UC Irvine

UC Irvine Previously Published Works

Title

Combined operations for lung volume reduction surgery and lung cancer.

Permalink

<https://escholarship.org/uc/item/00m2s3pn>

Journal

Chest, 110(4)

ISSN

0012-3692

Authors

McKenna, RJ
Fischel, RJ
Brenner, M
et al.

Publication Date

1996-10-01

DOI

10.1378/chest.110.4.885

Copyright Information

This work is made available under the terms of a Creative Commons Attribution License, available at <https://creativecommons.org/licenses/by/4.0/>

Peer reviewed

Combined Operations for Lung Volume Reduction Surgery and Lung Cancer*

Robert J. McKenna, Jr., MD; Richard J. Fischel, MD, PhD;
Matthew Brenner, MD; and Arthur F. Gelb, MD

Fifty-three lung masses were found in 51 (16%) of 325 patients who underwent lung volume reduction surgery. This included 11 non-small cell lung cancers and 42 benign lung masses. Eleven patients (mean age, 69.4 years) underwent a combined lung volume reduction surgery and resection of clinical stage I lung cancers (lymph node dissection with either lobectomy [3] or wedge resection [8]). There were no deaths or major complications. The average length of stay was 8.7 days. The mean FEV₁ was 654 mL (21.7% predicted) preoperatively and 1,079 mL (49% predicted) postoperatively. Patients who are screened for lung volume reduction surgery should be carefully evaluated for possible lung masses. Lung volume reduction surgery allows lung cancer surgery in patients who otherwise would be considered to have physiologically inoperable disease.

(CHEST 1996; 110:885-88)

Key words: emphysema; lung cancer; lung volume reduction surgery

Abbreviations: LVRS=lung volume reduction surgery

Poor pulmonary function may preclude attempted surgical cure for lung cancer. Alternative treatments, such as radiation therapy, have a very low 5-year survival and may also be contraindicated by poor pulmonary function.

Lung volume reduction surgery (LVRS) can significantly improve pulmonary function for selected patients with emphysema.¹⁻³ Because smoking is the primary cause of lung cancer and emphysema, some patients with both diseases are identified during the evaluation for LVRS. We hypothesize that LVRS may potentially allow resection of lung cancer in patients who otherwise have physiologically inoperable conditions.

This series, therefore, was reviewed to determine the incidence of both benign and malignant masses in candidates for LVRS and to evaluate the role of LVRS in improving the physiologic candidacy for surgery of patients with lung cancer.

MATERIALS AND METHODS

From May 1994 through December 1995, 325 patients underwent LVRS for emphysema at Chapman Medical Center and the

Hospital of the Good Samaritan. Our patient selection and technique for thoracoscopic LVRS⁴ have been described previously. The most important selection criterion was the presence of a strongly heterogeneous pattern of emphysema on CT scan and lung perfusion scan that showed target areas of poorly perfused, anatomically destroyed lung tissue.

The operative technique for thoracoscopic LVRS⁴ and thoracoscopic lobectomy⁵ have been described previously. Fiberoptic bronchoscopy was performed in all patients at the time of the operation. The goal of the LVRS was resection of 20 to 30% of each lung, which generally meant approximately half of each upper lobe. The tissue targeted for resection was determined by the preoperative CT scan and lung perfusion scan. If a lobectomy was performed, it was a standard, anatomic lobectomy with lymph node dissection for all ipsilateral N1 and N2 lymph nodes. To prevent seeding the incision, lung tissue that included a tumor was placed in a bag for removal. The cancer portion of the operation added no more than 30 min to the time of the procedure and added no morbidity. Chest CT scan, performed as part of the workup for emphysema, identified 49 peripheral lung masses in 47 (15%) of the patients who underwent LVRS.

Specimens from percutaneous needle biopsy, performed in three patients, diagnosed three non-small cell lung cancers. The remaining patients did not undergo needle biopsy because the lung mass was small and the patients were generally considered to be at high risk for pneumothorax. The diagnostic yield for bronchoscopy was considered to be very low for these peripheral masses, so it was performed at the time of the operation. Diagnosis, therefore, was primarily obtained at the time of the emphysema operation.

