EUROPEAN INTERBALKAN MEDICAL CENTER
Pulmonary Clinic

2nd one-day course in Interventional Pulmonology

"ENDOSCOPY LUNG VOLUME REDUCTION IN THE MANAGEMENT OF EMPHYSEMA PHENOTYPE OF COPD"

Saturday October 13, 2018

Nikopolis hotel
Thessaloniki, Greece

Under the Auspices

Hellenic Society of Respiratory & Occupational Chest Diseases

CONGRESS SECRETARIAT | INFORMATION

INVENTICS SA, Medevents
T. +30 2310 474 400 | F. +30 2310 801 454
E. info@medevents.gr | W. www.medevents.gr
GNTO LICENSE: 0933E60000074600

Invasive Techniques in the management of severe Pulmonary Emphysema

Lung Volume Reduction Surgery

LVRS

Athanasios Kleontas
BSc, MD, MSc, PhD(c), BTS

ESTS Regent www.ests.org
HCTSS Councilor www.hctss.gr
Thoracic Surgeon www.kleontas.com
Scientific Director www.galinos.gr
Managing Director www.datalife.gr

History

First had the idea that localized lung resection might benefit patients with diffuse end-stage lung emphysema

Brantigan et al. A surgical approach to pulmonary emphysema. Am rev Respir Dis 1959;43:669-672

It was his thought that
by removing the most diseased portions of lung,
one could restore the tethering effect
thus maintaining patency of the bronchioles and improve airflow

Brantigan et al. A surgical approach to pulmonary emphysema. Am rev Respir Dis 1959;43:669-672

Utilized a unilateral thoracotomy approach with excision of diseased lung.
The vascular physiology, with resultant hemodynamic changes caused improvement in dyspnea

de Perrot M, Licker M, Spiliopoulos A. Muscle-sparing anterior thoracotomy for one-stage bilateral lung volume reduction operation. *Ann Thorac Surg* 1998;66:582–584.
Dahan M, Salerin F. Berjaud J, et al. Value of hemodynamics in the surgical indications of emphysema. *Ann Chir* 1989;43:669–672.

Athanasios Kleontas
BSc, MD, MSc, BTS, PhD(c)
Thoracic Surgery
2018

History

Reported his results for the treatment of end-stage emphysema by unilateral parenchymal laser ablation via thoracoscopic approach

Wakabayashi A, Brenner M, Kayaleh RA, et al. Thoracoscopic carbon dioxide laser treatment of bullous emphysema. *Lancet* 1991;337:881–883.

Utilized a median sternotomy approach with bilateral excision of diseased, emphysematous upper lobes

Cooper JD, Trulock EP, Triantafillou AN, et al. Bilateral pneumectomy (volume reduction) for chronic obstructive pulmonary disease. *J Thorac Cardiovasc Surg* 1995;109:106–116.

There were multiple technical variations, including the employment of a unilateral thoracoscopy approach, a bilateral thoracoscopy approach and bilateral minithoracotomies in addition to median sternotomy. The initial published reports were almost universally encouraging and documented rates of morbidity and mortality that were relatively favorable

Bingisser R, Zollinger A, Hauser M, et al. Bilateral volume reduction surgery for diffuse pulmonary emphysema by video-assisted thoracoscopy. *J Thorac Cardiovasc Surg* 1996;112:875–882.

Kotloff RM, Tino G, Bavaria JE, et al. Bilateral lung volume reduction surgery for advanced emphysema. A comparison of median sternotomy and thoracoscopic approaches. *Chest* 1996;110:1399–1406.

McKenna RJ, Brenner M, Gelb AF, et al. A randomized, prospective trial of stapled lung reduction versus laser bullectomy for diffuse emphysema. *J Thorac Cardiovasc Surg* 1996;111:317–322.

Athanasios Kleontas
BSc, MD, MSc, BTS, PhD(c)
Thoracic Surgery
2018

Rationale

Hemodynamics
Lowering intrathoracic pressure, improves venous return, decrease pulmonary vascular resistance and improves cardiac index

VentilationPerfusion Mismatch
Distended alveolar airspaces compress adjacent, well perfused alveoli

It would not seem rational to treat patients who demonstrate inadequate pulmonary reserve by removing significant amounts of lung tissue

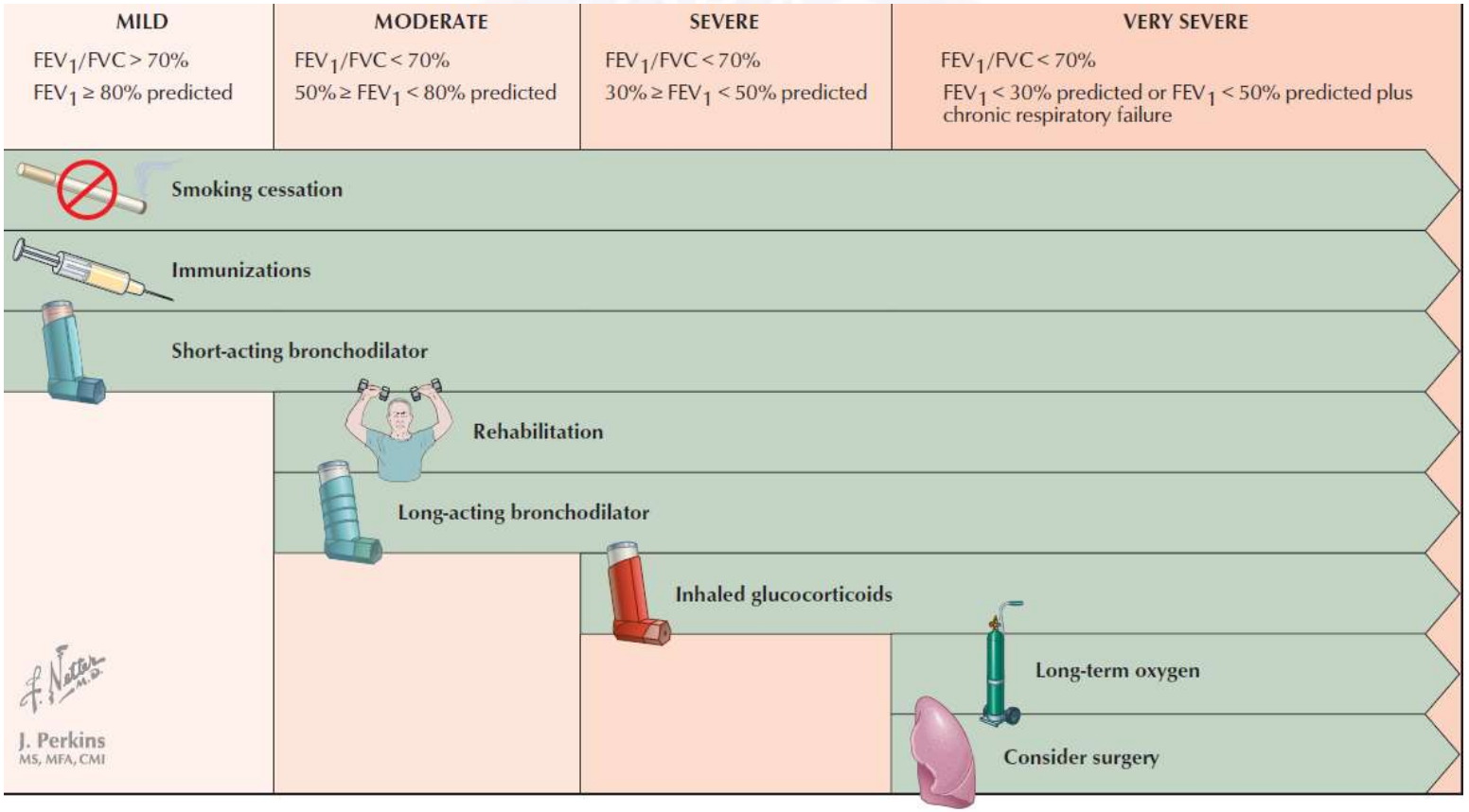
Chest wall Diaphragm
The lung becomes hyperinflated, thus distending the chest wall and flattening the diaphragm → limit their contractility, decreased in- ex- volumes

Airway Resistance
The loss of elastic recoil leads to closure of the terminal bronchioles earlier in the expiratory cycle

Athanasios Kleontas
BSc, MD, MSc, BTS, PhD(c)
Thoracic Surgery
2018

Shields' General Thoracic Surgery
J. Locicero, R. Feins, Y. Colson, G. Rocco
8th edition 2019 Wolters Kluwer

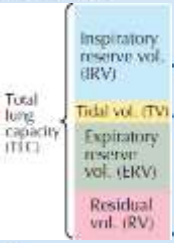
Therapy


MILD
FEV1/FVC > 70%
FEV1 ≥ 80% predicted
MODERATE
FEV1/FVC < 70%
50% ≥ FEV1 < 80% predicted
SEVERE
FEV1/FVC < 70%
30% ≥ FEV1 < 50% predicted
VERY SEVERE
FEV1/FVC < 70%
FEV1 < 30% predicted or FEV1 < 50% predicted plus chronic respiratory failure
Smoking cessation
Immunizations
Short-acting bronchodilator
Rehabilitation
Long-acting bronchodilator
Inhaled glucocorticoids
Long-term oxygen
Consider surgery
J. Perkins
MS, MFA, CMI

