RePneu™ lung volume reduction coils for emphysema

SUMMARY

The RePneu™ lung volume reduction coil (LVRC) is a new medical device intended to treat severe emphysema. RePneu™ LVRCs are tiny coils made of ‘memory metal’. They are implanted into diseased parts of the lung endoscopically, with several being inserted in each procedure. RePneu™ LVRCs are delivered to the lung straightened but when released in the lung spring back into a predetermined shape, gathering the lung tissue around them. This is intended to prevent air getting trapped in the lung. An early study found people reported an improvement in their quality of life when treated using RePneu™ LVRCs but more research is needed before it is known how well this treatment works in the longer term, how effective it is compared to existing therapies and to identify which patients will benefit most.

BACKGROUND

Emphysema is a type of lung disease which can cause severe breathlessness particularly when someone is exercising or moving around. Breathing difficulties are caused by long-term damage to the lungs, usually because of smoking. More rarely, other factors such as exposure to air pollutants, chronic asthma or a genetic condition cause or contribute to the disease\textsuperscript{1,2}.

Emphysema is caused by inflammation resulting from irritation to the lung. Over many years this inflammation leads to permanent changes and damage to the smaller airways and air sacs (alveoli) in the lungs. This damage means the lungs lose their normal elasticity which results in both airway obstruction and over inflation of the lungs (hyperinflation).
Emphysema can be described as ‘heterogeneous’ or ‘homogeneous’ depending on how the disease is distributed within the lungs. In homogeneous emphysema the disease is distributed more evenly than in heterogeneous emphysema, where the extent of the disease varies more between different parts of the lungs.

Emphysema commonly occurs with chronic bronchitis - inflammation of the airways of the lungs (the bronchi) - and the term chronic obstructive pulmonary disease (COPD) is used to describe airflow obstruction due to chronic bronchitis, emphysema, or both.

An estimated 3 million people have COPD in the UK. About 900,000 have diagnosed COPD and an estimated 2 million people have COPD which remains undiagnosed. About 1.6% of all patients registered with a GP in England have been diagnosed with COPD. A flare-up (exacerbation) of COPD is one of the most common reasons for admission to hospital (1 in 8 admissions is due to COPD). In the UK, COPD accounts for approximately 30,000 deaths each year. COPD becomes more common with increasing age and the average age of diagnosis is 67 years. COPD is closely associated with levels of deprivation and rates are higher in more deprived communities.

It has been estimated that in the UK over 20% of patients with emphysema have severe disease.

**CURRENT PRACTICE**

Emphysema is treatable, but not curable. If a person smokes, the most important way to prevent their emphysema from becoming worse is for them to stop smoking. Damage already done to airways cannot be reversed, but stopping smoking prevents the disease from worsening.

The appropriate treatment for emphysema will depend on its severity and symptoms. Inhalers, other medicines, nebulisers, oxygen therapy and non-invasive ventilation can be used to ease symptoms. People with emphysema may also benefit from exercise, education and psychological support (pulmonary rehabilitation).

For a small minority of people with emphysema lung volume reduction surgery (LVRS) may be a treatment option. In LVRS the worst affected areas of the lung are removed in order to allow the remaining lung to work more effectively. LVRS is usually performed using minimally invasive surgical techniques. The surgery works best in people who have disease that is worse in the upper parts of their lungs. One expert suggests that LVRS is likely to improve symptoms only in emphysema patients with significant hyperinflation of the lungs. Most people who have this surgery get some benefit. However, about one person in four gets no benefit from the operation, and about one person in twenty dies during or shortly after surgery. In 2010 to 2011 there were 105 lung volume reduction surgeries recorded in England (finished consultant episode, OPCS-4 E54.6).

Lung transplantation is not a realistic option in most cases.

