

# Anatomy of the rectum and anal canal

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## Abstract

Collectively the rectum and anal canal constitute the very terminal segment of the large intestine, and thus of the entire gastrointestinal tract. Their distal location renders the rectum and anal canal readily accessible to direct inspection and examination. The prime function of the rectum is to act as a distensible reservoir for faeces, while the anal canal incorporates in its wall a powerful muscular sphincter which is of paramount importance in the mechanism of faecal continence. Diseases of the rectum and anal canal, both benign and malignant, account for a very large part of colorectal surgical practice worldwide. This article emphasizes the clinically and surgically-relevant aspects of the anatomy of the rectum and anal canal.

**Keywords** Anal cushions; anal sphincters; inferior hypogastric plexus; lymphatic drainage; mesorectum; perineum; rectal blood supply

The rectum is the direct continuation of the sigmoid colon and commences in front of the body of the third sacral vertebra (Figure 1). The longitudinal orientation of the rectum conforms to the ventral concavity of the sacrum. Thus the rectum runs downwards and backwards initially, and then downwards and forwards to reach the levator hiatus (the gap in the pelvic floor between the two levator ani muscles through which the pelvic viscera pass inferiorly into the perineum). This natural ventral bend in the rectum is termed the sacral flexure. At the levator hiatus the rectum becomes continuous with the anal canal. The anorectal junction is situated approximately 4 cm anterior to the tip of the coccyx. The rectum, being situated above the level of the pelvic floor and below the level of the pelvic brim, is an entirely intrapelvic viscus (Figure 1). In addition to presenting the ventral bend, the rectum possesses a succession of three, smooth, laterally-facing curves. The upper and lower curves are directed to the right and the middle curve to the left (Figure 1). Each of the three 'curves' presents on the inside a transverse, sickle-shaped fold. Also known as rectal shelves or the 'valves of Houston', these folds are produced by the thickened muscle in the rectal wall projecting inwards with overlying mucosa. The middle rectal shelf is the most constant and prominent of the three shelves, and is almost invariably encountered during sigmoidoscopy. The inferior third of the rectum is somewhat dilated and is termed the *ampulla* (Figure 1). The haustrations, appendices epiploicae and taeniae coli which characterize the sigmoid colon and other segments of the colon (and which have

been described in the previous article) are noticeably absent on the rectal wall. Indeed it is this abrupt change in external appearance that enables the surgeon to identify the rectosigmoid junction with confidence, at operation. The rectosigmoid junction is approximately 6 cm below the level of the sacral promontory. Approached from the distal end, however, as when performing a rigid or flexible sigmoidoscopy, the rectosigmoid junction is seen to be 14–18 cm from the anal verge. The rectum in the adult measures 10–14 cm in length.

## Relationship of the peritoneum to the rectum

Unlike the transverse colon and sigmoid colon, the rectum lacks a mesentery. The posterior aspect of the rectum is thus entirely free of a peritoneal covering. In this respect the rectum resembles the ascending and descending segments of the colon, and all of these segments may be therefore be spoken of as retroperitoneal. The precise relationship of the peritoneum to the rectum is as follows.

The upper third of the rectum is covered by peritoneum on its anterior and lateral surfaces; the middle third of the rectum is covered by peritoneum only on its anterior surface while the lower third of the rectum is below the level of the peritoneal reflexion (the level at which the peritoneum leaves the anterior rectal wall to reach the viscus in front) and consequently has no peritoneum covering any of its surfaces. The middle rectal shelf is a convenient and fairly accurate indicator of the level of peritoneal reflexion. This relationship of the peritoneum to the rectum is readily appreciated at operation for rectal cancers once the peritoneum on either side of the rectum is incised longitudinally and the rectum is straightened prior to its mobilization and eventual excision.