Preoperative Assessment

TABLE 82.1 Inclusion Criteria (Patients Must Meet All Criteria to Participate)

History and physical examination	Consistent with emphysema; BMI ≤31.1 kg/m^2 (men) or ≤32.3 kg/m^2 (women) at randomization; stable on ≤20 mg prednisone (or equivalent) daily
Radiographic	HRCT scan evidence of bilateral emphysema
Pulmonary function (pre-rehabilitation)	FEV_1 ≤ 45% predicted (≥15% predicted if ≥70 years); TLC ≥100% predicted; RV ≥150% predicted
Arterial blood gas (pre-rehabilitation)	P_{CO2} ≤60 mm Hg (Denver: P_{CO2} ≤55 mm Hg) P_{O2} ≥45 mm Hg (Denver: P_{O2} ≥30 mm Hg) on room air
Cardiac assessment	Approval for surgery before randomization by cardiologist if any of the following are present: unstable angina; LVEF cannot be estimated from the echocardiogram; LVEF ≤45%; dobutamine-radionuclide cardiac scan indicates coronary artery disease or ventricular dysfunction; arrhythmia (≥5 PVCs per minute; cardiac rhythm, other than sinus; PACs at rest)
Surgical assessment	Approval for surgery by pulmonary physician, thoracic surgeon, and anesthesiologist after rehabilitation and before randomization
Exercise	Post-rehabilitation 6-minute walk ≥140 m; able to complete 3 minutes of unloaded pedaling in exercise tolerance test (before and after rehabilitation)
Consent	Signed consent forms for screening, rehabilitation, and randomization
Smoking	Plasma cotinine ≤13.7 ng/mL (or arterial carboxyhemoglobin ≤2.5% if using nicotine products); nonsmoking for 4 months before initial interview and throughout screening
Rehabilitation	Must complete pre-randomization assessments, rehabilitation program, and all post-rehabilitation and randomization assessments



BMI, body mass index; FEV_1, forced expiratory volume in 1 second; HRCT, high-resolution computed tomography; LVEF, left ventricular ejection fraction; PAC, premature atrial contraction; PVC, premature ventricular contraction; RV, residual volume; TLC, total lung capacity.
Reprinted from National Emphysema Treatment Trial Research Group. Rationale and designs of the National Emphysema Treatment Trial (NETT): a prospective, randomized trial of lung volume reduction surgery. *J Thorac Cardiovasc Surg* 1999;118:518. Copyright © 1999 The American Association for Thoracic Surgery. With permission.

Athanasios Kleontas
BSc, MD, MSc, BTS, PhD(c)
Thoracic Surgery
2018

Shields' General Thoracic Surgery
J. Locicero, R. Feins, Y. Colson, G. Rocco
8th edition 2019 Wolters Kluwer

Preoperative Assessment

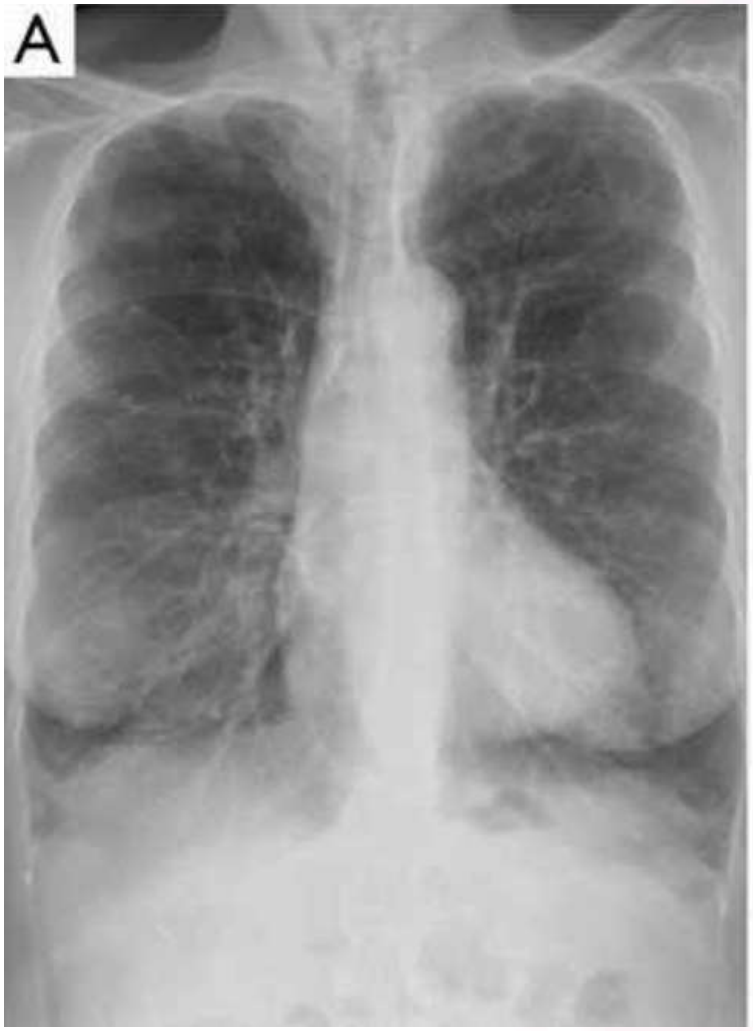
TABLE 82.2 Exclusionary Criteria (Presence of Any Criterion Makes the Patient Ineligible)

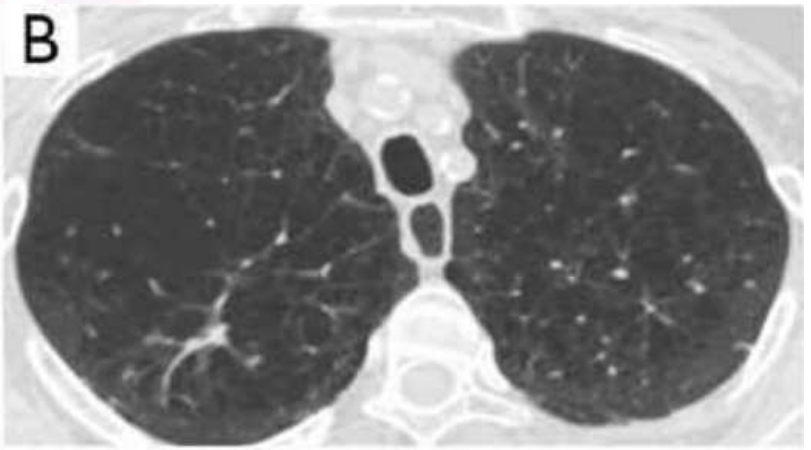
Previous operation	Lung transplantation; LVRS; median sternotomy or lobectomy
Cardiovascular	Arrhythmia that might pose a risk during exercise or training; resting bradycardia (<50 beats/min); frequent multifocal PVCs; complex ventricular arrhythmia; sustained SVT; history of exercise-related syncope; MI within 6 months and LVEF <45%; congestive heart failure within 6 months and LVEF <45%; uncontrolled hypertension (systolic >200 mm Hg, diastolic >110 mg Hg)
Pulmonary	History of recurrent infections with clinically significant sputum production; pleural or interstitial disease that precludes surgery; clinically significant bronchiectasis; pulmonary nodule necessitating surgery; giant bulla (greater than one third the volume of the lung); pulmonary hypertension; peak systolic PPA ≥45 mm Hg (≥50 mm Hg in Denver) or mean PPA ≥35 mm Hg (≥38 mm Hg in Denver); (right heart catheterization is required to rule out pulmonary hypertension if peak systolic PPA on echocardiogram ≥45 mm Hg); requirement for ≥ 6 L oxygen to keep saturation 90% or greater with exercise
Radiographic	CT evidence for diffuse emphysema judged unsuitable for LVRS
General	Unplanned weight loss of <10% usual weight in 90 days before enrollment; evidence of systemic disease or neoplasia expected to compromise survival during 5-year period; 6-minute walk distance ≤140 m after rehabilitation; any disease or condition that interferes with completion of initial or follow-up assessments; unwillingness or inability to complete screening or baseline data collection procedures

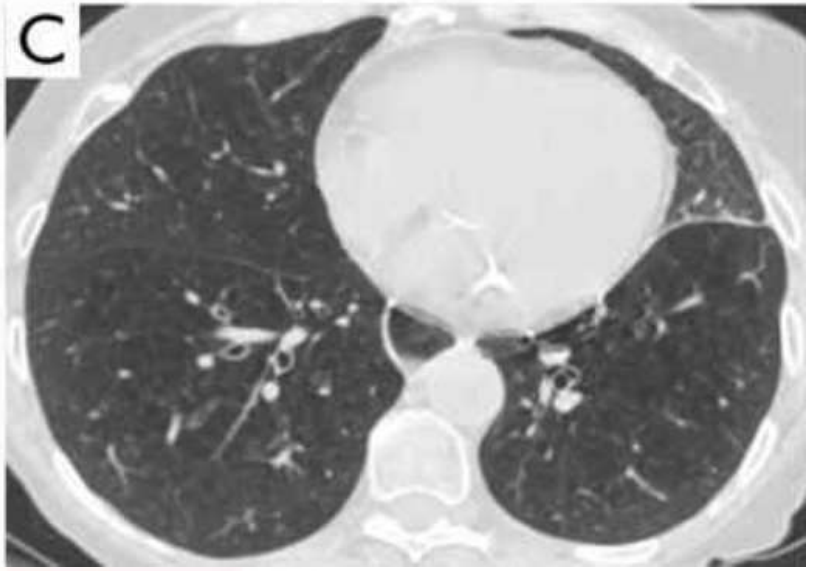
CT, computed tomography; LVEF, left ventricular ejection fraction; LVRS, lung volume reduction surgery; MI, myocardial infarction; PPA, pulmonary artery pressure; PVC, premature ventricular contraction; SVT, supraventricular tachycardia.
Reprinted from National Emphysema Treatment Trial Research Group. Rationale and designs of the National Emphysema Treatment Trial (NETT): a prospective, randomized trial of lung volume reduction surgery. *J Thorac Cardiovasc Surg* 1999;118:518. Copyright © 1999 The American Association for Thoracic Surgery. With permission.

