# Esophageal Stricture Compliance Measuring Device

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## ABSTRACT

We created a device that measures the compliance of esophageal strictures by measuring pressure of the strictures against the dilation balloon and the volume of liquid inside the balloon. LabVIEW displays a real time pressure vs. volume graph from which compliance can be measured. We tested the device on several mock esophagi of various sizes.

## PROBLEM STATEMENT

Develop a device that can measure the compliance of esophageal strictures. Then test the device on mock esophagi to determine a relationship between curve shape and esophageal thickness and configure the device to work with a hospital laptop.

## BACKGROUND

Esophageal strictures occur in the lower esophagus just above the cardiac sphincter. The main cause of strictures is acid reflux disease and eosinophilic esophagitis but they can also be caused by cancer and genetics. Larger strictures cause the opening of the esophagus to shrink, making it difficult to swallow.

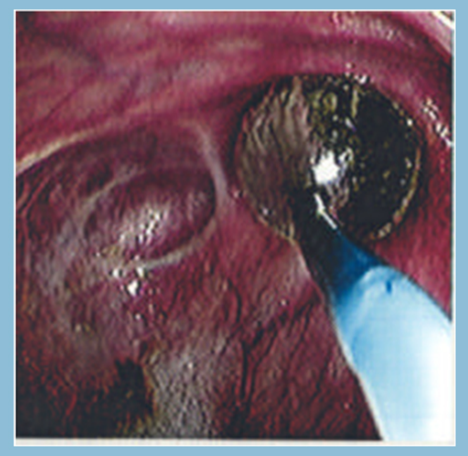

Figure 1: A balloon dilation of an esophageal stricture.

Figure 2: A dilated esophageal stricture.

## DESIGN CRITERIA

- The device must work with the current method of dilation and measure the volume of saline and the pressure within the balloon.
- The device must display the graph in real time and be able to be viewed during the procedure.
- The device must be equipped for hospital use by being compatible with hospital laptop.

## DEVICE SETUP

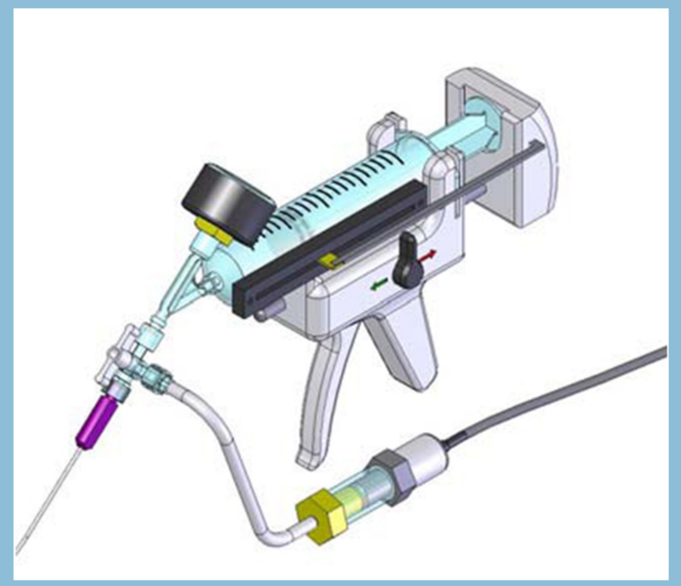

Figure 3: The current setup consists of a syringe gun with a linear potentiometer attached to its side to measure the change in volume. A pressure transducer attaches at a T -joint to measure the pressure in the balloon

