Kansas City

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Lung Volume Reduction Surgery for Severe Emphysema

Policy Number: 7.01.71
Origination: 7/1994
Last Review: 3/2014
Next Review: 3/2015

Policy

Blue Cross and Blue Shield of Kansas City (Blue KC) will provide coverage for lung volume reduction surgery when it is determined to be medically necessary because the criteria shown below are met.

When Policy Topic is covered

Lung volume reduction surgery as a treatment for emphysema may be considered **medically necessary** in patients with emphysema who meet ALL of the following criteria*:

- Predominantly upper lobe emphysema with hyperinflation and heterogeneity (i.e. target areas for removal)
- Forced expiratory volume in one second (FEV-1):
  - For patients who are younger than 70 years of age, the FEV-1 must be no more than 45% of the predicted value.
  - For patients who are 70 years of age or older, the FEV-1 must be no more than 45% of the predicted value and greater than or equal to 15% of the predicted value.
- Marked restriction in activities of daily living despite maximal medical therapy
- Age younger than 75 years
- Acceptable nutrition status; i.e. 70-130% of ideal body weight
- Ability to participate in a vigorous pulmonary rehabilitation program
- No coexisting major medical problems that would significantly increase operative risk
- Willingness to undertake risk of morbidity and mortality associated with LVRS
- Abstinence from cigarette smoking for at least 4 months

*patient selection criteria are based on the National Emphysema Treatment Trial (NETT)

When Policy Topic is not covered

Lung volume reduction surgery is considered **investigational** in all other patients.

Considerations

The following additional criteria, also from the NETT trial, may provide further information in determining whether a patient is a candidate for lung volume reduction surgery:

- PaO2 on room air greater than or equal to 45 mm Hg (greater than or equal to 30 mm Hg at elevations of 5,000 feet or higher)
- PaCO2 on room air less than or equal to 60 mm Hg (less than or equal to 55 mm Hg at elevations of 5,000 feet or higher)
- Post-rehabilitation 6-minute walk of at least 140 m, and able to complete 3 min. unloaded pedaling in exercise tolerance test

Description of Procedure or Service

Lung volume reduction surgery (LVRS) is proposed as a treatment option for patients with severe emphysema who have failed optimal medical management. The procedure involves the excision of diseased lung tissue and aims to reduce symptoms and improve quality of life.

Lung volume reduction is a surgical treatment for patients with severe emphysema involving the excision of peripheral emphysematous lung tissue, generally from both upper lobes. The precise mechanism of clinical improvement for patients undergoing lung reduction surgery has not been firmly established. However, it is believed that elastic recoil and diaphragmatic function are improved by reducing the volume of diseased lung. In addition to changes in chest wall and respiratory mechanics, the surgery is purported to correct ventilation perfusion mismatch and improve right ventricular filling.

Research on LVRS has focused on defining the sub-group of patients most likely to benefit from the procedure. Potential benefits of the procedure e.g., improvement in functional capacity and quality of life must be weighed against the potential risk of the procedure e.g., risk of post-operative mortality.

Rationale

The policy was created in 1999 with a search of the MEDLINE database. The policy was on "no further review" status from 2005 to 2010 following the 2003 publication of the National Emphysema Treatment Trial (NETT) findings. In 2010, the policy returned to active review and was updated regularly with MEDLINE searches. The most recent literature search was for the period April 2012 through April 29, 2013. Below is a summary of the key published literature to date:

National Emphysema Treatment Trial (NETT)

The NETT was a large multicenter prospective randomized controlled trial (RCT) comparing lung volume reduction surgery (LVRS) to optimal medical therapy. Two-year findings were published in 2003 by Fishman and colleagues. (1) The trial included 1,218 patients, and the analysis was intention to treat, reporting on of all randomized patients. The primary outcomes included total 30-day, and 90-day mortality and maximal exercise capacity. Secondary outcomes included pulmonary function, the distance walked in 6 minutes, and self-reported health-related quality of life and general quality of life. At the time of data analysis, 371 (30%) patients had been followed up for a total of 24 months. Primary findings of the Fishman et al. study are summarized below:

	90-day mortality (%)		**Total mortality (no death/total)**		**Improvement in Exercise Capacity at 24 mo (%)****		**Improvement in Quality of Life at 24 mo (%) *****	
	Med Tx	**Surg Tx**	**Med Tx**	**Surg Tx**	**Med Tx**	**Surg Tx**	**Med Tx**	**Surg Tx**
All patients	1.3	7.9	160/610	157/608	3	15	9	33
High-risk patients*	28	0	30/70	42/70	2	7	0	10
Upper lobe emphysema with low exercise capacity	3.3	2.9	51/151	26/139	0	30	10	48
Upper lobe emphysema with high exercise capacity	0.9	2.9	39/213	34/206	3	15	11	41
Non-upper lobe emphysema, low exercise capacity	0	8.3	28/84	26/65	7	12	7	37
Non-upper lobe emphysema, high exercise capacity	0.9	10.1	27/109	14/111	3	3	12	15

*High risk is defined as those with a forced expiratory volume in 1 second that was 20% or less of the predicted value and either homogeneous emphysema on computed tomography or a carbon monoxide diffusion capacity that was 20% or less of the predicted value

** Improvement in exercise capacity in patients followed up for 24 months after randomization was defined as an increase in the maximal workload of more than 10 W from the patient's post-rehabilitation baseline value

*** Improvement in health-related quality of life in patients followed up for 24 months after randomization was defined as a decrease in the score on the St George's Respiratory Questionnaire (SGRQ) of more than 8 points (on a 100-point scale) from the patient's post-rehabilitation baseline score

Conclusions drawn from these data include:

- Overall, lung volume reduction surgery increased the chance of improved exercise capacity but did not confer a survival advantage over medical therapy.
- There was a survival benefit for those patients who had both predominantly upper lobe emphysema and low baseline exercise capacity. This survival advantage appears to be due to the very high mortality and marked progressive functional limitation of those treated medically.
- Patients considered at high risk and those with non-upper lobe emphysema and high baseline exercise capacity were found to be poor candidates for lung volume reduction surgery.

In 2006, a follow-up analysis of data from NETT was published; there was a median follow-up of 4.3 years compared to 2.4 years in the initial full report. (2) Seventy percent of randomized patients participated in the extension of follow-up conducted in 2003, and 76% participated in the mailed quality-of-life data collection in 2004. The analysis was done on an intention-to-treat basis including all 1,218 randomized patients. Median follow-up was 4.3 years.

Overall, LVRS showed a mortality benefit compared to medical therapy. During follow-up, 46.5% (283/608) patients in the lung volume reduction surgery (LVRS) group and 53.1% (324/610) patients in the medical therapy group died (relative risk [RR]: 0.85, p=0.02). However, the long-term mortality benefit was limited to the subgroup of participants who had predominately upper lobe emphysema and low exercise capacity (those found in the initial report to benefit from LVRS) (RR=0.57, p=0.01). Moreover, in this subgroup of patients (n=290), compared to medical therapy, those in the LVRS group were also more likely to have an improvement in exercise capacity throughout 3 years of follow-up testing ($p<0.01$) and to have an 8-point improvement in quality of life through 4 years of follow-up testing (p=0.003).

In the subgroup of patients with predominately upper lobe emphysema and high exercise capacity (n=419), there was not a survival benefit associated with LRVR, but there was a significantly higher improvement in exercise capacity over 3 years ($p<0.001$) and quality of life over 4 years (p=0.003 in year 4). Patients with non-upper lobe emphysema, and either high or low exercise capacity, did not significantly benefit from surgery in terms of mortality rates, exercise capacity or quality of life. A limitation of the long-term follow-up study was that fewer than 80% of surviving NETT participants took part in the study extension.

In 2010, Sanchez and colleagues published an analysis of data from the National Emphysema Treatment Trial further examining factors associated with a positive outcome after LVRS. (3) The analysis focused on patients with upper lobe predominance and a heterogeneous distribution of emphysema defined as a difference in severity of emphysema in any 2 zones of the lung of at least 2 points on a 0-to-4 severity scale. Of the 1,218 patients enrolled in the study, 511 patients (42%) met both of these criteria; 261 were in the LVRS group, and 250 were in the medical therapy group, Using Kaplan-Meier analysis, the 3-year survival rate was 81% in patients receiving LVRS and 74% for those the medical group, p=0.05. At 5 years, the estimated survival rate was significantly higher in the LVRS group than the medical therapy group, 70% versus 60%, p=0.02. Maximal exercise capacity, another

NETT primary outcome, was a mean of 49 watts in the LVRS group and 38 watts in the medical therapy group at 1 year, p<0.001. At 3 years, the values in the two groups were 43 and 38 watts, respectively, and the between-group difference was not statistically significant.

