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Case reports

Percutaneous balloon pericardiostomy for non-surgical management of recurrent pericardial tamponade: a case report

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Abstract. We report the case of a 26-year-old male with recurrent hemorrhagic cardiac tamponade occurring after initial management by needle pericardiocentesis and pigtail catheter drainage. As an alternative to open surgical pericardial fenestration, a percutaneous balloon pericardiostomy was performed with an 18 mm balloon catheter and over-the-wire insertion of a 16 F chest tube for 72 h of pericardial drainage. This non-surgical approach resulted in successful resolution of recurrent cardiac tamponade.

Key words: Tamponade – Balloon dilation

Pericardial effusions with cardiac tamponade are often managed initially via needle pericardiocentesis with placement of a small drainage catheter [1]. Reaccumulation of fluid with recurrent hemodynamic compromise has been traditionally considered an indication for surgical intervention since the initial description of the limited subxyphoid pericardiotomy by Larrey in 1829 [2]. Surgical evacuation of pericardial fluid via the intercostal or subcostal approach involves creation of a pericardial window with or without resection of pericardial tissue [3,4]. This approach often requires general anesthesia and is associated with risks including bleeding, infection, respiratory impairment, and death.

We present a case of recurrent cardiac tamponade in a previously healthy young male. He was managed with percutaneous balloon pericardiostomy and tube drainage, performed under local anesthesia in the catherterization suite as an alternative to traditional surgical management. A review of the technique and potential indications is provided.

Case report

A previously healthy 26-year-old male presented with 2 weeks of upper respiratory illness and 1 week of progressive dyspnea, chest pain, and fever. He denied drug use or recent trauma and had no cardiac risk factors. On arrival he was in moderate distress with blood pressure 118/88 mmHG, an 18 mmHG pulsus paradoxus, pulse rate 106 bpm, respiratory rate 24 breaths/min, oral temperature 38.2 °C, jugular venous distension to the angle of the jaw, distant heart sounds with a 3 component pericardial friction rub, clear lung fields, and a 12 cm non-tender liver detected by percussion.

The patient's electrocardiogram revealed sinus tachycardia and his chest radiograph revealed an enlarged, globular cardiac silhouette. Laboratory values included normal hemoglobin, hematocrit, serum electrolytes, blood urea nitrogen and creatinine. The white blood count was 8200/mm^3 with normal differential and the erythrocyte sedimentation rate was 59 mm/h. Arterial blood gases (room air) revealed pH 7.42, PCO_2 33 mmHG, and PO_2 65 mmHg. An echocardiogram demonstrated a large pericardial effusion with right atrial invagination and lack of inferior vena cava collapse on "sniffing", suggestive of early cardiac tamponade [5, 6].

A right heart catheterization revealed the following pressures: right atrium 18 mmHg, right ventricle 42/19 mmHg, pulmonary artery 38/20 mmHg, and pulmonary capillary wedge 23 mmHg. Thermodilution cardiac output was 6.0 l/min, heart rate was 104 bpm, radial artery pressure 154/60 mmHg with a 20 mmHg paradox, and systemic vascular resistance was 907 dyne·s·cm^{-5}. A subxyphoid pericardiocentesis was performed under fluoroscopic guidance with an over-the-wire introduction of a 7 F 65 cm pigtail catheter (Cook Corp., Bloomington, IN). The initial intrapericardial pressure 22 mmHg and was observed to continuously track a simultaneous right atrial pressure waveform. A therapeutic pericardiocentesis was performed with immediate removal of 730 ml of hemorrhagic fluid and repeat hemodynamics included radial artery pressure 130/60 without pulsus paradoxus, right atrial pressure 15 mmHg, pulmonary capillary wedge pressure 16 mmHg intrapericardial pressure 0 to −3 mmHg, thermodilution cardiac output 11.0 l/min, heart rate 100 bpm, and systemic vascular resistance 603 dyne·s·cm^{-5}. The pericardial pigtail catheter was sutured in place under sterile dressings. The clinical impression was that of early cardiac tamponade, possible myopericarditis, and possible sepsis. Appropriate cultures were obtained and the patient was started on an oral non-steroidal anti-inflammatory regimen.

