Percutaneous treatment of right ventricular rupture with ADO II device via subxiphoid pericardial window: After percutaneous treatment of cardiac tamponade

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Introduction

Pericardiocentesis (PC) is essentially a diagnostic and potential life-saving therapeutic procedure. Currently, echocardiography-guided and fluoroscopic-guided PC are considered the standard clinical practice in the treatment of large pericardial effusions and cardiac tamponade (1). The morbidity rate is approximately 1–3% and the mortality rate due to injuries directly caused by the procedure is less than 1% (2). Although considered relatively safe, this invasive procedure may be associated with certain risks and potential serious complications such as mortality, cardiac arrest, pericardial/epicardial thrombus, cardiac chamber laceration requiring surgery, injury to an intercostal vessel, pneumothorax requiring chest tube placement, ventricular tachycardia, pulmonary oedema, local/systemic infection, and cardiac perforation leading to tamponade (1). The cardiac perforation rate is approximately 1% (1). Although cardiac perforation patients are primarily treated by surgical repair, percutaneous treatment is another alternative for patients with extreme tenuous hemodynamic parameters and multiple comorbidities as in our case (3). We report a case of right ventricle (RV) apical wall rupture that occurred during PC, which was successfully repaired percutaneously using AMPLATZER ductal occluder type II (ADO II) (St. Jude Medical, St. Paul, Minnesota, US) devices via subxiphoid pericardial window.

Case Report

A 45 years old man was referred to our hospital after percutaneous treatment of cardiac tamponade from subxiphoid pericardial window in an emergency situation. In his medical history, he had lung cancer and diffuse bone metastasis. On admission, his blood pressure was 80/60 mm Hg, echocardiography displayed a sinus tachycardia rhythm, and spontaneous drainage was not seen from 6F sheath with rapid clotting of aspirated fluid. Transthoracic echocardiography (TTE) showed pericardial effusion with cardiac tamponade signs. With the suspicion of RV rupture, agitated saline serum was used in TTE, which shows that bubbles pass from the pulmonary artery to RV. We confirmed that the 6-F sheath was in the RV and that RV apical rupture was present. Given the presence of multiple comorbidities, critical illness, and hemodynamic instability, surgical repair was considered to have a prohibitive risk and percutaneous closure was performed.

A 0.035-inch hydrophilic guidewire (Radifocus; Terumo, Tokyo, Japan) with 6F Right judkins catheter (Glidecath; Terumo, Tokyo, Japan) was advanced through the 6-F sheath. Angiography showed that the 6F sheath was inside the main pulmonary artery (Fig. 1a, Video 1). Then, a 0.035-inch hydrophilic guidewire was replaced by a 0.035–inch AMPLATZER super stiff wire (Fig. 1b). We then replaced the 6F sheath with 6F delivery system and advanced it to the RV over the stiff wire (Video 2). Based on the known diameter of 6F sheath (1F=0.33 mm, 6F=2 mm) and anatomy of RV rupture area, we used the ADO II 3 mm central waist diameter and 9 mm retention discs diameter. The ADO II device was loaded with the delivery system and advanced into the RV (Fig. 2a). The distal disc was opened in the RV and the entire system was then pulled back as a unit and the distal disc was placed on the RV wall (Fig. 2b, Video 3). The delivery system was withdrawn from of the RV and the proximal disc was opened in the pericardial cavity. Before releasing the device, we checked the device stabilization and leakage by giving contrast medium from the delivery system (Fig. 2c, Video 4). In addition, coronary angiography was performed during the device deployment to exclude possible mechanical compression of the epicardial coronary artery. An angiogram was done after successful deployment of ADO II, which showed us a firm stabilization of the device and absence of leakage into the RV (Fig. 3a, Video 5). In addition, we noticed that the contrast medium used during the procedure remained in the pericardial cavity (Fig. 3b, Video 6). Approximately 500 cc effusion (blood and contrast medium) was evacuated from the pericardial cavity, tamponade was treated successfully, and hemodynamic parameters of the patient became stable (Fig. 3c). The stabilized patient was taken to the intensive care unit. He was discharged nine days later with prescriptions of 75 mg clopidogrel and 100 mg acetylsalicylic acid per day.

