

PULMONARY ARTERY RUPTURE IN A PATIENT RECEIVING AN ORTHOTOPIC HEART TRANSPLANT AFTER TOTAL ARTIFICIAL HEART EXPLANT

KOICHI NOMOTO*, MENACHEM M. WEINER**
AND ADAM EVANS***

Abstract

Our case illustrates a patient who suffered a pulmonary artery rupture despite previous total artificial heart implantation and replacement with orthotopic heart transplant. Pulmonary artery rupture during or following cardiac surgery has been reported to occur due to both pulmonary artery catheter use and surgical technique. Our case is the first to demonstrate the occurrence of this complication in the total artificial heart patient population.

Conflict of interest: none.

Sources of financial support: Intramural departmental funding.

Introduction

Pulmonary artery (PA) rupture is well-recognized and devastating complication that can occur during or following cardiac surgery. The occurrence of PA rupture in a patient who had an orthotopic heart transplant and had previously undergone total artificial heart (TAH) implantation has not been previously reported.

Case Report

A 55-year-old male with history of infective endocarditis, congestive heart failure, hypertension, chronic kidney disease status post re-operative mitral valve replacement, aortic valve replacement and tricuspid valve repair complicated by recurrent perivalvular leakage of the mitral and aortic prostheses, underwent TAH implantation. (SynCardia Systems, Inc, Tucson, AZ). Three months later he was deemed a candidate for heart and kidney transplantation.

* MD, Assistant Professor of Anesthesiology and Critical Care.

** MD, Assistant Professor of Anesthesiology.

*** MD, MBA, Assistant Professor of Anesthesiology and Critical Care.
Affiliation: Icahn School of Medicine at Mount Sinai.

Corresponding author: Koichi Nomoto, MD. Department of Anesthesiology, Icahn School of Medicine at Mount Sinai, New York, NY. One Gustave L. Levy Place, Box 1010; New York, NY 10029. Fax: 212-426-2009. E-mail: koichi.nomoto@mountsinai.org

A suitable donor was identified and he was admitted to the cardiothoracic ICU with a femoral pulmonary artery catheter (PAC) after combined orthotopic heart and kidney transplant and explant of TAH. An intra-aortic balloon pump was placed in the operating room to support end-organ perfusion and was discontinued on POD 2. Continuous veno-veno hemodialysis was initiated on POD 3. The tip of femoral PAC was located at the right main PA confirmed by daily chest X-ray, and was removed on POD 4.

On POD 5, he was successfully extubated to nasal cannula in the morning, but refused to take anything orally. In the evening, a nasogastric tube was placed and associated with mild coughing during the maneuver. This was complicated by sudden onset of increased mediastinal tube output (>1L) and hemodynamic instability. He was emergently intubated and aggressive resuscitation maneuvers were initiated. Transesophageal echocardiogram (TEE) performed immediately at the bedside confirmed the diagnosis of cardiac tamponade. He was taken to the operating room emergently and underwent re-exploration with cardiopulmonary bypass. The bleeding source was identified from a 1cm hole at the left main PA distal to the transplant anastomosis and repaired via pericardial patch. He was transferred back to the ICU in critical but stable condition on high doses of pressors and inotropes.

On POD 7, he developed acute liver failure that required maximum doses of multiple inotropes and pressors. Extracorporeal membrane oxygenation was placed at the bedside in an attempt to salvage the situation. On POD 10, care was withdrawn after multiple discussions of his poor prognosis. His family members refused autopsy.

Discussion

Our patient developed acute postoperative shock from massive bleeding following nasogastric tube placement. The differential diagnosis for the acute onset of shock included aortic dissection, cardiac tamponade, hypovolemia, left and/or right ventricular dysfunction, valvular dysfunction, intra-cardiac thrombus or vegetation and pulmonary thromboembolism. TEE

in the ICU setting has been increasingly used to aid diagnosis and management of patients with acute hemodynamic instability. Wake et al¹ published a retrospective review of post-cardiac surgery patients who received urgent TEE. They indicated that in only 41.5% of cases the presumed clinical diagnosis agreed with the TEE diagnosis. Furthermore, clinical management was changed as a result of TEE findings in 58.5% of patients. If the change in management was a surgical intervention, mortality was significantly lower than pharmacological therapy.

