Peer reviewed article

Advances in thoracic surgery: emphysema and simultaneous bronchial carcinoma

E. Pezzetta[a], *J. W. Fitting*[b], *H. B. Ris*[a]

[a] Service de Chirurgie
[b] Division de Pneumologie
Centre Hospitalier Universitaire Vaudois, Lausanne, Switzerland

Introduction

Lung volume reduction surgery (LVRS), first described by Brantigan in 1957, has recently been reintroduced and refined as a treatment option in the management of severe disabling pulmonary emphysema [1, 2]. This surgical approach to emphysematous lung disease allows resection of the most impaired and non-functional lung tissue, with improvement of respiration mechanics and enhancement of the lung's elastic recoil and compliance [3, 4]. The method has shown promising short-term results with substantial improvement of dyspnoea, exercise tolerance, quality of life and pulmonary function in carefully selected patients; this has been observed in some recent controlled trials comparing LVRS with medical treatment [5–9]. However, despite widespread use of the procedure and the rapid progress of the technique, some aspects are still controversial or incompletely elucidated. The aim of this article is to summarise some of the recent data about patient selection criteria and surgical technique, with particular emphasis on the role of LVRS in lung cancer surgery and on the unilateral VATS approach.

Key words: pulmonary emphysema; lung cancer; surgery; unilateral LVRS

Selection criteria for LVRS

Indiscriminate use of LVRS should be avoided, and appropriate patient selection by rigorous assessment is mandatory [10, 11]. LVRS should be considered a palliative procedure to be offered only to a minority of patients with severe emphysema [11].

Table 1
Selection criteria for LVRS.

Clinical criteria
• Age <75 years
• Smoking cessation
• Absence of severe ischemic heart disease
• Absence of malignancy or poor medical condition
• Absence of severe nutritional disturbancies
• Absence of local contraindications for surgery (previous operation, pleurodesis, major thoracic deformity)
Functional criteria
• FEV_1 20–35% predicted
• DLCO >20% predicted
• Hyperinflation with increased RV/TLC and RV >200% predicted
• Mean pulmonary artery pressure <35 mmHg
• $PaCO_2$ <55 mmHg
Imaging criteria
• Heterogeneous pattern of emphysema on high resolution CT Scan and on ventilation perfusion scintigraphy

Assessment for LVRS is based on (a) general, (b) functional and (c) imaging features. These criteria, currently applied in most institutions, are summarized in table 1. Clinical criteria include age, which is arbitrarily cut off at 75 years, smoking cessation and absence of general or local contraindications for surgery. Functional criteria play an essential role in patient selection. Relevant results in this respect recently emerged from a preliminary report of the National Emphysema Treatment Trial: a significantly impaired outcome with high postoperative mortality and little functional benefit in survivors has been observed in patients with DLCO <20% in combination with FEV_1 <20% predicted [12]. Morphological criteria, mainly established by high resolution CT scan and ventilation- perfusion lung scintigram (fig. 1), are useful tools in determining a heterogeneous pattern of emphysema and identifying target areas of non-functional lung parenchyma for resection [13, 14]. Imaging features are considered important predictors of postoperative functional outcome [10, 11, 15]. In heterogeneous emphysema with upper lobe predominance LVRS has a better and longer-lasting effect than in homogeneous emphysema [15]. This was recently emphasised in a retrospective analysis by Kotloff et al., who de-

No financial support to declare.

