Endobronchial Valve Therapy for Severe Emphysema Patients

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ANZSRS QLD Branch Meeting
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1. Case Study – Ms. H
2. The Basics of Emphysema
3. Treatment Options for Emphysema

Case Study - Ms. H

July 2013

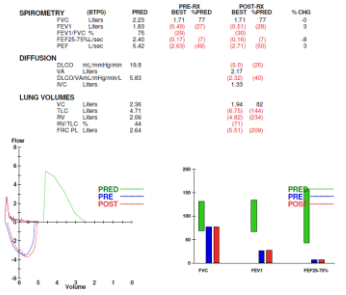
- Experiencing a progressive decline in exercise tolerance
- Severe COPD secondary to emphysema
- 40 year smoking history
- Mild pulmonary hypertension (RVSP 41mmHg)

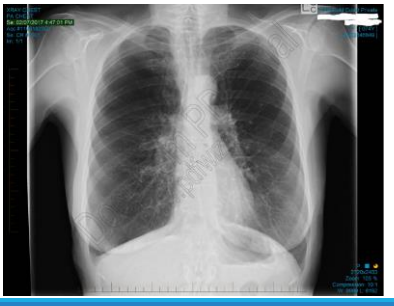
Case Study - Ms. H

July 2017

- Dyspnoeic
- Diminishing exercise capacity
- Stable lung function results
- Pulmonary rehabilitation twice a week
- Assess suitability for Endobronchial Valve Lung Volume Reduction (EBVLVR)

PFT 27/07/2017



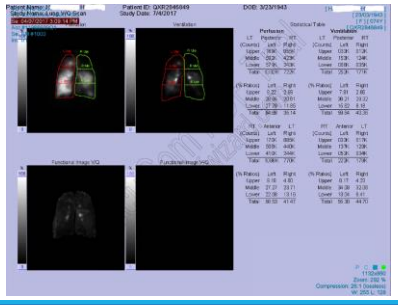


Case Study - Ms. H

July 2017

Differential Ventilation/Perfusion (V/Q) scan

Right upper 3%	Left upper 8%
Right mid 29%	Left mid 36%
Right lower 8%	Left lower 16%



Case Study - Ms. H

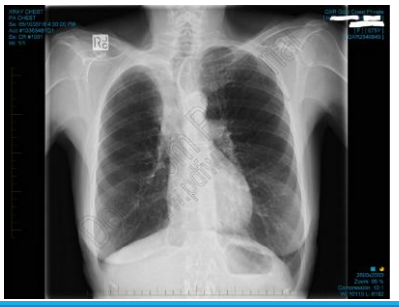
October 2017

- EBVLVR
- 4 valves inserted (3 RUL, 1 RML)
- Post-procedure right sided pneumothorax - settled after 12 days of ICC drainage

Late October 2017

- Improved exercise tolerance (130 metre improvement in a repeat 6MWT)
- Spirometry revealed an increased FEV_1 and an 800mL (I) in improvement in FVC

PFT 25/01/2018



Case Study – Ms. H

January 2018

- Less hyperinflation
- Reduced dyspnoea
- Improved exercise capacity
- Complications: Pneumothorax and a productive cough

Emphysema

- Gradual and permanent enlargement of the air spaces distal to the terminal bronchioles
- Alveoli walls weaken and eventually rapture creating large air pockets (bullae)
- ↓ surface area available for gas exchange = ↑ physiological dead space
- ↓ elastic recoil, early airway closure during exhalation and air trapping
- The ability of healthier parts of the lung to expand is reduced causing shortness of breath
- The diaphragm loses its normal domed shape and becomes flat, placing increased work on other muscles of inspiration

Emphysema (Causes)

1. Long term cigarette smoking
2. Alpha-1 antitrypsin deficiency
   - Alpha-1 antitrypsin: responsible for protecting the lung from neutrophil elastase
   - Neutrophil elastase: acts to digest damaged/aging cells and bacteria
   - Insufficient alpha-1-antitrypsin → neutrophil elastase attacks healthy lung tissue

Emphysema (Types)

Centrilobular
- Proximal respiratory bronchioles
- Upper lobes

Panlobular
- Entire alveolar unit
- Lower lobes (areas of high blood flow)

Paraseptal
- Peripheral lobes

Emphysema (Distribution)

Homogenous
- Equal distribution of emphysema throughout the lung
- Not (always) suitable for lung volume reduction techniques

Heterogeneous
- One lobe or part of a lobe is particularly effected

Treatment Options

The Global Initiative for Chronic Obstructive Lung disease (GOLD)

Classification of airflow limitation severity in COPD (Based on post-bronchodilator FEV_1)		
In patients with $FEV_1/FVC < 0.70$:		
GOLD 1	Mild	$FEV_1 \geq 80\%$ predicted
GOLD 2	Moderate	$50\% \leq FEV_1 < 80\%$ predicted
GOLD 3	Severe	$30\% \leq FEV_1 < 50\%$ predicted
GOLD 4	Very Severe	$FEV_1 < 30\%$ predicted