Athanasios Kleontas
BSc, MD, MSc, BTS, PhD(c)
Thoracic Surgery
2018

Preoperative Assessment



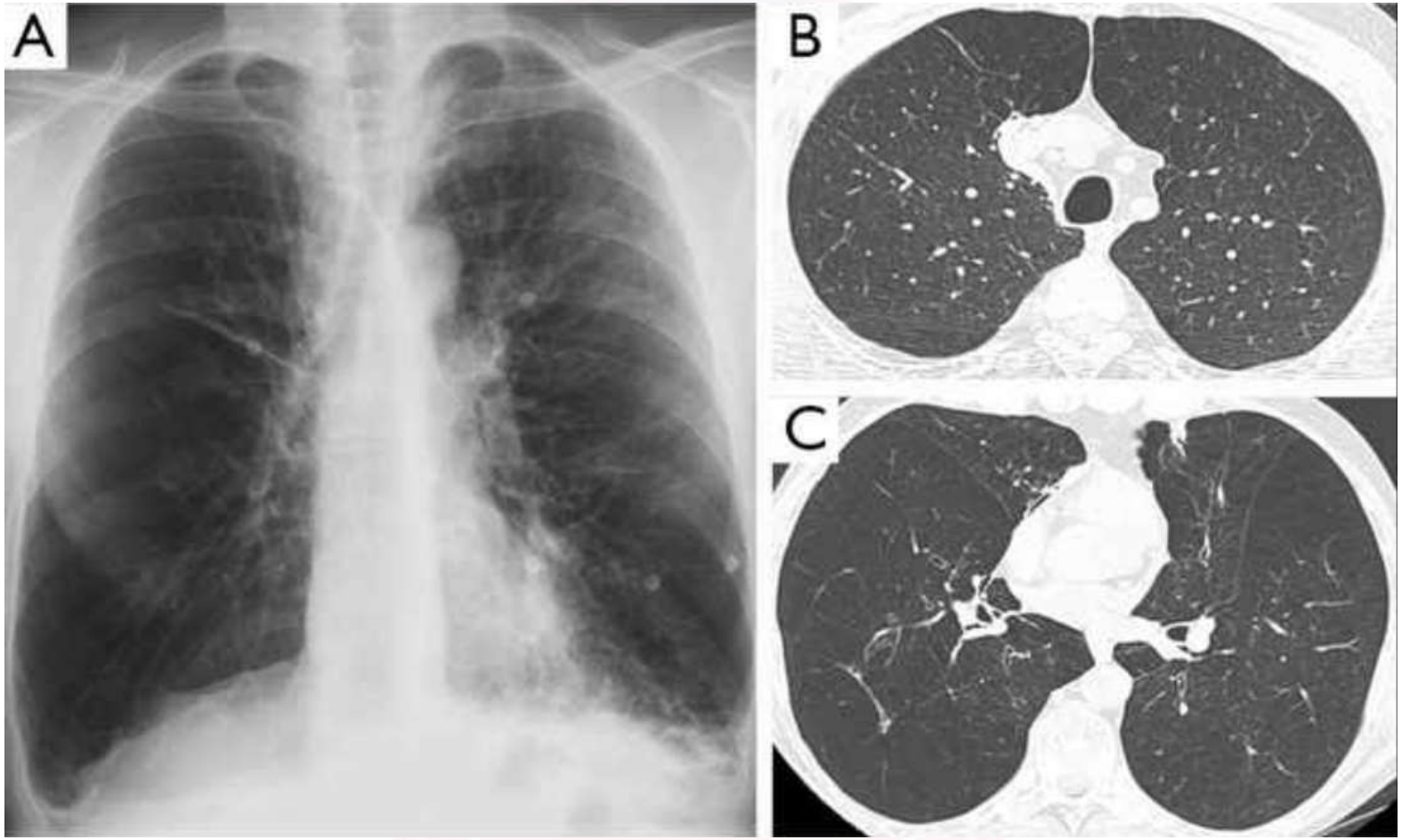




Athanasios Kleontas
BSc, MD, MSc, BTS, PhD(c)
Thoracic Surgery
2018

The complex care of severe emphysema: role of awake lung volume reduction surgery
Eugenio Pompeo et al for the Awake Thoracic Surgery Research Group (ATSRG)
Ann Transl Med 2015;3(8):108

Preoperative Assessment

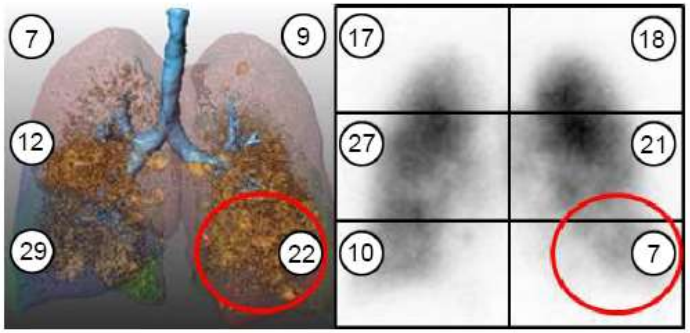


Athanasios Kleontas
BSc, MD, MSc, BTS, PhD(c)
Thoracic Surgery
2018

The complex care of severe emphysema: role of awake lung volume reduction surgery
Eugenio Pompeo et al for the Awake Thoracic Surgery Research Group (ATSRG)
Ann Transl Med 2015;3(8):108

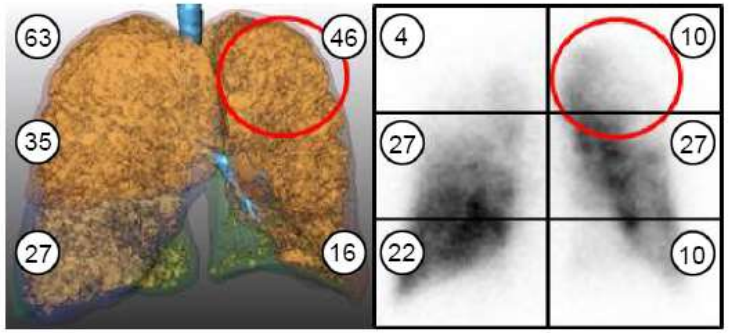
Preoperative Assessment

A Example of high HI and high INL perfusion



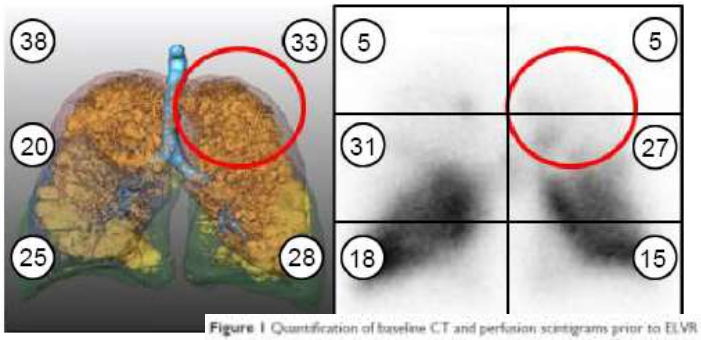
Better improvement in FEV_1
Better improvement in 6MWT