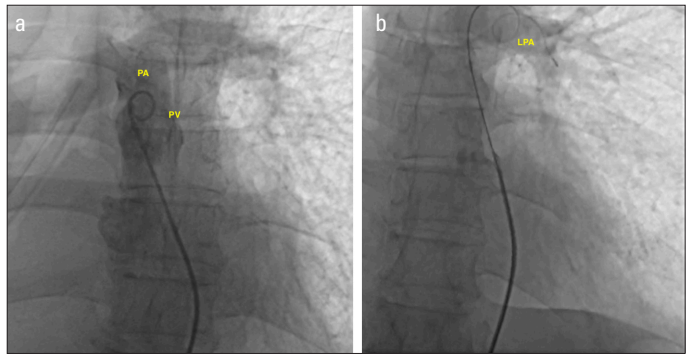

Figure 1. a: Pigtail was advanced through the sheath and angiography revealed that the sheath was inside the main pulmonary artery. b: Stiff wire (arrow) in the LPA
PA - pulmonary artery; PV - pulmonary valve; LPA - left pulmonary artery

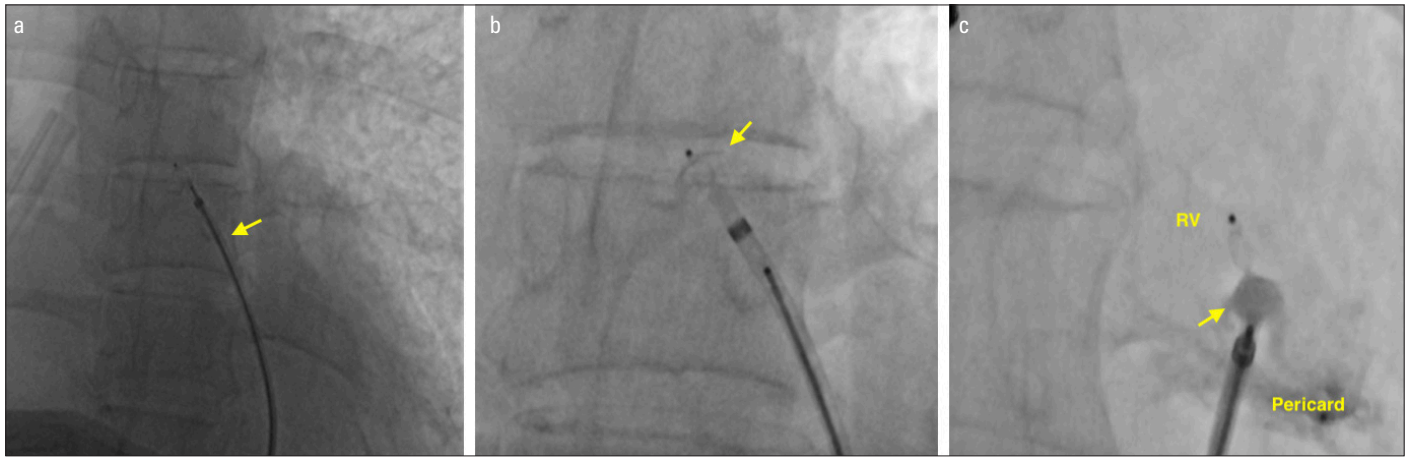

Figure 2. a: ADO II device was loaded with the delivery system and advanced into the RV. b: The distal disc was opened in the RV. c: Giving contrast medium from the delivery system for detecting leakage between RV and pericardium

