Name of Policy: Lung Volume Reduction Surgery for Severe Emphysema

Policy #: 151
Category: Surgery
Latest Review Date: June 2014
Policy Grade: A

Background/Definitions:
As a general rule, benefits are payable under Blue Cross and Blue Shield of Alabama health plans only in cases of medical necessity and only if services or supplies are not investigational, provided the customer group contracts have such coverage.

The following Association Technology Evaluation Criteria must be met for a service/supply to be considered for coverage:
1. The technology must have final approval from the appropriate government regulatory bodies;
2. The scientific evidence must permit conclusions concerning the effect of the technology on health outcomes;
3. The technology must improve the net health outcome;
4. The technology must be as beneficial as any established alternatives;
5. The improvement must be attainable outside the investigational setting.

Medical Necessity means that health care services (e.g., procedures, treatments, supplies, devices, equipment, facilities or drugs) that a physician, exercising prudent clinical judgment, would provide to a patient for the purpose of preventing, evaluating, diagnosing or treating an illness, injury or disease or its symptoms, and that are:

1. In accordance with generally accepted standards of medical practice; and
2. Clinically appropriate in terms of type, frequency, extent, site and duration and considered effective for the patient’s illness, injury or disease; and
3. Not primarily for the convenience of the patient, physician or other health care provider; and
4. Not more costly than an alternative service or sequence of services at least as likely to produce equivalent therapeutic or diagnostic results as to the diagnosis or treatment of that patient’s illness, injury or disease.
**Description of Procedure or Service:**

Lung volume reduction surgery (LVRS) i.e., bilateral resection of 20% to 30% of lung volume, has been used to treat patients with severe emphysema who have failed 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.

**Policy:**

**Effective for dates of service on or after June 14, 2011:**

Lung volume reduction surgery as a treatment for emphysema meets Blue Cross and Blue Shield of Alabama’s medical criteria for coverage in patients with emphysema who meet all of the following criteria, as based on the NETT trial:

1. Age < 75 years;
2. Predominantly upper lobe emphysema with hyperinflation and heterogeneity (i.e., target areas for removal);
3. For patients who are younger than 70 years of age, the FEV-1 must be no more than 45% of the predicted value;
4. 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;
5. Acceptable nutritional status, i.e., 70% -- 130% of ideal body weight;
6. Marked restriction in activities of daily living despite maximal medical therapy;
7. Ability to participate in a vigorous pulmonary rehabilitation program;
8. No coexisting major medical problems that would significantly increase operative risk;
9. Understands and agrees to undertake the risk of morbidity and mortality associated with LVRS;
10. Abstains from cigarette smoking for at least 4 months.

Lung volume reduction surgery for all other patients does not meet Blue Cross and Blue Shield of Alabama’s medical criteria for coverage.
**Lung volume reduction surgery** performed using the unilateral or thorascopic laser, or bronchoscopic approach **does not meet** Blue Cross and Blue Shield of Alabama’s medical criteria for coverage and is considered **investigational**.

*Blue Cross and Blue Shield of Alabama does not approve or deny procedures, services, testing, or equipment for our members. Our decisions concern coverage only. The decision of whether or not to have a certain test, treatment or procedure is one made between the physician and his/her patient. Blue Cross and Blue Shield of Alabama administers benefits based on the member’s contract and corporate medical policies. Physicians should always exercise their best medical judgment in providing the care they feel is most appropriate for their patients. Needed care should not be delayed or refused because of a coverage determination.*

**Key Points:**
The failure of medical treatment to lead to prolonged improvement of symptoms in severe emphysema has led to the introduction of various surgical procedures over the past 90 years. LVRS was first introduced by Brantigan and Mueller in 1957; then it was reintroduced by Cooper et al in 1995. There have been many clinical trials and many published reports in the literature on this procedure. The largest trial so far has been the National Emphysema Treatment Trial (NETT). The results of this trial were published by Fishman et al in May 2003. This policy is based on a 2003 TEC Assessment that focused on the results of this trial.

**NETT**
NETT was a large multicenter prospective randomized controlled trial (RCT) comparing lung volume reduction surgery (LVRS) with optimal medical therapy. Two-year findings were published in 2003 by Fishman et al. The trial included 1218 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 six 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 next:

<table>
<thead>
<tr>
<th>NETT TRIAL</th>
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<tbody>
<tr>
<td><strong>Patients</strong></td>
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<tr>
<td></td>
</tr>
<tr>
<td>All pts</td>
</tr>
<tr>
<td>High-risk pts*</td>
</tr>
<tr>
<td>Upper lobe emphysema w/ low exercise</td>
</tr>
</tbody>
</table>

*Proprietary Information of Blue Cross and Blue Shield of Alabama  
Medical Policy #151*
capacity

