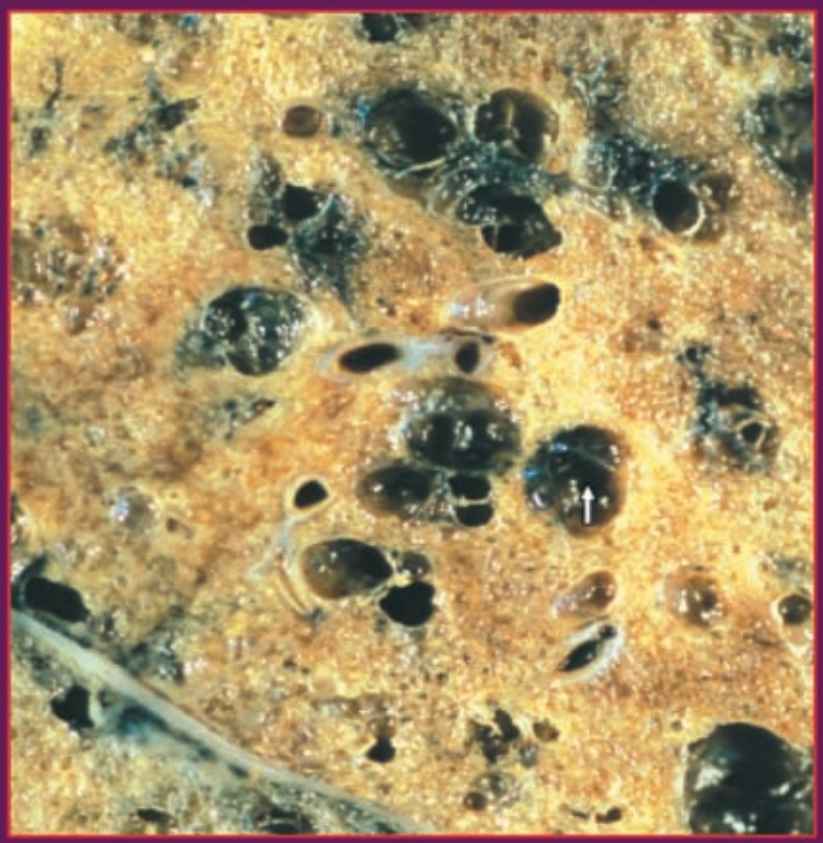
Clinical Challenges

COPD

C. F. Donner · M. Carone



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Edited by

C. F. Donner and M. Carone

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Preface

When we first discussed *Clinical Challenges in COPD* with the publishers, we both agreed to produce something quite different from the usual textbook format of publications in respiratory medicine. The majority of books on the subject of COPD have largely the same characteristics, with differences only in the depth and type of information provided, depending on whether the specific target readership is the general practitioner, pulmonary clinician or academic clinician. With this new venture, we hoped and planned to produce a publication on COPD that addressed *all* clinicians dealing with pulmonary patients in an innovative format. We wanted to break away from the traditional idea of expounding a list of diseases or therapeutic approaches: even if these were well described in terms of their aetiology, pathogenesis, diagnosis and treatment, we felt that we would not be adding anything new to the stock of literature already published in this field. We also did not want simply to provide a list of clinical cases.

In this book, we have tried to integrate all of these aspects and present them from a novel viewpoint: starting from the description of a *real* clinical case – such as the clinician typically encounters in everyday clinical practice – the idea was to open up a panel discussion, as it were, on all aspects related to the diagnosis and treatment of the case that would be of interest to the clinical specialist. In this way, we hoped to give the reader an update on the state-of-the-art on specific aspects of respiratory medicine relevant to clinical practice, presented in a novel, easy-to-read manner.

We selected 21 topics, which, while they do not represent all aspects of COPD, cover all of the *real* cases that a clinician may encounter in everyday clinical practice.

All chapters have a similar structure, providing:

- a background, to set the scene and give the general picture of the specific clinical problem;
- a case report, including history, basic diagnostic assessment, differential diagnosis, and treatment (pharmacological, rehabilitation and follow-up);
- a discussion, examining the different possible scenarios arising from the different assessment approaches;
- a conclusion, summing up what has emerged from the discussion and giving clear options for diagnosis, management and follow-up of the specific patient/disease.

The discussion section, in particular, follows the style of a panel discussion: it examines the four or five questions most likely to come from the floor, debating these from the different angles possible. For this reason, where there were debatable perspectives, we sought to have two or more co-authors to enable interaction as though they were part of a panel of experts.

