ANATOMY AND PHYSIOLOGY OF THE COLON, RECTUM, AND ANUS

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Anatomy

The large bowel.

Blood supply and lymphatic drainage.

Venous drainage.

The large bowel is a closed receptacle, 1.5 m long, with an ileocaecal valve at its cephalad end, which prevents reflux, and the dentate line of the anus at the caudad end. While the transverse colon always has a mesentery, the ascending colon has a mesentery in only 12% of people and the descending colon has one in 22%. The sigmoid colon also has a mesentery and is sometimes unusually long (dolico-colon)—a feature which facilitates torsion or volvulus.

Blood supply to the colon

The blood supply to the right colon as far as the distal transverse colon is through the superior mesenteric artery and then by the inferior mesenteric artery, which anastomoses with the pudendal vessels to a minor degree in the anal canal. Arterial disease of the aorta may often narrow or even occlude the mesenteric arteries, particularly the inferior mesenteric artery, in which event the circulation is continued by the anastomosis near the gut wall—the so called marginal artery. Of the smaller arteries, those of the transverse colon seem especially liable to atherosclerosis.

The venous drainage from the right colon is predominantly to the right hepatic lobe and from the rectum and left colon to the left hepatic lobe owing to the “streaming” of blood in the portal vein. The lymphatic vessels pass along the respective arteries to the para-aortic glands, with smaller glands located on the colonic wall and midway between this and the aorta.

Nerve supply to the colon

The nerve supply of the smooth muscle fibres, themselves in direct communication with each other by gap junctions, consists of an intramural plexus with connections from the extrinsic nerves. The sympathetic components pass from the aortic plexuses along the arteries. These nerves carry inhibitory impulses mediated through α , β , and non- α , and non- β purine receptors. There are possibly also some stimulatory fibres.

Bilateral extensive sympathectomy abolishes visceral pain. The main motor or parasympathetic fibres come from the vagus nerve to the gut supplied by the superior mesenteric artery; more distally the gut receives parasympathetic nerves from the sacral outflow. These sandwich the inferior mesenteric vessels and run up the bowel wall to reach as far as the distal transverse colon.

Anteroposterior (left) and lateral view (right) of rectum and anus.

Functions of the colon

Absorption and secretion in the large bowel. Thicker arrows indicate absorption.

Activity of large bowel.

Intramural autonomic nerve plexus.

Rectum

The rectum, totally sheathed in longitudinal muscle fibres, is continuous with the anal canal, where the external sphincter of voluntary muscle provides an additional sheath. The levator ani sling muscle acutely angles (at 60°-105° in normal subjects) the rectoanal junctions forwards, its nerve supply running on its upper aspect and thereby being liable to damage by inordinate stretching of the muscle—for example, during childbirth.

The colorectum is lined with columnar epithelium as far as the dentate line in the middle of the anal canal, where sensitive squamous epithelium in continuity with that of the perineum takes over. Submucous anal glands may extend deeply into the sphincter, and if infected may lead to perianal abscess and fistula.

The principal functions of the colon include dehydration and storage of ileal effluent to form faeces. Water, electrolytes, and some metabolites are removed by the mucous membrane, which is moved over the luminal content by local and total wall contraction. Potassium is added to the content by mucus secretion. In general, the more the movement, the greater the absorption of fluid; in many cases looseness of stool is associated with relative inactivity of the muscle wall and constipation by excessive contractility.

Although the colon does not show the regularly recurring interdigestive migrating complex of movements which progresses from the oesophagus through the stomach to the terminal ileum, in some subjects contractile activity from the ileum does pass into the ascending colon.

We know that the intrinsic nerve plexus is basically responsible for colorectal contraction because its partial absence in the congenital Hirschsprung's disease, its destruction by trypanosomes in Chagas' disease, and prolonged drug taking—for example, of chlorpromazine or senna—leads to obstruction or severe constipation.

The intrinsic plexus is, however, under the influence of gut hormones and other hormones—for example, cholecystokinin, motilin, vasoactive intestinal peptide, and catecholamines—whose varying circulating concentrations significantly affect the contractile activity. Thus after meals motility rises considerably, perhaps because of cholecystokinin activity, while the extrinsic nervous plexus also has appreciable effect. Sleep greatly reduces colonic activity, which immediately increases on awakening. Mental stress increases contractility. A high fibre diet helps to retain water and increase the faecal bulk, thus aiding defecation.

