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CASE REPORT

Left Ventricular Perforation and Improper Catheter Placement in Ascending Aorta as a Complication of Emergency Pericardiocentesis

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Abstract
Complications associated with pericardiocentesis can be severe and life-threatening. We report a case of a 25-year-old male presented in the emergency department after a polytrauma. The initial full-body scan showed grade I aortic isthmus injury, hemopericardium at 10-mm depth, grade 3 hepatic lacerations, and grade V spleen laceration complicated by hemoperitoneum. The indication for total splenectomy was emergent. Postprocedural, the patient was hemodynamically unstable and an emergency ultrasound-guided pericardiocentesis was performed to treat the hemopericardium. After draining 500 mL of coagulated blood, rupture of the aortic isthmus with pericardial effusion was suspected. A CT angiography showed an improper catheter placement with left ventricular perforation and the presence of the catheter tip in the ascending aorta. Emergency median sternotomy was performed to remove the catheter and to repair the left ventricle. The patient's hemodynamic condition improved hours after intervention, and he was discharged 11 days later. Pericardiocentesis should be performed guided by ultrasonography, and even so, it carries risks of complications. Cardiac injury after pericardiocentesis is a rare but serious complication that must be identified quickly and should be treated by a multidisciplinary team.

Keywords Emergency pericardiocentesis · Pericardium · Heart injury · Polytrauma · Blunt injury · Echocardiography

Introduction

Blunt chest trauma can result in significant cardio-vascular injury including cardiac contusion, valvular dysfunction, aortic laceration, aortic isthmus injury, and hemopericardium. Pericardiocentesis (PC) is performed in the setting of cardiac tamponade to correct the extrinsic compression and to improve the hemodynamic status in instable patients. PC may be carried out blindly or under ultrasonography guidance to reduce the risk of procedural complications. Ultrasound-guided PC is considered the standard clinical practice with low morbidity and mortality that include cardiac perforation or cardiac chamber laceration.

Iatrogenic cardiac tamponade after PC is a serious and life-threatening condition that must be promptly diagnosed and treated. Several options are available (open, endovascular, or percutaneous) in order to repair an iatrogenic cardiac perforation.

Here, we present a case of left ventricular perforation as a complication of emergency PC. Open catheter retrieval and repair of the ventricular perforation were performed.

Case Report

A 25-year-old man was admitted to the emergency department after a high-energy trauma due to a road traffic accident as passenger with seat belt of a vehicle hit by a truck. Initially, he was admitted in a level 2 trauma center where he presented a cardiac arrest that was resuscitated after 5 min of CPR. A full-body scan was performed that showed a grade 5 spleen laceration and grade 3 hepatic lacerations complicated by

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hemoperitoneum, grade 1 aortic isthmus injury, a small uncomplicated pericardial effusion (thickness at the heart posterior surface < 10 mm), left pneumothorax, right hemothorax, and multiple costal fractures.

Because of hemodynamic instability in the context of spleen and hepatic lacerations complicated by a massive hemoperitoneum, an emergency laparotomy was performed. Exploration of the abdominal cavity showed a massive hemoperitoneum evaluated at 3 l, and hemostasis splenectomy was performed associated with direct liver lacerations sutures. The patient was transferred to the intensive care unit for further resuscitation and warming.

Due to poor improvement in hemodynamic status and the presence of a small hemopericardium, an ultrasound-guided PC was performed through a left lateral sternal puncture using a Tray Pigtail Catheter of 8,3fr (Fig. 1) and 500 ml of blood was immediately drained. The patient's hemodynamic condition was stabilized hours after intervention with a new degradation 24 h later.

In the context of recent polytrauma with grade 1 aortic isthmus injury, a new CT angiography including ascending and descending aorta was performed to help the differential diagnosis of aortic rupture and for prepare an eventual endovascular treatment.

Images showed that catheter used during PC had perforated the left ventricle (Fig. 2a), and its extremity was into the innominate artery (Fig. 2b).

Patient was immediately transported to a level 1 trauma center where a vascular and cardiac team transferred the patient to the operating room for catheter removal and left ventricle repair by median sternotomy. Exploration showed that catheter entry point was located next to the left anterior descending artery (LAD) (Fig. 3). This perforation was treated during beating-heart surgery, using teflon 5-0 double pledgeted polypropylene purse suture. The pericardiac cavity was drained with drains, and the left and right pleura were drained as well.