B Example of high HI and low INL perfusion



Better improvement in FEV_1
Less improvement in 6MWT

C Example of low HI and high INL perfusion



D Example of low HI and low INL perfusion

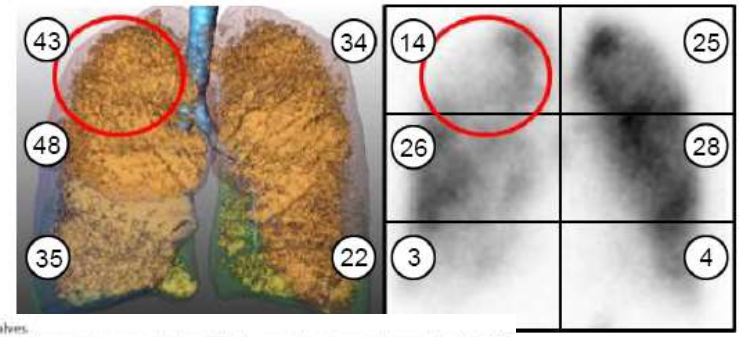
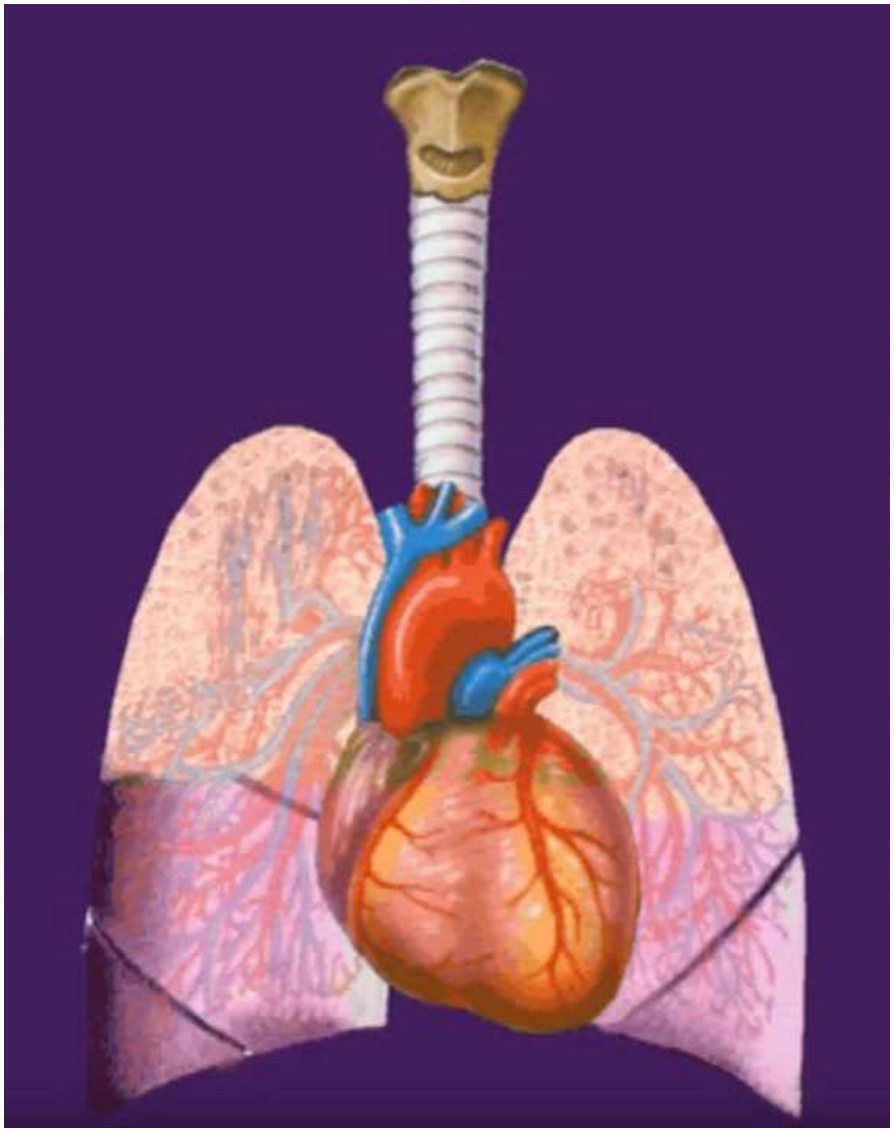


Figure 1 Quantification of baseline CT and perfusion scintigrams prior to ELVR with valves.
Notes: CT scans on inspiration were assessed by MeVisPULMO[©] for segmentation of emphysema clusters in the lung. The brown colored areas show pixels of <−950 Hounsfield units, suggestive of emphysema. The numbers in the CT indicate the percentage of emphysema in each lung lobe relative to the total number of voxels in the respective lobe. The HI is defined as the difference in emphysema score between TL and INL. A high HI indicates a more heterogeneous emphysema. The numbers in the perfusion scintigrams indicate the tracer activity in the respective region as percentage of both lungs, calculated for the geometric mean. The patients were grouped into high and low levels of the medians of HI (12.2%) and INL perfusion (14.7%) among all patients. The red circle marks the TL for ELVR. Views are from anterior to posterior. (**A**) Example of a patient with high HI (13%) and high INL perfusion (18%). (**B**) Example of a patient with high HI (30%) and low INL perfusion (10%). (**C**) Example of a patient with low HI (5%) and high INL perfusion (15%). (**D**) Example of a patient with low HI (8%) and low INL perfusion (3%).
Abbreviations: CT, computed tomograms; ELVR, endoscopic lung volume reduction; FEV_1, forced expiratory volume in 1 second; 6MWT, 6-minute walk test; HI, heterogeneity index; TL, target lobe; INL, ipsilateral nontarget lobe.

Athanasios Kleontas
BSc, MD, MSc, BTS, PhD(c)
Thoracic Surgery
2018

Lung perfusion and emphysema distribution affect the outcome of endobronchial valve therapy
Christian Thomsen et al - International Journal of Chronic Obstructive Pulmonary Disease
June 2016 Volume 2016:11(1) Pages 1245—1259

Surgical Goal

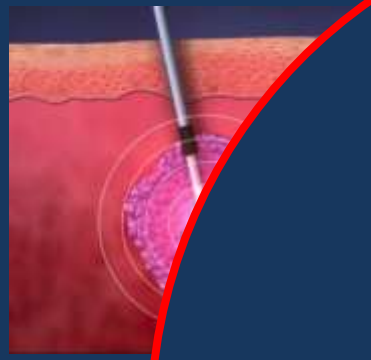


https://www.youtube.com/watch?v=fUaq5hRIsuA

Athanasios Kleontas
BSc, MD, MSc, BTS, PhD(c)
Thoracic Surgery
2018

Surgical Techniques

Laser Ablation



Stapling

Non Resecting

Rolling
ing

Athanasios Kleontas
BSc, MD, MSc, BTS, PhD(c)
Thoracic Surgery
2018

Shields' General Thoracic Surgery
J. Locicero, R. Feins, Y. Colson, G. Rocco
8th edition 2019 Wolters Kluwer

Unilateral VS Bilateral

TABLE 2. UNILATERAL VERSUS BILATERAL LUNG VOLUME REDUCTION SURGERY

Author	Year	*n*	Technique	Mortality (%)	LOS (*d*)	Change in FEV_1
McKenna (8)	1996	87	Unilateral	3	11.4	31%
Naunheim (7)	1996	50	Unilateral	2	13	35%
Keenan (9)	1996	57	Unilateral	2	17	27%
Cooper (10)	1996	150	Bilateral	4	13.5	51%
Kotloff (4)	1996	80	Bilateral	13.8	22	41%
Argenziano (5)	1996	85	Bilateral	7	17	61%
McKenna (11)	1997	154	Bilateral	4	11	52%
Kotloff (4)	1996	40	Bilateral	2.5	15	41%
NETT (18, 19)	2003/4	511	Bilateral	2.2	10	NR

Definition of abbreviations: LOS = length of stay; NETT = National Emphysema Treatment Trial; NR = not reported.

Athanasios Kleontas
BSc, MD, MSc, BTS, PhD(c)
Thoracic Surgery
2018

Lung Volume Reduction Surgery Technique, Operative Mortality, and Morbidity
Malcolm M. DeCamp, Robert J. McKenna, Claude C. Deschamps, and Mark J. Krasna
Annals ATS Issues Vol. 5, No. 4 | May 01, 2008

Unilateral VS Bilateral

Unilateral or severely asymmetric emphysema

Contralateral pleurodesis

Contralateral thoracotomy with or without prior lung resection

Ipsilateral lung cancer resection with contralateral LVRS for a patient with limited lung function

Hemodynamic instability during the first side of planned bilateral LVRS

Massive air leak during the first side of planned bilateral LVRS

Severe native lung hyperinflation following single lung transplantation for emphysema