<table>
<thead>
<tr>
<th></th>
<th>Surgery Grp</th>
<th>Medical-Therapy Grp</th>
<th>Surgery Grp</th>
<th>Medical-Therapy Grp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper lobe emphysema w/ high exercise capacity</td>
<td>6/206 (2.9%)</td>
<td>2/213 (0.9%)</td>
<td>34/206 (0.07)</td>
<td>39/213 (0.07)</td>
</tr>
<tr>
<td>Non-upper lobe emphysema w/ low exercise capacity</td>
<td>7/84 (8.3%)</td>
<td>0/65 (0%)</td>
<td>28/84 (0.15)</td>
<td>26/65 (0.18)</td>
</tr>
<tr>
<td>Non-upper lobe emphysema w/ high exercise capacity</td>
<td>11/109 (10.1%)</td>
<td>1/111 (0.9%)</td>
<td>27/109 (0.10)</td>
<td>14/111 (0.05)</td>
</tr>
</tbody>
</table>

*High risk patients were defined as those with a FEV₁ that was 20% or less of the predicted value and either homogeneous emphysema on CT or a carbon monoxide diffusion capacity that was 20% or less of the predicted value.

<table>
<thead>
<tr>
<th>Patients</th>
<th>Improvement in Exercise Capacity at 24 months** (#/total #) (%)</th>
<th>Improvement in Quality of Life at 24 months*** (#/total #) (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Surgery Grp</td>
<td>Medical-Therapy Grp</td>
</tr>
<tr>
<td>All pts</td>
<td>54/371 (15%)</td>
<td>10/378 (3%)</td>
</tr>
<tr>
<td>High-risk pts*</td>
<td>4/58 (7%)</td>
<td>1/48 (2%)</td>
</tr>
<tr>
<td>Upper lobe emphysema w/ low exercise capacity</td>
<td>25/84 (30%)</td>
<td>0/92 (0%)</td>
</tr>
<tr>
<td>Upper lobe emphysema w/ high exercise capacity</td>
<td>17/115 (15%)</td>
<td>4/138 (3%)</td>
</tr>
<tr>
<td>Non-upper lobe emphysema w/ low exercise capacity</td>
<td>6/49 (12%)</td>
<td>3/41 (7%)</td>
</tr>
<tr>
<td>Non-upper lobe emphysema w/ high exercise capacity</td>
<td>2/65 (3%)</td>
<td>2/59 (3%)</td>
</tr>
</tbody>
</table>
**Improvement in exercise capacity in patients followed for 24 months after randomization was defined as an increase in the maximal workload of more than 10W from the patient’s post-rehabilitation base-line value.

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

Conclusions drawn from these data include:

- Overall, LVRS 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 LVRS.

In 2006, a follow-up analysis of data from NETT was published; there was a median follow-up of 4.3 years compared with 2.4 years in the initial full report. 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 1218 randomized patients. Median follow-up was 4.3 years.

Overall, LVRS showed a mortality benefit compared with medical therapy. During follow-up, 46.5% (283/608) patients in the 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 with medical therapy, those in the LVRS group were also more likely to have an improvement in exercise capacity throughout three years of follow-up testing (p<0.01) and to have an eight-point improvement in quality of life through four 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 LVRS, but there was a significantly higher improvement in exercise capacity over three years (p<0.001) and quality of life over four years (p=0.003 in year four). 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 et al published an analysis of data from the National Emphysema Treatment Trial further examining factors associated with a positive outcome after LVRS. 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 two zones of the lung of at least two points on a 0-to-4 severity scale. Of the 1218 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 three-year survival rate was 81% in patients receiving LVRS and 74% for those in the medical group, p=0.05. At five 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 one year, p<0.001. At three 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 two meta-analyses of RCTs have been published. Each meta-analysis included eight RCTs published between 1999 and 2006. However, 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 with LVRS at three 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). The authors did not conduct subgroup analyses eg, by location of emphysema, exercise capacity, or heterogeneity of emphysema.

Selected RCTs (other than NETT)
Hillerdal et al conducted a multicenter study in Sweden evaluating LVRS that was published in 2005. Eligibility criteria included age 75 years or younger, 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 six-week physical training program. Of the 114 patients eligible for the initial training (of 304 evaluated), three were unable to complete the program; five died before completion; the remaining 106 patients were randomized to continued physical training alone (n=53) or LVRS plus continued physical training for three months postsurgery (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 four scale points. In an analysis adjusting for age and sex, there was a significant difference in the score on the SGRQ at six months (mean difference [MD], 14.3 points) and 12 months (MD, 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 six of the eight SF-36 subscales in the LVRS group compared with 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 seven deaths in the LVRS group (13%) and two 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 two 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 et al published a study with data from five centers in Canada (Canadian Lung Volume Reduction Surgery [CLVRS] trial). 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 patients were randomized to LVRS (n=32) or continued medical therapy (n=30). The researchers had originally planned to enroll 350 subjects, but due to the low proportion of screened subjects who were eligible, they stopped recruitment when only 18% of their target was met (467 people 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 two-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 three and six months, there was a significantly higher change from baseline in FEV-1 in the LVRS group compared with the medical therapy group, but there was a nonsignificant difference between groups in FEV-1 at 12 and 24 months. The mean difference in FEV-1 at 24 months was 0.06 liters.

