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Augment clinical measurement using a constraint-based esophageal model[1] WENJUN KOU, Feinberg School of Medicine, Northwestern University, SHASHANK ACHARYA, Mechanical Engineering, Northwestern University, PETER KAHRILAS, Feinberg School of Medicine, Northwestern University, NEELESH PATANKAR, Mechanical Engineering, Northwestern University, JOHN PANDOLFINO, Feinberg School of Medicine, Northwestern University — Quantifying the mechanical properties of the esophageal wall is crucial to understanding impairments of trans-esophageal flow characteristic of several esophageal diseases. However, these data are unavailable owing to technological limitations of current clinical diagnostic instruments that instead display esophageal luminal cross sectional area based on intraluminal impedance change. In this work, we developed an esophageal model to predict bolus flow and the wall property based on clinical measurements. The model used the constraint-based immersed-boundary method developed previously by our group. Specifically, we first approximate the time-dependent wall geometry based on impedance planimetry data on luminal cross sectional area. We then fed these along with pressure data into the model and computed wall tension based on simulated pressure and flow fields, and the material property based on the strain-stress relationship. As examples, we applied this model to augment FLIP (Functional Luminal Imaging Probe) measurements in three clinical cases: a normal subject, achalasia, and eosinophilic esophagitis (EoE). Our findings suggest that the wall stiffness was greatest in the EoE case, followed by the achalasia case, and then the normal.

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