Five additional patients were referred specifically for the evaluation of a combined operation for emphysema and presumed lung cancer. An operation was not performed on two of these five patients. One patient had a rapidly growing mass in the right middle lobe that crossed the fissure into the lower lobe. The bilobectomy necessary to resect the tumor would have removed the only good lung tissue seen on the chest CT scan and the lung perfusion scan. The chest CT scan in the other patient identified a left hilar

*From the Lung Center, Chapman Medical Center, Orange, Calif, the Hospital of the Good Samaritan, Los Angeles (Drs. McKenna and Fischel); and Pulmonary Department (Dr. Gelb), Lakewood Regional Medical Center, Lakewood, Calif, and Pulmonary Division, UCLA Dept of Thoracic Surgery (Drs. McKenna and Fischel), Beckman Laser Institute (Dr. Brenner), and UCLA Pulmonary Division (Dr. Gelb), Los Angeles.
Supported in part by DOE grant DE-f603-91 ER61227, NIH grant R01192, and the Heart and Lung Surgery Foundation.
Manuscript received May 15, 1996; revision accepted June 13.
Reprint requests: Dr. McKenna, 1245 Wilshire Blvd. Suite 606, Los Angeles, CA 90017

Table 1—Patients Who Underwent Combined Operations for Both Lung Cancer and LVRS*

Patient	Age, yr/Sex	CA	Type	Procedure	LVRS	LOS, d
1	77/M	T1N0	ADENO	Wedge	UNI-ST	11
2	75/M	T1N0	SQUAM	Wedge	UNI-ST	10
3	64/M	T2N0	ADENO	Wedge	UNI-ST	6
4	60/M	T1N0	SQUAM	Wedge	BILAT-ST	13
5	75/M	T1N0	SQUAM	RML	BILAT-ST	15
6	66/F	T1N0	SQUAM	RUL	BILAT-ST	6
7	81/M	T2N0	SQUAM	RLL	BILAT-ST	4
8	78/M	T1N0	SQUAM	RUL	BILAT-ST	11
9	56/M	T2N0	ADENO	Wedge	BILAT-ST	5
10	71/F	T1N2	SQUAM	Wedge	BILAT-ST	8
11	60/F	T1N0	ADENO	Wedge	BILAT-ST	7

*SQUAM=squamous cell carcinoma; ADENO=adenocarcinoma; RML=right middle lobectomy; RUL=right upper lobectomy; UNI-ST=unilateral staple LVRS; BILAT-ST=bilateral staple LVRS; CA=cancer; LOS=length of stay.

mass invading the main left pulmonary artery, so a left pneumonectomy would have been required to remove the tumor. Her FEV₁ was 0.55 L, so she was deemed to have a physiologically inoperable condition.

All operations were performed with video-assisted thoracic surgery. Our standard operation was unilateral LVRS during the time that the first three patients with cancer underwent their operations. Subsequently, eight patients underwent resection of their lung cancers and simultaneous bilateral staple LVRS (our current standard procedure). When the frozen section showed a cancer, the procedure included lymph node dissection and either lobectomy or wedge resection. Lobectomy was performed if the cancer was located in the severely emphysematous lung tissue targeted for lung volume reduction. A wedge resection was used for patients with cancers in the healthier areas of lung tissue.

RESULTS

Fifty-three lung masses were resected in 51 (16%) of 325 patients who underwent LVRS. Forty-two patients (13%) were found to have histologically benign lung masses that included 20 calcified nodules, 17 granulomas, 4 fibrotic nodules, and 1 hamartoma. Two patients had both a granuloma and lung cancer. Cultures were positive in only two patients: acid-fast bacilli (one) and *Aspergillus* (one).

Eleven clinical stage I non-small cell lung cancers were resected. Of these 11 cancers, 3 were specifically referred for combined cancer and emphysema surgery, 7 were found during the evaluation for LVRS, and 1 was an incidental pathologic finding. No additional cancers were identified at bronchoscopy. Therefore, the chest CT scan obtained for the evaluation of 325 patients for LVRS identified 7 (2%) previously undiagnosed lung cancers.

One patient with multiple areas of pleural scarring was found pathologically to have a localized cancer in one area of scarring. Even retrospectively, this could not be appreciated on the preoperative CT scan. Intraoperatively, the cancer was not diagnosed because

it was grossly no different from other areas of scar that were resected.

Three women and 8 men with an average age of 69.4 years underwent resection of emphysema and lung cancer (Table 1). Preoperatively, all cancers were clinical stage I. Ten of the 11 cancers were also pathologic stage I. Dissection of normal-sized nodes in patient 10 showed N1 and N2 disease, so she had pathologic stage III (T1N2) cancer.

There were no operative deaths. Prolonged air leak (≥ 7 days) occurred in 5 patients (45%). There were no other postoperative complications. The average hospital length of stay was 8.7 days. The operative mortality for the entire LVRS series is 3.5%, with an average length of stay of 11.1 days, and a 47% incidence of prolonged air leak. The mean increase in FEV₁ for all the patients undergoing bilateral thoracoscopic LVRS was 59%.