**NEW TECHNOLOGY**

PneumRx Incorporated’s RePneu™ lung volume reduction coil (LVRC) is a medical device designed to treat severe emphysema. The device is implanted using a bronchoscope so no surgical cuts are needed. During the procedure several devices may be implanted into the...
lung. A specific delivery system is required (consisting of a guide wire, a catheter and forceps with a loading cartridge). Treatment with RePneu™ LVRCs is intended to be used in addition to current therapies as an alternative to lung volume reduction surgery.

RePneu™ LVRCs are made of metal wire (nitinol) which ‘remembers’ a pre-formed shape. During a procedure the coils are implanted, one at a time, into an area of diseased lung using a bronchoscope. The bronchoscope is passed through the nose into the windpipe (trachea) and then to the part of the bronchial tree supplying the target area of the lung. A guide wire is then fed through the bronchoscope using an (fluoroscopic) imaging system. A tube (catheter) is then passed over the guide wire, the guide wire is removed and a straightened RePneu™ LVRC is fed through into the catheter. The catheter is then removed whilst the coil is held in place using a grasper. Once released into the lung the coil returns to a predetermined shape, and in so doing, gathers the lung tissue around it. This in turn may keep air from entering the diseased airways beyond the coil and redirect air to healthy tissue, which has more room to expand, thus allowing the lung to function better. The company state that in bench tests each coil compresses 35-50cc lung volume.

The procedure to implant RePneu™ LVRCs is carried out by a lung specialist while the patient is under conscious sedation or general anaesthesia. The decision as to which is used depends on the discretion of the specialist and the treating centre. The company state that the procedure typically takes between 20 and 40 minutes and that people undergoing the procedure would need to have at least one overnight stay in hospital. Normally only one lung is treated during each procedure, the other being treated 30 days later.

RePneu™ LVRCs are made in three different lengths (100mm, 125mm and 150mm in their straight form) for different sized airways and come in boxes of five of the same length. The company state that on average ten coils are implanted in each procedure. All of the coils are implanted in one of the following areas of the lung: right upper lobe, right lower lobe, left upper lobe or left lower lobe. They state that the decision on how many coils to implant is made by the doctor based on the number of suitable sites in the targeted area of lung (sub-segments of the desired length) and that this decision can be made before the procedure. The company also state that if necessary RePneu™ LVRCs can be removed or repositioned using the delivery system and by reversing the implantation process.

The RePneu™ device was CE marked in October 2010 but is not currently available within the NHS outside of research.

The cost of RePneu™ LVRCs and the delivery system were not available for this briefing. The cost of the procedure and associated hospital stay would be in addition to this. The tariff for fibre optic bronchoscopy is £503 and the tariff for complex thoracic surgery (which includes lung volume reduction surgery) without complications and co-morbidities is £5,396.

Other non-surgical approaches to lung volume reduction are currently being researched. One technique is the implantation of one-way valves (endobronchial valves) into the lungs. These are intended to prevent air reaching diseased parts of the lung whilst still allowing air to escape (preventing parts of the lung becoming over-inflated). One expert comments that endobronchial valves do not work if collateral ventilation is present. This is when air can pass into the target area of the lung from adjacent damaged lung through channels which bypass the normal airways. The issue of collateral ventilation is not likely to be relevant to the RePneu™ device.

Two further non-surgical ways to reduce lung volume that are currently being developed are the use of steam to form scar tissue in the lungs (thermal vapour ablation) and expandable foam to seal diseased lung tissue.
To date there are no published trials which assess how effective treatment using RePneu™ LVRCs is compared to other lung reduction treatments for emphysema. Two non-comparative studies have been completed and published and two are ongoing. One randomised controlled trial is ongoing and another is planned. Some details of these studies are given here.

Two small non-comparative studies of the RePneu™ device have been published. A pilot study in 11 patients undergoing 21 procedures reported that all procedures were well tolerated. Thirty three adverse events were reported, none of which were deemed severe\(^1\).\(^3\).