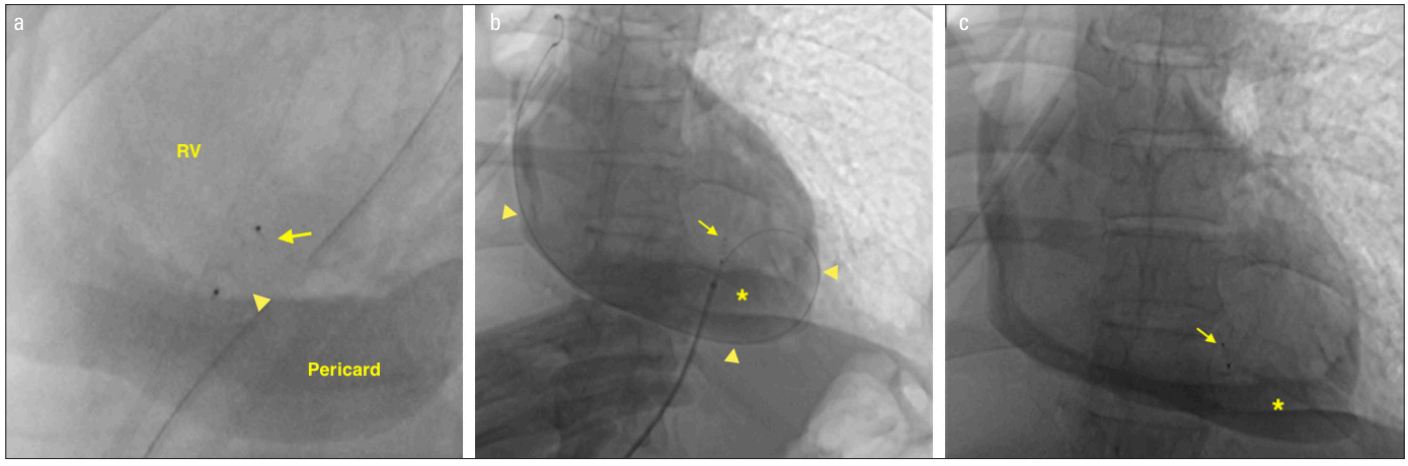

Figure 3. a: Optimal ADO II device configuration after deployment. (arrow: distal disc, arrowhead: proximal disc). b: Contrast medium in the pericardial cavity. (arrow: ADO II device, arrowheads: 0.035 inch hydrophilic wire, asterisk: pericardial fluid). c: Final image after drainage of pericardial fluid (arrow: ADO II device, asterisk: pericardial fluid)

Discussion

Echocardiography-guided PC has the highest rate of procedural success and the lowest major complication rate when compared to blind or surgical methods. The most catastrophic complication of PC is ventricular free wall rupture (VFWR). Surgical repair remains the current mainstay of treatment for VFWR; however, percutaneous closure can be an alternative treatment modality depending on the patient's clinical conditions, multiple comorbidities, and the high risks associated with surgery (4). Therefore, Dar et al. (3) showed that percutaneous repair of RV VFWR with AMPLATZER Vascular Plug devices is a feasible and safe procedure for high surgical risk patients. Due to the presence of multiple comorbidities, critically illness, and hemodynamic instability, we performed the percutaneous intervention procedure. If the percutaneous approach is planned and adopted, the size and diameter of the ruptured segment of ventricle, location and anatomic relationship to the adjacent epicardial coronary tree, and endocardial structures are critical features for deciding the type of percutaneous device (5). In our case, RV apical-lateral segment rupture occurred with 6F sheath (2 mm in diameter) during the PC procedure. In addition, the ruptured segment was far from the epicardial coronary tree and endocardial structures. Percutaneous closure with coils or AMPLATZER occluder devices now offers a feasible alternative for the treatment of these VFWRs via antegrade (transepetal) and retrograde approaches (5). Although the rupture size was small, we avoided the use of coil due to high risk of its embolization and extension into the RV cavity or pericardial space. It is recommended that the device waist be oversized, at least 1–2 mm larger than the pseudoaneurysm neck diameter, in order to provide adequate closure of the neck. In the ruptured segment of the RV, wall thickness was 3 mm. Although 6 mm AMPLATZER Vascular Plug II (AVP II) (3 mm in diameter), which is the smallest length, might be enough to span the ruptured segment of the RV, we did not prefer the usage of AVP II. This is because, during the procedure, AVP II could protrude into the RV cavity or pericardial space, but could not maintain its original configuration. However, ADO II (device length: 4 mm) have enough longer waist lengths, expanded skirts on both sides, which may allow for better device positioning within the ruptured

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segment, and more optimal device configuration leading to occlusion and reduction of the chance of embolization as in our case (6). Another point that should be emphasized is that we performed this procedure successfully via the subxiphoid pericardial window, which is safe and feasible.

Conclusion

Percutaneous closure of RV rupture due to catheter during PC with ADO II device via subxiphoid pericardial window can be safely and effectively performed with good success rates in carefully selected and high surgical risk patients. The size, dimensions of ruptured segments, and relative anatomy are important in planning percutaneous approaches and selecting device. During this intervention, concurrent TTE monitoring with conventional fluoroscopy could provide critical assistance in determining the precise size of the ruptured segment, aid the decision for adequate device selection, and identify complications. Therefore, it would better to use both TTE and fluoroscopy for a successful percutaneous intervention in such cases.

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

Video 1. 6F pigtail was advanced through the 6-F sheath and angiography showed that 6F sheath was inside the main pulmonary artery

Video 2. 6F delivery system was deployed in to the RV

Video 3. The distal disc was opened in the RV and the entire system was then pulled back as a unit, and the distal disc was placed on the RV wall

Video 4. No leakage during deployment process of device

Video 5. Optimal ADOII device configuration after deployment

Video 6. Contrast medium which was used during the procedure has remained in the pericardial cavity

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