Digital Ultrasonic Measurement System

GASTROINTESTINAL SUMMARY

WHY USE SONOMICROMETRY TO STUDY THE GASTROINTESTINAL SYSTEM ?

The gastrointestinal (GI) tract is a sophisticated physiological system comprising of a complex muscle architecture and enteric nervous system. A large proportion of the GI's function is mechanical in nature thus investigators have attempted to quantify GI physiology using biomechanical parameters analogous to cardiac muscle studies. The goal of these parameters is to provide quantitative assessment of distensibility and include compliance and tone. Intestinal compliance can be defined as the ratio of change in diameter versus change in transmural pressure. Tone is defined by the luminal cross-sectional area (CSA), or more specifically, by the sustained reduction in CSA during a contraction episode. Values of compliance and tone are often derived from pressure-volume curves which can be generated with luminal balloons or bolus injections.

While these methods have provided valuable information regarding GI function, certain limitations have raised doubts as to their accuracy and applicability. For example, in order for a luminal balloon to accurately measure CSA in the intestine, the entire circumference must be in contact with the tissue. This obstacle is also present when using balloons for volume measurements in the stomach and intestines. Another limitation of balloons is that they tend to elongate due to their own resistance to deformation. All these can lead to erroneous measurements in CSA, volume, wall tension or compliance. A further consequence of using balloons is the geometric assumption that the intestinal tube is circular or that the stomach is spherical when in actuality they are elliptical, especially at lower pressures. Therefore, unless proper geometry is considered, the measurement of compliance or tone with balloons in the GI tract is more qualitative in nature. Pressure transducers can also be used quantify GI motility, however regional inferences may be difficult since contractions in one area of the GI can manifest pressure changes in another area.

Geometric measurements such as volume, diameter and cross-sectional area in the GI can be made accurately using sonomicrometry, a technique utilizing piezoelectric crystals to measure distances within a biologic medium. These crystals transmit and receive waves of ultrasound that travel at known velocities. Distances between crystals are then calculated based on the time taken for a wave to travel between a transmitting crystal and its corresponding receiver. Our Sonometrics digital sonomicrometer provides many benefits to the investigator carrying out gastrointestinal research. First, our crystals (up to 32) can be placed anywhere along the GI tract, from the esophagus to the colon. Crystal attachment is quick and easy and requires neither an oscilloscope nor cumbersome calibrations; a constant source of measurement error. Placement of our crystals along the GI tract enables the researcher to quantify and qualify, in real time, peristaltic and segmentation contractions in the stomach or intestines. Positioning of our crystals around the circumference of the intestine or stomach allows diameter, CSA and volume measurements to be made accurately. More importantly, our crystals are not influenced by phasic contractions or mechanical loads generated in the GI tract that have been known to impair lumen balloons. Furthermore, our sonomicrometer and unique crystals can be used in any laboratory setting. Experiments can be performed in the acute or chronic time frames, either in vivo or in the isolated tissue preparation. And since our sonomicrometer is part of a data acquisition system, investigators can design multi-instrumented experiments and collect and analyze data incorporating pressure catheters, force transducers or electromyography devices.

Wall thickness and regional segment length can also be determined using sonomicrometry. Our Sonometrics digital sonomicrometer system provides an affordable, high resolution (15 μM) method of quantifying wall thickness and segment length in real time. Furthermore, no post-imaging analysis associated with echography or video imaging is required since measurements are made in millimeter distances. More importantly, the same crystals used to make volume and CSA measurements can also be used to make simultaneous wall thickness and segmental shortening measurements. Thus, our sonomicrometer can provide collateral evaluation of lumenal volume/dimension and wall thickness, another

important index of GI performance and compliance. As with the compliance and CSA analysis, our software is also equipped to execute calculations involving wall thickness and segment length measurements. Altogether, our Sonometrics digital sonomicrometer and software system provides the investigator with the means of performing a thorough examination of gastrointestinal function.

Whatever your research needs might be, our Sonometrics digital sonomicrometer and software provides the investigator with the necessary tools to fulfill their investigative objectives, whether you are involved in pharmacological studies, or physiological or pathological animal model development or post-ectomy evaluations. From acute large animal studies to chronic transgenic models, our sonomicrometer can become a valuable component of your research laboratory. Furthermore, our hardware and software can be customized to meet any unique needs your research may require. Contact us today, to find out further how Sonometrics can help you achieve a new level of research excellence.

REFERENCES

GastroIntestinal Function and Sonomicrometry

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