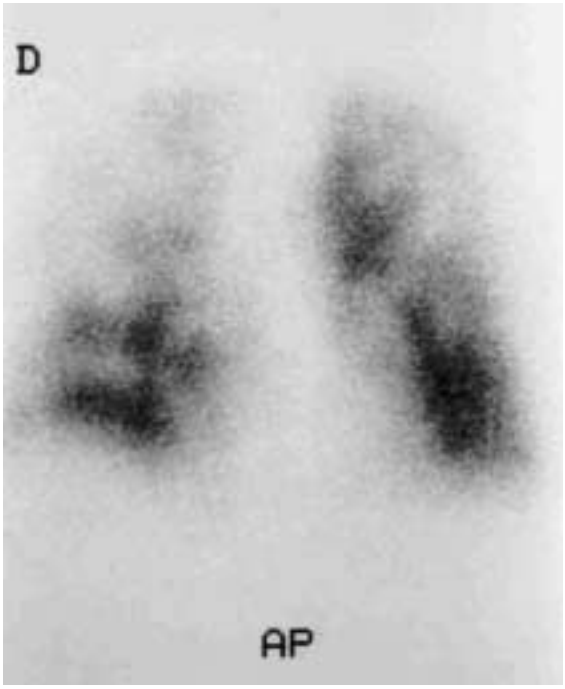


Figure 1

Lung perfusion scintigraphy showing heterogeneous pattern of disease with upper lobe predominance.

fined the apical perfusion fraction as the percentage of total lung perfusion to the apical third of both lungs [16]. A significantly better postoperative functional improvement was observed in patients with marked apical hypoperfusion and an apical perfusion fraction of <10%.

To better define the lung areas and the amount of tissue to be resected, the preoperative morphological criteria need further refinement. This may be accomplished by assessing regional lung function, possibly obtained by superposition of ventilation-perfusion scintigram and high-resolution CT scan.

The incidence of solitary pulmonary nodules in emphysema patients

Among the clinical criteria, poor medical condition and non-thoracic malignancy have generally been considered contraindications for surgery [11]. In addition, candidates for LVRS are at high risk of developing lung cancer, and preoperative assessment may lead to the incidental discovery of pulmonary nodules, as shown in figure 2 [17–19]. On preoperative imaging or histological analysis of the surgical specimen Hazelrigg and co-workers identified at least one pulmonary nodule in 39.5% of 281 patients undergoing LVRS [17]. 78 nodules were resected, 17 were malignant and 13 cases of non-small-cell lung cancer (NSCLC) were observed.

Figure 2

Left lower lobe solitary pulmonary nodule incidentally discovered during LVRS assessement.

McKenna et al observed a nodule in 51 (16%) of 325 patients evaluated for LVRS and 11 NSCLC were identified [18]. Only 3 patients were treated by formal lobectomy and wedge resections were carried out in the remaining 8 cases. Pigula described 10 similar cases undergoing nodule resection in conjunction with LVRS [19].

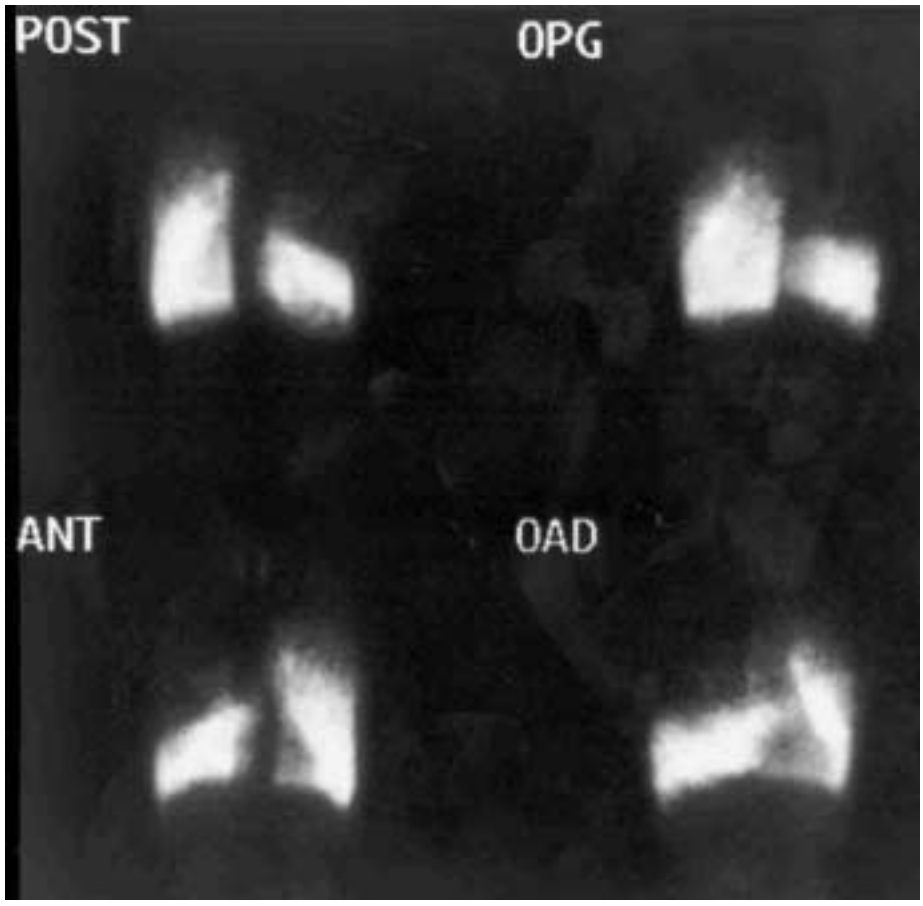
The incidence of lung cancer in emphysema patients

