Case report - Assisted circulation

Right ventricular failure after left ventricular assist device implantation with concomitant pulmonary embolectomy needing right ventricular assist device support in a patient with terminal heart failure and asymptomatic pulmonary thrombus

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Abstract

We present a case in which a left ventricular assist device (LVAD) was implanted in a patient with terminal heart failure and preoperatively diagnosed asymptomatic thrombus in the right pulmonary artery. LVAD implantation was performed with concomitant thromboembolectomy in deep hypothermic circulatory arrest (DHCA) and intra-operatively right ventricular assist device (RVAD) implantation for the treatment of acute right ventricular failure became necessary. The patient was weaned from the RVAD after eight days of support.

Keywords: Terminal heart failure; Left ventricular assist device; Asymptomatic pulmonary thrombus; Right ventricular assist device

1. Background

Congestive heart failure is considered a major risk factor for venous thromboembolism, defined as pulmonary embolism (PE) and/or deep venous thrombosis, particularly in patients < 40 years of age with exceedingly high relative risk for PE [1]. It is estimated that between 0.1% and 0.5% of patients who survive develop chronic pulmonary hypertension [2, 3]. We present a case in which a left ventricular assist device (LVAD) was implanted in a patient with terminal heart failure, who had preoperatively diagnosed asymptomatic thrombus in the right pulmonary artery. Concomitant with LVAD insertion thromboembolectomy in deep hypothermic circulatory arrest (DHCA) was performed. For the treatment of acute RV failure (RVF) right ventricular assist device (RVAD) implantation became necessary.

2. Case report

A 43-year-old man with ischemic cardiomyopathy and double-vessel coronary artery disease with very depressed left ventricular function (LVEF 15%) was admitted to our institution in stable condition without catecholamine support and breathing spontaneously in room air, for evaluation of the indication for heart transplantation or ventricular assist device implantation. The patient had a history of recurrent deep venous thrombosis (4 episodes documented between 2003 and 2005) with marcoumar therapy. He reported having had sporadic hemoptysis in the previous eight weeks. Transthoracic echocardiography (TTE) showed dilated right ventricle, tricuspid valve incompetence grade II and severe global hypokinesia with ‘low output’ syndrome. A pulmonary artery catheter was placed and measurements performed: mixed oxygen venous saturation was 53.8%, pulmonary artery pressure 58/30–41 mmHg, PCWP 20 mmHg, TPG 21 mmHg, CVP 22 mmHg and CI 2.2 l/m²/min. Computer tomography of the chest identified a large fresh thrombus in the lumen of the right pulmonary artery with 80–90% narrowing. The left pulmonary artery was shown to be free of thrombi. Due to high TPG LVAD implantation was scheduled as bridge-to-transplantability with concomitant pulmonary thromboembolectomy in DHCA, and short-term use of an RVAD of type Levitronix (Waltham, MA) was planned in the case of high risk for intraoperative development of RVF.

After sternotomy and bicaval connection of the patient to the cardiopulmonary bypass (CPB) thromboembolectomy of the right pulmonary artery (PA) in DHCA (18 °C) for 27 min with inspection of the left PA was performed. The large thrombus was evacuated from the lumen of the right PA; the left PA was free of thrombi. A Berlin Heart LVAD of type INCOR I was implanted in the standard manner in the fibrillating heart. Transesophageal echocardiography showed optimal LVAD cannula position without signs of malposition or intracardiac obstruction. After rewarming, careful deairing and initiation of LVAD, NO inhalation at 40 ppm was started with high dosage of catecholamines (adrenalin 0.3 mg/kg/min). Pulmonary artery pressure...
measured by pulmonary artery catheter decreased by up to 20% of the preoperative value. After separation from CPB right heart failure occurred: 'low flow' of the LVAD, ballooning of the RV, shift of the interventricular septum to the left side, poor RV systolic function, and CVP >20 mm. CPB was therefore restarted. A Levitronix RVAD with original inflow and outflow cannulas was implanted in the right atrium and pulmonary artery without a second attempt at CPB weaning.

After discontinuation of CPB the LVAD and RVAD were producing flow of 5.5 l/min and 5.0 l/min, respectively, and CVP was maintained at 10 mmHg. Rethoracotomy was required on the first postoperative day (POD) due to diffuse bleeding (oozing, not surgical bleeding). Under echocardiographic monitoring of RV functional status we started with RVAD weaning. In TTE examinations performed daily, progressive improvement of RV function was documented. On POD #7 RVAD flow was further reduced to 1 l/min and NO inhalation was reduced to 20 ppm. On the 8th POD the RVAD was successfully removed. Nine days after RVAD removal adrenalin was discontinued and the patient was free of catecholamine support with good systolic function of the RV (RVEF 40%, RVEDD 29 mm), CVP level of 10–15 mmHg and stable LVAD flow of 5 l/min. The patient required a prolonged ICU stay of 83 days and was transferred to the regular ward of his local hospital, where he received physiotherapy and was mobilized. Unfortunately he died because of sepsis after 161 days of LVAD support.

3. Discussion

Right ventricular failure developing after LVAD support has shown unfavorable outcomes with subsequent long stay in intensive care and high hospital mortality [4]. PE itself may lead to acute right ventricular failure despite successful surgical embolectomy due to severe ischemia reperfusion injury of the lung, decrease of contractility of RV aggravated by cardioplegia in the case of CPB with DHCA. To avoid deterioration of severe pulmonary ischemia reperfusion injury due to increased pulmonary flow by RVAD, some authors have used ECMO shunting between the right and left atrium to maintain sufficient preload for LVAD and also to prevent pulmonary injury due to excessive pulmonary flow [5]. The presence of thrombi in the pulmonary artery in patients scheduled for LVAD implantation significantly increases the risk for postoperative RVF. RVAD support may be useful in isolated RV failure after embolectomy and also in the case of RV failure after LVAD insertion.

The initiation of RVAD support in this case of intraoperative RVF led to myocardial recovery and reversibility of pulmonary hypertension, with successful weaning from the RVAD after eight days of support without recurrence of RVF. Concomitant use of RVAD with LVAD to aid recovery of the RV stressed by pressure overload during the acute phase of PE was shown to be a very helpful therapeutic tool. In cases with alteration of the RV, presenting in preoperative echocardiographic studies, RVAD placement should be performed as a primary option to avoid the RV ballooning and irreversible cardiomyocyte stretching that occur with delayed RVAD insertion. Acute PE is not a contraindication for LVAD implantation. However, studies are needed for prospective evaluation of criteria and predictors of RVAD weaning in the case of acute postoperative RVF requiring RVAD support.

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References