Athanasios Kleontas
BSc, MD, MSc, BTS, PhD(c)
Thoracic Surgery
2018

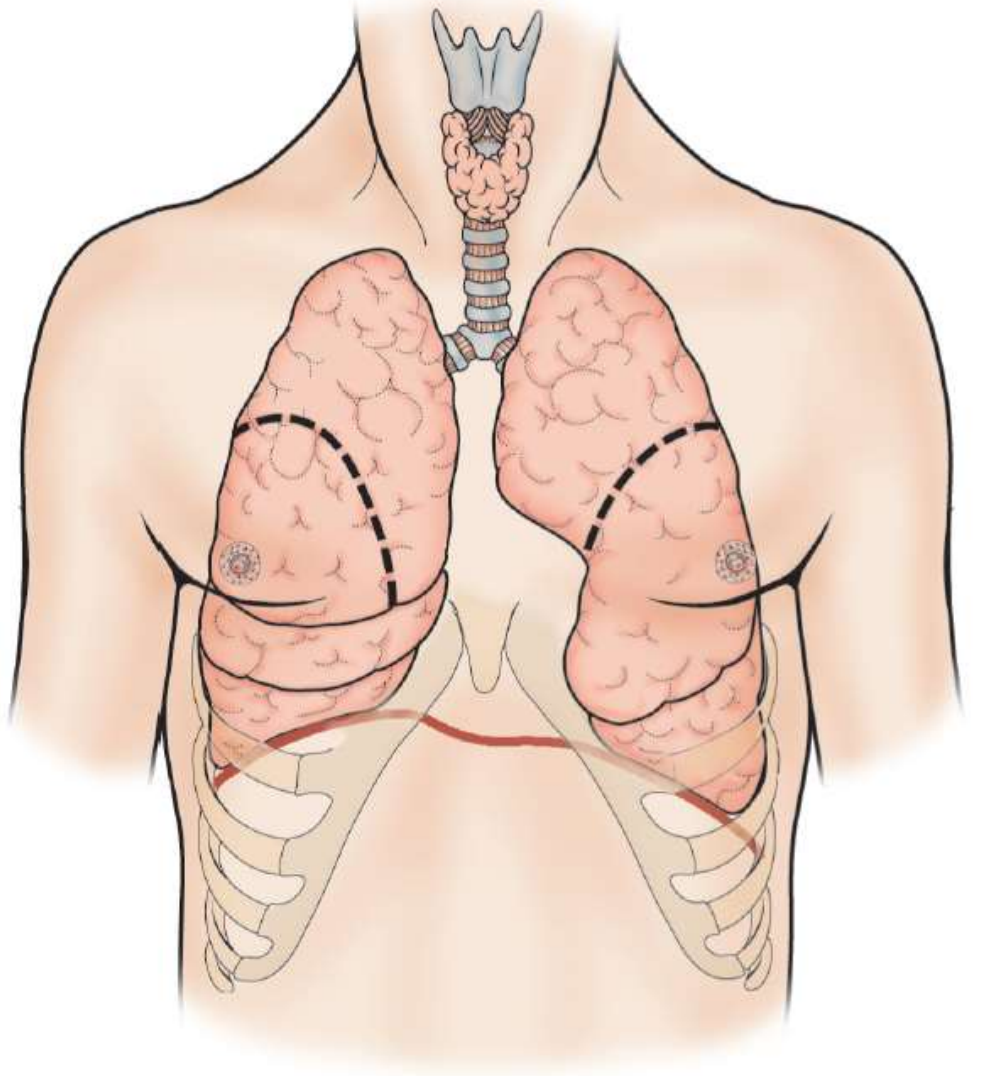
Lung Volume Reduction Surgery Technique, Operative Mortality, and Morbidity
Malcolm M. DeCamp, Robert J. McKenna, Claude C. Deschamps, and Mark J. Krasna
Annals ATS Issues Vol. 5, No. 4 | May 01, 2008

Candidacy

TABLE 82.5 Criteria for LVR Candidacy

	Good Candidate	Bad Candidate
History and physical	≤75 years Smoking cessation ≥6 months Daily prednisone ≤10 mg No significant comorbidity High motivation and compliance Good nutritional status	>75 years Evidence of reversible bronchoconstriction Recurrent infections with daily sputum Severe HTN, CHF, CAD, MI, renal disease Pulmonary HTN Cachexia or obesity (BMI>30) High-risk pleural disease (empyema, pleurodesis) Prior major thoracotomy
Imaging	Hyperinflation on chest x-ray Heterogeneous emphysema distribution Upper-lobe predominance	Increased interstitial markings Homogeneous distribution
Function and PFTs	FEV_1 ≤40% predicted TLC ≥120% predicted RV ≥150% predicted DL_{CO} ≥20% predicted 6MWT >140 m after rehab	FEV_1 ≤15% predicted DL_{CO} ≤20% predicted PaO_2 ≤55 mm Hg $PaCO_2$ ≥55 mm Hg Mean PA pressure ≥40 mm Hg

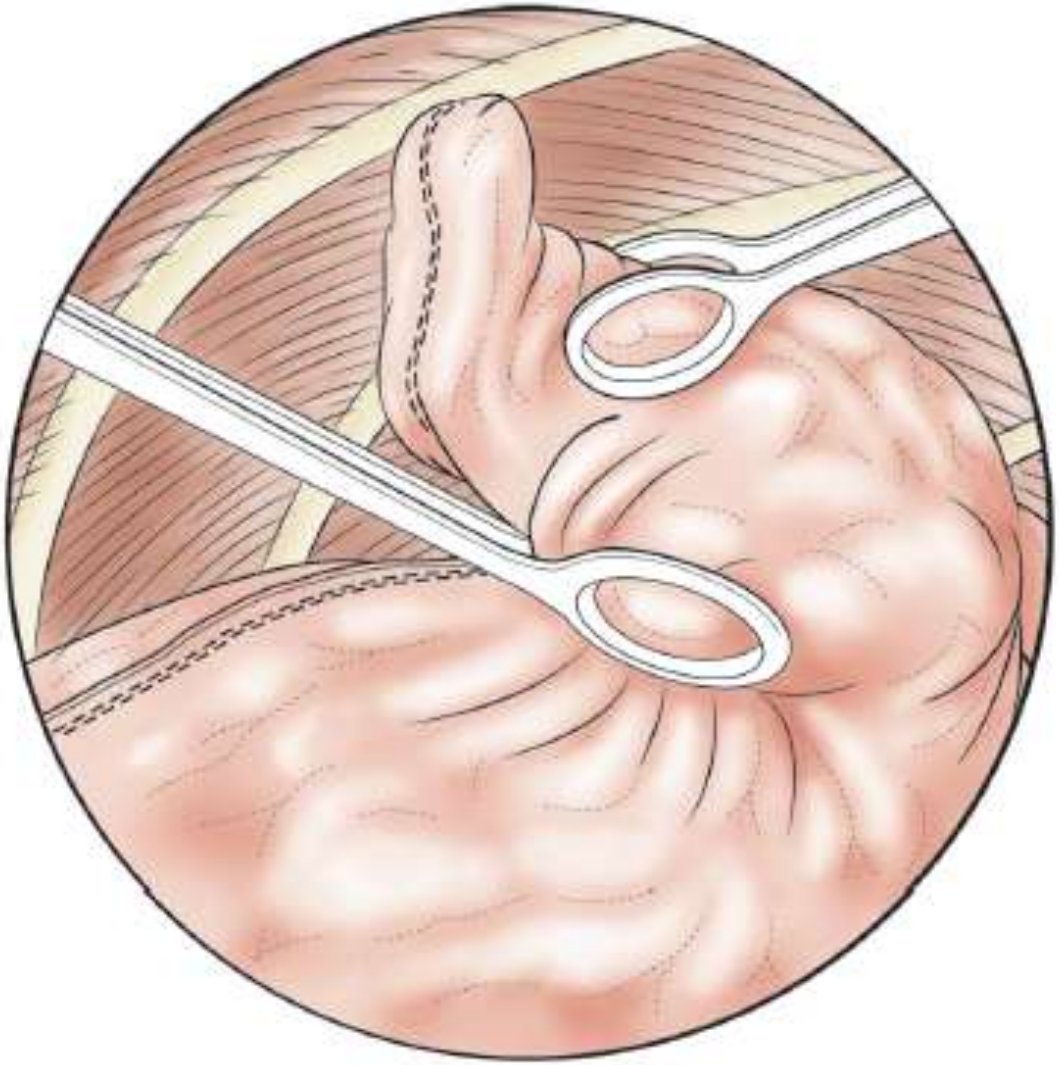
Procedure



Athanasios Kleontas
BSc, MD, MSc, BTS, PhD(c)
Thoracic Surgery
2018

Operative Thoracic Surgery
L. Kaiser, S. Thompson, G. Jamieson
6th edition 2018 Taylor & Francis Group

Procedure



Athanasios Kleontas
BSc, MD, MSc, BTS, PhD(c)
Thoracic Surgery
2018

Operative Thoracic Surgery
L. Kaiser, S. Thompson, G. Jamieson
6th edition 2018 Taylor & Francis Group

Procedure

https://www.youtube.com/watch?v=mqc5FJFmDSc

Athanasios Kleontas
BSc, MD, MSc, BTS, PhD(c)
Thoracic Surgery
2018

Indications

BOX 13-1 Indications and Contraindications for Lung Volume Reduction Surgery and Lung Transplantation

Indications Common to Both Procedures

- Emphysema with destruction and hyperinflation
- Marked impairment (FEV_1 < 35% predicted)
- Marked restriction in activities of daily living
- Failure of maximal medical treatment to correct symptoms

Contraindications to Both Procedures

- Abnormal body weight (<70% or >130% of ideal)
- Coexisting major medical problems increasing surgical risk
- Inability or unwillingness to participate in pulmonary rehabilitation
- Unwillingness to accept the risk of morbidity and mortality of surgery
- Tobacco use within the past 6 months
- Recent or current diagnosis of malignant disease
- Increasing age (>65 years for transplantation, >70 years for volume reduction)
- Psychological instability, such as depression or anxiety disorder