Non-small-cell lung cancer (NSCLC) is nowadays treated by anatomical lung resection (lobectomy or pneumonectomy), and procedures of lesser extent such as wedge or segmental resections carry a significantly higher risk of local recurrence [20]. The simultaneous presence of emphysematous lung disease and cancer is a not infrequent and vexing clinical problem. Anatomical lung resection would normally be considered a prohibitively high risk for these patients because of poor underlying pulmonary function. However, traditional operability criteria for lung cancer have somewhat changed with growing experience of LVRS. It has been shown that patients with NSCLC and severe emphysema considered inoperable because of poor lung function may not only undergo lobectomy safely but may even have increased pulmonary function after resection. This is primarily due to an effect of LVRS related to tumour resection. LVRS criteria may therefore be extended and applied to selected patients presenting with lung cancer associated with severe em-

Figure 3

Right upper lobe NSCLC in a patient with severe heterogeneous emphysema with upper lobe predominance, as seen on chest X-ray (fig. 3a) and on preoperative perfusion scintigraphy (fig. 3b). Preoperative and postoperative FEV_1 and RV were 1,60 L (52%), 4,87 L (222%) and 2,47 L (80,5%), 2,38 L (108%) respectively.

a



b

physema. However, this is only possible in situations where the tumour is located within the target area for LVRS, as highlighted by Edwards et al., who introduced the principle of "lobar volume reduction surgery" [21]. The feasibility of lobectomy was demonstrated in 29 emphysematous patients; two groups were considered on the basis of postoperative predicted FEV_1 (>40% and <40% respectively). In the group with the most severe functional impairment the measured post- operative FEV_1 was significantly higher than predicted, a fact which paralleled the postoperative functional improvement observed in this group of patients as compared to the preoperative status [21]. Other reports have also shown a subjective and objective improvement in emphysema patients undergoing lobectomy for lung cancer if the cancer is within the target areas of anticipated LVRS [22–24]. There is increasing evidence that selected patients harbouring concomitant emphysema and pulmonary malignancy can undergo simultaneous LVRS and cancer surgery [18, 21, 22], but only if the neoplasm is located in the target area for LVRS [18, 19, 22]. In our experience 10 patients have undergone surgery in this setting. In 7 cases the neoplasm was located in target areas for LVRS and these patients underwent lobectomy (fig. 3). Improved lung function was seen after cancer resection combined with LVRS. In the remaining 3 cases the lesion was in a part of the lung not considered for LVRS and the patients underwent segmental resection combined with upper lobe LVRS (fig. 4). A favourable postoperative outcome was observed in all the cases. Nevertheless, further studies are required to determine the value of this concept in terms of long-term functional outcome and cancer-related survival.