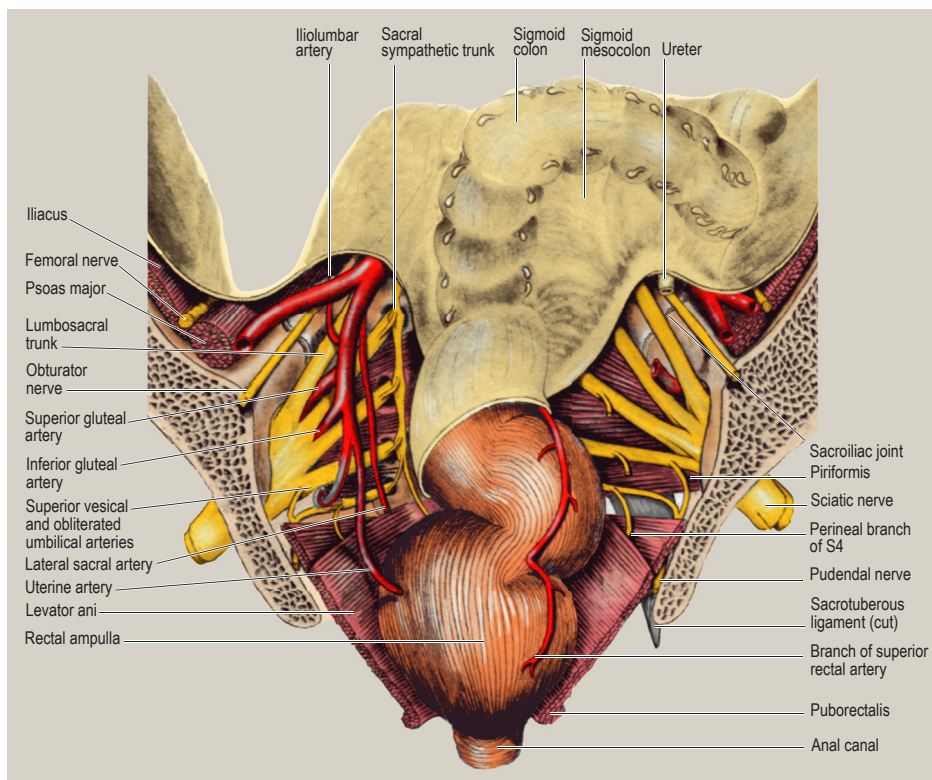
## Fascial coverings of the rectum

The entire length of the rectum (except perhaps the very distal centimetre) is surrounded by a cuff of fat termed the perirectal fat, which is generally more abundant posteriorly than anteriorly. It is in this perirectal fat that the epi-rectal and para-rectal lymph nodes are located (see below under 'lymphatic drainage'), and it is in this perirectal fat that the superior rectal vessels travel before entering the rectum. The perirectal fat is in turn surrounded by a distinct circumferential fascial layer called the *fascia propria of the rectum*. The fascia propria enclosing the perirectal fat with the contained lymph nodes is referred to as the *mesorectum*. The term does not imply that the rectum possesses a suspensory mesentery. However it is a very important principle of rectal cancer surgery that for a successful outcome, the rectum must be removed with a completely intact *mesorectum*.

## Arterial supply and venous drainage of the rectum

The principal artery supplying the rectum is the superior rectal artery (the name given to the inferior mesenteric artery at the point where the latter crosses the pelvic brim to enter the pelvic cavity). The superior rectal artery runs with the pelvic attachment of the sigmoid mesocolon to enter the perirectal fat behind the rectum. Here it breaks up into two, sometimes three, longitudinal vessels which travel on either side of the rectum before sinking into the rectal wall (Figure 1). Supplementary arteries

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**Figure 1** Coronal view of the posterior half of the pelvic cavity, showing the anterior aspect of the rectum.

which contribute to the blood supply of the rectum are the middle rectal arteries, the inferior rectal arteries and the median sacral artery. The right and left middle rectal arteries arise from the corresponding internal iliac artery and run infero-medially just above the pelvic floor to reach the rectum. The middle rectal arteries are inconstant in size and are usually not prominent vessels. They may be absent on one or both sides. Each inferior rectal artery is a branch of the internal pudendal artery and is given off as soon as the latter enters the perineum. The inferior rectal artery crosses the ischio-anal fossa from lateral to medial to enter the anal wall. It is the principal artery of the anal canal. However, through the anal wall it is capable of supplying the distal third of the rectum. The median sacral artery arises from the posterior aspect of the aorta just proximal to the aortic bifurcation. It runs down the anterior aspect of the sacrum and on reaching the pelvic floor it runs anteriorly to terminate in the rectal wall. It is of trivial importance where the blood supply of the rectum is concerned.

The venous drainage of the rectum mirrors the arterial supply. From a rich and valveless intramural venous plexus blood enters the valveless, perirectal venous plexus, whence rectal blood is carried mainly in the superior rectal vein. The superior rectal vein running alongside the artery, crosses the pelvic brim from below upwards to become the inferior mesenteric vein. Thereafter the inferior mesenteric vein drains the sigmoid colon, descending colon and splenic flexure before emptying into the splenic vein and thereby into the portal vein. Some venous blood from the intramural and perirectal venous plexuses travels bilaterally in the middle rectal veins and drains into the internal iliac veins. Venous blood from these rectal plexuses also finds its way through the anal wall into the inferior rectal veins which

drain into the internal iliac veins via the internal pudendal veins. The anal mucosa and submucosa thus represent sites of natural portosystemic venous anastomoses. To a limited extent these anastomoses are also present in the rectal wall. In portal hypertension these anastomoses may become considerably engorged and distended, and if ruptured, may give rise to life-threatening rectal bleeding.

### Lymphatic drainage of the rectum

As with the lymphatic drainage of the colon, rectal lymph is initially received by the lymphoid follicles in the mucosa. Thereafter, the lymph passes successively through three tiers of mesorectal lymph nodes (equivalent to epicolic, paracolic and intermediate nodes) before reaching the so-called principal nodes. For the TNM (tumour, node, metastasis) cancer classification they are divided into those close to the rectal wall (N1) and those more centrally placed, but still within the mesorectum (N2). The principal lymph nodes that receive most of the lymph from the upper two-thirds of the rectum are the inferior mesenteric lymph nodes which are situated around the origin of the inferior mesenteric artery. Lymph from the lower third of the rectum drains into three sets of principal nodes; the inferior mesenteric lymph nodes and the internal iliac lymph nodes bilaterally (also called the pelvic side wall nodes). Adjuvant radiotherapy with curative intent as well as radical extirpative surgery must therefore address all these lymph node groups.

### Topographical relations of the rectum

Posteriorly, the rectum is related to i) the ventral surface of the lower half of the sacrum and the adjoining coccyx, and ii) the

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