Indications

Discriminating Conditions Favoring Lung Volume Reduction Surgery

- Marked thoracic distention
- Heterogeneous disease with obvious apical target areas
- $FEV_1 > 20\%$ predicted
- Age between 60 and 70 years

Discriminating Conditions Favoring Lung Transplantation

- Diffuse disease without target areas
- $FEV_1 < 20\%$ predicted
- Hypercapnia with $PaCO_2 > 55$ mm Hg
- Pulmonary hypertension
- Age younger than 60 years
- α_1-Antitrypsin deficiency

Clinical Series

TABLE 82.3 Early Clinical Series

Series	Approach	Number of Patients	Operative Mortality (%)	Percent Change in FEV_1 (M)	Percent Change in RV	Percent Change in 6MWT
Naunheim et al[9]	Unilateral VATS	50	4.0	+35% (3)	−33%	+20%
Keenan et al[8]	Unilateral VATS	67	1.7	+27% (3)	−15%	+14%
Mineo et al[51]	Unilateral VATS	14	0	+50% (3)	−20%	+22%
McKenna et al[35]	Unilateral VATS	87	2.5	+31% (3–12)	—	—
	Bilateral VATS	79	3.5	+57% (3–12)	—	—
Bingisser et al[10]	Bilateral VATS	20	0	+42% (3)	−23%	+39%
Kotloff et al[11]	Bilateral VATS	40	2.5	+41% (3–6)	−23%	+35%
	Bilateral sternotomy	80	4.2	+41% (3–6)	−28%	+21%
Argenziano[52]	Unilateral VATS	28	3.6	+31% (3–6)	—	58%
	Bilateral clamshell	68	7.5	+53% (3–6)	—	55%
Hazelrigg et al[7]	Bilateral VATS	50	0	+40% (12)	−37%	+47%
	Bilateral sternotomy	29	0	+40% (12)	−28%	+26%
Cooper et al[40]	Bilateral sternotomy	150	4	+51% (6)	−28%	+17%
Miller et al[53]	Bilateral sternotomy	40	7.5	+98% (6)	—	+104%
Daniel et al[54]	Bilateral sternotomy	26	3.8	+40% (3)	−31%	—
Bousamra et al[55]	Bilateral sternotomy	37	7.0	+59% (6)	—	+30%
Date et al[56]	Bilateral sternotomy	39	0	+40% (3–6)	−25%	+19%

VATS, video-assisted thoracic surgery; FEV_1, forced expiratory volume in 1 second; M, months of follow-up; RV, residual volume; 6MWT, 6-minute walk test.

Athanasios Kleontas
BSc, MD, MSc, BTS, PhD(c)
Thoracic Surgery
2018

Shields' General Thoracic Surgery
J. Locicero, R. Feins, Y. Colson, G. Rocco
8th edition 2019 Wolters Kluwer

National Emphysema Treatment Trial

Multicenter (17 US), open-label, randomized, controlled trial

Enrollment: 1998-2002

Mean follow-up: 29.2 months

Analysis: Intention-to-treat

Primary outcomes:

All-cause mortality

Improvement in exercise capacity at 24 months

N=1,218

	LVRS (n=608)		Medical therapy (n=610)
		Primary outcome	
RR:1.01; P=0.9	0.11/P-Y	All cause mortality	0.11/P-Y
P<0.001	15%	Improvement in exercise capacity at 24 months	3%
		Secondary outcomes	
P<0.001	7.9%	All cause mortality at 90 days	1.3%
P<0.001	33%	Improvement in QOF at 24 months	9%

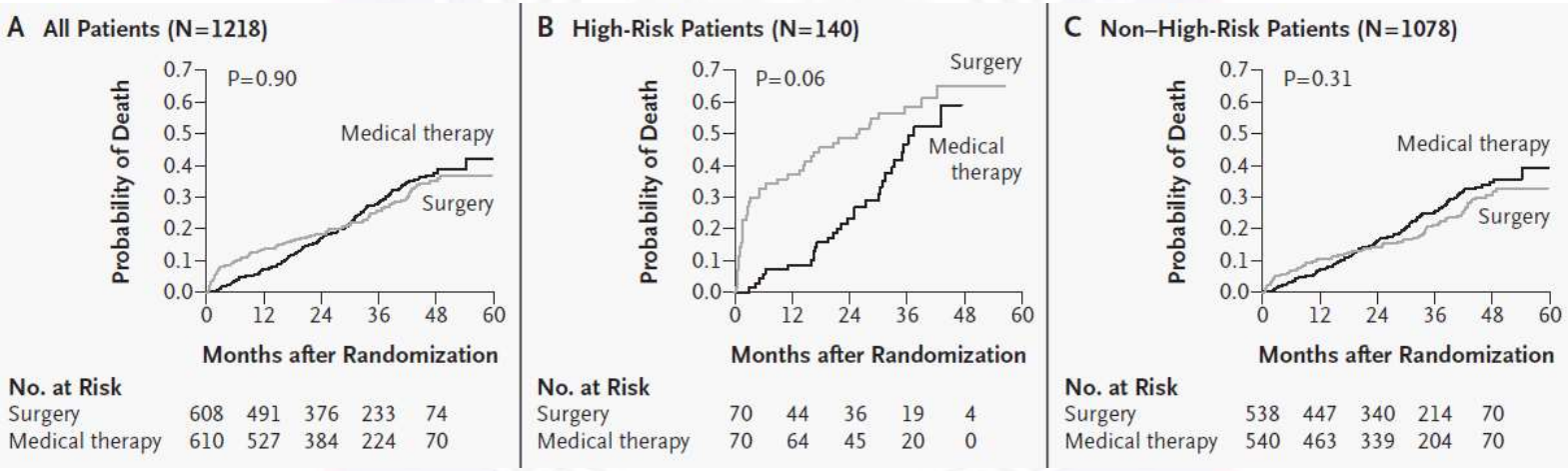
Athanasios Kleontas
BSc, MD, MSc, BTS, PhD(c)
Thoracic Surgery
2018

A Randomized Trial

Comparing Lung-Volume–Reduction Surgery with Medical Therapy for Severe Emphysema

N Engl J Med 2003;348:2059-73

National Emphysema Treatment Trial



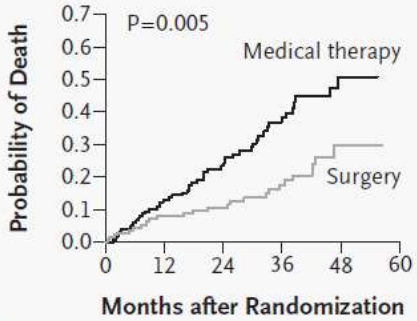
Athanasios Kleontas
BSc, MD, MSc, BTS, PhD(c)
Thoracic Surgery
2018

A Randomized Trial

Comparing Lung-Volume–Reduction Surgery with Medical Therapy for Severe Emphysema
N Engl J Med 2003;348:2059-73

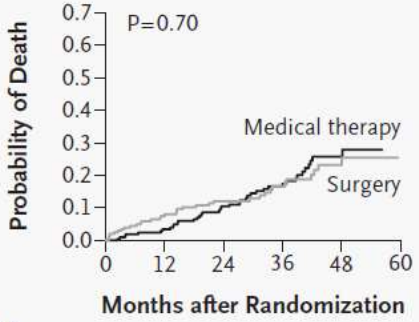
National Emphysema Treatment Trial

D Upper-Lobe Predominance, Low Base-Line Exercise Capacity (N=290)



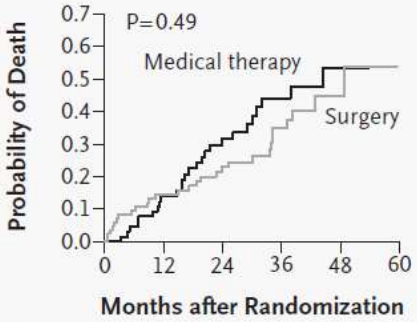
No. at Risk					
Surgery	139	121	93	61	17
Medical therapy	151	120	85	43	13

E Upper-Lobe Predominance, High Base-Line Exercise Capacity (N=419)



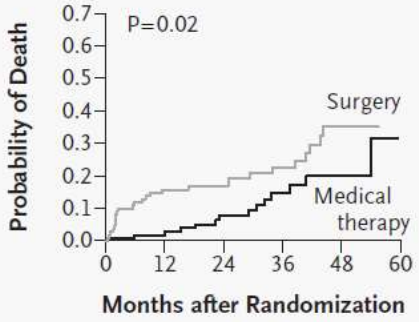
No. at Risk					
Surgery	206	176	124	82	35
Medical therapy	213	192	149	104	35

F Non–Upper-Lobe Predominance, Low Base-Line Exercise Capacity (N=149)



No. at Risk					
Surgery	84	67	52	28	6
Medical therapy	65	55	36	17	5

G Non–Upper-Lobe Predominance, High Base-Line Exercise Capacity (N=220)



No. at Risk					
Surgery	109	83	71	43	12
Medical therapy	111	96	69	40	17

Athanasios Kleontas
BSc, MD, MSc, BTS, PhD(c)
Thoracic Surgery
2018

A Randomized Trial

Comparing Lung-Volume–Reduction Surgery with Medical Therapy for Severe Emphysema
N Engl J Med 2003;348:2059-73

Review

Table 1 Summary of RCTs on conservative medical therapy and LVRS

Author	Year published	Cases (N)	Imaging diagnosis	Cases underwent conservative medical therapy (n)	Cases underwent LVRS(n)
Criner, G.	1999	37	CT scan	18	19
J[16] Geddes, D[12]	2000	48	CT scan	24	24
Pompeo, E. [17]	2000	60	CT scan	30	30
Fishman, A [18]	2003	1218	CT scan	608	610
Goldstein, R. S [19]	2003	55	CT and V/Q scan*	28	27
Mineo[20]	2004	60	CT scan	30	30
Hillerdal, G. [2]	2005	106	CT and V/Q Scan*	53	53
Miller, J. D[21]	2005	93	CT and V/Q Scan*	58	35

*: V/Q scan, also known as lung scan, which evaluates both the Ventilation and Perfusion of the lungs using scintigraphy and medical isotopes. Q is the symbol for perfusion which represents the movement of blood through the arteries that supply the lung.