Surgical technique

First performed by sternotomy, LVRS was then accessed by VATS, which is now considered as the technique of choice. Whether LVRS should be performed as a unilateral or bilateral simultaneous procedure is still controverted. To date no randomised prospective study has compared unilateral versus bilateral LVRS. Several studies have shown a better clinical and functional outcome after the bilateral procedure than after the unilateral approach [25–27]. McKenna et al. reported a better functional outcome after bilateral thoracoscopic LVRS and noticed lower 1-year mortality compared with unilateral LVRS [25]. These results contrast with those of Kotloff et al. [26], who reported an increase in hospital mortality and postoperative respiratory failure in patients treated by simultaneous bilateral LVRS. Similarly, Serna and co-workers described better results after bilateral LVRS with significantly higher 2-year survival [27]. Naunheim et al. found no difference in survival between bilateral and unilateral LVRS [28]. Our experience with a systematic unilateral VATS approach since 1996 has shown no mortality, tracheostomy or prolonged intensive care unit stay after LVRS. Significant clinical and functional benefit was noticed in 28 patients during a follow-up which lasted at least 2 years [29]. Only 2 patients, both with alpha-1-antitrypsin deficiency, underwent contralateral surgery during the observation period. LVRS should be considered a purely palliative procedure and, in consequence, the least aggressive approach should be chosen that will result in an acceptable quality of life, which need not necessarily be reflected in pulmonary function measurements. In addition, after the unilateral procedure LVRS can be repeated on the contralateral side if required; however, the published results after staged bilateral LVRS are scant and controversial. Pompeo et al. reported a better clinical outcome after staged bilateral than after simultaneous bilateral LVRS [30]. Although a simultaneous bilateral approach may lead to better immediate functional results than a unilateral procedure, the subsequent decline and loss of pulmonary function during the postoperative period is also more pronounced after bilateral than unilateral procedures. An annual decline of 260 ml *vs* 100 ml respectively has been reported [31]. This aspect needs to be investigated in a properly conducted prospective study investigating the value of LVRS in emphysematous patients, patient selection and the best surgical approach.

Figure 4

Chest X-ray showing stage I left lower lobe NSCLC in a patient with severe heterogeneous emphysema submitted to apical segmentectomy of the left lower lobe. Preoperative and postoperative FEV_1 and RV were 0.82 L (34%), 2,74 L (150%) and 0,84 L (34%), 3,28 L (185%) respectively.

Correspondence:
Dr Edgardo Pezzetta
Service de Chirurgie
Centre Hospitalier Universitaire Vaudois
CH-1011 Lausanne
E-Mail: EdgardoPezzetta@chuv.hospvd.ch

References

1 Brantigan O, Mueller M. Surgical treatment of pulmonary emphysema. Am Surg 1957;23:789–804.
2 Cooper JD, Trulock EP, Triantafillou AN, Patterson GA, Pohl MS, Deloney PA, et al. Bilateral pneumectomy (volume reduction) for chronic obstructive pulmonary disease. J Thorac Cardiovasc Surg 1995;109:106–16.
3 Sciurba FC, Rogers RM, Keenan RJ, Slivka WA, Goresan J, Ferson et al. Improvement in pulmonary function and elastic recoil after lung reduction surgery for diffuse emphysema. N Engl J Med 1996;334:1095–99.
4 Gelb AF, Zamel N, McKenna RJ, Brenner M. Mechanism of short term improvement in lung function following emphysema resection. Am J Respir Crit Care Med 1996;154:945–51.
5 Goodnight-White S, Jones JW, Baaklini WA. Lung volume reduction surgery (LVRS) in patients with severe emphysema: 1 year follow-up. Am J Respir Crit Care Med 2001; 163: A486
6 Geddes D, Davies M, Koyama H, Hansell D, Pastorino U, Pepper J et al. Effect of lung volume reduction surgery in patients with severe emphysema. N Engl J Med 2000; 343:239–45.
7 Pompeo E, Marino M, Nofroni I, Matteucci G, Mineo TC. Reduction pneumoplasty versus respiratory rehabilitation in severe emphysema: a randomized study. Pulmonary emphysema research group. Ann Thorac Surg 2000;70: 948–53.
8 Lödfahl CG, Hillerdal G, Ström K. Randomized controlled trial of volume reduction surgery: preliminary results up to 12 months. Am J Respir Crit Care Med 2000;161:A585.
9 Criner GJ, Cordova FC, Furukawa S, Kuzma AM, Travaline JM, Leyerson V et al. Prospective randomized trial comparing bilateral lung volume reduction surgery to pulmonary rehabilitation in severe chronic obstructive pulmonary disease. Am J Respir Crit Care Med 1999;160:2018–27.
10 Todd TR. The preoperative selection for emphysema surgery. Eur J Cardio-thorac Surg 1999;16:s51–s56.

