Title: A model-based approach for tissue characterization of the uterine cervix using ultrasonic backscatter

Abstract

Despite significant efforts from worldwide organizations, preterm birth remains a major causal factor of neonatal morbidity and mortality. While etiologies are thought to vary among patients, spontaneous preterm birth involves premature remodeling and dilation of the cervix. Previous works have focused extensively on investigating how the extracellular matrix, and more specifically collagen, remodels and influences biomechanical properties (e.g., cervical stiffness) as a means of defining the normal changes this tissue undergoes during pregnancy. However, a growing body of evidence suggests smooth muscle forms a cervical sphincter and preterm birth may be resultant from this sphincter failing. Our group has extensively investigated the utility of parameters like shear wave speed to provide objective measures of tissue stiffness and demonstrated shear wave speed is promising for cervical assessment. However, these tools do not answer the question as to why the cervix progressively changes in terms of its stiffness throughout gestation. To elucidate additional information, this dissertation investigates the utility of backscatter coefficient parameters to characterize cervical microstructure in humans and a non-human primate model, as these parameters have been demonstrated to directly quantify features of the acoustic impedance distribution in a variety of tissues. Specifically, these parameters were used to assess their spatial and biological variability in *ex vivo* specimens, their temporal dependence as a function of gestational age, and their ability to quantify smooth muscle activity. These results highlight both promise and challenges of these potential imaging biomarkers to quantify cervical microstructure. Ultimately, this work provides foundations for use of these parameters for longitudinal *in vivo* monitoring.