Abstract Submitted
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A fully resolved fluid-structure-muscle-activation model for esophageal transport[1] WENJUN KOU, Theoretical and Applied Mechanics Program, Northwestern University, AMNEET P.S. BHALLA, Department of Mechanical Engineering, Northwestern University, BOYCE E. GRIFFITH, Leon H. Charney Division of Cardiology, Department of Medicine, New York University School of Medicine, MARK JOHNSON, Department of Biomedical Engineering, Northwestern University, NEELESH A. PATANKAR, Department of Mechanical Engineering, Northwestern University — Esophageal transport is a mechanical and physiological process that transfers the ingested food bolus from the pharynx to the stomach through a multi-layered esophageal tube. The process involves interactions between the bolus, esophageal wall composed of mucosal, circular muscle (CM) and longitudinal muscle (LM) layers, and neurally coordinated muscle activation including CM contraction and LM shortening. In this work, we present a 3D fully-resolved model of esophageal transport based on the immersed boundary method. The model describes the bolus as a Newtonian fluid, the esophageal wall as a multi-layered elastic tube represented by springs and beams, and the muscle activation as a traveling wave of sequential actuation/relaxation of muscle fibers, represented by springs with dynamic rest lengths. Results on intraluminal pressure profile and bolus shape will be shown, which are qualitatively consistent with experimental observations. Effects of activating CM contraction only, LM shortening only or both, for the bolus transport, are studied. A comparison among them can help to identify the role of each type of muscle activation.

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