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Extended Abstract

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Computer simulation of colonic propulsive activity

Omar Alqatrawi
Arabian Gulf University, Bahrain
E-mail: alqatrawiomar@gmail.com

The fundamental features of the large intestine (colon) are to store, system and expel fecal mass residues. These require sustained motor pastime in the organ which is used for the era of migrating myoelectrical complexes (MMC) in order to mix and propel the content. The aim of this lookup is to discover an superb way to deal with patients with constipation or diarrhea. The mathematical model of a phase of the intestine with an enclosed bolus was once constructed. The colon used to be represented as a thin deformable smooth organic shell with the bolus modeled as a non-deformable stable sphere. The bolus in action was once subjected to dry and viscous friction, and the inertia forces had been neglected. The results of simulations of motion patterns resembled these recorded experimentally and furnished quantitative insights into the spatio-temporal patterns of modifications in configuration, the distribution of contact forces over the bolus, and estimated the average speed of colonic transit. Thus, a reciprocal relationship in the contraction of the longitudinal and circular clean muscle was necessary to assurance the "mixing" kind of movements. Strong conjoint contractions of both muscle layers were critical to expel the bolus from the gut. The dynamics of stress-strain distribution, proven the rise in the depth of lively propulsive forces in the circular smooth muscle layer throughout the whole phase of propulsion of the bolus. Viscous, in contrast to dry friction had a marked effect on the average velocity of colon transit. Thus, the addition of osmotic (lactulose, sorbitol) and rapidly performing lubricant (mineral oil) laxatives, intraluminally shortened the time required for expulsion of the bolus significantly. The mathematical model of a section of the gut reproduces qualitatively and quantitatively the dynamics of colonic transit. Viscous and now not dry friction is the dominating parameter in the steadiness of propulsion. A biomechanical model and mathematical method of the problem of propulsion of a solid non-deformable pellet through an isolated phase of the colon are presented. The organ is modeled as a smooth orthotropic cylindrical organic shell. Its wall is reinforced by transversely isotropic muscle fibers of orthogonal type of weaving embedded in a connective tissue stroma. The mechanical homes of the wall are assumed to be nonlinear, deformations are finite. The longitudinal and circular easy muscle syncitia possesses electrical homes and are beneath manage of a pacemaker, which is represented via the interstitial mobilephone of Cajal. The mannequin describes the dynamics of the technology and propagation of the mechanical waves of contraction–relaxation along the floor of the bioshell and propulsion of the pellet. The governing system of equations has been solved numerically. The blended finite-difference and finite-element approach has been used. The results of numerical experiments exhibit that pendular moves by myself furnish a ordinary transit, without mixing though, of the bolus. Non-propagating segmental contractions exhibit small amplitude librations of the pellet besides its seen propulsion. Only the coordinated pastime of the longitudinal and circular clean muscle layers in a structure of the peristaltic reflex presents physiologically substantial simultaneous propulsion and mixing of the intraluminal content. The foremost features of the giant intestine (colon) are to store, process and expel fecal mass residues. These require sustained motor undertaking – the technology of migrating myoelectrical complexes (MMC) that mix and propel the content. Patterns of MMCs produced via the colon below regular physiological conditions are associated with non-propagating and excessive amplitude propagating mass movements. They take place commonly and assist to push the bulky content beforehand of them. The disparity between mechanical and propulsive activities triggered by using anatomical and/or neuropathological changes in the colon, e.g. Hirschpurg' disease, irritable bowel syndrome, result in idiopathic/slow transit constipation, obstructed defecation or diarrhea. The severity and diversity of clinical symptomatology, relative inaccessibility and the complexities posed by means of the presence of solid or semi-solid fecal masses, along with the heterogeneity of in vitro experimental findings, makes it hard to unravel underlying pathophysiological mechanisms and thus design superb treatments. At the initial moment of time, the whole system is in the resting state. It is supposed that the left and right boundaries of the tube are rigidly fixed. Discharges of the pacemaker cell trigger contractions in smooth muscle. When the maximum of the total force in the longitudinal muscle layer is achieved, contraction of the circular muscle layer starts. The complete activation of the circular muscle layer begins as the maximum of the total force in the longitudinal muscle layer is accomplished. The right boundary of the tubular segment remains in the resting state throughout.

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