Treatment Options

Mild Emphysmea
- Smoking cessation
- Short acting Beta$_2$ agonists
- Regular physical activity, healthy diet
- Influenza vaticinations

Moderate Emphysema
- Pulmonary Rehabilitation
- Long-acting muscarinic antagonist (LAMA) and/or long-acting beta$_2$ agonist (LABA)
- Inhaled corticosteroids

Severe Emphysema
- Oxygen therapy (if patient hypoxic)
- Low doses of Theophylline
- Lung Volume Reduction techniques

Lung Volume Reduction (LVR)

1. Lung volume reduction surgery: ↓ use since introduction of…
2. Bronchoscopic lung reduction techniques:
   - Airway bypass stents
   - Biologic lung volume reduction
   - Bronchoscopic thermal vapour ablation
   - Endobronchial coils
   - Endobronchial valves

LVR (Indications)

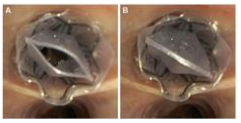
- Age less than 75 years
- Severe dyspnoea despite optimal medical therapy and maximal pulmonary rehabilitation
- Longer than six months of smoking cessation
- Marked airflow obstruction on spirometry (FEV$_1$ less than 45 percent predicted, consistent with the diagnosis of advanced COPD)
- DLCO > 20% predicted
- Lung volume measurements showing air trapping (RV > 150% predicted, TLC > 100% predicted, an increased RV/TLC ratio)
- CT findings of hyperinflation and heterogeneously distributed emphysema with some areas having better preserved lung tissue Post pulmonary rehabilitation 6MWT distance greater than 140 metres

LVR (Contraindications)

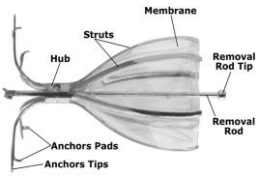
- Age greater than 75 years
- Cigarette smoking within the prior six months
- A comorbid illness that would increase the likelihood of surgical mortality
- Severe obesity
- Inability to complete a 6 to 10 week program of pulmonary rehabilitation
- A chest wall deformity, previous pleurodesis, or thoracotomy that would preclude surgery
- A chest HRCT scan that shows minimal emphysema or shows homogeneously distributed emphysematous changes without areas of preserved lung tissue
- Findings on HRCT that would be considered a contraindication for LVR (e.g., giant bulla, interstitial lung disease, pulmonary nodule)
- Markedly abnormal alveolar gas exchange with a DLCO less than 20 percent of predicted, an arterial partial pressure of carbon dioxide (PaCO2) >60 mmHg or an arterial partial pressure of oxygen (PaO2) <45
- Pulmonary hypertension (pulmonary artery systolic pressure >45 mmHg)
- Advanced alpha-1 antitrypsin deficiency (not an absolute contraindication)

Endobronchial Valves

- Designed to reduce hyperinflation
- Minimally invasive procedure
- One way valves inserted into a region of emphysematous lung to prevent air entering whilst allowing trapped air to escape
- Targeted portion of the lung reduces allowing healthier regions to expand and function more effectively



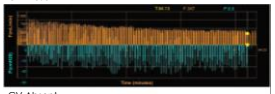
Endobronchial Valves (Structure)



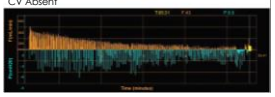
Collateral Ventilation (CV)

- Increased in Emphysema
- The Chartis ® system is used to determine the presence of CV by providing flow and pressure readings for specific lobes
- A balloon catheter is used to block flow to the target region
- The system then calculates airway resistance and measures CV in the isolated lobe

CV Present



CV Absent



Endobronchial Valves (Insertion)

- Procedure is conducted under general anaesthetic and takes 15-20 minutes
- Using a balloon catheter the airway is measured and the appropriate sized valve is selected
- Using a standard bronchoscope, valves are delivered to target airways using a flexible delivery catheter
- 3 to 8 values per procedure
- Recovery is quick (~ 3 days hospitalisation)

Endobronchial Valves

COMPLICATIONS

- Pneumothorax
- COPD exacerbations
- Haemoptysis
- Pneumonia
- Dyspnoea

BENEFITS

Increased Quality of Life:

- ↑ Exercise capacity

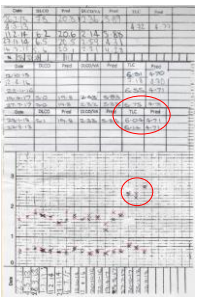
Primary Outcomes:

- % change in FEV_1
- 6MWT

Conclusion

Following EBVLVR, significant improvements were evident in Ms. H's lung function which have increased her capacity to live somewhat comfortably with severe emphysema

Questions?



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