Additional RCTs evaluating LVRS for treating emphysema have been published, and 2 meta-analyses of RCTs have been published. (4, 5) Each meta-analysis included 8 RCTs published between 1999 and 2006. However, the NETT accounted for about 75% of the patients in both meta-analyses, limiting the usefulness of the findings of the pooled analyses. In the more recent meta-analysis, pooled analyses found a significantly higher odds of mortality in the medical therapy group compared to LVRS at 3 months (odds ratio [OR]: 5.16, 95% confidence interval [CI]: 2.84 to 9.35) and no statistically significant difference between groups in mortality at 12 months (OR: 1.05, 95% CI: 0.82 to 1.33). (5) The authors did not conduct sub-group analyses e.g., by location of emphysema, exercise capacity, or heterogeneity of emphysema.

Selected RCTs (other than NETT) are summarized below:

Hillerdal and colleagues conducted a multicenter study in Sweden evaluating LVRS that was published in 2005. (6) Eligibility criteria included age 75 years or younger, forced expiratory volume in one second (FEV-1) of no more than 35% of predicted normal value; excessive hyperinflation with a residual volume of at least 200% of predicted, with radiologic signs of emphysema and decreased mobility of the diaphragm. Participants were required to successfully complete a 6-week physical training program. Of the 114 patients eligible for the initial training (of 304 evaluated), 3 were unable to complete the program, and 5 died before completion; the remaining 106 patients were randomized to continued physical training alone (n=53) or LVRS plus continued physical training for 3 months post-surgery (n=53). A total of 42 (79%) patients in the surgery group and 43 (81%) in the physical training group were followed for 1 year; intention-to-treat analysis was used. The primary outcome was health status according to the Swedish version of the Short-Form General Health Survey (SF)-36 instrument and the disease-specific St. George's Respiratory Questionnaire (SGRQ). Both instruments have scores ranging from 0 to 100; in the SF-36, 100 represents the best health status and in the SGRQ, 100 represents poor health status. For both instruments, the minimally important clinical difference was defined as 4 scale points. In an analysis adjusting for age and sex, there was a significant difference in the score on the SGRQ at 6 months (mean difference of 14.3 points) and 12 months (mean difference of 14.7 points), favoring the LVRS group. The total score on the SF-36 at follow-up was not reported. At 12 months, there was significantly more improvement in 6 of the 8 SF-36 subscales in the LVRS group compared to the physical training group. The researchers only reported mean difference in the scales, not the proportion of patients who achieved a certain level of improvement. Mortality was a secondary outcome. There were 7 deaths in the LVRS group (13%) and 2 deaths in the physical training group (4%); this difference was not statistically significant (p=0.5), but the study was likely underpowered for this outcome. Six of the deaths in the LVRS group were caused by respiratory failure and pneumonia; the seventh patient died suddenly at home. Respiratory failure was also the cause of the 2 deaths in the physical training group. The authors point out that the baseline SGRQ scores were lower than in the NETT (59 versus 53, respectively), suggesting a more severely impaired population. The study did not examine patient outcomes according to upper-lobe predominance or initial exercise capacity.

In 2006, Miller and colleagues published a study with data from 5 centers in Canada. (7) Eligibility criteria included: age between 40 and 79 years; disabling dyspnea; FEV-1 of no more than 40% of predicted; diffusing capacity no more than 60%; and total lung capacity no more than 120% or residual volume no less than 200%. After eligibility screening, medical therapy was optimized, and then patients were randomized to LVRS (n=32) or continued medical therapy (n=30). The researchers had originally planned to enroll 350 individuals, but due to the low proportion of screened individuals who were eligible, they stopped recruitment when only 18% of their target was met (467 individuals were screened to identify 62 who were eligible). Thus, the study may have been underpowered to detect differences in outcomes between groups. None of the randomized patients were lost to follow-up, and analysis was intention to treat. The overall 2-year survival rate was similar in the two groups; there were 5/32 (16%) deaths in the LVRS group and 4/30 (13%) deaths in the medical therapy group (p=0.935).