Clinically, no patients were more dyspneic after lung resection. Patients were followed up with a dyspnea scale of 1 to 4, where 4 was severely limiting dyspnea. Postoperatively, the dyspnea scale was unchanged in four patients. This included patient 5 who, despite a 64.7% improvement in postoperative FEV₁, experienced no improvement in dyspnea because his lobectomy removed his best lung parenchyma. One patient improved by 1 grade, and 6 patients had a preoperative dyspnea scale of 3 that went to 1 postoperatively.

The average preoperative FEV₁ was 0.654 L (21% predicted), and the average postoperative FEV₁ was 1.079 L (49% predicted). Compared with the preoperative pulmonary function, no postoperative function was worse. The five patients who had the cancers located in the areas targeted for the lung volume reduction (patients 3, 6, 8, 9, and 11) experienced major postoperative improvement in pulmonary function (Table 2).

Clinical improvement was excellent for the two patients who underwent right upper lobectomy for a bilateral upper lobe pattern of emphysema with the cancer in the severely emphysematous tissue targeted for resection. Patient 5 underwent a right middle lobectomy (which removed his best lung tissue, as determined by the CT scan and lung perfusion scan) and bilateral upper lobe LVRS for a strongly heterogeneous pattern of emphysema to balance the loss of good pulmonary tissue. Postoperatively, he continues to receive oxygen therapy despite a 440 mL (64.7%) improvement in FEV₁ because his best lung tissue had to be removed to resect his cancer.

The results of the Medical Outcome Study Short Form 36 (MOS SF-36) quality of life questionnaire correlated with the results with the dyspnea scale (Table 2). This showed substantial clinical improvement for six patients after the resection, a small

improvement for one patient, and no change for the remaining four patients.

Clinical follow-up is complete for all 325 patients who underwent LVRS. During this time, 1 patient who, even retrospectively, had no mass on the chest CT scan died of a pulmonary embolus 10 months after LVRS. To date, no resected cancer has recurred, although follow-up is short (range, 2 to 20 months; mean, 9.7 months).

DISCUSSION

The postoperative results of this series suggest that the pulmonary function criteria for pulmonary resection need to be reevaluated for selected patients who are candidates for LVRS. Traditionally, to undergo a pulmonary resection, a patient should have a predicted postoperative FEV₁ of 0.8 to 1 L, and patients are considered to be high risk if their preoperative FEV₁ is less than 1.2 L.⁶ In this study, the average preoperative FEV₁ was 0.65 L (21.7% predicted), and none of the patients met these traditional pulmonary function criteria to undergo lung surgery.

LVRS can be performed successfully in patients with an FEV₁ as low as 230 mL, so thus far, a lower limit of FEV₁ that contraindicates LVRS has not been identified.³ This study suggests that the pulmonary function criteria for resection of a lung mass are different for patients who can also undergo simultaneous LVRS.

Although a small, peripheral stage I lung cancer can be cured with either a wedge resection or a lobectomy, a lobectomy is the procedure of choice because it has a much lower incidence of local recurrence and a better 5-year survival.^{7,8}

LVRS provides the greatest improvement in pulmonary function for patients with a bilateral upper lobe pattern of severe emphysematous destruction of lung tissue.³ If a lung cancer is located in the area targeted for lung volume reduction, then the preferred operation, a standard anatomic lobectomy with lymph node dissection, may be done. These patients may thus receive the benefit of both the optimal cancer operation and the optimal lung volume reduction operation for improvement in their pulmonary function.

If the cancer is located in the "good" lung tissue that would normally be preserved during a lung volume reduction operation, then a wedge resection can be done for the cancer and lung volume reduction in the target areas. The total amount of lung resected was the same regardless of the location of the lung cancer. Thus, patients with the cancer in the area of the severe emphysematous change targeted for resection would be expected to get greater clinical improvement. For patients with the cancer in the better lung tissue, the loss of pulmonary function expected from the resection

Table 2—Pulmonary Function and Survival in Patients Who Underwent Combined Operations for Both Lung Cancer and LVRS*