The pulmonary artery catheter (PAC) has been widely used as a diagnostic and hemodynamic monitoring tool since it was first introduced in 1970. However, several studies have demonstrated that the PAC does not improve outcome and is prone to various complications^{2,3}. PA rupture is probably the most disastrous complication associated with the use of PAC. The incidence of PA rupture is 0.01-0.47%, but the mortality rate is 50-75%⁴. The initial presentation may be massive pulmonary hemorrhage, subtle cough with minimal hemoptysis, or may even be totally asymptomatic. Survivors of an initial episode of hemoptysis might develop a pulmonary artery false aneurysm (PAFA) where the tip of PAC was located^{5,6}. Delayed pulmonary hemorrhage occurs in 30-40% of cases of a PAFA induced by PA rupture. This recurrence can be fatal in nearly all cases. Re-bleeding can occur from 2 weeks to 7 months after the initial event⁶. However, PAFA has also been reported to resolve spontaneously⁷. Thus, the incidence of PAFA and PA rupture is probably underestimated since hemoptysis episodes or radiologic infiltrations associated with PAC use are not fully investigated⁵.

The PA rupture in our case was in the left distal PA despite daily chest X-ray confirmation of the tip of PAC located at the right PA. The left PA could have been predisposed to injury from previous PAC use or adhesions from prior surgeries. The coughing during nasogastric tube placement increased his intrathoracic pressure. This was subsequently complicated by PA rupture and cardiac tamponade. The patient could have developed left main PAFA induced by previous PAC placements into left main PA from his two prior cardiac surgeries. On the other hand, one might argue that the surgical technique was associated with PA rupture.

Implantation of a TAH removes the native ventricles and atrioventricular valves but leaves remnants of the atria, pulmonary artery and aorta for anastomoses. However, this is unlikely as the perforation site was beyond the anastomosis area of any of the previous surgeries.

The TAH has been approved by the Food and Drug Administration as a bridge to transplantation since 2004 and for destination therapy since 2012. With expanded indications for its use, the frequency of implantation is expected to rise⁸. Thus, familiarization with the device and complications that can arise is important. Complications that have already been

published include compression of the vena cavae and pulmonary veins^{9,10}. This is the first report of a PA rupture following implantation and then explantation of a TAH.

In conclusion, our case illustrates a patient who suffered a PA rupture following previous TAH implantation and replacement with orthotopic heart transplant. Since PA rupture is a potentially iatrogenic and fatal complication of PAC, the use of PAC should be judicious and limited by proper patient selection. Furthermore, one must remain vigilant to this complication in the TAH patient population.

References

1. WAKE PJ, ALI M, CARROLL J, SIU SC, CHENG DC: Clinical and echocardiographic diagnoses disagree in patients with unexplained hemodynamic instability after cardiac surgery. *Can J Anaesth*; 2001, 48:778-783.
2. RAJARAM SS, DESAI NK, KALRA A, GAJERA M, CAVANAUGH SK, BRAMPTON W, YOUNG D, HARVEY S, ROWAN K: Pulmonary artery catheters for adult patients in intensive care. *Cochrane Database Syst Rev*; 2013, 2:CD003408.
3. MARIK PE: Obituary: Pulmonary artery catheter 1970 to 2013. *Ann Intensive Care*; 2013, 3:38.
4. POPLAUSKY MR, ROZENBLIT G, RUNDBACK JH, CREA G, MADDINENI S, LEONARDO R: Swan-Ganz catheter-induced pulmonary artery pseudoaneurysm formation: Three case reports and a review of the literature. *Chest*; 2001, 120: 2105-2111.
5. BUSSIÈRES JS: Iatrogenic pulmonary artery rupture. *Curr Opin Anaesthesiol*; 2007, 20:48-52.
6. MULLERWORTH MH, ANGELOPOULOS P, COUYANT MA, HORTON AM, ROBINSON SM, PETRING OU, MITCHELL PJ, PRESNEILL JJ: Recognition and management of catheter-induced pulmonary artery rupture. *Ann Thorac Surg*; 1998, 66:1242-1245.
7. YOU CK, WHATLEY GS: Swan-Ganz catheter-induced pulmonary artery pseudoaneurysm: a case of complete resolution without intervention. *Can J Surg*; 1994, 37:420-424.
8. MIZUGUCHI KA, PADERA RF JR, KOWALCZYK A, DORAN MN, COUPER GS, FOX AA: Transesophageal echocardiography imaging of the total artificial heart. *Anesth Analg*; 2013, 117:780-784.
9. ARABIA FA, COPELAND JG, PAVIE A, SMITH RG: Implantation technique for the Cardio West total artificial heart. *Ann Thorac Surg*; 1999, 68:698-704.
10. KONDRUWEIT M, STRECKER T, SEITZ T, UDER M, WEYAND M, TANDLER R: Stenting of the superior vena cava in a patient with a total artificial heart. *J Thorac Cardiovasc Surg*; 2008, 135:455-456.