Athanasios Kleontas
BSc, MD, MSc, BTS, PhD(c)
Thoracic Surgery
2018

Review

Mortality at 3 months
LVRS>>>MT

Review: Meta-analysis of mortality of group A vs group B
Comparison: 01 Group A vs Group B
Outcome: 01 Group A vs Group B

Study or sub-category	Group A n/N	Group B n/N	OR (fixed) 95% CI	Weight %	OR (fixed) 95% CI
Criner,G,J	3/19	1/18		6.98	3.19 [0.30, 33.89]
Geddes,D	4/24	1/24		6.73	4.60 [0.47, 44.60]
Pompeo,E	1/30	1/30		7.80	1.00 [0.06, 16.76]
Goddstein R,S	2/28	1/27		7.63	2.00 [0.17, 23.44]
Fishman A	48/608	8/610		59.38	6.45 [3.02, 13.75]
Hillerdal,G	6/49	1/43		7.55	5.86 [0.68, 50.78]
Miller,J,D	1/54	0/54		3.93	3.06 [0.12, 76.70]
Total (95% CI)	812	806		100.00	5.16 [2.84, 9.35]

Total events: 65 (Group A), 13 (Group B)
Test for heterogeneity: Chi?= 2.49, df = 6 (P = 0.87), I?= 0%
Test for overall effect: Z = 5.40 (P < 0.00001)

0.1 0.2 0.5 1 2 5 1
Group A Group B

Review: Meta-analysis of mortality of group A vs group B
Comparison: 01 Group A vs Group B
Outcome: 01 Group A vs Group B

Study or sub-category	Group A n/N	Group B n/N	OR (fixed) 95% CI	Weight %	OR (fixed) 95% CI
Criner,G,J	3/19	1/18		17.19	3.19 [0.30, 33.89]
Geddes,D	4/24	1/24		16.56	4.60 [0.47, 44.60]
Pompeo,E	1/30	1/30		19.21	1.00 [0.06, 16.76]
Goddstein R,S	2/28	1/27		18.79	2.00 [0.17, 23.44]
Hillerdal,G	6/49	1/43		18.58	5.86 [0.68, 50.78]
Miller,J,D	1/54	0/54		9.67	3.06 [0.12, 76.70]
Total (95% CI)	204	196		100.00	3.26 [1.22, 8.73]

Total events: 17 (Group A), 5 (Group B)
Test for heterogeneity: Chi?= 1.20, df = 5 (P = 0.94), I?= 0%
Test for overall effect: Z = 2.35 (P = 0.02)

0.1 0.2 0.5 1 2 5 1
Group A Group B

Athanasios Kleontas
BSc, MD, MSc, BTS, PhD(c)
Thoracic Surgery
2018

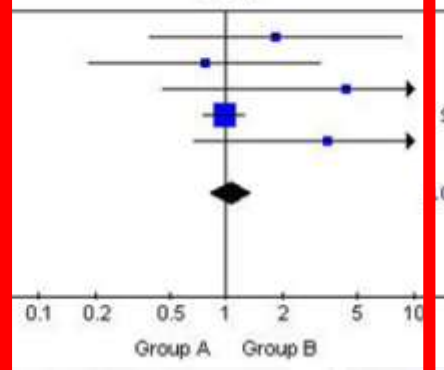
Several clinical interests regarding lung volume reduction surgery for severe emphysema: meta-analysis and systematic review of randomized controlled trials
Huang et al. Journal of Cardiothoracic Surgery 2011, 6:148

Review

Mortality at 12 months
LVRS=MT

Study or sub-category	Group A n/N	Group B n/N	OR (fixed) 95% CI	Weight %	OR (fixed) 95% CI
Geddes,D	5/24	3/24		1.86	1.84 [0.39, 8.77]
Pompeo,E	4/30	5/30		3.39	0.77 [0.19, 3.20]
Goddstein R,S	4/28	1/27		0.68	4.33 [0.45, 41.55]
Fishman A	157/608	160/610		92.64	0.98 [0.76, 1.26]
Hillerdal,G	7/49	2/43		1.43	3.42 [0.67, 17.43]
Total (95% CI)	739	734		100.00	1.05 [0.82, 1.33]

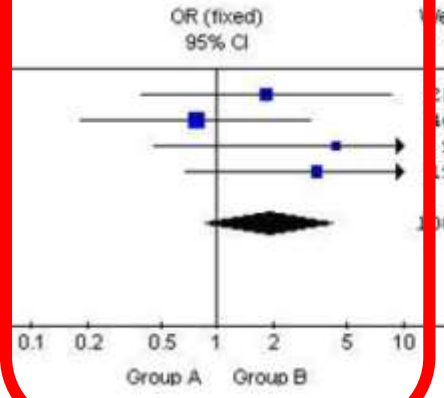
Total events: 177 (Group A), 171 (Group B)
Test for heterogeneity: Chi?= 4.49, df = 4 (P = 0.34), I?= 10.8%
Test for overall effect: Z = 0.36 (P = 0.72)



Review: Meta-analysis of mortality of group A vs group B
Comparison: 01 Group A vs Group B
Outcome: 01 Group A vs Group B

Study or sub-category	Group A n/N	Group B n/N	OR (fixed) 95% CI	Weight %	OR (fixed) 95% CI
Geddes,D	5/24	3/24		25.25	1.84 [0.39, 8.77]
Pompeo,E	4/30	5/30		16.06	0.77 [0.19, 3.20]
Goddstein R,S	4/28	1/27		9.28	4.33 [0.45, 41.55]
Hillerdal,G	7/49	2/43		19.41	3.42 [0.67, 17.43]
Total (95% CI)	131	124		100.00	1.88 [0.86, 4.14]

Total events: 20 (Group A), 11 (Group B)
Test for heterogeneity: Chi?= 2.55, df = 3 (P = 0.47), I?= 0%
Test for overall effect: Z = 1.58 (P = 0.11)



Athanasios Kleontas
BSc, MD, MSc, BTS, PhD(c)
Thoracic Surgery
2018

Several clinical interests regarding lung volume reduction surgery for severe emphysema: meta-analysis and systematic review of randomized controlled trials
Huang et al. Journal of Cardiothoracic Surgery 2011, 6:148

Review

Table 2 A summary of lung function, gas exchange, DLCO% and 6MWD of five RCTs on the 3rd, 6th, 12th postoperative month

Variables	Postoperative follow-up (month)	No of RCTs	No of total patients	GroupA/B	WMD95%CI	p-value
FEV1	3	2[12,16]	80	39/41	0.23(0.08,0.37)	0.002
	6	3[2,17,19]	180	89/91	0.32(0.23,0.41)	<0.00001
	12	3[2,17,19]	169	65/64	0.28(0.20,0.36)	<0.00001
FEV1%	3	2[12,16]	80	39/41	11.31(6.29,15.69)	<0.00001
	6	3[2,17,19]	180	89/91	10.16(7.42,12.89)	<0.00001
	12	3[2,17,19]	167	85/82	7.65(4.97,10.33)	<0.00001
RV%	3	2[12,16]	80	39/41	-54.44(-75.23, -33.85)	<0.00001
	6	3[2,17,19]	170	87/83	- 54.09(- 64.66, -43.52)	<0.00001
	12	3[2,17,19]	166	86/80	- 53.42(- 63.74, -43.10)	<0.00001
TLC%	3	2[12,16]	80	39/41	- 21.70(- 30.98, -12.42)	<0.00001
	6	2[2,19]	115	59/56	- 15.73(- 22.44, -9.02)	<0.00001
	12	3[2,17,19]	120	59/61	- 16.24(- 23.07, -9.41)	<0.00001
DLCO%	6	2[17,19]	105	52/53	0.01(-0.25,0.27)	0.95
	12	2[17,19]	96	51/45	0.01(-0.25,0.27)	0.25
Pa02	6	2[17,19]	136	67/6	9.98(9.65,10.13)	<0.00001
	12	2[2,17]	114	60/54	6.37(6.10,6.64)	<0.00001
PaC02	6	4[2,11,17,21]	229	108/121	- 1.54(- 1.72, - 1.36)	<0.00001
	12	2[2,17]	114	60/54	-2.00(-2.23, -1.77)	<0.00001
6MWD	3	2[12,16]	80	39/41	10.5(-16.30,37.38)	0.44
	6	5[2,11,17,19 ,21]	274	129/145	68.34(36.58,100.09)	<0.00001
	12	3[2,17,19]	168	85/83	76.92(60.87,92.98)	<0.00001