Patient	FEV ₁ , L (% Predicted)		Clinical Status	Postop Dyspnea
	Preoperative	Postoperative		
1	0.66 (20)	0.69 (26)	Alive, NED, 22 mo	Same
2	0.77 (25)	0.76 (25)	Alive, NED, 22 mo	Same
3	0.64 (23)	1.12 (59)	Alive, NED, 22 mo	++
4	0.95 (26)	0.97 (86)	Alive, NED, 12 mo	Same
5	0.68 (20)	1.12 (42)	Alive, NED, 16 mo	Same
6	0.56 (25)	0.84 (40)	Alive, NED, 7 mo	++
7	0.89 (29)	1.31 (41)	Alive, NED, 7 mo	++
8	0.48 (16)	1.4 (47)	Alive, NED, 7 mo	++
9	0.72 (20)	2.12 (95)	Died, NED, 10 mo	++
10	0.33 (12)		Alive, NED, 3 mo	+
11	0.53 (23)	0.63 (28)	Alive, NED, 2 mo	++

*NED=no evidence of disease by history; Postop Dyspnea=clinical status of the patient's pulmonary function after the operation listed as same (no change), +=improved, or ++=much improved.

of "good" lung tissue for the cancer operation is counterbalanced by the benefit from LVRS, so the cancer can generally be resected without any measurable loss in pulmonary function.

With that surgical philosophy, 11 of 13 patients evaluated for resection of a lung cancer underwent a combined operation for cancer and emphysema, and all 11 patients underwent a complete resection with clear margins. Patients with poor pulmonary function that previously precluded resection can now undergo lung cancer surgery if it is combined with LVRS.

Mediastinal nodal dissection diagnosed N2 disease in 5 to 14% of patients whose conditions were preoperatively staged by CT scan as N0.⁹⁻¹¹ One patient in this study had unsuspected N2 disease. Ten of 11 patients in this series have pathologic stage I disease, so they have a good prognosis from the point of view of their cancers. No cancers have recurred at the present time, but the follow-up is short. The expected 3-year mortality for patients with an FEV₁ less than 30% predicted is 30%.¹⁰ Long-term follow-up is needed to determine the survival from combined operations for cancer and emphysema.

In summary, 2% of patients who underwent LVRS were found to have previously undiagnosed lung cancers. Surgical treatment for lung cancer is now possible for patients who, prior to LVRS, had inoperable conditions due to poor pulmonary function. During the evaluation for LVRS, the chest CT scan should be studied to look for an unsuspected lung cancer.

REFERENCES

- Cooper JD, Trulock EP, Triantafyllou AN, et al. Bilateral pneumectomy (volume reduction) for chronic obstructive pulmonary disease. *J Thorac Cardiovasc Surg* 1995; 109:106-19
- McKenna RJ Jr, Brenner M, Gelb A, et al. A randomized, pro-

- spective trial of stapled lung reduction versus laser bullectomy for diffuse emphysema. *J Thorac Cardiovasc Surg* 1996; 111:317-21
- 3 McKenna RJ Jr, Brenner M, Fischel RJ, et al. Should stapled lung volume reduction surgery be unilateral or bilateral? *J Thorac Cardiovasc Surg* (in press)
 - 4 Fischel RJ, McKenna RJ Jr, Peters H. Thoracoscopic lung volume reduction surgery. *Surg Rounds* 1996; 19:272-8
 - 5 McKenna RJ Jr. Thoracoscopic lobectomy and lymph node dissection. *J Thorac Cardiovasc Surg* 1994; 107:879-82
 - 6 Lockwood P. Lung function test results and the risk of postthoracotomy complications. *Respiration* 1973; 30:529-42
 - 7 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
 - 8 Warren W, Faber LP. Segmentectomy versus lobectomy in patients with stage I pulmonary carcinoma. *J Thorac Cardiovasc Surg* 1994; 107:1087-94
 - 9 Libshitz HI, McKenna RJ Jr, Haynie TP, et al. Mediastinal evaluation in lung cancer. *Radiology* 1984; 151:295-99
 - 10 Fletcher C, Peto R. The natural history of chronic airflow obstruction. *BMJ* 1979; 11:1645-48
 - 11 Asamura H, Nakayama H, Kondo H, et al. Lymph node involvement, recurrence, and prognosis in resected small peripheral, non-small cell lung carcinomas: are these carcinomas candidates for video-assisted lobectomy? *J Thorac Cardiovasc Surg* 1996; 111:1125-34
 - 12 Stewart AL, Hays RD, Ware JE. The MOS Short Form General Health Survey: reliability and validity in a patient population. *Med Care* 1988; 26:724-35

P H Y S I C I A N S

*cardiac & general
thoracic surgery*

Update

*December 4-7, 1996
Rio Mar, Puerto Rico*

Call for Abstracts _____
Submission deadline: Aug. 30, 1996

FOR INFORMATION CALL: 1-800-343-ACCP