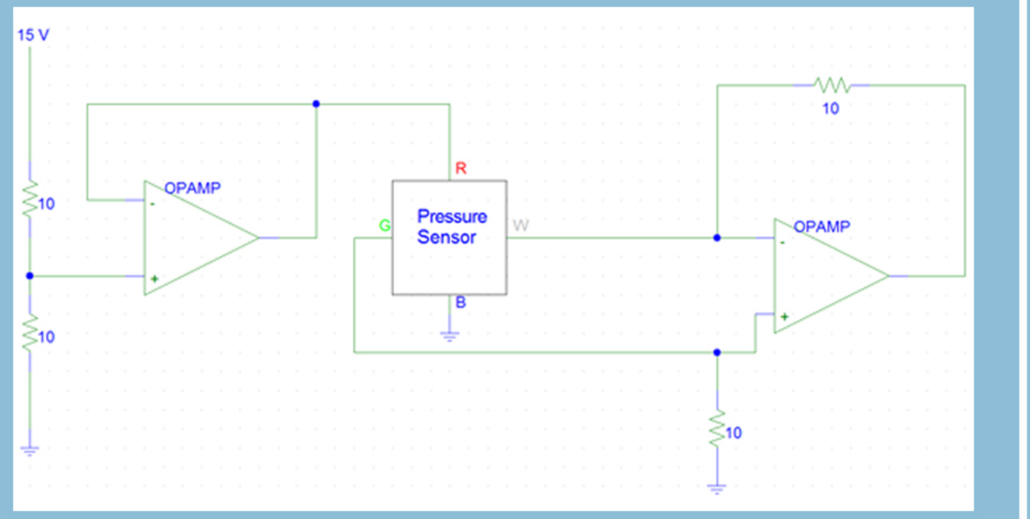


Figure 5: The circuit used to amplify the pressure sensor output voltage.

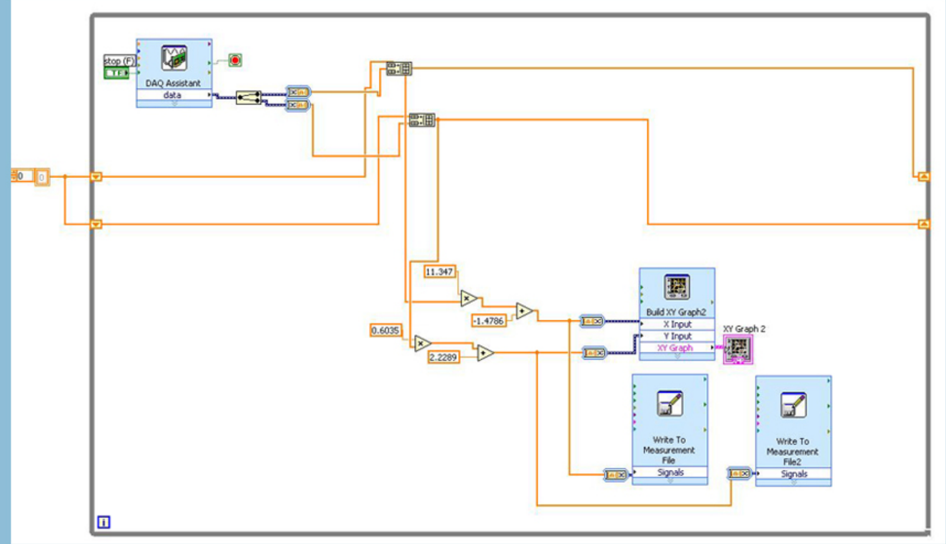

Figure 4: The LabVIEW program used to acquire the voltage data, convert to units of pressure and volume and display a real time compliance graph.

Figure 6: The eight liquid latex esophagi constructed for testing the device.

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## TESTING

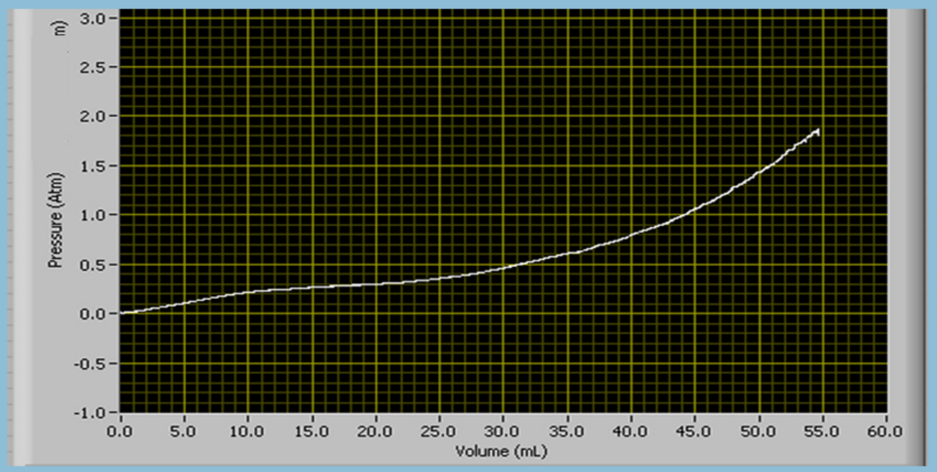

Figure 7: The compliance graph made with LabVIEW. The x-axis is calibrated in milliliters and the y-axis is calibrated in atm. Pressure was applied to the balloon causing it to inflate.

