92 min. The intraoperative findings confirmed the presence of aortic dissection and rupture in the ascending aorta, with an initial tear near the orifice of the left coronary artery and an adventitial tear in the left sinus of Valsalva. Reconstruction of the left sinus of Valsalva and ascending aorta and coronary artery bypass grafting from the aorta to the left anterior descending branch using the saphenous vein graft were performed. The postoperative course was uneventful. The patient had no neurological deficit and was transferred to a rehabilitation hospital 45 days after surgery.

Discussion

Cardiac tamponade, including aortic rupture into the pericardial sac, is one of the most problematic complications of AADA; it can cause rapid deterioration of the hemodynamic state and may result in shock and cardiopulmonary arrest. Among the complications of AADA, cardiopulmonary arrest caused by cardiac tamponade has the worst outcome [4–6]. Pericardial drainage for AADA management has been abandoned, and drainage should be considered only when it is difficult to maintain hemodynamics by the start of surgery [7]. However, we previously reported favorable results of CPD in the prevention of elevation of blood pressure while adjusting the amount of drained fluid [1, 2]. Moreover, CPD was evaluated as class IIa in the guidelines of the European Society of Cardiology [8].

We recently reported the efficacy of CPD and return (CPD-R), in which the drained bloody fluid is returned directly to the venous line for increasing the circulating blood volume simultaneously with drainage in some cases [9]. However, in cases of massive accumulation of pericardial effusion because of aortic rupture into the pericardial sac, CPD is not sufficient to maintain blood pressure. In the case reported here, although ECMO was initiated for CPR and CPD was performed, the hemodynamic state of the patient remained unstable until the drainage line was directly connected to the venous line of the ECMO system.

The advantages of the combined use of PD-R and ECMO included the maintenance of hemodynamics by draining the amount of bloody pericardial effusion, the maintenance of ECMO flow, and the rapid reduction of central venous pressure, which may increase perfusion of the brain. One limitation of this method is the possibility of aeration in the ECMO circuit. We prevented aeration with careful deairing with a one-way valve. In addition, because the drainage route was directly connected to the venous line of the ECMO system, air embolism was less likely to occur due to capture of the centrifugal blood pump or gas exchange devices. Another limitation is that there may be a risk of applying a too high negative pressure to the drainage tube. However, measuring the inner pressure of the drainage tube is impossible in the urgent situation. We think that there can be no other way to check high negative pressure than by verifying resistance while aspirating pericardial fluid with a syringe.

This report demonstrates the usefulness of PD-R connected to an ECMO system for patients with a massive amount of pericardial drainage and hemorrhagic shock complicated by AADA. PD-R connected to an ECMO system is useful while waiting for aortic repair in this patient cohort.

Conclusion

In cases with a massive amount of pericardial drainage and sustained hemorrhagic shock, PD-R connected to an ECMO system is useful for the management of critical cardiac tamponade caused by AADA.

Statement of Ethics

Written informed consent was obtained from the patient for publication of this case report and any accompanying images.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

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Author Contributions

S. Ijuin was involved in main work, data collection, and manuscript writing. M.T., C.N., A.I., S. Izumi, N.I., S.M., S. Ishihara, T.D., and S.N. were involved in data collection and manuscript revision. T. Tsukube was involved in final revision.

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Fig. 1. Controlled pericardial drainage-return connected to an extracorporeal membrane oxygenation (ECMO) system. Pericardial drainage (red arrow) and connection between a pericardial drainage catheter and the ECMO catheter (red circle).

Fig. 2. **a** Enhanced computed tomography (CT) image showing dissection of the ascending aorta with pericardial effusion. **b** Enhanced CT image showing the pericardial effusion and a drainage catheter (red circle).