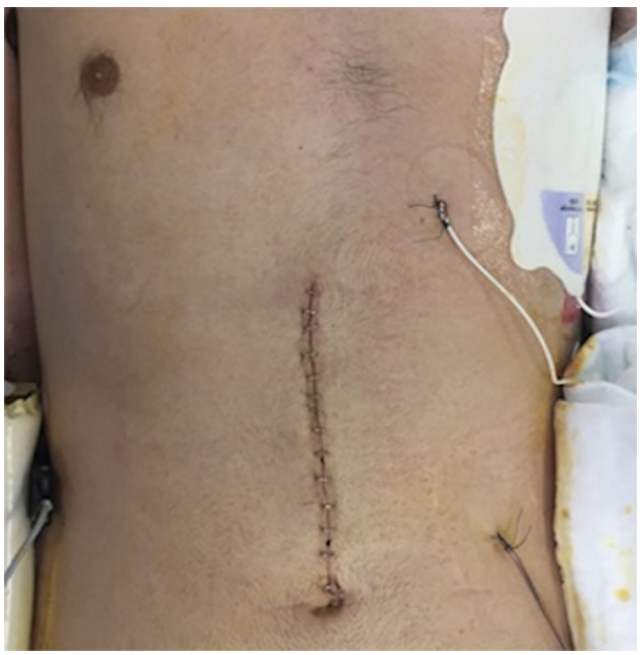

Fig. 1 Patient view with left lateral sternal puncture for the PC

Patient did not present further complications. He was discharged from intensive care unit on day 9 and from the hospital on day 11. After 1 year of follow-up, patient did not experience complication from PC, nor from open repair.

Discussion

Trauma is a leading cause of morbidity and mortality worldwide especially in young patients with a significant portion of these patients presenting cardiac trauma that can vary from 8 to 76% due to a lack of standardized diagnostic criteria [1].

Hemopericardium with rupture of the heart after blunt cardiac injury is a rare condition with an incidence of 0.3% in a series of more than 20,000 trauma victims, but with a mortality of up to 76% [2].

Ultrasound-guided pericardiocentesis is currently considered the standard of care with different site of puncture (subxiphoid, apical, or parasternal) [3]. Apical and left lateral sternal puncture 1 cm below the xiphoid is considered the standard and has greatly reduced complication rates. Several methods are used to avoid complications like US with probe mounted needle or the use of agitated saline after needle insertion. Even so, the overall complication rate ranges between 4 and 10% and wrong paths between 1 and 2% [4].

In case of a large bloody effusion, it is difficult to distinguish between effusion drainage and a cardiac perforation and the catheter must be clamped in case of unexpected high volume or abnormal and misunderstood evolution. A new imagery has to be repeated to exclude any complications.

Left cavities represent most of the posterior surface of the heart and are hidden by the right cavities; thus, this case highlights a rare complication of US-guided PC. To our knowledge, this is the first description of a left ventricular perforation and improper catheter placement up to the ascending aorta.

Minimally invasive management modeled on cardiac procedure was discussed with respect to this case. Transapical left ventricular access is used for diagnostics, hemodynamic assessment, and cardiac interventions [5]. Procedures always involve imaging guidance [6] while CT-fluoroscopy fusion imaging can identify the mediastinal structures and "safe path" for puncture [7]. The percutaneous treatment of cardiac perforation can be achieved by placement of a closure device from Amplatzer family (St. Jude Medical, St. Paul, MN, USA) or specially dedicated devices [5].

