Case Study: Chronic Pleural Pressure Measurement

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Summary: Previous attempts to measure pleural pressure chronically have involved direct access to the pleural cavity resulting in lung damage or signal dampening due to tissue growth and encapsulation. A novel procedure using a fluid filled catheter attached under the serosal layer of the esophagus enabled chronic pleural pressure measurement. Comparison of pressure values from intrapleural catheter and subpleural telemetry measurements demonstrated accurate and proportionate changes. Furthermore, subpleural telemetry provided consistent pressure measurements for 14 weeks, without loss of signal, lung damage, or catheter tip encapsulation.

Introduction

Pleural pressures are used to evaluate lung function, but have generally been measured acutely and only in anesthetized models [Costa 1985, Murphy 1994]. These direct methods usually involved insertion of a pressure-sensitive probe into the pleural cavity, invariably causing lung damage, and with little potential for chronic measurement. Previous studies indicate that esophageal pressure changes within the thoracic cavity accurately emulate pleural pressure changes [Palecek 1969, Gillespie 1973, Koo 1976].

A study was conducted to determine whether it would be possible to chronically catheterize and measure *subpleural* pressure using a method that would address the problems of lung damage, tissue growth and catheter tip encapsulation, and accompanying signal loss. These measurements would be compared to direct intrapleural measurements to assess the relative quality of signal.

Novel Placement, Novel Transmitter

A fluid-filled catheter was inserted by threading it through a needle channel between the serosal and muscularis layers of the esophagus (Fig. 1). When continuous monitoring indicated that maximal pressure changes were attained, the catheter was secured. The transmitter (Model TA11PA-C40, Data Sciences International, Saint Paul, MN USA) was secured to the abdominal wall during closure and the animal was allowed to recover.

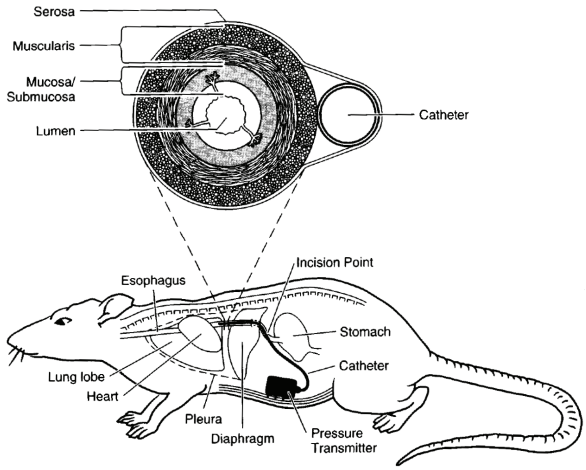

Figure 1: Schematic showing subpleural catheter placement and position of the telemetry transmitter. Cross-section shows catheter placement between serosal and muscularis layers.

Subpleural Pressure Validated

A comparison of data obtained simultaneously using intrapleural catheters and subpleural telemetry demonstrated that subpleural pressure measurements (Fig. 2) are accurate and change in proportion to values obtained directly over a range of -3 to -34 cm H_2O. Furthermore, pressure changes remained constant over 14 study weeks with no loss of signal, tissue growth, or catheter encapsulation.

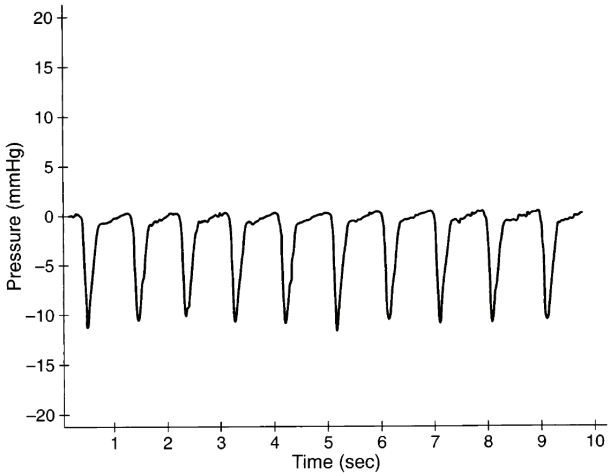

Figure 2: A tracing showing typical subpleural pressure changes in a conscious, unrestrained rat.

Case Study: Chronic Pleural Rat Pressure Measurement

For one rat whose catheter was later confirmed to have penetrated into the pleural cavity, the pressure signal was reduced by over 50% during study weeks 4-14, confirming that chronic insertion of a catheter into the pleural cavity will result in signal loss and tip encapsulation.

Discussion

This novel placement and transmitter provides unique monitoring conditions:

- Chronic data acquisition
- Unrestrained and conscious animals
- Long durations (weeks rather than days)

Subpleural telemetry may be used to chronically monitor breathing rates or airflow obstruction; or when combined with a plethysmograph chamber or a face mask and pneumotachometer these data may be used to chronically monitor changes in lung compliance and airflow resistance—two critical parameters in the assessment of lung function.

About the DSI Telemetry

Founded in 1984, Data Sciences International (DSI) pioneered the use of wireless implantable monitors for collecting physiologic data to become the global leader in implantable telemetry systems. DSI plays an important role in establishing the safety of new pharmaceuticals by providing accurate and reliable blood pressure, ECG, EEG, temperature, and activity measurements from animals used to study the effects of these compounds.

Our implantable wireless monitoring devices provide the most humane approach to monitoring laboratory animals for drug safety research. In addition, animal welfare researchers have shown that DSI's technology can reduce the number of animals used in research by as much as 90%.

To learn more about DSI, or to discuss how DSI telemetry can provide a solution for your research needs, contact your local DSI representative or visit our Web site.

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