Percutaneous suture based device closure of an inadvertent right ventricle perforation following pericardiocentesis

Departments of *Cardiology, and **Cardio-thoracic Surgery, ***Vascular Surgery, Advanced Cardiac Centre, Post Graduate Institute of Medical Education & Research; Chandigarh-India

Introduction

Pericardiocentesis is an emerging, lifesaving procedure in patients with cardiac tamponade. Inadvertent right ventricle (RV) perforation during pericardiocentesis is a life-threatening complication, which often requires an open surgical repair (1). There are few case reports about the percutaneous closure of iatrogenic RV perforation (2-7). Here, we describe a patient with iatrogenic RV perforation, who had an unsuccessful attempt of percutaneous closure with a suture based vascular closure device.

Case Report

A 66-year-old woman presented to the emergency room with progressive dyspnea and cough of 3 weeks’ duration. On examination, she had tachycardia, raised jugular venous pressure, pulsus paradoxus, and muffled heart sounds. Echocardiography revealed large pericardial effusion (Fig. 1a), dilated inferior vena cava with reduced respiratory variation, RV diastolic collapse, and exaggerated respiratory variation in mitral and tricuspid inflow, which was suggestive of cardiac tamponade. Echocardiography guided emergency pericardiocentesis through subxiphoid space was planned. Following the needle puncture and aspiration of hemorrhagic fluid from the possible pericardial space, a pigtail catheter was positioned through a 6F sheath. As continuous aspiration yielded fresh blood without any decrease in pericardial fluid on echocardiography, there was a suspicion of iatrogenic RV perforation. Echocardiography confirmed the position of the pigtail catheter in the RV (Fig. 1b and 1c). She was urgently shifted to the catheterization laboratory. Fluoroscopy confirmed iatrogenic RV perforation with the pigtail being positioned in the main pulmonary artery (Fig. 2a). Another subxiphoid puncture was performed to place a pigtail catheter in pericardial space, and approximately 1 L of hemorrhagic fluid was aspirated to relieve the tamponade. Following pericardiocentesis, she had hemodynamic improvement and was stable. There was no further accumulation of blood in the pericardial space in the next 12 hours.

The cardiothoracic team was consulted for open surgical repair of RV perforation. Following discussion with the cardiothoracic team, the patient, and her relatives, written informed consent was obtained for percutaneous closure of RV perforation, along with the standby support of the surgical team for emergency open repair.

Under local anesthesia, a pulmonary artery pigtail catheter was exchanged with a 0.035,” 150 cm long guidewire and positioned at the distal left pulmonary artery. Over the wire, a Perclose ProGlideTM suture-based device, Perclose ProGlideTM (Abbott Vascular, Santa Clara, CA, USA), was tracked through RV perforation site to the pulmonary artery (Fig. 2b and 3a). Following removal of the guidewire, the device was pulled back till back bleeding from the device lumen stopped. At this position, a suture knot was tied and trimmed by the Perclose knot pusher and trimmer (Fig. 2c). Immediately after the percutaneous intervention, echocardiography showed the gradual accumulation of blood in the pericardial space, which was drained with the pigtail catheter in situ. The patient was immediately shifted to the operation theatre, where a midline thoracotomy

Figure 1. Transthoracic echocardiography showing a large pericardial effusion posterior to the left ventricle in parasternal long-axis view (a), apical four-chamber view (b), and parasternal short-axis view (c) showing a pigtail catheter in the right ventricle (white arrow).
was performed, and a pleuro-pericardial window was made. Approximately, 100 mL of clotted blood was removed from the pericardial space. The RV rent of about 1 × 1 cm size (Fig. 3b) was repaired with 4-0 Prolene pledgeted suture. The device delivered suture knot was found in the pericardial cavity. She remained hemodynamically stable during the postoperative recovery phase. On day 2 of surgery, she had acute shortness of breath and hypotension secondary to massive pulmonary thromboembolism and succumbed to the illness. Histopathological examination of the pericardial tissue showed metastatic signet ring cell adenocarcinoma. The primary malignancy could not be localized during her lifetime, and the patient’s relatives refused an autopsy.

**Discussion**

Echocardiography-guided pericardiocentesis is the standard of care for cardiac tamponade. In the Mayo Clinic series of 1,127 patients of echocardiography-guided pericardiocentesis, the procedural success rate was 97%, and the complication rate was 4.7% (1). A total of 17 (1.5%) patients had cardiac chamber entry/lacerations during pericardiocentesis, of which 5 patients required open surgical repair, and 1 patient died of RV perforation (1). The RV perforation can be life-threatening owing to continued bleeding and tamponade (4). Mortality rates associated with venous catheter perforation can be as high as 65% (4). Surgical repair of iatrogenic RV perforation is associated with
high mortality and morbidity because of compromised hemodynamic state, anticoagulation, or associated comorbid illness (4).

Vascular closure devices (VCD) are commonly used following trans-femoral arterial access and are known to improve patient comfort and shorten hospital stay following percutaneous coronary intervention (8). Suture mediated VCD is a simplified knot delivery with a pre-tied knot, which produces mechanical closure and hemostasis (8, 9). Their off-label use is usually restricted to atypical vascular sites such as subclavian arteries, common carotid artery, and even descending aorta (9-11). Collagen plug based devices (2-5) and septal occluder devices (6, 7) have been used for successful closure of iatrogenic RV perforation. The collagen plug based device was successful even in the closure of right atrial perforation (12). An unsuccessful attempt of RV closure by the septal occlude device is also reported, and the patient finally had an open surgical repair (13). To the best of our knowledge, this is the first attempted case of Perclose ProGlide™ suture mediated device for closure of RV perforation. Though the effectiveness of the suture based device for RV perforation had been demonstrated in situ cadaveric heart (14), we had an unsuccessful attempt in the index case. The possible mechanism of failure was the friable nature of cardiac muscle owing to which the surgical closure was done over pledgets. As the ventricle is in continuous motion, it is possible that the sutures cut through the muscle layer while being stretched when tying the knot. An enlarged RV rent of 1×1 cm on surgical exploration was suggestive of tearing of the RV tissue by percutaneous suture knot of VCD. Retrospectively, a backup guidewire could have been placed across the site for orthogonal deployment of the second device, expecting failure of the first one. When withdrawing the device, we could have maintained guidewire access anticipating failure, which we did not do. In hindsight, it is probably wiser to attempt percutaneous closure of ventricular perforations with collagen plug based occlusive devices like Angioseal (2-5) rather than the suture based devices. The predisposing factors for pre-terminal pulmonary thromboembolism were prolonged immobilization and possible hypercoagulable state secondary to underlying malignancy.

**Conclusion**

We described a patient with iatrogenic RV perforation, who had open surgical repair of the RV rent following an unsuccessful attempt of percutaneous closure by suture based VCD.

**Informed consent:** Informed consent was obtained from the patient’s family for publication of case details and images. All the procedures performed were in accordance with the ethical Declaration of Helsinki. Perclose ProGlide™ is an investigational device used for closure of right ventricular perforation.

**References**

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**Address for Correspondence:** Rajesh Vijayvergiya, MD, Department of Cardiology, Advanced Cardiac Centre, Post Graduate Institute of Medical Education & Research, Chandigarh-India

Phone: +91 172 275 6218

E-mail: rajeshvijay999@hotmail.com

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