

# APPLIED ANATOMY AND PHYSIOLOGY

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The intestine must subserve basic functions of moving contents from proximal to distal in a rhythmical fashion to allow mixing, digestion and absorption of contents. The motility of the intestine has been studied for more than a century and all readers should know of the seminal experiments of Bayliss and Starling in their 1899 paper 'The movements and innervation of the small intestine', which led to adoption of the term 'peristalsis'. In the small intestine, fasting motility can be described by the three phases of the migrating motor complex (MMC), with fed activity resembling phase II. Colonic motility is much more complicated and still poorly understood with some features akin to the MMC but also specific phenomena such as retrograde movements (presumed to allow greater resident time and therefore fluid and electrolyte absorption). The main characteristics of intestinal motility are shown in Table 73.1. The intestine, like the heart, is autonomous in generating its own rhythmical electrical, and therefore local motor, activity by intrinsic pacemaker activity generated by small fibroblast-like cells called the interstitial cells of Cajal. These cells, which are mainly resident within the muscularis propria, have several key functions, including setting the membrane potential of smooth muscle cells so that they are primed to contract and connecting smooth muscle cells electrically so that synchronous contractions can occur. The management of common chronic disorders that present to surgeons such as chronic constipation and irritable bowel syndrome. The existence of several rare neuromuscular diseases that may affect the intestine. The limited role of surgery in the treatment of most of these disorders is affected by a hierarchy of external control systems but mainly by the enteric nervous system (ENS) via the myenteric plexus. The myenteric plexus is one of the two intramural plexuses of the

TABLE 73.1 Contractile activity of the intestine. Region Broad category Small intestine Phase I Quiescence (40–60% of total time) Phase II High-frequency contractions allowing mixing and absorption (20–30% of total time) Phase III High-amplitude propagated activity (5–10 minutes) Large intestine Phasic contractions Low-amplitude propagated pressure waves High-amplitude propagated pressure waves Retrograde pressure waves Simultaneous pressure waves Periodic colonic and rectal motor activity (localised bursts) Tonic contractions Sustained activity responsible for tone a Most akin to phase III of the migrating motor complex and responsible for mass movements of faecal content. The management of common chronic disorders that • present to surgeons such as chronic constipation and irritable bowel syndrome The existence of several rare neuromuscular diseases that • may affect the intestine The limited role of surgery in the treatment of most of • these disorders a

affected by a hierarchy of external control systems but mainly by the enteric nervous system (ENS) via the myenteric plexus. The myenteric plexus is one of the two intramural plexuses of the

ENS (the other being the submucosal plexus). The former has the major role in motor functions while the latter has roles in sensing, mucosal blood flow regulation and secretion. Both are composed of small groups of enteric neurones that congregate with glial cells to form ganglia, these being Summary box 73.1 Regulation of intestinal contractile activity /uni25CF /uni25CF /uni25CF /uni25CF /uni25CF The rectum constitutes a final and specialised end to the intestine. Its role is mainly for temporary storage of faeces prior to defecation. This role permits both further water absorption and the ability of higher mammals to socially defecate (an ability shared with small rodents as well as many larger species). To this end, the wall of the rectum is specialised in terms of compliance and of having nerve endings that provide conscious perception of filling. In concert with the upper anal The ENS has a neurochemical complexity and number of neurones (five times the number in the spinal cord) that has led to it being called the 'little brain' ( Summary box 73.1 ). Thus, although higher control mechanisms including the autonomic nervous system (ANS) and brain allow the intestinal motility to respond to wider environmental cues, e.g. waking, exercise, the smell and taste of food and stress, the intestine can initiate and sustain peristalsis without any external inputs. canal, the rectum is also capable of distinguishing solid, liquid and gas by the 'sampling' reflex. Together the act of defecation requires complex neuromuscular functions and it is no surprise that it goes wrong with sufficient regularity to cause much human misery in the form of constipation and incontinence (see Chapter 80 ).

Longitudinal muscle Mucosa Figure 73.1 Schematic diagram of the enteric nervous system. SMP , submucosal plexus. (Reproduced by permission from Springer Nature. Furness JB. The enteric nervous system and neurogastroenterology. *Hepatology* 2012; 9 : 286-94. © 2012.) Myogenic control mechanisms Interstitial cells of Cajal generating slow wave activity Neurogenic control mechanisms ENS (a variety of cells in myenteric and submucosal ganglia) ANS (sympathetic and parasympathetic mainly via ENS ganglia) Central nervous system (CNS) (brain-gut interactions) Chemical control mechanisms Local paracrine (especially from mucosal enteroendocrine cells) Endocrine Myenteric plexus Circular muscle Deep muscular plexus Outer SMP Inner SMP Submucosal artery Muscularis mucosae *Nat Rev Gastroenterol*

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