

## LUNG TISSUE CULTURE CHAMBER

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### Abstract

The incidence of allergy and asthma is an ever-increasing health problem in our world today. A great deal of research is currently being directed toward determining the cause of these diseases. Lung tissue research at the cellular level deals with three individual cells; the endothelial cells lining the blood vessels in the lung, the epithelial cells lining the air sacs of the lung and the white blood cells that migrate from the blood to the lung. These cells are isolated and grown in culture so that they can later be analyzed using microscopy, molecular biology and tests of cell function. If these cells could be grown together in a system and

environment that is similar to an actual functioning lung, the relationship between them and how they react to each other in an allergenic environment could be more greatly understood. This system needed for this experiment will provide an adequate way of testing the cells asthmatic response to antigens/allergens. There are no current devices that incorporate endothelial cells, epithelial cells and life-like flow.

The final design is a three piece device with a base that allows for growing of the epithelial cells in the correct orientation, a space for a fluid matrix in between the two cell layers, and a piece that allows for flow over the top of the endothelial cells mimicking blood flow. The three pieces are then clamped together to insure a proper seal, thus creating a small scale working model of the lung.

### Lavage

A lavage is a very uncomfortable diagnostic procedure in which a fiber optic scope is inserted down the throat and into the lung of the patient. Sterile water is injected into the lung. The sterile water is then removed and contains secretions, cells, and proteins that can be further analyzed. This test is very painful and needs to be improved.

### Motivation

Asthma is one of the most common obstructive airway diseases. The number of victims affected by this disorder is rapidly increasing, and the need for a cure is long overdue. This disease is a result of the lung having an exaggerated immune response and hyper-inflammation induced by various antagonists (allergens, pollutants, exercise). Research focuses on three cells found in the lung tissue; the endothelial cells lining the blood vessels, the epithelial cells lining the air sacs, and white blood cells that migrate in from the blood to the lung in response to the presence of an invader. The type of white blood cell that causes the exaggerated immune response in asthmatics seems to be the eosinophil. Within the lungs of those suffering from asthma and other lung diseases the number of eosinophils covering the endothelial tissue is much higher than for normal individuals, and this number increases greatly during attacks. The epithelial and endothelial cells have different functions. The endothelial cells have gaps and tight junctions, which allow specific white blood cells to migrate through them and attack foreign materials. The epithelial cells lining the inside of the lung have cilia, which are small hair-like projections that slow up invading antigens allowing the immune system to attack the invaders. In an allergic response the allergens contact epithelial cells, which release histamines. These histamines cause endothelium cells to secrete protein that promotes eosinophils to attach to problem areas. The affect these cells have on the endothelium and epithelium is very important to allergy research. Scientists feel that they will be able to investigate the correlation between asthma and the higher levels of eosinophils.

### **Design Criteria**

- The device must allow for growth of epithelial cell in the correct orientation.
- The device must allow for blood flow over endothelial cells as well as allow for the proper growth of endothelial cells.
- The device must create an airtight seal around epithelial cells.
- The device must be made of materials that are currently being implemented in similar testing procedures.
- The matrix/interstitial fluid should consist of a minimum of .1 to .5 ml or 100 to 200 micro liters.
- The most important feature is that the matrix must be accessible; otherwise it is impossible to view exactly what goes on during an asthmatic/allergic reaction.
- The device must be able to withstand repeated use for non-disposable components.
- The device must be able to withstand repeated handling by technician as well as varying blood flow.
- The device should be sterile and easy to clean.
- The device should be durable enough to last through the period of the growth of the lung tissue (~3 weeks), and also the time required to perform analysis of the system (~24-48 hours).
- The device should contain filters made of polycarbonate and use polyethylene for the remaining components.

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