After 24 h repeat aspiration of the pericardial catheter at the bedside required positional changes to yield an additional 250 ml of fluid. In order to minimize further risk of secondary infection and/or further inflammation related to continued catheter placement, the pericardial catheter was removed. During the subsequent 24 h period, the patient re-developed dyspnea at rest and he gradually became hypotensive with radial artery pressure 75/45 mmHg, paradox 15–20 mmHg, heart rate 138 bpm, and cardiac output decreasing to 3.0 l/min. Echocardiogram confirmed reaccumulation of a large pericardial effusion. At this point, all blood, sputum, urine, and pericardial fluid cultures remained sterile, initial cytologic examination of the pericardial fluid was negative for

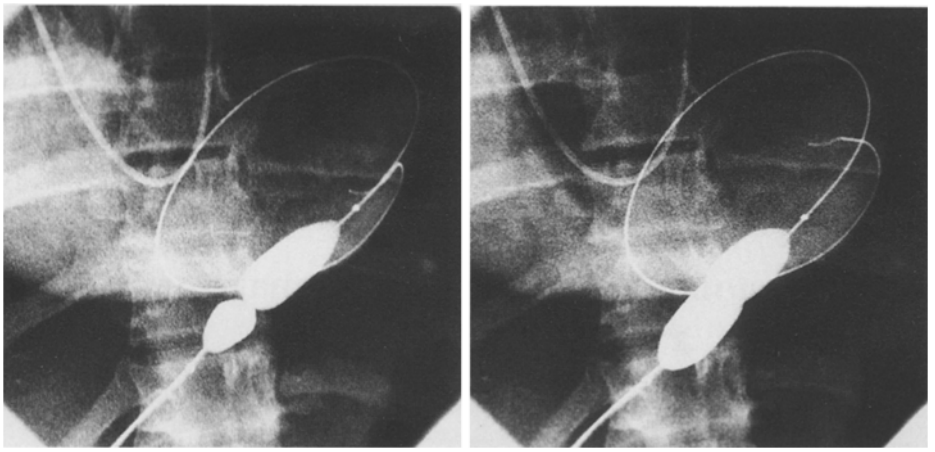

Fig. 1. Postero-anterior projections demonstrating the 18 mm balloon catheter during initial inflation (*left panel*) across the inferior portion of the pericardium. Instillation of a small amount of angiographic contrast media into the pericardium prior to balloon inflation permitted accurate definition of pericardial borders. The pericardial indentation noted during the first balloon inflation (*left panel*) disappeared during the second balloon inflation (*right panel*).

malignant cells, and the presumptive clinical diagnosis was viral pericarditis. For these reasons, the patient was considered to be a candidate for repeat percutaneous drainage of his pericardium as an alternative to traditional surgical intervention with open pericardial fenestration and partial resection.

After obtaining written informed consent, the patient was returned to the catheterization laboratory and received subxiphoid local anesthesia with 1% lidocaine, and sedation and analgesia with small incremental i.v. doses of midazolam (Roche Laboratories, 1.0 mg total dose) and morphine sulfate (4.0 mg total dose). Hemodynamic measurements confirmed recurrent tamponade. Therefore, a subxiphoid pericardial puncture was performed with a Cook needle, a standard 8 F pigtail catheter was reinserted over a guide wire into the pericardial space. A small amount (10–20 ml) of radiographic contrast media was injected to define pericardial limits under fluoroscopic visualization. Then, a 0.038 inch, 300 cm Amplatz extra stiff guidewire (Cook Corp., Bloomington, IN) was inserted into the pericardial space through the pigtail and advanced until it passed freely under the heart in a pattern consistent with intra-pericardial localization. The pigtail was then withdrawn over the stiff guidewire and an 8 F, 39 cm dilator (USCI, Billerica, MA) inserted for tissue dilation, followed by insertion of an 18 mm diameter, 4 cm length balloon valvuloplasty catheter (Mansfield Co., Mansfield, MA). The deflated balloon was easily positioned across the contrast media-outlined inferior pericardial margins. Manual inflations of the balloon catheter were performed (Fig. 1) until the mid-balloon pericardial "neck" was observed to dilate fully. Two such pericardial dilations were performed, during which the patient experienced minimal discomfort and remained hemodynamically stable without bradycardia or hypotension. Following withdrwawal of the balloon catheter over the stiff guidewire, a 16 F tapered thoracic tube (Argyle, Division of Sherwood Medical, St. Louis, MO) was easily passed percutaneously over the stiff guidewire into the pericardial space and connected to a Hemo-Vac (Zimmer, Dover, OH) to provide continuous suction drainage via a closed system. Immediate pericardial drainage produced 550 ml of bloody fluid. The percutaneous pericardiostomy tube was sutured into position and left in the pericardial space for 96 h utilizing sterile dressing changes every 24 h. The patient was continued on indomethacin 25 mg p.o.q.i.d. An additional 1205 ml of fluid was drained with a marked decrease in fluid drainage observed over the subsequent 48–72 h time period. The patient's hemodynamics returned to normal, he defervesced, and both dyspnea and chest pain resolved over 48 h. The pericardiostomy tube was removed at the bedside without difficulty on the fourth day following its insertion, once drainage had decreased to <10 ml over 8 h.

