INTRODUCTION

Asthma is a chronic respiratory condition characterized by reversible airway obstruction, inflammation, and hyperactivity of the airways to various stimuli. The mechanics of individual airways, such as pressure-area relationships and compliance, are important because they integrate to affect the overall lung function.

RATIONALE

Past Work on Isolated Airways and ASM
- Previous studies have examined the static pressure-area relationships of isolated airways.
- Dynamic length cycling of ASM causes it to remodel so as to generate less force than when held at a static length.

• Breathing is a dynamic process
  - An isolated airway with intact ASM examined dynamically will produce pressure-area relationships that more accurately represent the impact of breathing on wall mechanics.

SPECIFIC AIMS

- To develop a system to study the dynamic properties of isolated airways with intact ASM.
- The system must be:
  - User-friendly
  - Computer-controlled
  - Adaptable, in order to produce different breathing patterns

SYSTEM OVERVIEW

- The system functions as follows:
  1. A computer-controlled stepper motor drives a syringe pump
  2. The syringe pump delivers solution into the isolated airway
  3. The height of the pressure column determines the pressure of the Kohn solution that is delivered into the isolated airway
  4. The pressure and flow going into the isolated airway are measured

SOFTWARE

- Program 1 – Creating Desired Pressure Waveform
  - Allows user to make a desired sinusoidal pressure waveform to simulate breathing
  - 5 to 10 cmH2O for normal breaths; 5 to 25 cmH2O for deep inspirations
  - Translates waveform into a corresponding pulse train and step function that drives the stepper motor

- Program 2 – Outputting Waveform and Collecting Data from Transducers
  - Outputs pulse train and step function to stepper motor driver
  - Collects and records flow and pressure data from transducers

HARDWARE

- The side and top view of the system show (from left to right): the stepper motor, the gear and gear rack, the 50cc syringe, the pressure column, and the organ bath.

INITIAL TESTING

- Initial testing has shown that the pressures delivered past the pressure column are sinusoidal and oscillate in the correct range.
- Some noise is present due to the stepping of the stepper motor.

PROJECT END GOAL

- Perform experiments using airways excised from calf lungs
- Using the sampled pressure and flow data, determine the following relationships for pre- and post-activated ASM:
  - Transmural Pressure and Cross-sectional Area
  - Transmural Pressure and Compliance

REFERENCES


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