Case report - Assisted circulation

Atypical tamponade hemodynamic in a patient with temporary left ventricular assist device

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Abstract

Postoperative bleeding and tamponade are considered major complications after implantation of left ventricular assist devices. Firstly, 40% of patients supported by ventricular assist devices experience early postoperative bleeding, and 20% developed tamponade requiring re-exploration. Secondly, we present a case of a patient with tamponade, on temporary left ventricular assist device (LVAD) support with atypical hemodynamic and echocardiographic manifestations demonstrated with computed tomography (CT)-M mode, conventional Doppler, color Doppler and echo imaging.

Keywords: Left ventricular assist device; Tamponade

1. Case report

A 52-year-old male was admitted after several days of chest pain. Anterior wall myocardial infarction was diagnosed and emergent stent was placed in his left anterior descending artery. There was no other significant coronary artery disease. Due to cardiogenic shock an intra-aortic balloon pump was placed. His clinical course was complicated by respiratory failure with need for tracheostomy, pelvic infected hematoma, sepsis, and the need for a high mid-epigastric feeding tube. Presurgical echocardiographic examination estimated ejection fraction to be 10%, and showed severe functional mitral regurgitation, but no aortic regurgitation. Right heart catheterization revealed elevated pulmonary artery pressure (43/30 mmHg), mean wedge pressure (28 mmHg), and mean right atrial pressure (29 mmHg). His cardiac index was 1.8 l/min/m\textsuperscript{2}. It was felt that implantation of a permanent left ventricular assist device (LVAD) will carry a very high risk for localized and/or systemic infection and the patient underwent placement of temporary left ventricular assist device with placement of the inflow cannula in the left atrium (LA), and outflow cannula in the ascending aorta (Fig. 1a,b). The patient’s heart rate decreased to 76 bpm, blood pressure increased to 105/88/93 mmHg, right atrial pressure and pulmonary artery pressure decreased to 13 mmHg and 39/19 mmHg, respectively. Total cardiac index increased to 2.5 l/min/m\textsuperscript{2}, and LVAD flow was 3.3 l/min. All the hemodynamic evalu-
Postoperative bleeding and tamponade are considered major complications after implantation of left ventricular assist devices [1]. It has previously been reported that 40% of patients supported by ventricular assist devices experienced early postoperative bleeding, and up to 20% developed tamponade requiring re-exploration [2]. Tamponade can present as dyspnea, hypoxia, or other forms of hemodynamic collapse. Transesophageal echocardiography may miss the diagnosis and exploratory medial sternotomy may be required to definitively make the diagnosis [2, 3]. Common hemodynamic characteristics of cardiac tamponade, including tachycardia, shock or pulsus paradoxus, may be masked by LVAD action. Therefore, high clinical suspicion is warranted when pump flows are decreased, unresponsive to fluid challenge, or right atrial pressure is suddenly increased [3]. Although regional atypical tamponade with LA compression without RA or RV collapse has been previously described in postsurgical patients [4], the hemodynamic and echocardiographic presentation in our patient was unique in many aspects. Although systemic blood pressure decreased, it was preserved around a mean of
70 mmHg, and did not display respiratory variation (pulsus paradoxus). Despite the circumferential nature of the pericardial fluid, only the right ventricle and LA seemed to be collapsed. Contrary to classic tamponade, in which reciprocal respiratory changes in the RV and left ventricle (LV) relationship are common, our patient’s ventricular septum was constantly shifted to the right, aggravating the restriction to RV filling already imposed by the pericardial fluid. Furthermore, mitral, tricuspid, hepatic vein, and pulmonary vein flow did not change during the respiratory cycle. Finally, as opposed to the ‘classic’ end diastolic equalization of pressure in all cardiac chambers, our patient had low left atrial and pulmonary artery pressures, driving flow towards the LA from the right and LVs. These features derive from the unique hemodynamic environment created by a temporary LVAD. The pericardial fluid restricted right ventricular inflow, resulting in increased right atrial pressure. The continued suction from the inflow cannula in the LA, in addition to reduced RV output, resulted in left atrial collapse. The negative pressure in the LA produced backward movement of the mitral leaflets, abolishing any forward flow into the LV, and creating systolic and diastolic mitral regurgitation. Furthermore, the compressed LA distorted the integrity of the aortic annulus, creating new onset aortic regurgitation. The continued yet diminished LVAD flow into the aorta, induced preferential backwards flow from the aorta into the LV. This culminated in a futile cycle of flow from the LA to the LVAD and aorta, with backward flow to the LV and LA. Suction from right ventricle created by the negative left atrial pressure, combined with the elevated left ventricular pressure from aortic regurgitant flow, resulted in shifting of the interventricular septum towards the right.

In conclusion, with LVAD circulation, typical clinical, hemodynamic, and echocardiographic signs of tamponade may not be present. Tamponade should be suspected whenever pump flows are decreased and filling pressures are increased, especially if not responsive to a fluid challenge.

References