
LUNG VOLUME REDUCTION COILS AS A NOVEL BRONCHOSCOPIC TREATMENT FOR EMPHYSEMA

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Abstract

Chronic obstructive pulmonary disease remains a major cause of morbidity and mortality worldwide. Despite regular advances in pharmacology, there remains great potential for addressing structural deficiencies, especially in emphysema. The loss of alveolar attachments to small bronchial tubes results in diffuse loss of elastic recoil and airway collapse during exhalation. This appears physiologically as hyperinflation of lung volumes with flattened diaphragms and significantly elevated residual volumes (RV) on pulmonary function testing (predicted RV > 175%).

Bilateral implantation of multiple shape memory nitinol lung volume reduction coils (LVRCs) (BTG plc, London, UK/Pneum-Rx, Inc., Mountain View, CA) is currently being investigated as a novel treatment for GOLD Class 3 or 4 emphysema patients who suffer from dyspnea primarily due to significant air trapping. The RENEW trial is a recently completed international multicenter clinical study that demonstrated effective lung volume reduction and re-establishment of elastic recoil in emphysematous lungs via a substantially less invasive manner than traditional open-chest surgery. Alternate bronchoscopic interventions use unidirectional valves, bronchial thermal vapor, and even the installation of biodegradable gels/synthetic polymers. While these options may reduce hyperinflation, they do not prevent airway collapse or improve elastic recoil like LVRCs. The nitinol coils not only enhance the lung's natural scaffolding but also work in both heterogeneous and homogenous emphysema, unlike other techniques, and are fully independent of collateral ventilation.

Using computed tomography (CT), affected lung lobes are identified as potential treatment sites. Ten coils are implanted into one lung via a flexible bronchoscope under total intravenous anesthesia and fluoroscopic guidance. The procedure occurs in an outpatient setting during a 45-minute session with minimal recovery time. After 2 months, the second lung is treated in a similar manner. In addition to general subjective clinical improvement, statistically significant gains in the 6-minute walk test (6MWT), forced expiratory volume in 1 second test (FEV1), residual volume test (RV), and St. George's Respiratory Questionnaire (SGRQ) have all

been demonstrated. Principal risks involve pneumothorax (9.7%) and an inflammatory "tension opacity" on subsequent imaging that manifests clinically as transient pneumonitis but generally responds well to a brief course of oral steroids.

By implanting LVRCs directly into multiple airways, this simple bronchoscopic procedure offers clinically impaired emphysema patients a novel bridge to pulmonary transplant or potential destination therapy through the re-establishment of elastic recoil and lung volume reduction.

Key Points:

- Lung volume reduction coils constructed of shape memory nitinol alloy are implanted via fiber-optic bronchoscopy to re-establish elastic recoil, thereby limiting airway collapse and hyperinflation.
- Contrary to other bronchoscopic techniques that isolate or destroy tissue, coils improve function in homo/heterogeneous lungs and are fully independent of collateral ventilation.
- This minimally invasive technique provides emphysema patients a novel bridge to lung transplant or destination therapy with statistically significant improvements in 6MWT, FEV1 and RV tests, and SGRQ.

Conflict of Interest Disclosure: Dr. Connolly is a clinical investigator in the RENEW trial.

Keywords: chronic obstructive pulmonary disease, COPD, lung volume reduction coils, emphysema, nitinol coils