Serial echocardiograms revealed resolution of the pericardial fluid and maintenance of normal cardiac function. Biochemical analysis of pericardial fluid was consistent with a sterile exudate. All pericardial fluid, blood, sputum, and urine cultures were negative, as were serological studies and his PPD (with positive control). The patient was discharged 9 days following admission, managed with a 1 month regimen of oral indomethacin, and has remained asymptomatic with no evidence of recurrent pericardial effusion on follow-up.

Discussion

Optimal management of hemodynamically significant pericardial effusions includes effective drainage of fluid to relieve the vascular obstruction. The percutaneous placement of indwelling pigtail catheters for drainage has been reported [7,8], but these catheters may be ineffective due to catheter clotting. In those patients in whom standard catheter drainage fails to prevent recurrent tamponade, the usual approach is to proceed to open surgical drainage via a left thoracotomy or subxyphoid approach with the creation of a "window" into the pleural or peritoneal spaces.

Recently, Palacios and colleagues [9] reported an initial experience with a percutaneous balloon technique for creating pericardial fenestration and drainage in 5 patients with malignant pericardial effusions and tamponade. In that report, the investigators left a pigtail catheter in place for 2–3 days for continued drainage. All of their patients developed a left pleural effusion, suggesting a pericardial-pleural window had been created.

The technique described in the present report is similar in some respects to that described by Palacios, but one important difference is emphasized. Because of recurrent tamponade despite pigtail catheter drainage, we utilized the technique of balloon dilation to permit percutaneous placement of a large bore 16 F drainage tube into the pericardium, similar to that which would have been placed at open thoracotomy. Effective drainage was achieved and, in contrast to the findings of Palacios and colleagues, no evidence for the creation of a pericardial-pleural communication was observed.

An alternative approach to using the balloon for dilating the pericardium would have been the passage of progressively larger stiff dilators over a guidwire until a large drainage tube could have been passed. However, such an approach would likely have taken additional time, produced more discomfort, and each passage of a progressively larger dilator would have been associated with the possibility of guidewire displacement or stiff dilator perforation. The balloon technique was accomplished in less than 10 min with minimal discomfort in this minimally sedated patient.

While the present patient tolerated this procedure well, several potential disadvantages and complications

need to be recognized. This technique does not provide for obtaining pericardial tissue specimens, as can be easily accomplished at open thoracotomy. Similarly, this technique does not provide the opportunity to mechanically disrupt large amounts of pericardial adhesions. In addition to subjecting the patient to the risks of neddle pericardiocentesis (cardiac puncture, epicardial coronary laceration, intra-abdominal or non-cardiac intra-thoracic organ trauma, pericardiocutaneous fistula), the use of a large balloon catheter would increase the potential for cardiovascular or thoracic trauma if sufficient care is not taken to ensure proper placement. The utilization of intra-pericardial instillation of contrast media prior to balloon positioning assisted in identification of the pericardial-balloon interface prior to inflation. Finally, this technique does not prevent the potential for closure of the pericardial fenestration, a complication that has been reported following open surgical fenestration [10].

The potential advantages of the percutaneous balloon pericardiostomy approch described in this report include the ability to perform the procedure rapidly in the cardiac catheterization laboratory without awaiting availability of an operating room, the lack of need for general anesthesia, and the availability of accurate hemodynamic assessment in the catheterization laboratory before and immediately following the procedure. At present, no standard guidelines are universally accepted for management of pericardial effusions and tamponade. Because of the various etiologies and natural histories of pericardial effusion, the therapeutic approach needs to be individualized. The percutaneous balloon pericardiostomy technique might be considered as an alternative to surgical subxyphoid pericardiotomy in selected patients with pericardial effusions which fail to resolve or which worsen despite conventional therapy with pericardiocentesis with pigtail drainage. This technique should not be utilized in cases of traumatic cardiac tamponade in whom visual inspection of intra-pericardial structures is often required to obtain vascular repair. This technique will require prospective controlled trials in comparison with other established procedures prior to its widespread application.

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