

Coronary Artery Revascularization with Concomitant Bilateral Lung Volume Reduction Surgery without Cardiopulmonary Bypass

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Abstract

Coronary artery revascularization with concomitant lung volume reduction surgery without cardiopulmonary bypass has never been reported as a combined operative procedure for concurrent cardiac and pulmonary disease. A patient is described who underwent bilateral lung volume reduction surgery with coronary artery bypass grafting without cardiopulmonary bypass, respectively, in the hope of reducing peri-operative morbidity. The procedure was performed through a median sternotomy in a single (combined) operative session.

Background

Patients with concomitant cardiac and pulmonary disease requiring surgical intervention are traditionally treated with two separate operations in a staged fashion depending on clinical priority. Occasionally, however, both are required concomitantly when each is separately indicated in order to reduce overall morbidity and/or mortality. Typically, such combined procedures involve coronary artery bypass grafting (CABG), using cardiopulmonary bypass (CPB), with pulmonary resection. However, concern exists regarding the adverse immunosuppressive and pulmonary effects of extracorporeal circulation. Diminished pulmonary function and increased capillary permeability, with the associated increase in lung water, may make combined procedures (using CPB) in those patients with poor pulmonary function especially dangerous. We describe a patient in whom

bilateral lung volume reduction surgery (LVRS) was performed for severe emphysema with concurrent CABG without the use of CPB in a combined surgical procedure through a median sternotomy.

Case Report

A 68-year-old wheelchair bound male with a previous anterior myocardial infarction and Alpha-1 anti-trypsin deficiency giving rise to severe bullous emphysema (FEV₁ of 0.4 L, pCO₂ of 50mmHg), further exacerbated by a 60-pack year smoking history, was deemed ineligible for lung transplant but was offered LVRS to improve pulmonary function. Preoperative work-up uncovered calcified coronary arteries and coronary disease with diffuse left anterior descending (LAD) and right coronary stenoses. The left ventricular size and function were normal. His functional capacity was limited by his respiratory status and he was asymptomatic from his coronary disease. LVRS without CABG was felt to carry too high a cardiac risk and his end stage emphysema precluded isolated CABG. Thus a combined CABG/LVRS was planned. Due to severely compromised pulmonary function and concerns related to CPB and the heart-lung machine, "off pump" techniques (CABG without CPB) were planned for his coronary bypass.

Double lumen endotracheal intubation and epidural analgesia were utilized in addition to standard techniques. A full median sternotomy was used. Bilateral lung volume reduction was carried out first, using multiple firings of the Autosuture GIA® stapler. Pericardial sleeves were employed to buttress the suture line. Due to the 10-15 cm distance between the sternum and the anterior surface of the heart, the internal thoracic artery was not utilized. A two-vessel

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saphenous vein CABG was performed without CPB. The Medtronic Octopus II® stabilizer and Medtronic mister/blower devices and silastic snares, placed proximally on each vessel, were used for the anastomoses. The LAD and acute marginal branch of the right coronary artery (the only non-calcified portion of the right system) were bypassed. A complex atheromatous plaque was encountered when the aortotomy for the proximal anastomosis was performed (by partial aortic side-clamping), so a localized endarterectomy and saphenous vein patch were used. The 5,000 units of heparin used was reversed after construction of the bypasses. The patient was extubated in the operating room and returned to the intensive care unit (ICU) for further monitoring. He was discharged to the ward after 4 days but was readmitted to the ICU 8 days post-operatively when he developed bilateral basilar pneumonia and subsequently required prolonged ventilatory support. After developing another episode of pneumonia, the family elected not to pursue aggressive resuscitative measures and the patient passed away 6 months after his surgery.