The authors are outstanding authorities in their specific field, each with many high-level publications to their name. Notwithstanding their expert status, we asked them to write in a colloquial manner, as if they were talking from the floor. As such, we hope to offer here a distillation of the best knowledge available in the field, to provide clinicians with a useful tool to keep on their desk for rapid consultation in daily practice. We would like to thank all of the

authors for the time and effort they have devoted to the task despite their heavy clinical and scientific commitments and for their goodwill in following the editors' guidance to produce an innovative book. We hope that this publication will not only be useful reading, but also a 'companion' for all clinicians who, we are confident, will appreciate this new format.

Claudio F. Donner
Mauro Carone
Italy, December 2006

1

Improvement of symptoms in a 62-year-old COPD patient after lung volume reduction surgery

R. J. McKenna Jr.

BACKGROUND

Emphysema is a disease that causes great morbidity and mortality worldwide and for which the medical treatment has had little impact upon quality of life or survival. Therefore, a variety of operations have been tried over the years in an attempt to help patients suffering from severe emphysema. This chapter will use a case report to present the current status of lung volume reduction surgery (LVRS) in the treatment of severe emphysema.

In the US, there are approximately 14 million people who suffer from chronic obstructive pulmonary disease (COPD) and about 2 million of these have primarily emphysema. This is the third most common overall cause of death in the country.

Unfortunately, medical management has had little impact on the morbidity and mortality of emphysema. Pulmonary rehabilitation has slightly improved quality of life and has reduced the number of hospitalizations, but has failed to improve pulmonary function or to improve survival [1]. Oxygen therapy for patients with hypoxaemia (oxygen saturations $< 90\%$) has been shown to improve survival.

Otto Brantigan first performed what we now call LVRS in the 1950s at the University of Maryland. Through unilateral thoracotomy incisions, he performed wedge resections of the lung in areas of severe emphysema. This procedure did produce significant clinical improvement in patients, but there was an 18% hospital mortality rate and there was no good scientific documentation of the benefit. Wakabayashi [2] used unilateral thoracoscopy and the Nd:YAG laser to reduce lung volume, but there was little scientific documentation of the benefit and again there was significant morbidity and mortality, so this did not become popular. Cooper *et al*. [3] introduced modern LVRS as bilateral wedge resections of the lung through a median sternotomy with bovine pericardium to buttress the staple lines on the lung. McKenna *et al*. [4] performed a randomized, prospective trial to confirm that the staple procedure produced better improvement in pulmonary function than the laser procedure. Subsequent studies established a bilateral staple operation as the standard procedure [5].

The basic concept of LVRS was to identify patients with a heterogeneous pattern of emphysema (usually in the upper lobes). The operation removed approximately 30% of each lung. Removal of areas of lung parenchyma that were not essentially a functional tissue allowed the remaining lung to function more effectively. This resulted in improved elastic recoil of the lung [6].

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The National Emphysema Treatment Trial (NETT) was a randomized, prospective trial comparing best medical management with or without LVRS [7]. Of the 1210 patients in the trial, 608 underwent LVRS and 610 underwent medical management alone. The first NETT publication of results confirmed that older patients with the most severe emphysema ($FEV_1 < 20\%$ and diffusion capacity of the lung for carbon monoxide [DLCO] $< 20\%$) and homogeneous emphysema were at risk for greatest morbidity and mortality, with little chance of benefit [8]. The overall results of the NETT showed that, for patients with upper lobe emphysema and poor exercise tolerance, LVRS provided better pulmonary function, exercise tolerance, quality of life, and survival than medical management. For patients with upper lobe emphysema and better exercise tolerance, LVRS provided better pulmonary function, exercise tolerance, and quality of life, but no survival benefit, compared to medical management [9]. For patients with non-upper lobe emphysema and poor exercise tolerance, LVRS provided better pulmonary function, exercise tolerance, and quality of life, but no survival benefit, compared to medical management. A substudy in the NETT showed that bilateral staple LVRS *via* a median sternotomy or video assisted thoracoscopic surgery (VATS) had the same morbidity, mortality and benefit, although the VATS approach had a shorter length of stay and cost [10]. Other randomized trials have confirmed these results [11–13].

This chapter will illustrate the basic workup and procedure for LVRS and then discuss the different possible scenarios arising from the diverse possible assessment and approaches.

