The Safety, Efficacy, and Durability of Lung Volume Reduction Surgery: A 10-Year Experience

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Disclosures

- Board of Directors – Avery Laboratories
- Consultant: PneumRx, Inc. (not active)

No conflicts related to this presentation.
LVRS: Historical Perspective

- 2003: The National Emphysema Treatment Trial
- 2003: Centers for Medicare and Medicaid Coverage
- 2014: STS database analysis 538 cases: 2003 - 2011


LVRS: Reasons for Poor Utilization

• High surgical morbidity and mortality
• Inconsistent and unpredictable benefits
• Lack of proven durability
• Anticipation of a bronchoscopic approach
CUMC LVRS 2004-2014

• Safety: 6-month surgical morbidity and mortality
• Efficacy: 1-year functional outcomes
• Durability: 5-year functional outcomes and survival
CUMC LVRS 2004-2014

- Evaluation completed per NETT protocol
- CMS selection criteria
- IRB Approved registry
- VATS approach/reinforced staple lines
Baseline Characteristics (n=91)

- Age (yrs), mean ± SD: 62.5 ± 6.3
- Gender, % Male: 41.8
- FEV₁ (Post BD) % pred, mean ± SD: 25.8 ± 6.2
- RV % pred, mean ± SD: 214.0 ± 42
- DLCO % pred, mean ± SD: 28.6 ± 7.2
- 6MWD ft, mean ± SD: 1248.1 ± 263.6
- Max Workload watts, mean ± SD: 37.6 ± 19.9
Surgical results

- 91 patients (89 bilateral, 2 unilateral)
- 88% VATS, 12% sternotomy (VATS used exclusively since 2005)
- 6 month mortality: 0 (0%)
- Discharge disposition
  - Home – 90%
  - Inpatient Rehabilitation – 10%
- LOS (days), median (IQR): 8 (6,10)
- 3 patients required re-intubation/tracheostomy (all 3 were weaned and decannulated prior to discharge, none since 2010)
- Prolonged air leaks > 7 days: 52 (57%)
One-year results (change from baseline, n=58)

- FEV$_1$ % Pred: +11.1 (8.6, 13.6) P < 0.0001
  $\Delta$ = 43%
- RV % Pred: -64.4 (-72.7, -56.1) P < 0.0001
- DLCO % Pred: +5.2 (3.0, 7.3) P < 0.0001
- 6 MWD: +128.7 ft. (76.9, 180.5) P < 0.0001
- CPET: +10.7 watts (6.9, 14.6) P < 0.0001
- UCSD Shortness of Breath Score: -27.4 (-35.5, -19.4) P < 0.0001
One-year results: FEV₁ % predicted

**FEV₁ % pred (Mean ± SD)**

Pre-op: 25.9 ± 6.2 (n=58)
1 year: 37.0 ± 12.8 (n=58)

p < 0.0001
5-year results (change from baseline, n=18)

• FEV$_1$ % Pred: $+11.1$ (7.1, 15.0) $\Delta = 44\%$  
  $P < 0.0001$

• RV % Pred: $-94.3$ (-109.7, -78.8)  
  $P < 0.0001$

• DLCO % Pred: $+4.1$ (0.2, 7.9)  
  $P = 0.0405$

• 6 MWD: $-59.5$ (-224.8, 105.8)  
  $P = 0.4580$

• CPET: $+10.24$ watts (4.4, 16.1)  
  $P = 0.0020$

• UCSD Shortness of Breath Score: $-20.5$ (-37.3, -3.8)  
  $P = 0.0192$
5-year results: FEV$ _1$

FEV$ _1$ % pred (Mean ± SD)

Pre-op: 25.1 ± 5.9  (n=18)
1 year: 40.3 ± 13.2  (n=16)
2 years: 38.5 ± 10.1  (n=14)
5 years: 36.2 ± 9.7  (n=18)
Survival Analysis

N: 91
No. of deaths: 23
Median Survival: 9.1 yrs. (6.2, NA)
Survival: 1 Yr.: 0.99 (0.96-1.00)*
Survival: 2 Yr.: 0.97 (0.93-1.00)*
Survival: 5 Yr.: 0.78 (0.67-0.89)*

*95% Confidence Intervals
Causes of Late Death

- 23 late deaths (10 mos. to 10 yrs. post- LVRS)
  - 12 (52%) deaths from respiratory failure
  - 9 (39%) deaths from non-respiratory causes
    - Lung cancer - 3
    - Murder - 1
    - Ovarian cancer - 1
    - Heart failure - 1
    - Uterine cancer - 1
    - Complications from shingles - 1
    - Kidney failure - 1
  - 2 (9%) Unknown - 2 (6,10 years post- LVRS)
Conclusions

• Bilateral LVRS can be performed with a negligible mortality risk using VATS techniques

• Early (1-year) results show a significant and meaningful improvement in pulmonary function

• Long term (5-year) results demonstrate that LVRS is durable in many patients

• These results represent the standard against which alternative LVRS techniques should be measured
Study Limitations

• Single center experience

• Late functional follow-up incomplete

• Patient selection criteria as well as the magnitude and geography of surgical resection still is largely surgical “art” and needs to be more scientifically defined