In the second study, pre-published online, 16 people with severe heterogenous emphysema were treated with RePneu™. A total of 28 procedures were performed and the number of coils placed in each procedure varied from 5 to 12. Fourteen patients were followed up for six months. Following treatment there was a statistically significant improvement in self-reported quality of life measured using the St George’s Respiratory Questionnaire (SGRQ) of 14.9 points (±12.1 points; \(p<0.005\)). The authors report that no adverse events were observed during the bronchoscopy or coil placement and that collapsed lung (pneumothorax) occurred in 1 of 28 procedures and mild coughing up of blood (hemoptyisis) occurred in 21 of 28 procedures. In four cases passing (transient) chest pain occurred\(^1\).\(^4\),\(^5\).

A randomised controlled trial comparing the RePneu™ device to standard non-surgical medical care in people with emphysema is ongoing. The trial will compare the change in self-reported quality of life (measured using the SGRQ) in the two groups at three months. The estimated study completion date is December 2012\(^1\).\(^6\).

A study of lung volume reduction using the RePneu™ device in people with heterogeneous emphysema in both lungs is ongoing. The study will measure the change in self-reported quality of life (measured using the SGRQ) from before treatment to six months after treatment. The estimated enrolment is 58 and the estimated study completion date is July 2012\(^1\).\(^7\).

A study of lung volume reduction using the RePneu™ device in people with homogeneous emphysema is ongoing. The planned enrolment is 10 and the estimated completion date is February 2013. The study will examine the change in walking ability (measured using the six minute walk test) at six months compared to before treatment\(^1\).\(^8\).

A randomised controlled trial of lung volume reduction using the RePneu™ device is planned to begin in September 2012. The trial will include people with emphysema in both lungs who have completed a pulmonary rehabilitation program and/or are regularly performing maintenance respiratory rehabilitation. The trial aims to recruit 315 participants who will be randomised to have lung volume reduction using the RePneu™ device or to receive standard non-surgical medical care. The trial will compare the change in walking ability (measured using the six minute walk test) between the two groups at one year. The change in self-reported quality of life (measured using the SGRQ) will also be compared\(^1\).\(^9\).

The results of randomised controlled trials of RePneu™ LVRCs are awaited. Further research into how this new treatment compares to currently available treatments, which patients might benefit most and its long term safety and efficacy is needed.
NIHR Horizon Scanning Centre

POTENTIAL IMPACT

Emphysema is an irreversible disease and although patients may benefit from inhaled therapies and pulmonary rehabilitation many remain significantly disabled. It is a Government policy priority area.

If shown to be effective, treatment with RePneu™ LVRCs might provide a less invasive alternative to lung volume reduction surgery in the small number of people for whom this is appropriate. It is also possible that RePneu™ LVRCs could be used for those who otherwise would benefit from lung volume reduction surgery but are not considered fit enough for such surgery. The company state that treatment with RePneu™ LVRCs may also delay the need for a lung transplant.

In the absence of cost information for the RePneu™ LVRC it is not possible to compare the cost of this procedure with that of lung volume reduction surgery. One expert suggests the usual length of hospital stay for LVRS is 7-10 days. Presumably the reduction in hospital stay with this new procedure would bring savings in terms of hospital and staff resources but this would need to be balanced against the cost of the RePneu™ LVRC devices, delivery system and staff training.

If this less invasive procedure allows lung volume reduction in patients with severe emphysema who would not previously have been considered for lung volume reduction surgery this will bring additional costs for the health service. These additional costs would need to be assessed against the potential benefits to the health and well-being of people with severe emphysema.

Lay summary

The RePneu™ lung volume reduction coil (LVRC) is a new medical device intended to treat a severe lung disease called emphysema. Emphysema can make it hard to breathe. LVRCs are tiny metal coils which are put inside a person’s lungs to close off small areas of unhealthy lung. This prevents air becoming trapped in these areas. The coils are put in place using a tube which goes down the windpipe. Once in place the coils stay there. RePneu™ LVRCs could be used instead of having an operation to remove unhealthy lung tissue. One study suggests that these coils may help people with severe emphysema but more evidence is needed to see how well this treatment works and which patients it might be best for.

REFERENCES