CASE REPORT

A 62-year-old male complained of significant limitation in activities of daily living. He had severe dyspnoea with taking a shower, bending over, carrying anything, and activities around the house. He could walk approximately 15 m without stopping. He had smoked two packs of cigarettes per day for 30 years before dyspnoea, which led him to stop smoking 10 years ago. He had 2–5 episodes of bronchitis per year and had been hospitalized three times for acute exacerbations of his emphysema.

Tests confirmed that he had severe emphysema. His computed tomography (CT) scan showed severe emphysema in the upper lobes bilaterally and much better parenchyma in the lower lobes. A lung perfusion scan confirmed the heterogeneity. In some patients the CT scan does not show heterogeneity, while the perfusion scan (particularly in the oblique and lateral views) shows significant heterogeneity. His pulmonary function tests (PFTs) showed an FEV_1 of 910 ml (32% predicted), total lung capacity (TLC) of 7.11 (141% of predicted), a residual volume (RV) of 5.91 (267% of predicted), and DLCO of 34%. His 6-min walk was 120 m.

He had received maximal medical management that included inhalers, oxygen at night, and prednisone for episodes of acute bronchitis. He completed a pulmonary rehabilitation program that included education, upper body conditioning, and exercise on the treadmill. He exercised daily on the treadmill for 30 min at 1 mile/h. The rehabilitation coordinator confirmed that he was compliant and showed good effort. This is critical because noncompliant patients have greater morbidity and mortality for LVRS, so they are turned down for the procedure. PFTs after rehabilitation showed no change, while his 6-min walk test increased to 132 m.

Because the patient was still severely limited after maximal medical management, he underwent LVRS. The bilateral VATS procedure took 60 min. There were no adhesions on either side and approximately 70% of the right upper lobe was resected and 60% of the upper division was resected. He was extubated in the operating room. The patient had no air leaks noted in the operating room, but the right side developed a small leak in the recovery room and the left side developed a moderate sized leak. He was followed for 2 days in the intensive care unit, where he received nebulizer treatment and was ambulated three times per day.

Table 1.1 Typical PFTs for a candidates for LVRS

PFT	*Predicted value (%)*
FEV_1	<45
TLC	>100 (mean = 143)
RV	>200 (mean = 270)

FEV_1 = forced expiratory volume in the first second; PFT = pulmonary function test; RV = residual volume; TLC = total lung capacity.

He was transferred to the ward on the third postoperative day. His right-sided air leak resolved so the chest tubes on the right were removed on the fourth postoperative day. Because he still had an air leak on the left, his chest tubes were disconnected from the chest drainage system and connected to Heimlich valves. His postoperative course was otherwise uneventful and he was discharged on the seventh postoperative day with a left chest tube and Heimlich valve for a persistent air leak. The tube was removed when the patient returned to the office 3 days later and was found to have no air leak. He continued in pulmonary rehabilitation for the next month. His quality of life improved significantly. His postoperative PFTs showed an FEV_1 of 1350 ml (47% predicted), TLC of 5.59 l (111% of predicted), an RV of 3.91 l (177% of predicted), and DLCO of 39%. His 6-min walk was 149 m.

DISCUSSION

Patient selection is the key to a successful result after LVRS. Only 10–20% of patients with severe emphysema are potential candidates for LVRS. It is a palliative procedure, so the patients must have symptoms that warrant the procedure. Table 1.1 shows the typical pulmonary function for patients who undergo LVRS.

What is the importance of the preoperative pulmonary rehabilitation?

Rehabilitation provides only a small impact on quality of life and does not improve pulmonary function, however it is important for patient selection and preparing the patient for LVRS [14]. In the hospital after LVRS, the patient must work very hard at pulmonary toilet and ambulation to minimize complications. This is important for patient selection because patients who show a strong effort in preoperative rehabilitation demonstrate that they are adequately motivated to do well after LVRS. Achieving certain goals, such as the ability to walk for 30 min without stopping on the treadmill also conditions patients to minimize complications after LVRS.

Can the lung function be too bad for LVRS?

Patients with an $FEV_1 < 20\%$ or a DLCO $< 20\%$ predicted value have an increased risk of mortality and a low chance of benefit from emphysema [8]. However, some patients with those PFTs can still benefit from LVRS, especially if they have a strongly heterogeneous pattern of emphysema [9].

Must patients have a heterogeneous pattern of emphysema?

The basic concept of LVRS is to resect areas of non-functioning lung to allow other areas to function more effectively. By definition, that means a heterogeneous pattern of emphysema.