11 Mc Kenna RJ, Brenner M, Fischel RJ, Singh N, Yoong B, Gelb AF et al. Patient selection criteria for lung volume reduction surgery J Thorac Cardiovasc Surg 1997;114:957–67.

12 National Emphysema Treatment Trial Research Group. Patients at high risk of death after lung volume reduction surgery. N Engl J Med 2001;345:1075–83.

13 Turnheer R, Engel H, Weder W, Stammberger U, Laube I, Russi EW et al. Role of lung perfusion scintigraphy in relation to chest computed tomography and pulmonary function in the evaluation of candidates for lung volume reduction surgery. Am J Respir Crit Care Med 1999;159:301–10.

14 Wang SC, Fisher KC, Slone RM, Gierada DS, Yusen RD, Lefrak SS et al. Perfusion scintigraphy in the evaluation of lung volume reduction surgery: correlation with clinical outcome. Radiology 1997;204:243–8.

15 Weder W, Turnheer R, Stammberger U, Burge M, Russi EW, Bloch KE. Radiologic emphysema morphology is associated with outcome after surgical lung volume reduction. Ann Thorac Surg 1997;64:313–9.

16 Kotloff RM, Hansen-Flaschen J, Lipson DA, Tino G, Arcasoy SM, Alavi A et al. Apical perfusion fraction as a predictor of short term functional outcome following bilateral lung volume reduction surgery. Chest 2001;120:1609–15.

17 Hazelrigg SR, Boley TM, Weber D,Magee MJ, Naunheim KS. Incidence of lung nodules found in patients undergoing lung volume reduction. Ann Thorac surg 1997;64: 303–6.

18 Mc Kenna RJ, Fischel RJ, Brenner M, Gelb AF. Combined operations for lung volume reduction surgery and lung cancer. Chest 1996;110:885–8.

19 Pigula FA, Keenan RJ, Ferson PF, Landreneau RJ. Unsuspected lung cancer found in work-up for lung reduction operation Ann Thorac Surg 196;61:174–6.

20 Ginsberg RJ, Rubinstein LV. Randomized trial of lobectomy versus limited resection for T1 N0 non-small cell lung cancer. Ann Thorac Surg 1995;60:615–23.

21 Edwards JG, Duthie DJR, Waller DA. Lobar volume reduction surgery: a method of increasing the lung cancer resection rate in patients with emphysema. Thorax 2001;56:791–5.

22 De Meester SR, Patterson GA, Sundaresan RS, Cooper JD. Lobectomy combined with volume reduction for patients with lung cancer and advanced emphysema. J Thorac Cardiovasc Surg 1998; 115:681–8.

23 Korst RJ, Ginsberg RJ, Ailawadi M, Bains MS, Downey RS, Rush Vw et al. Lobectomy improves ventilatory function in selected patients with severe COPD. Ann Thorac Surg 1998; 66:898–902.

24 Carretta A, Zannini P, Puglisi A, Chiesa G, Vanzulli A, Bianchi A et al. Improvement of pulmonary function after lobectomy for non small cell lung cancer in emphysematous patients. Eur J Cardio-Thorac Surg 1999;15:602–7.

25 Mc Kenna RJ, Brenner M, Fischel RJ, Gelb AF. Should lung volume reduction for emphysema be unilateral or bilateral? J Thorac Cardiovasc Surg 1996;112:1331–9.

26 Kotloff RM, Tino G, Palvesky HI, Hansen-Flaschen J, Wahl PM, Kaiser LR, et al. Comparison of short term functional outcomes following unilateral and bilateral lung volume reduction surgery. Chest 1998;113:890–5.

