Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

A fully coupled bolus-esophageal-gastric model for esophageal emptying based on the immersed boundary method[1] WENJUN KOU, Theoretical and Applied Mechanics, Northwestern University, JOHN E. PANDOLFINO, PETER J. KAHRILAS, Feinberg School of Medicine, Northwestern University, NEELESH A. PATANKAR, Department of Mechanical Engineering, Northwestern University — In this work, we develop a fully coupled bolus-esophageal-gastric model to study esophageal emptying based on the immersed boundary method. The model includes an esophageal segment, an ellipsoid-shaped stomach, and a bolus. It can easily handle the passive and active function of the lower esophageal sphincter (LES). Two groups of case studies are presented. The first group is about the influence from tissue anisotropy. Simulation shows that the weaker (or more compliant) part suffers from a higher wall shear stress and higher pressure load when the bolus is filled in and emptied from the LES segment. This implies a degradation cycle in which a weaker tissue becomes much weaker due to an increased load, a possible pathway to the esophageal lower diverticulum. The second group is about bulge formation resulting from asymmetric anatomy and a compliant LES. In particular, we find a right bulge tends to develop for a compliant LES. The bulge is most pronounced with a highest stiffness of the gastric wall. This implies that the competition between the LES stiffness and gastric wall stiffness might be another factor related to the esophageal lower diverticulum.

[1]The support of grant R01 DK56033 and R01 DK079902 from NIH is gratefully acknowledged.

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Date submitted: 22 Jul 2016 Electronic form version 1.4