The NETT identified the best patients for LVRS as those with a bilateral upper lobe pattern of emphysema and poor exercise tolerance. They had improvement in exercise tolerance, lung function, quality of life, and survival. Patients with either bilateral upper lobe emphysema and better exercise tolerance or patients with poor exercise tolerance and no upper lobe emphysema achieve better exercise tolerance, lung function, and quality of life, but not longer survival. PFTs confirm that the patients have severe emphysema, but do not predict heterogeneity, which is the most important selection factor. Gelb *et al*. [15] showed that only 30% of patients with $FEV_1 < 50\%$ have severe emphysema scores on thin cut CT scans. Even fewer patients have significant heterogeneity on thin slice CT scans. A complete evaluation of the radiological pattern of emphysema requires a chest X-ray, CT scan and lung perfusion scan. For an experienced observer, the chest X-ray shows the pattern of emphysema in most patients [16]. The CT confirms this. There are a few patients with a strongly heterogeneous pattern of emphysema that is apparent only on the perfusion scan, so this is an important test [17].

What are other contraindications to LVRS?

Patients with conditions that would increase the risk for LVRS or would significantly shorten the life expectancy of the patient have a relative contraindication for the procedure. The NETT showed that older patients (>70 years), patients with $FEV_1 < 20\%$, DLCO < 20% predicted value, and homogeneous disease have increased risk of mortality with little chance of benefit. Some studies have reported that patients with poor lung function tests, but with good target areas for LVRS had good results. Patients with shortened life expectancies due to medical illnesses, such as cancer or heart disease, are not candidates. Depression and anxiety interfere with postoperative compliance so those conditions must be assessed preoperatively.

Is there a role for unilateral LVRS?

The intent of the operation is a bilateral staple procedure through either a median sternotomy or VATS. Occasionally, patients are only candidates for unilateral VATS because they have had a resection on one side, pleural symphysis on one side, heterogeneous emphysema on only one side, or if they develop a large air leak on the first side of an operation where a bilateral procedure was intended. If a large leak occurs on both sides, the patients often have respiratory failure, require ventilation, and have a high mortality rate. In general, a bilateral operation can be performed with the same morbidity, mortality, and length of stay as a unilateral operation, but the improvement is considerably better after the bilateral operation [5].

Are patients with α_1 anti-trypsin deficiency candidates for LVRS?

Patients with α_1 anti-trypsin deficiency can benefit from LVRS. Series have shown that the improvement in FEV_1 may not be as great, but the improvement in quality of life may be significant [18]. It also appears that the duration of the benefit may not be as long as the benefit for LVRS in smoking-related emphysema.

What is the postoperative course after LVRS?

The care of patients after LVRS can be challenging. There is a 5% hospital mortality rate. Patients are usually extubated in the operating room. They are followed initially in the intensive care unit. Aggressive pulmonary toilet with nebulizer treatments and chest physical therapy is critical. Broad-spectrum antibiotics are added if the patients show any signs of increasing hypoxia or fever. Ninety percent of patients develop an air leak after LVRS. Other complications are seen in Table 1.2 [10].

Table 1.2 Typical complications after LVRS

Complication	*Incidence (%)*
None	–
Air leak	90
Atrial fibrillation	3
Other arrhythmias	22
Tracheostomy	10
Pneumonia	20
Re-admission to intensive care	10

What about bronchoscopic LVRS?

Recently, in an effort to reduce the morbidity and mortality of LVRS, a variety of different bronchoscopic procedures have been experimented to provide volume reduction [19, 20]. The hope is to develop a bronchoscopic procedure to induce atelectasis. The techniques have included bronchial valves, bronchial blockers, and biologic glue to maintain atelectasis. The preliminary data with these procedures show some benefit, although the improvement has not been as much as with LVRS. Another novel approach has been the placement of a stent through fistulae created between the bronchus and areas of emphysema. This bypasses the collapsed small airways and allows better air movement. Unfortunately, while these stents initially work well, mucus and scars quickly close the stents and make them non-functional. The future of LVRS may be with endobronchial approaches, but the current prototypes do not work well enough to replace LVRS.

SUMMARY

LVRS is an exciting new treatment for patients with emphysema who are symptomatic despite maximal medical management. The key to success after LVRS is proper patient selection. The most important factor is a heterogeneous pattern of emphysema, usually in the upper lobes. The NETT showed that LVRS, compared to medical management, provides better quality of life, pulmonary function, exercise tolerance, and survival for patients with upper lobe emphysema and poor exercise tolerance.

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