BRIEF COMMUNICATIONS

LUNG VOLUME REDUCTION SURGERY FOR A PATIENT RECEIVING MECHANICAL VENTILATION AFTER A COMPLEX CARDIAC OPERATION

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Lung volume reduction surgery (LVRS) may be indicated after cardiac operations to improve pulmonary mechanics in patients with severe emphysema who are receiving mechanical ventilation. This intervention facilitates successful weaning.

History. A 57-year-old woman who formerly smoked cigarettes had severe mitral stenosis and pulmonary emphysema and was evaluated for mitral valve replacement. She had been receiving long-term home oxygen therapy for 7 months. The patient had been repeatedly hospitalized during the previous year because of exacerbation of chronic obstructive pulmonary disease. At a previous anesthesiologic evaluation, the patient had been considered to be ineligible for operation because a reduction of respiratory function of at least 30% is to be expected in the early postoperative phase after mitral valve replacement.[1]

Preoperative cardiac findings. Echocardiograpy documented severe mitral stenosis (mitral valve area 0.8 cm^2) with an almost immobile mitral valve. The left ventricular ejection fraction was normal (64%). Both atria were dilated.

Coronary angiography revealed a normal coronary circulation. Catheterization of the left side of the heart demonstrated slight mitral and aortic insufficiency (regurgitation 20%). The diastolic pressure gradient across the mitral valve was 13 mm Hg.

Preoperative pulmonary findings. The patient was extremely limited in her everyday activities. The data on her preoperative pulmonary function are summarized in Table I. Blood gas analysis while she was receiving medical therapy showed an oxygen tension of 54 mm Hg, a carbon dioxide tension of 44.4 mm Hg, and an oxygen saturation of 89% without supplemental oxygen. Computed tomographic scan of the chest revealed moderately heterogenous bilateral distribution of the emphysema, with predominance in the apical segments of the lower lobes and the right upper lobe.

Operative procedures and postoperative course. The initial plan was to perform mitral valve replacement with the patient in ventricular fibrillation and without cross-clamping of the aorta. This operation was to be followed by bilateral LVRS. During cannulation of the ascending aorta, however, a type A dissection occurred. Therefore, not only was the mitral valve replaced (CarboMedics mitral valve, 27 mm; Sulzer CarboMedics, Inc., Austin, Texas), but the ascending aorta (Vascutec-Gelvave, 26 mm) was as well, with deep hypothermic circulatory arrest (16° C for 17 minutes) and retrograde cerebral perfusion. LVRS was postponed to optimize hemostasis and stabilize hemodynamics.

Eight hours after the operation, an unstable early postoperative course necessitated reoperation for pericardial tamponade. Bilateral pneumothorax developed on the first postoperative day, and extubation was impossible. On the left side, a severe air leak persisted. Mechanical ventilation with an inspired oxygen fraction of 1.0 was needed. Bilateral LVRS was performed on the third postoperative day. The left side was operated on through a thoracotomy to ensure the inclusion of the air leak in the area of resection. The right side was operated by means of video-assisted thoracoscopy. The apical segments of the lower lobes on both sides and the most destroyed parts of the upper lobe on the right side (anterior and apical segment) were resected with nonbuttressed endoscopic staples (TLC 45; Ethicon Endo-Surgery, Cincinnati, Ohio).

Immediately after LVRS, ventilation became more effective. The tidal volume increased by 40%, and the inspired oxygen fraction could be reduced from 1.0 to 0.65.

Table I. *Pulmonary function before and 3 months after operation*

	Preop	*Postop*
FEV_1 (L)	0.91 (40% pred)	1.47 (65% pred)
FEV_1/FVC (%)	0.40	0.55
RV (L)	7.06 (343% pred)	3.43 (164% pred)
TLC (L)	9.42 (184% pred)	6.35 (124% pred)
RV/TLC	0.75	0.54
VC (L)	2.36 (84% pred)	2.67 (98% pred)

Preop, Before LVRS; *Postop,* 3 months after LVRS; *FEV_1,* forced expiratory volume in 1 second; *pred,* predicted; *FVC,* forced vital capacity; *RV,* residual volume; *TLC,* total lung capacity; *VC,* vital capacity.

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The postoperative course was complicated by urinary tract infection with *Escherichia coli* and by pneumonia caused by *Pseudomonas aeruginosa*. Tracheotomy was performed on day 5 after LVRS. Subsequently, the patient could be weaned from the ventilator. The tracheal cannula was removed 18 days after the LVRS.

During the remainder of the patient's hospitalization, oxygen supplementation was reduced to intermittent application of 0.5 L/min. Pulmonary function at 3 months revealed an impressive increase of forced expiratory volume in 1 second and a marked decrease of the ratio of residual volume to total lung capacity (Table I). The patient was able to perform everyday activities without oxygen supplementation.

Comment. LVRS has been reintroduced into clinical practice in recent years as a treatment for severe pulmonary emphysema.[2] LVRS improves respiratory mechanics by reduction of the hyperextension of the emphysematous chest and results in a marked improvement of respiratory function.[3]

Argenziano and associates[4] reported extended indications for LVRS. Our group demonstrated that LVRS improves pulmonary function maximally in patients with a heterogenous pattern of emphysema, but exceptional indications for LVRS must be evaluated.[5] Commonly, the procedure is performed on an elective basis under stable conditions. To our knowledge, this is one of the first reports of LVRS in a patient dependent on mechanical ventilation. Our observations show that LVRS improved the respiratory condition of the patient immediately and made subsequent extubation possible 18 days later.

Previous studies have demonstrated reduced pulmonary function as long as 6 months after mitral valve replacement.[1] In contrast, we noted persistent respiratory improvement at 3 months after the operation. Before and after the operation, the patient did not show signs of left ventricular insufficiency; therefore, the improvement in pulmonary function seems the result solely of the reduction in lung volume.

We conclude that LVRS may be performed successfully in selected patients with severe pulmonary emphysema who are dependent on mechanical ventilation, and that it facilitates successful weaning. In addition, the favorable outcome in this case may indicate that the pulmonary risk of patients for whom severe emphysema is the only contraindication for cardiac surgery could be reduced when postoperative respiratory function is improved by simultaneously performed LVRS.

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