Discussion and Conclusions

Several investigators¹⁻³ have described disadvantages and potential complications that can arise in combined CABG/lung resection, in particular during CPB. There is an increased risk of intrapulmonary hemorrhage on the heart-lung machine,¹ technical problems associated with anticoagulation and coagulopathy, and perioperative immunosuppression that might increase short-term infectious complications.^{3,4} However, in patients undergoing combined procedures, CABG without CPB may be beneficial in reducing morbidity through decreased post-operative bleeding and transfusion requirements,^{4,5} and the reduced incidence of pulmonary injury (fluid overload, activation of the inflammatory response, and endothelial cell injury)⁶ and neurological complications.⁷ A reduced heparin dose may also lead to a decreased risk of hemorrhage. In this case, only 5,000 units were administered as multiple firings of the GIA® stapler was deemed to increase the risk of intrapulmonary hemorrhage.

The operative mortality in patients with coexisting lung disease undergoing isolated CABG is significantly increased.⁸ In addition, the perioperative risks of adverse cardiac events in patients undergoing stand-alone lung resection with significant coronary artery disease (CAD) is also substantially increased.^{4,9} In these cases of combined operable co-morbidities, it therefore seems that a combined procedure would be called for. The early results of combined cardiac and pulmonary surgery were encouraging,^{10,11} pointing to minimal increases in morbidity. One later study¹² found no increase in early or late morbidity or mortality while using the combined approach.

The concomitant occurrence of critical CAD and severe

emphysema tends to be low. In one study, 20% of patients qualifying for LVRS demonstrated relevant, usually asymptomatic, CAD with normal left ventricular function.⁹ Patients in this study with significant CAD (n=9) either had LVRS with no cardiac interventions (n=2) or pre-LVRS targeted percutaneous transluminal coronary angioplasty (PTCA) (n=2). Four patients were rejected from LVRS based entirely on significant two-vessel disease (n=3) or one-vessel disease (right coronary ostium) (n=1) not accessible to PTCA. Only one patient had pre-LVRS CABG using CPB whose outcome was uneventful.

In another study,¹³ nine patients accepted for LVRS were also treated for their CAD. Patients either had LVRS with PTCA and/or stent (n=7) or LVRS and CABG with CPB (n=2) in a combined procedure. These CABG/LVRS patients both proceeded along an uneventful course, although there was no indication of when post-operative extubation occurred. Significant improvements in FEV₁ over the first six months were observed in all cases with values for the CAD patients equal to that of LVRS patients without CAD. The mean pre-operative FEV₁ for those patients was 0.73 +/- 0.05 L (as compared to 0.4 L in this case) indicating all their LVRS patients with CAD suffered from less severe pulmonary dysfunction. It is worth noting that the perioperative morbidity and mortality was similar to patients without CAD.

Median sternotomy was employed for surgical access in our patient. Although it may offer limited exposure for pulmonary surgery, in particular the posterior fields, it offers good exposure to both lung hila and has been the standard approach by some surgeons for routine pulmonary resection.¹⁴ In this combined operative procedure a single incision through the midline permitted access to both lungs and the heart. In comparison to posterolateral thoracotomy, a reduction in postoperative pain and analgesic requirements, as well as a more rapid recovery of pulmonary function with median sternotomy has been reported.¹⁵

Although this case represents only one CABG/LVRS without CPB, the fact that the patient developed the need for and required prolonged ventilatory support and eventually died due to pneumonia, underscores that these are very sick patients who have substantially reduced pulmonary reserve. With successful extubation of the patient in the operating room and a benign early post-operative course, it certainly appears that the beating heart approach for CABG may be advantageous in patients with very poor pulmonary function. In the combined CABG/LVRS study,¹³ no data was given to permit evaluation of the time of extubation.

This patient is only the third LVRS patient reported in the literature to have a CABG concomitantly, and the first without the use of CPB. Although the patient died due to an

independent infection, CABG without CPB may be a viable option in those very high-risk patients with extremely poor pulmonary function who also have significant CAD not amenable to PTCA and whose lung deficiencies will not tolerate CPB.

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