LVRS>>>MT

Athanasios Kleontas
BSc, MD, MSc, BTS, PhD(c)
Thoracic Surgery
2018

Several clinical interests regarding lung volume reduction surgery for severe emphysema: meta-analysis and systematic review of randomized controlled trials

Huang et al. Journal of Cardiothoracic Surgery 2011, 6:148

Review

Comparison of two surgical approaches

Median Sternotomy vs VATS

mortality at 90-day P=0.67

overall mortality P=0.42

mean intra-operative blood loss P=0.99

transfusion needs P=0.99

mean operation time of MS was shorter 21.7 minutes in comparison with VATS (P<0.001)

Athanasios Kleontas
BSc, MD, MSc, BTS, PhD(c)
Thoracic Surgery
2018

Review

Comparison of two surgical approaches

Median Sternotomy vs VATS

intra-operative complications of MS was less in comparison with VATS P=0.02

intra-operative hypoxemia of MS was less in comparison with VATS P=0.004

hospital stay of post LVRS was longer for MS than VATS P=0.01

Athanasios Kleontas
BSc, MD, MSc, BTS, PhD(c)
Thoracic Surgery
2018

Review

Comparison of two surgical approaches

Median Sternotomy vs VATS

at postoperative 30 days, independently living patients were less for MS than VATS
P=0.02

there was no appreciable difference in lung function between the two approaches after follow-up 12 and 24 months

costs for either operation or the associated hospital stay were less for VATS than for MS
P<0.01

Athanasios Kleontas
BSc, MD, MSc, BTS, PhD(c)
Thoracic Surgery
2018

Several clinical interests regarding lung volume reduction surgery for severe emphysema: meta-analysis and systematic review of randomized controlled trials
Huang et al. Journal of Cardiothoracic Surgery 2011, 6:148

Review

Conclusions

LVRS offers the more benefits regarding survival, lung function, gas exchange, exercise capacity and QOL,

despite the higher mortality in initial three postoperative months.

LVRS with the optimization of surgical approach and material for reinforcement of the staple lines, should be recommended to patients suffering from severe heterogeneous emphysema.

Athanasios Kleontas
BSc, MD, MSc, BTS, PhD(c)
Thoracic Surgery
2018

Review

Complications

- **Pulmonary**
  - Air leak 30%
  - Pneumonia 3.9 → 8.2%
  - Reoperation 10%
- **Gastrointestinal** 6%
- **Cardiac**
  - Arrhythmia 22%
  - MI
  - Pulmonary emboli

Athanasios Kleontas
BSc, MD, MSc, BTS, PhD(c)
Thoracic Surgery
2018

Lung volume reduction surgery in the post-National Emphysema Treatment Trial era
B. Payne Stanifer, Mark E. Ginsburg
Journal of Thoracic Disease, Vol 10, Suppl 23 August 2018

Future

Table 1 Evolutionary changes in anesthesia protocol between intubated and nonintubated LVRS methods at our institution

Anesthesia characteristics	IVATS	NIVATS	
		Non-resectional awake	Non-resectional *minimalist*
Tracheal intubation	Yes	No	No + laryngeal mask
Anesthesia protocol	GA ± TEA	TEA	IBA
Sedation	GA	No	Yes (target control)
Ventilation	Mechanical	Spontaneous	Spontaneous
Diaphragm paralysis	Yes	No	No
Consciousness	No	Yes	No
Amnesia	Yes	No	Yes/no
Coughing reflex	No	Yes	Yes/no

LVRS, lung volume reduction surgery; IVATS, intubated video-assisted thoracic surgery; NIVATS, non-intubated video-assisted thoracic surgery; GA, general anesthesia; TEA, thoracic epidural analgesia; IBA, intercostal block analgesia.

Staged unilateral lung volume reduction surgery: from mini-invasive to minimalist treatment strategies
Eugenio Pompeo et al. Journal of Thoracic Disease, Vol 10, Suppl 23 August 2018

LVRS or BLVR

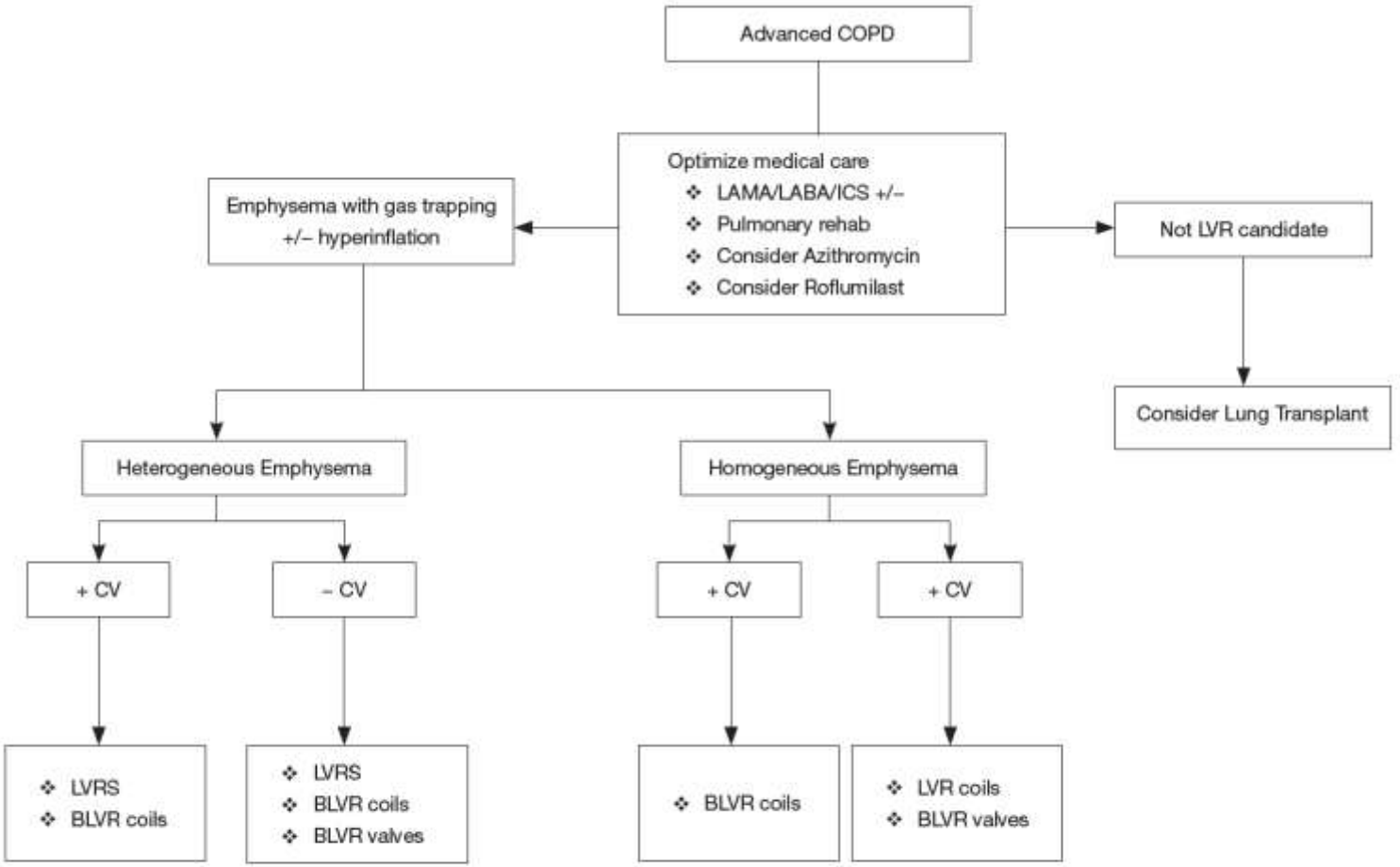


Figure 1 Therapeutic pathway in advanced COPD. Adapted from 2017 report of Global Initiative for Chronic Obstructive Lung Disease (GOLD) (36). COPD, chronic obstructive pulmonary disease; LAMA, long acting muscarinic antagonists; LABA, long acting beta agonists; ICS, inhaled corticosteroids.

Athanasios Kleontas
BSc, MD, MSc, BTS, PhD(c)
Thoracic Surgery
2018

Lung volume reduction surgery or bronchoscopic lung volume reduction: is there an algorithm for allocation? Matthew Gordon, Sean Duffy, Gerard J. Criner
J Thorac Dis 2018;10(Suppl 23):S2816-S2823