At 3 and 6 months, there was a significantly higher change from baseline in FEV-1 in the LVRS group compared to the medical therapy group, but there was a non-significant difference between groups in FEV-1 at 12 and 24 months. The mean difference in FEV-1 at 24 months was 0.06 liters.

Observational studies

In 2012, Baldi and colleagues conducted a retrospective analysis that included longer term follow-up than had been reported in the RCTs. The study included 52 emphysema patients who had lung volume reduction surgeries between 1993 and 2000. (8) The 5-year survival rate was 73% and the 12-year survival rate was 20%. Eleven of 52 patients (21%) underwent lung transplantation a mean of 52 months after LVRS. In a multivariate model, 2 variables were statistically associated with patient survival. These were preoperative pulmonary arterial pressure (hazard ratio [HR]: 2.11, 95% CI: 0.99 to 4.45) and upper lobe distribution of emphysema (HR: 2.43, 95% CI: 1.10 to 5.36).

Summary

Findings from the National Emphysema Treatment Trial (NETT), a multicenter randomized, controlled trial, suggest that lung-volume reduction surgery (LVRS) is effective at reducing mortality and improving quality of life in selected patients with severe emphysema. In subgroup analysis, LVRS offered a survival advantage only in the group of patients not considered high risk who had predominately upper lobe emphysema and low initial exercise capacity. Moreover, patients with upper lobe emphysema, regardless of initial exercise capacity, experienced significant improvement in exercise capacity and quality of life after LVRS. Other, smaller randomized controlled trials generally had similar findings though they tended to be underpowered for some outcomes and did not stratify by distribution of emphysema. For the subgroup of patients with predominately non-upper lobe emphysema, NETT did not find significant mortality advantages or symptom improvement with LVRS. Although NETT had positive findings for the study population as a whole, given the risks involved in surgery, additional data are needed to confirm the net health outcome in patients with non-upper lobe emphysema. Therefore, lung volume reduction surgery is considered medically necessary in patients with predominately upper lobe emphysema who are otherwise similar to NETT participants and investigational for other patients.

Practice Guidelines and Position Statements

The American Thoracic Society issued a statement on lung volume reduction surgery in 1996. (9) This was before publication of the National Emphysema Treatment Trial findings; at the time, the society stated that LVRS appeared to be helpful in some, but not all, patients with advanced emphysema. This statement is current as of May 2012.

Medicare National Coverage
Effective for services performed on or after January 1, 2004, Medicare considers LVRS reasonable and necessary for patients with severe upper lobe predominant emphysema or severe non-upper lobe emphysema and low exercise capacity who meet all of the following requirements (10):

Assessment	Criteria
History and physical examination	Consistent with emphysema BMI [body mass index] $\leq$31.1 kg/m ^{2} (men) or $\leq$ 32.3 kg/m ^{2} (women) Stable with $\leq$20 mg prednisone (or equivalent) daily
Radiographic	High Resolution Computer Tomography (HRCT) scan evidence of bilateral emphysema
Pulmonary function (pre-rehabilitation)	Forced expiratory volume in one second (FEV $_1$) $\leq$45% predicted, ($\geq$15% predicted if age $\geq$70 years)

	Total lung capacity (TLC) ≥100% predicted post-bronchodilator Residual volume (RV) ≥150% predicted post-bronchodilator
Arterial blood gas level (pre-rehabilitation)	PCO_2 ≤60 mm Hg (PCO_2 ≤55 mm Hg if 1-mile above sea level) PO_2 ≥45 mm Hg on room air (PO_2 ≥30 mm Hg if 1-mile above sea level)
Cardiac assessment	Approval for surgery by cardiologist if any of the following are present: Unstable angina; left-ventricular ejection fraction (LVEF) cannot be estimated from the echocardiogram; LVEF <45%; dobutamine-radionuclide cardiac scan indicates coronary artery disease or ventricular dysfunction; arrhythmia (>5 premature ventricular contractions per minute; cardiac rhythm other than sinus; premature ventricular contractions on EKG at rest)
Surgical assessment	Approval for surgery by pulmonary physician, thoracic surgeon, and anesthesiologist post-rehabilitation
Exercise	Post-rehabilitation 6-min walk of ≥140 m; able to complete 3 min unloaded pedaling in exercise tolerance test (pre- and post-rehabilitation)
Consent	Signed consents for screening and rehabilitation
Smoking	Plasma cotinine level ≤13.7 ng/mL (or arterial carboxyhemoglobin ≤2.5% if using nicotine products) Nonsmoking for 4 months prior to initial interview and throughout evaluation for surgery
Preoperative diagnostic and therapeutic program adherence	Must complete assessment for and program of preoperative services in preparation for surgery

There are additional criteria specifying eligible facilities.

