Concomitant bilateral lung volume reduction surgery and aortic valve replacement: Multidisciplinary strategies in achieving a successful outcome

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Significant cardiac comorbidity is generally considered a contraindication for lung volume reduction surgery (LVRS). We described a multidisciplinary approach that led to the successful management of a 53-year-old woman with severe aortic stenosis who had a forced expiratory volume in 1 second (FEV₁) of 20% predicted secondary to smoking-related end-stage emphysema.

CLINICAL SUMMARY

A 53-year-old woman was referred for aortic valve replacement (AVR). She had symptomatic (angina and dizzy spells) severe aortic stenosis (aortic valve area 0.8 cm², echocardiographic peak gradient 93 mm Hg, mean gradient 62 mm Hg), moderate aortic regurgitation, left ventricular hypertrophy, and left ventricular dysfunction. She had poor pulmonary function secondary to severe emphysema (Table 1) with marked functional limitation affecting daily activities and necessitating domiciliary oxygen therapy (Table 1). She had stopped smoking 12 months previously, was motivated to improve, and had good family support. Her emphysema was heterogenous in distribution with predominant upper-lobe involvement. Her coronary arteries were free of obstructive disease on angiogram, and she had no other significant comorbidity. She consented to concomitant bilateral LVRS and AVR. A thoracic epidural catheter was placed 4 hours before the scheduled surgery to minimize the risk of epidural hematoma related to the impending systemic anticoagulation required for cardiopulmonary bypass (CPB) to replace the valve. A double-lumen endotracheal tube was utilized, and the surgery was performed via a median sternotomy. The aortic valve was replaced using a 23-mm stented tissue valve. Following the AVR, while still on CPB, pleural adhesions on the deflated lungs were divided using electrocautery. The patient was then weaned

off CPB, and the anticoagulation was fully reversed. Following satisfactory cardiorespiratory stability and hemostasis, the LVRS proceeded with the left followed by the right lung utilizing single-lung ventilation. Approximately 30% of each lung was removed using a stapler buttressed with bovine pericardium. Following surgery, the patient underwent a planned early extubation. Adequate analgesia and regular physiotherapy were ensured during the postoperative period. There was minimal air leakage, and the chest drains were removed on postoperative day 4. The patient was discharged on postoperative day 8. At 4-month follow-up, she had a marked improvement in her quality of life (QOL), functional status, and pulmonary function measurements and no longer required oxygen therapy (Table 1).

TABLE 1. Symptoms and pulmonary function measurements before and after surgery

	Preoperative baseline	4-mo postoperative	Percentage improvement
NYHA symptoms	Class III	Class I	
Modified Medical Research Council Dyspnea Scale (degree of dyspnea)	Category 4 (severe)	Category 1 (slight)	
SF-36 Physical Function Score	20	70	
Supplemental oxygen therapy	15 h/d	None	
FEV ₁ , L (% predicted)	0.44 L (20)	0.85 L (38)	93
FVC, L (% predicted)	1.42 L (54)	2.35 L (89)	65
TLCO mmol CO · kPa ⁻¹ · min ⁻¹ , L (% predicted)	2.09 (28)	3.39 (46)	62
FRC, L (% predicted)	5.19 L (204)	2.90 L (114)	44
RV, L (% predicted)	4.47 L (267)	1.81 L (108)	60
TLC, L (% predicted)	6.27 L (139)	4.16 L (92)	34
RV/TLC (%)	71	44	38
6-minute walk (m)	190	432	127
Oxygen saturation on room air (%)	89	97	9

NYHA, New York Heart Association; SF-36, Short Form-36; FEV₁, forced expiratory volume in 1 second; FVC, forced vital capacity; TLCO, transfer factor for carbon monoxide; FRC, functional residual capacity; RV, residual volume; TLC, total lung capacity.

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DISCUSSION

LVRs has been shown to improve the QOL, respiratory physiology, and survival in highly selected patients.^{1,2} Significant cardiac comorbidity is generally considered a contraindication to LVRs. Untreated symptomatic severe aortic stenosis, however, is associated with a poor prognosis.³ In contrast, patients who undergo successful AVR for symptomatic aortic stenosis experience a significant survival benefit.³ Appropriate case selection allied with careful perioperative planning in this case resulted in QOL, functional, pulmonary, and prognostic benefits. A multidisciplinary approach was essential in providing an optimal outcome. A skilled anesthetist was required to ensure proper placement of the epidural catheter and double-lumen endotracheal tube and intraoperative management of the patient. An error in any of these areas could potentially lead to severe consequences. The epidural catheter was placed 4 hours before scheduled surgery, as this strategy has been shown to be safe despite full anticoagulation for CPB.⁴ A satisfactory postoperative thoracic epidural analgesia contributed to the patient's good compliance with physiotherapy and breathing exercises, thereby reducing the risks of postoperative sputum retention and chest infection. Careful anesthetic and intensive care management allowed for maintenance of cardiorespiratory stability and a successful planned early extubation, thereby minimizing the risks associated with mechanical ventilation. Daily medical management by the chest physicians in the perioperative period also ensured that the patient received optimal medical therapy for her emphysema.

The decision to perform the AVR first followed by reversal of anticoagulation prior to LVRs ensured that there was normal hemostasis during LVRs to minimize the risk of pulmonary hemorrhage. We also found it useful to divide the pleural adhesions while both lungs were deflated during CPB. We felt that it was important to achieve satisfactory cardiorespiratory stability and hemostasis before proceeding with the LVRs. A bioprosthetic valve was placed as the patient did not want anticoagulation associated with a mechanical valve. Although a tissue valve is not as durable as a mechanical valve, patients with an FEV₁ < 1 L have a mortality rate of approximately 10% per year. It is probable that a bioprosthetic valve may outlast the patient's life expectancy under these circumstances.⁵

In summary, careful perioperative planning and multidisciplinary strategies ensured a successful concomitant LVRs and AVR with satisfactory clinical outcome and marked benefit for the patient.

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Successful combined bilateral lung volume reduction and coronary artery bypass grafting surgery: Implications and advantages

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Coronary artery disease (CAD) is prevalent in patients with severe emphysema who are being considered for lung volume reduction surgery (LVRs).¹ The National Emphysema Treatment Trial excludes patients with a variety of cardiovascular risk factors from undergoing LVRs, as do many surgeons who perform the procedure outside the trial.² We describe a multidisciplinary approach that led to successful combined LVRs and coronary artery bypass grafting (CABG) surgery and discuss the implications and advantages relating to this combined approach.