Digital Ultrasonic Measurement System

RESPIRATORY SUMMARY

WHY USE SONOMICROMETRY FOR RESPIRATORY STUDIES?

It has been stated that a certain "technique can provide an answer to many questions in respiratory muscle mechanics, which until this time have been unsolvable." [1] The technique being referenced is sonomicrometry which allows researchers to accurately obtain respiratory muscle function real-time and *in vivo* enabling the design of a more physiologically relevant experiment. Although sonomicrometry dates back to the late 1960's, the technique was used almost exclusively to study cardiac function in large animals by measuring ventricular and myocardial diameters. By improving key elements of transducer and electronic design, Sonometrics Corporation has opened the door to a broader group of applications including those in the Biological Sciences.

Sonomicrometry utilizes piezoelectric transducers (commonly called "crystals") to measure distances within an aqueous medium. These crystals are sequentially energized at high repetition rates, generating waves of ultrasound that travel at known velocities in biological tissue. Distances between the networked crystals are calculated by the time taken for a wave to travel between an acting transmitter and its corresponding receivers. Crystals manufactured by Sonometrics Corporation are unique in that they act as both transmitters and receivers and can send and receive signals in all directions. This eliminates the need to align crystals to ensure satisfactory signals and allows for the acquisition of more data with fewer transducers.

With the validation of sonomicrometry for respiratory muscle studies[1;2], there has been a growing number of scientific literature using this versatile technology. Sonomicrometry has been used to study a variety of respiratory muscles including crural and costal[1;3-10], transverses abdominis[7] and intercostal muscles[2;11] in a variety of models including canines[1;5-11], sheep[3], rats[2] and human[4]. Studies have also been carried out to investigate the effects of thoracotomy surgical techniques[3] and thoracic epidural protocols[4] on diaphragmatic function. Finally, sonomicrometry can also be used to study respiratory muscle activity during different breathing environments including exercise[7], stimulated breathing after epiphrenic stimulation, occluded breaths[6], mechanical vibration of the rib cage to reduce dyspnea[11], effects of vagal input[9], hemidiaphragm paralysis[10] and chemical stimuli including drugs or progressive hypoxia or hypercapnia[8]. Indeed, sonomicrometry has proven to be an indispensable tool for studying respiratory mechanics.

Alternative methods to study respiratory mechanics include radiopaque markers[12;13], ultrasound[14] and barometric plethysmography[2]. Radiopaque markers viewed with a biplane video-fluoroscopic images for measuring changes muscle lengths involve complex post-processing to create the qualitative image and subsequent quantitative data. Ultrasound and barometric plethysmography can be difficult to perform for chronic studies especially on instrumented animals that may be agitated with thoracic wraps. Also 2D ultrasound images may be difficult to decipher the diaphragm from noise while manually measuring the diaphragm thickness. Sonometrics offers an accurate, and inexpensive method to digitally measure changes in muscle length, respiratory rate and diaphragm thickness.

The Sonometrics digital sonomicrometry system provides an affordable and exciting technique to measure real-time dimensional data that is accurate and reliable. Systems can be configured to acquire, view and analyze all research data simultaneously such as EMG, pressure, tidal volume and force recordings. Our products are often used as a central piece of equipment in research lab. Please contact us today, to find out how Sonometrics can help you achieve enhance the quality of your research.

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