SCOPE
Senior Consulting
Program for Engineering

Boston Scientific
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Boston Scientific SCOPE Team #9 (Pleural)

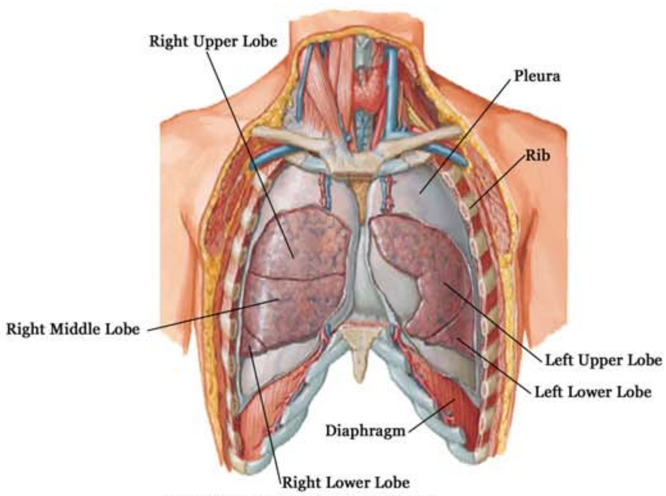
The Statement of Work:

Boston Scientific has identified an opportunity to develop flexible products for less invasive access, visualization, and biopsy within the pleural cavity. The tools would provide an effective alternative to thoracoscopy, with the main distinction and advantage being that the procedure would be conducted with minimum or no lung deflation.

The specific scope of the project would require further definition by the SCOPE team as they evaluate areas for product development. The project will include researching market opportunities, identifying technical challenges, generating ideas, developing preliminary functional prototypes, and conducting authentic testing (possibly in-vitro, if appropriate).

Anatomy of Pleural Space:

Inside the body, the lungs are covered by a thin, double-layered sac called the pleura. The pleura both lines the outside surface of the lung (the visceral pleura) and the interior surface of the pleural cavity (the parietal pleura). About three cell layers thick, the surfaces of the visceral and parietal pleura are usually separated by a thin layer of fluid, which lubricates the lungs, allowing them to expand without friction during breathing. A procedure called pleurodesis is sometimes performed, which essentially eliminates the function of the pleura. Adhering the lungs to the chest wall through mechanical or chemical irritation of the pleura, scarring results in the two becoming fused to one another. Once the two surfaces have adhered, the pleural space will no longer be subject to pleural effusions.



Netter FH. Atlas of Human Anatomy. Saunders, New York: 2006.

Meet the Team:

Pictured from left to right: Dewi Harjanto, Kristen Richter, Karen Levi, Kyle Rader, and Ray Young.
Not Pictured: Faculty advisors: Gill and Janey Pratt; Boston Scientific Liaison: Katie Krueger

Pleural Effusions:

A pleural effusion is an accumulation of fluid within the pleural space, or the space between the lung and the chest wall. Normally, there is a small amount of pleural fluid to reduce friction between the lung and the chest wall, but liquid can build up either through a failure to drain the liquid or an excess of liquid entering the pleural space. A pleural effusion is generally a symptom of a larger problem. Examples of causes for the two types of effustions are below:

Transudative: systemic problem
- Heart failure
- Cirrhosis

Exudative: local problem
- Pneumonia
- Local Cancer
- Inflammation

Once a pleural effusion is detected, if its cause is not known, there are a variety of procedures of varying levels of invasiveness performed to find its cause.

Current Methods of Diagnosis:

There are a number of different techniques that are used to investigate the underlying cause of a pneumothorax. They vary in invasiveness and effectiveness, and are illustrated below. Briefly, the four types of diagnostic techniques are:

Thoracentesis- fluid from the effusion is sampled through a blind procedure that can serve either as diagnostic or therapeutic
Closed Needle Biopsy- part of the parietal pleura is biopsied in a blind procedure using a needle.
Thoracoscopy- rigid tools are used in a video-assisted procedure to investigate the pleural space.
Thoracotomy- a large incision is made across the chest in an invasive procedure to study the space.

Minimally Invasive Procedures:

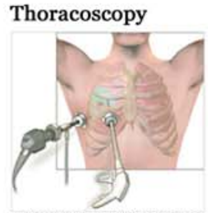
Minimally invasive procedures are on the cutting-edge of surgery. By minimizing the number and size of incisions made, the amount of anesthesia needed is reduced and hospital stay times are shortened. Furthermore, scarring is greatly decreased. Minimally invasive procedures can also be performed on a wider patient population. Although laparoscopic and endoscopic surgical procedures are much less invasive than open surgery, many improvements can be made, including reducing the size and number of ports needed.

We focused on developing a deformable trocar, which would greatly facilitate single-port surgery, which many see as the next frontier in minimally invasive surgery.

Thoracentesis

http://www.ynhh-healthlibrary.org/images/ei_2006.gif

Thoracoscopy



http://www.columbiasurgery.org/pat/thoracic/img/pic_vats.gif

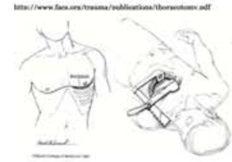
Level of Effectiveness

Level of Invasiveness

http://www.nlm.nih.gov/medlineplus/ency/images/ency/fullsize/8898.jpg

Closed Needle Biospy

http://www.facs.org/trauma/publications/thoracotomy.pdf



Thoracotomy

http://www.lina-medical.com/uploads/pics/trocar_27.jpg

http://www.aesculapusa.com/doc/doc_download.cfm?3636&uuid=E5CDC2BE2A5AE6066177445A79AFC6F0&&TRACER_AUTOLINK&&