27 Serna DL, Brenner M, Osann KE, Mc Kenna RJ, Chen JC, Fischel R, et al. Survival after unilateral versus bilateral lung volume reduction surgery for emphysema. J Thorac Cardiovasc Surg 1999;118:1101–9.

28 Naunheim KS, Kaiser LR, Bavaria JE, Hazelrigg SR, Magee MJ, Landreneau RJ, et al. Long term survival after thoracoscopic lung volume reduction: A multiinsitutional review. Ann Thorac Surg 1999;68:2026–31.

29 Geiser T, Schwizer B, Krueger T, Gugger M, Im Hof V, Dusmet M, et al. Outcome after unilateral lung volume reduction surgery in patients with severe emphysema. Eur J Cardio-Thorac Surg 2001;20:674–8.

30 Pompeo E, Mineo TC. Long term outcome of staged versus one stage bilateral thoracoscopic reduction pneumoplasty. Eacts/Ests Joint meeting 2001: abstracts, 280.

31 Brenner M, Mc Kenna RJ, Gelb AF, Fischel RJ, Wilson AF. Rate of FEV1 change following lung volume reduction surgery. Chest 1998;113:652–9.

Swiss
Medical Weekly

Official journal of
the Swiss Society of Infectious disease
the Swiss Society of Internal Medicine
the Swiss Respiratory Society

The many reasons why you should choose SMW to publish your research

What Swiss Medical Weekly has to offer:

- SMW's impact factor has been steadily rising, to the current 1.537
- Open access to the publication via the Internet, therefore wide audience and impact
- Rapid listing in Medline
- LinkOut-button from PubMed with link to the full text website http://www.smw.ch (direct link from each SMW record in PubMed)

- No-nonsense submission – you submit a single copy of your manuscript by e-mail attachment
- Peer review based on a broad spectrum of international academic referees
- Assistance of our professional statistician for every article with statistical analyses

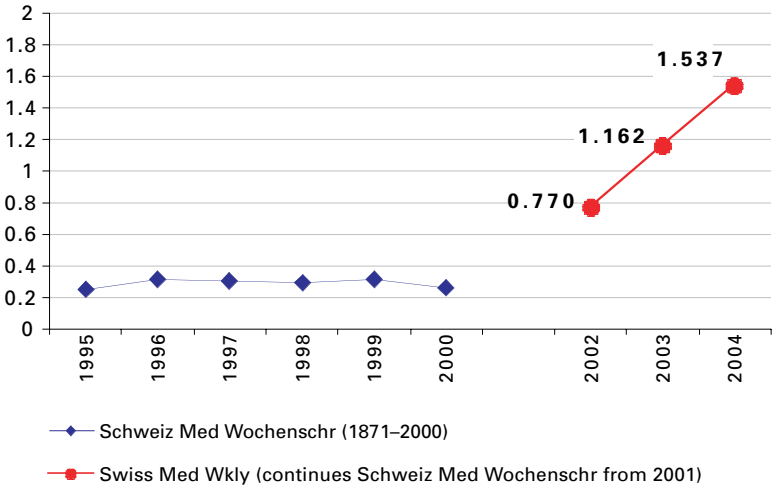
- Fast peer review, by e-mail exchange with the referees
- Prompt decisions based on weekly conferences of the Editorial Board
- Prompt notification on the status of your manuscript by e-mail
- Professional English copy editing
- No page charges and attractive colour offprints at no extra cost

We evaluate manuscripts of broad clinical interest from all specialities, including experimental medicine and clinical investigation.

We look forward to receiving your paper!

Guidelines for authors:
http://www.smw.ch/set_authors.html

Impact factor Swiss Medical Weekly



EMH FMH Schwabe
Editores Medicorum Helveticorum

All manuscripts should be sent in electronic form, to:

EMH Swiss Medical Publishers Ltd.
SMW Editorial Secretariat
Farnsburgerstrasse 8
CH-4132 Muttenz

Manuscripts: submission@smw.ch
Letters to the editor: letters@smw.ch
Editorial Board: red@smw.ch
Internet: http://www.smw.ch