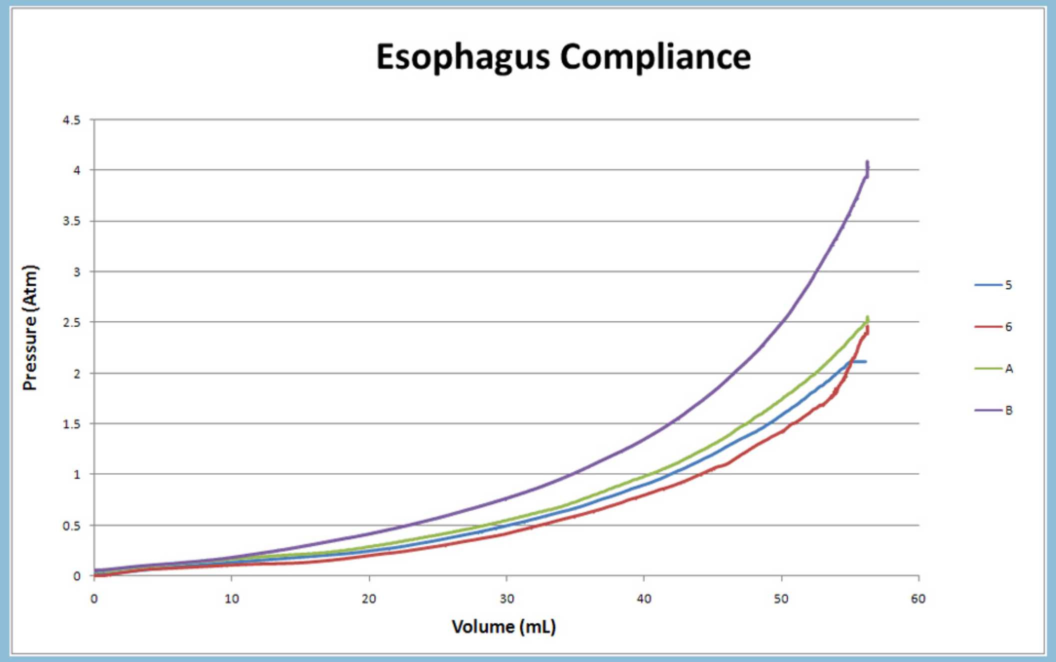


Figure 8: Compliance data from esophagi 5,6, A and B. Esophagus 5 had a thickness of 1.21 mm and diameter 15.02mm, esophagus 6 had a thickness of 0.94 mm and diameter 20.28mm, esophagus A had a thickness of 1.58 mm and diameter 16.05 mm, and esophagus B had a thickness of 1.02 mm and diameter 8.21 mm.

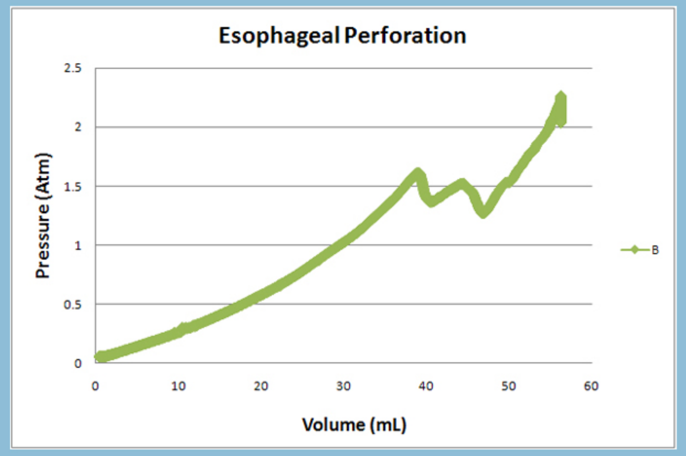


Figure 9: The graph shows the perforation of esophagus B. The drops in pressure represent tears in the esophagus.

## FUTURE WORK

- Obtain pressure sensor with 10 atm range
- Configure with A/D converter
- Contain pressure sensor and power supply in compact form for hospital setting
- Configure perforation alarm after testing
- Begin testing on animals and humans