References

1. Fishman A, Martinez F, Naunheim K et al. A randomized trial comparing lung-volume-reduction surgery with medical therapy for severe emphysema. N Engl J Med 2003; 348(21):2059-73.
2. Naunheim KS, Wood DE, Mohsenifar Z et al. Long-term follow-up of patients receiving lung-volume-reduction surgery versus medical therapy for severe emphysema by the National Emphysema Treatment Trial Research Group. Ann Thorac Surg 2006; 82(2):431-43.
3. Sanchez PG, Kucharczuk JC, Su S et al. National Emphysema Treatment Trial redux: accentuating the positive. J Thorac Cardiovasc Surg 2010; 140(3):564-72.
4. Tiong LU, Davies R, Gibson PG et al. Lung volume reduction surgery for diffuse emphysema. Cochrane Database Syst Rev 2006; (4):CD001001.
5. Huang W, Wang WR, Deng B et al. Several clinical interests regarding lung volume reduction surgery for severe emphysema: meta-analysis and systematic review of randomized controlled trials. J Cardiothorac Surg 2011; 6:148.
6. Hillerdal G, Lofdahl CG, Strom K et al. Comparison of lung volume reduction surgery and physical training on health status and physiologic outcomes: a randomized controlled clinical trial. Chest 2005; 128(5):3489-99.
7. Miller JD, Malthaner RA, Goldsmith CH et al. A randomized clinical trial of lung volume reduction surgery versus best medical care for patients with advanced emphysema: a two-year study from Canada. Ann Thorac Surg 2006; 81(1):314-20; discussion 20-1.
8. Baldi S, Oliaro A, Tabbia G et al. Lung volume reduction surgery 10 years later. J Cardiovasc Surg (Torino) 2012; 53(6):809-15.

9. American Thoracic Society. Lung volume reduction surgery. 1996. Available online at: www.thoracic.org/statements
10. Center for Medicare and Medicaid Services. National coverage determination for lung volume reduction surgery (reduction pneumoplasty) (240.1). 2005. Available online at: www.cms.hhs.gov

Billing Coding/Physician Documentation Information

32491	Removal of lung, other than pneumonectomy; with resection-plication of emphysematous lung(s) (bullous or non-bullous) for lung volume reduction, sternal split or transthoracic approach, includes any pleural procedure, when performed
32672	Thoracoscopy, surgical; with resection-plication for emphysematous lung (bullous or non-bullous) for lung volume reduction (LVRS), unilateral includes any pleural procedure, when performed
G0302	Preoperative pulmonary surgery services for preparation for LVRS, complete course of services, to include a minimum of 16 days of services
G0303	Preoperative pulmonary surgery services for preparation for LVRS, 10 to 15 days of services
G0304	Preoperative pulmonary surgery services for preparation for LVRS, 1 to 9 days of services
G0305	Postdischarge pulmonary surgery services after LVRS, minimum of 6 days of services

Additional Policy Key Words

N/A

Policy Implementation/Update Information

7/1/94	New policy. Added to surgery section, considered investigational.
3/1/00	No policy statement changes.
3/1/01	No policy statement changes.
3/1/02	No policy statement changes.
3/1/03	No policy statement changes.
3/1/04	Policy statement revised to include medically necessary indications. Remains investigational for those not meeting criteria.
3/1/05	No policy statement changes.
3/1/06	No policy statement changes.
3/1/07	No policy statement changes.
3/1/08	No policy statement changes.
3/1/09	No policy statement changes.
3/1/10	No policy statement changes.
3/1/11	Policy updated. 4-month timeframe added to time for tobacco abstinence, other policy statements unchanged.
3/1/12	No policy statement changes.
3/1/12	FEV-1 criteria in medically necessary statement changed to less than 45% predicted for patients age 70 or younger and greater than 15% predicted for patients over age 70.
3/1/14	No policy statement changes.