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COMPUTER SIMULATION OF COLONIC PROPULSIVE ACTIVITY

Omar Alqatrawi and **R N Miftahof**
Arabian Gulf University, Bahrain

The primary functions of the large intestine (colon) are to store, process and expel fecal mass residues. These require sustained motor activity in the organ which is used for the generation of migrating myoelectrical complexes (MMC) in order to mix and propel the content. The aim of this research is to find an effective way to treat patients with constipation or diarrhea. The mathematical model of a segment of the gut with an enclosed bolus was constructed. The colon was represented as a thin deformable soft biological shell with the bolus modeled as a non-deformable solid sphere. The bolus in motion was subjected to dry and viscous friction, and the inertia forces were neglected. The results of simulations of movement patterns resembled those recorded experimentally and provided quantitative insights into the spatio-temporal patterns of changes in configuration, the distribution of contact forces over the bolus, and predicted the average velocity of colonic transit. Thus, a reciprocal relationship in the contraction of the longitudinal and circular smooth muscle was necessary to guarantee the "mixing" type of movements. Strong conjoint contractions of both muscle layers were necessary to expel the bolus from the gut. The dynamics of stress-strain distribution, demonstrated the rise in the intensity of active propulsive forces in the circular smooth muscle layer throughout the entire phase of propulsion of the bolus. Viscous, compared to dry friction had a marked effect on the average velocity of colon transit. Thus, the addition of osmotic (lactulose, sorbitol) and rapidly acting lubricant (mineral oil) laxatives, intraluminally shortened the time required for expulsion of the bolus significantly. The mathematical model of a segment of the gut reproduces qualitatively and quantitatively the dynamics of colonic transit. Viscous and not dry friction is the dominating parameter in the stability of propulsion.

alqatrawiomar@gmail.com