Double lung procurement from a donor supported by a left ventricular assist device

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Abstract

Over the past several years, the selection criteria for marginal donor lungs have been extended. However, brain-dead patients with implanted mechanical circulatory support systems have not yet been considered as potential organ donors for lung transplantation. Our report presents the first successful procurement and transplantation of donor lungs from a patient supported by a left ventricular assist device. The procurement of the lungs demanded an extensive and careful anatomical preparation of the device, the heart, the lung and the mediastinum. The donor lungs were of good quality. The subsequent sequential bilateral lung transplantation was performed without complications. Postoperative course and follow-up were uneventful. This case demonstrates the feasibility of lung transplantations from organ donors supported by a mechanical circulatory support system.

Keywords: Left ventricular assist device · Lung transplantation · Lung procurement · Extended donor criteria

INTRODUCTION

To meet the growing demand for donor lungs, the pool of donor organs was extended by transplanting lungs of marginal quality [1, 2]. However, until now, patients with cardiac assist devices have not been accepted as potential donors for thoracic organ transplantation. Major concerns were the high-risk character of procurement and a potential impairment of donor lung quality. In this report, we describe the demands and potential problems of successful procurement from a donor supported by a left ventricular assist device (LVAD) and challenge the current policies of donor acceptance.

CASE REPORT

A 25-year old male, brain-dead patient (180 cm, 83 kg) was evaluated and assigned for organ donation by the German Organ Transplantation Foundation (DSO). The patient had undergone implantation of a LVAD (HeartWare®, HeartWare International, Inc., USA) as a bridge to heart transplantation 4 months earlier (Fig. 1) following emergency coronary surgery for acute myocardial infarction. Subsequent brain death was caused by a thrombotic occlusion of the left carotid artery.

The donor had been intubated 3 days prior in a regional hospital. The partial pressure of arterial oxygen (PaO₂)/fraction of inspired oxygen (FiO₂) ratio was 437. The chest X-ray showed prominent hilar regions, signs of bilateral pulmonary vascular congestion and a significant right-sided pleural effusion. Bronchoscopy revealed some viscous secretion in both inferior lobes without signs of current infection or aspiration. The prothrombin ratio was deranged (7%). Four transplant centres had previously rejected the donor lungs before our institution accepted the offer from Eurotransplant. The liver and both kidneys were also allocated.

The more complicated procurement prolonged the explantation by an additional 90 min. Following a complete dissection for the retrieval of liver and kidneys, a protective oscillatory saw was used for median sternotomy. The device outflow prosthesis (Dacron®) as well as the right ventricle was strongly attached to the sternum. The device and the heart were severely encapsulated by scar tissue. Special care was necessary to preserve the driveline and sustainment of sufficient right heart function during preparation. Gentle and careful preparation was required to avoid injuries and bleeding complications. Pulmonary artery pressure (PAP) was low on manual palpation. Following injection of heparin and regular cannulation, the LVAD was deactivated by cutting the driveline prior to aortic cross-clamping. Perfusion with low potassium dextran solution (Perfadex®) and explantation of the double lung block and the abdominal organs followed standard protocols. The donor lungs were of good quality, collapsed well and were of normal weight. There were no signs of infiltrations, persisting atelectasis or other abnormalities.

The recipient was a 57-year old male (176 cm, 93 kg) who had developed chronic lung failure following H1N1 influenza–induced acute respiratory distress syndrome (ARDS). The successful sequential bilateral lung transplantation was performed via anterolateral thoracotomies without splitting the sternum. No cardiopulmonary bypass was needed. Ischaemic times of the right and left lung were 6:20 and 9:10 h, respectively. Primary graft function was good. The recipient was extubated on Day 2 and discharged on postoperative Day 22 with a forced expiratory volume in 1 s of 3.24 l/s (94% of predicted). One episode of...
DISCUSSION

Over the last decade, the number of implanted mechanical circulatory support devices has rapidly increased. This includes artificial hearts, LVADs, right ventricular assist devices and extracorporeal cardiopulmonary assists. The number has tripled in the past 3 years [3]. This growing patient population frequently develops embolic or haemorrhagic cerebrovascular events. Currently, reviews on donor lung selection have not even addressed cardiac assist devices, and any prior cardiopulmonary surgery has been perceived as a relative contraindication [2, 4].

To our knowledge, successful transplantation of lungs from a donor with mechanical circulatory support has not been reported. Procurements of abdominal organs from such donors have only rarely been described [5].

Not all patients with mechanical circulatory support are suitable lung donors. Acute left heart failure may cause pulmonary oedema, resulting in poor gas exchange, radiological congestion as well as elevated weight of the explanted lungs. Chronic left heart failure may be associated with elevated PAP and pulmonary vascular resistance (PVR). Both are contraindications for pulmonary donation.

We consider prolonged periods of left heart failure, but not the time in which the donor is supported by a LVAD to be a risk factor. Our donor experienced only a brief period of cardiac failure and had been successfully evaluated for cardiac transplantation (mean PAP 33 mmHg, PVR 114 dyn s/cm²) early after LVAD implantation. The chest X-ray indicated possible pulmonary congestion, but pulmonary artery hypertension was ruled out by manual palpation. However, we strongly advise the intraoperative assessment of PAP, which is best done by introducing a line for pressure measurement.

LVAD patients frequently develop infectious complications that may prohibit organ donation [3]. Driveline infections most often present with symptoms and purulent secretions. However, subacute infections may be verified only intraoperatively. The explantation procedure is, in itself, most critical. Cardiac redo operations after LVAD implantation are well-known high-risk procedures. Chest CT scans are routinely performed prior to elective resternotomies. In the acute event of organ donation, a CT scan is usually not available. This considerably increases the risk for complications. Any injury to the outflow prosthesis, damage of the driveline or compromise of the right heart could prove fatal for all organs. If the heart is not allocated for donation, a skilled cardiac surgeon may not be present in the donor hospital. As was the case in our report, this procedure should only be performed by a thoracic procurement surgeon experienced in cardiac redo procedures.

Increased procurement times did not seem to affect initial transplant function. As demonstrated in our case, cold ischaemic times, primary graft function and recipient outcome were not impaired by a prolonged donor procedure.

In summary, this case demonstrates the practicability and technical feasibility of lung donation despite a implanted LVAD system supporting the donor’s failing heart. Brain-dead patients with implanted or extracorporeal cardiopulmonary support should be seriously considered and evaluated for lung donation. The shortage of donor organs necessitates the need to explore and use all possible options.

Conflict of interest: none declared.

REFERENCES