In 2013, Agzarian et al published long-term results of the CLVRS Trial. Fifty-two of 62 randomized patients (84%) were available for the long-term follow-up eight to ten years after treatment. One patient was excluded before surgery and nine others were lost to follow-up. The proportion of patients surviving five and ten years was 46% and 7%, respectively, in the LVRS group and 25% and 0% in the control group. According to Kaplan-Meier survival analysis, median survival was 63 months in the LVRS group and 47 months in the control group; the difference between groups was not statistically significant, p=0.20.

Observational studies
In 2012, Baldi et al 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 LVRSs between 1993 and 2000. The five-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, two 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).

In 2014, Decker et al reviewed data on 538 patients from the Society of Thoracic Surgeons (STS) Database who received LVRS, and compared these data with those of the 608 NETT participants randomized to the surgery group. None of the patients in the STS database had an FEV1 less than 20% of predicted or a carbon monoxide diffusing capacity less than 20% of predicted; thus, these patients would not have been considered high risk in NETT. However, about 10% of patients in the STS database had previous cardiothoracic surgery and 1.5% had
lung cancer, and these would have been exclusion criteria in NETT. Overall, the mortality rate within 30 days of LVRS was not significantly different in the STS database compared with NETT (5.6% vs 3.6%, p=0.113). When database findings were compared with non-high-risk NETT participants, the 30-day mortality rate was significantly higher among patients in the STS database than NETT patients (5.6% vs 2.2%), p=0.005. This study was descriptive and did not attempt to propose patient selection criteria for LVRS.

Summary
Findings from the National Emphysema Treatment Trial (NETT), a multicenter randomized controlled trial, suggest that lung-volume reduction surgery is effective at reducing mortality and improving quality of life in selected patients with severe emphysema. In sub-group 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 had a mortality advantage. Moreover, patients with upper lobe emphysema, regardless of initial exercise capacity, experienced significant improvement in exercise capacity and quality of life after lung volume reduction surgery. 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, the NETT did not find significant mortality advantages or symptom improvement with LVRS. Although the 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. 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. As of April 2014, this statement is archived and had not been updated.

A search of the American College of Chest Physicians website did not identify any guidelines or position statements on lung volume reduction surgery for severe emphysema.

Key Words:
Lung volume reduction surgery (LVRS), emphysema, National Emphysema Treatment Trial (NETT)

Approved by Governing Bodies:
Not applicable
**Benefit Application:**
Coverage is subject to member’s specific benefits. Group specific policy will supersede this policy when applicable.

ITS: Home Policy provisions apply
FEP contracts: Special benefit consideration may apply. Refer to member’s benefit plan. FEP does not consider investigational if FDA approved and will be reviewed for medical necessity.

**Current Coding:**

**CPT:**
- 32491 Removal of lung, other than total 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 (Effective January 1, 2012)

**HCPCS:**
- G0302 Pre-operative pulmonary surgery services for preparation for LVRS, complete course of services, to include a minimum of 16 days of services
- G0303 Pre-operative pulmonary surgery services for preparation for LVRS, 10 to 15 days of services
- G0304 Pre-operative pulmonary surgery services for preparation for LVRS, 1 to 9 days of services
- G0305 Post-discharge pulmonary surgery services after LVRS, minimum of 6 days of services

**References:**


Policy History:

Medical Policy Group, February 2004
Medical Policy Administration Committee, March 2004
Available for comment March 22-May 5, 2004

Medical Policy Group, February 2007 (1)
Medical Policy Administration Committee, February 2007
Available for comment February 10-March 26, 2007

Medical Policy Group, February 2010 (1) No new studies identified per literature search

Medical Policy Group, June 2010 (1)
Medical Policy Group, June 2011 (1): Update to Policy, Key Points and References related to FEV-1 values
Medical Policy Administration Committee, July 2011
Available for comment July 6 through August 22, 2011

Medical Policy Group, December 2011 (1): 2012 Verbiage update to code 32491 (3), added code 32672 (1)
Medical Policy Group, June 2012 (1): 2012 Updates to Description, Key Points & References
Medical Policy Panel, June 2013

Medical Policy Group, June 2013 (3): 2013 Updates to Key Points and References; no change in policy statement
Medical Policy Panel, June 2014

Medical Policy Group, June 2014 (3): 2014 Updates to Key Points & References; no change in policy statement
This medical policy is not an authorization, certification, explanation of benefits, or a contract. Eligibility and benefits are determined on a case-by-case basis according to the terms of the member’s plan in effect as of the date services are rendered. All medical policies are based on (i) research of current medical literature and (ii) review of common medical practices in the treatment and diagnosis of disease as of the date hereof. Physicians and other providers are solely responsible for all aspects of medical care and treatment, including the type, quality, and levels of care and treatment.

This policy is intended to be used for adjudication of claims (including pre-admission certification, pre-determinations, and pre-procedure review) in Blue Cross and Blue Shield’s administration of plan contracts.