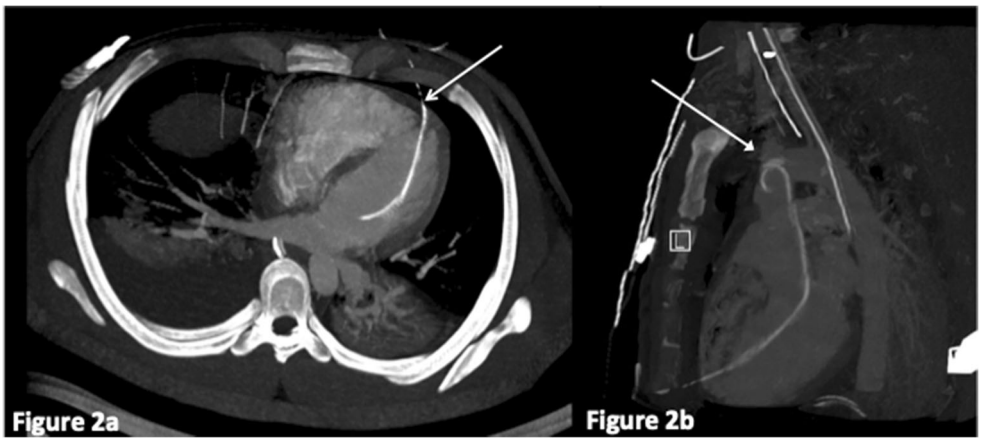

Fig. 2 Multiplanar reconstructions of the catheter path (**a** axial view, white arrow showing entry point on the left ventricle; **b** 3D reconstruction, white arrow showing innominate artery)

Intramediastinal and pericardial rupture may be encountered during trauma of the ascending aorta (twisting movements) [8]. A contained sub-advential aortic rupture can evolve towards complete rupture or progressive posttraumatic pseudoaneurysm (2%). In case of aortic injury associated with iatrogenic perforation of cardiac cavities, an endovascular approach can be considered.

Use of a percutaneous closure system via an exchange over a guide wire or endovascular approach could be considered to close the ventricular injury, but open surgery was performed due to catheter entry point, adjacent to the LAD, and age of patient.

PC is a life-saving invasive procedure, considered relatively safe but it may be associated with procedure-related morbidity and mortality. In a national registries study, Sethi et al. reported a high inpatient mortality (7.8–28%) after pericardiocentesis, particularly when associated with percutaneous coronary procedures or structural hearth interventions [9]. In a study of over 1100 patients, the US-guided PC had a minor complication rate of 3.5% and major complication rate of 1.2% [10]. A systematic review showed that for trauma patients, the survival following PC was 83% and 91% when pericardiocentesis was the sole intervention. For trauma patients who underwent PC followed by a thoracotomy, the mortality was increased at 21% [11].

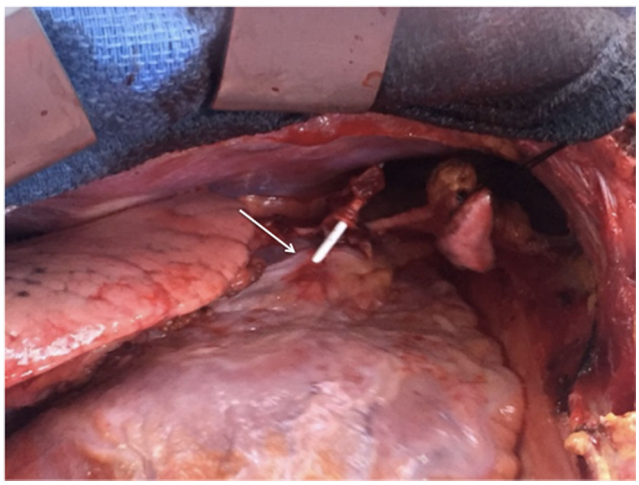

Fig. 3 Intraoperative point-of-view showing catheter entry point located next to the LAD (white arrow)

Conclusion

A left ventricle perforation as complication of an ultrasound-guided pericardiocentesis is rare. Repeated imagery in case of poorly understood of clinical evolution allows identification of such complication. Open surgery is a safe technique for cardiac reparation especially in case of left ventricle perforation closed to coronary arteries that must be done in a level 1 trauma center by a multidisciplinary team.

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Author Contribution All authors contributed to the case report conception, and material preparation, data collection, and image processing were performed by Philippe Tresson, Calin Gheorghe Precup, and Benoit Cosset. The first draft of the manuscript was written by Philippe Tresson, and all authors commented on previous version of the manuscript. All authors read and approved the final manuscript.

Declarations

Consent to Participate Written informed consent was obtained from the patient.

Consent for Publication The patient has consented to the submission of the case report to the journal.

Conflict of Interest The authors declare that they have no conflicts of interest.

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