Drugs

Many drugs have a potent effect on the colon, either by stimulation or inhibition of motor receptors or by similar actions on inhibitory receptors. Thus normal bowel tone may be increased or depressed to produce diarrhoea or functional obstruction. Both reduction of serum potassium concentrations and inhibition by slow calcium channel blockers can have a profound effect on smooth muscle function. There is no evidence that bacterial toxins are responsible for the toxic megacolon syndrome of ulcerative colitis.

Defecation

Intramural autonomic nerve plexus.

Mechanism of defecation.

Factors necessary for anal continence.

The anal canal is slightly shorter in women than men (mean 3.7 cm v 4.6 cm). It has a high pressure zone resulting from tonic contraction of the internal and external sphincters, which is responsible for continence. Voluntary contraction can, however, double this pressure (squeeze pressure).

Anorectal sensation permits discrimination of solids from gas. The rectum is normally empty, and when people awaken and eat breakfast, enhancing left colonic motility, faeces enter the rectum, and the person is called to stool. Sitting on the toilet helps to straighten out the anorectal angle and faeces enter the anal canal, to be passed if the passage is not voluntarily stopped. Further faeces from as far cephalad as the splenic flexure may be passed, the average daily volume being 150 ml.

It is possible to delay expulsion: the rectum can accommodate passively a distension of up to 400 ml, maintaining a low rectal pressure, and faeces may even be propelled back into the sigmoid colon. Chronic tolerance of faeces in the rectum may be associated with severe constipation.

Maintenance of continence is dependent on several major factors:

- An effective barrier to outflow provided by anal sphincters and perhaps an acute anorectal angle
- A capacious, passively distensible and evacuable reservoir
- Intact rectal and anal sensation
- Bulky and firm faeces.

Normally the anus seems to have a cyclic (15 per minute) pattern of contraction, which may assist continence and anal cleanliness by retrograde propulsion. The soft vascular submucosal tissue above the dentate line, which on hypertrophy produces haemorrhoids, also aids the occlusion of the canal.

The line drawings were prepared by Paul Somerset, medical illustration department, Wythenshawe Hospital.

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ANY QUESTIONS

What is the maximum length of time for which a woman should receive the three monthly injections of medroxyprogesterone acetate (Depo-Provera) for contraception?

The manufacturer's guidelines for medroxyprogesterone acetate for contraceptive use state, "longterm use is intended only in women in whom other contraceptives are contraindicated or have caused unacceptable side effects or are otherwise unsatisfactory" and that its use should be "consistent with good clinical contraceptive practice and a general medical as well as gynaecological examination should be undertaken at yearly intervals." Long term in this instance means for as long as the patient requires contraception.

A recent study suggested that the degree of oestrogen deficiency induced by medroxyprogesterone acetate may have an adverse effect on bone density.¹ Subsequent correspondence, however, suggested that these

workers may have inadequately matched treated subjects and controls for all the relevant risk factors (parity, socioeconomic state, smoking, alcohol intake, nutrition, levels of exercise, and the contraceptive practice of controls).²

The relation between breast cancer and medroxyprogesterone acetate has also recently been studied.³ The study showed a relative risk in those who had ever used the drug of 1.21. This risk did not increase with duration of use but was increased in women who had been exposed to the drug initially within the previous four years and was of the same order of magnitude as that for oral contraceptives.—P B TERRY, consultant in obstetrics and gynaecology, Aberdeen

1 Cundy T, Evans M, Roberts H, Wattie D, Ames R, Reid IR. Bone density in women receiving depot medroxyprogesterone acetate for contraception. *BMJ* 1991;303:13-6.

2 Hinchley H. DMPA and bone density. *BMJ* 1991;303:467.

3 WHO Collaborative Study of Neoplasia and Steroid Contraceptives. Breast cancer and depot-medroxyprogesterone acetate: a multinational study. *Lancet* 1991;338:833-8.