Colorectum

6

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6.1 Anatomy

The colon and rectum together measure between 125 and 140 cm in the adult. The colon is divided into the caecum (10 cm) and ascending (15 cm), transverse (40 cm), descending (25 cm), and sigmoid (25–40 cm) colons. The rectum measures approximately 13–15 cm (Fig. 6.1). The main function of the colon is absorption of water and electrolytes and the storage of faecal material until it can be excreted. The caecum is that part that lies below the ileocaecal valve and receives the opening of the appendix. It is mostly surrounded by peritoneum, allowing it to be mobile in the right iliac fossa. The base of the appendix is attached to the posteromedial surface of the caecum. The ascending colon extends upward from the caecum to the inferior surface of the right lobe of liver. Here it becomes continuous with the transverse colon by turning sharply to the left, forming the right colic or hepatic flexure. The ascending colon is bound to the posterior abdominal wall by peritoneum covering its front and sides. The transverse colon extends from the hepatic flexure to the left, hanging downward and then ascending to the inferior surface of the spleen, where it turns sharply downward to form the left colic or splenic flexure. The transverse colon is completely surrounded by peritoneum with the transverse mesocolon being attached to its superior border (the length of the transverse mesocolon accounts for the variability in the position of the transverse colon) and the greater omentum to its lower border. The descending colon extends downward from the splenic flexure to the left side of the pelvic brim. It is bound to the posterior abdominal wall by peritoneum covering its sides and front. The sigmoid colon is continuous with the descending colon and hangs as a loop into the pelvic cavity. It is completely surrounded by peritoneum and a fan-shaped piece of mesentery attaches it to the posterior abdominal wall, thus allowing mobility. The rectum begins as a continuation of the sigmoid colon in front of the third sacral vertebra and follows the curvature of the sacrum and coccyx to where it pierces the pelvic floor to become continuous with the anal canal. Peritoneum covers the anterior and lateral surfaces of the upper third and the anterior surface of the middle third, the lower third being devoid of a peritoneal covering. At

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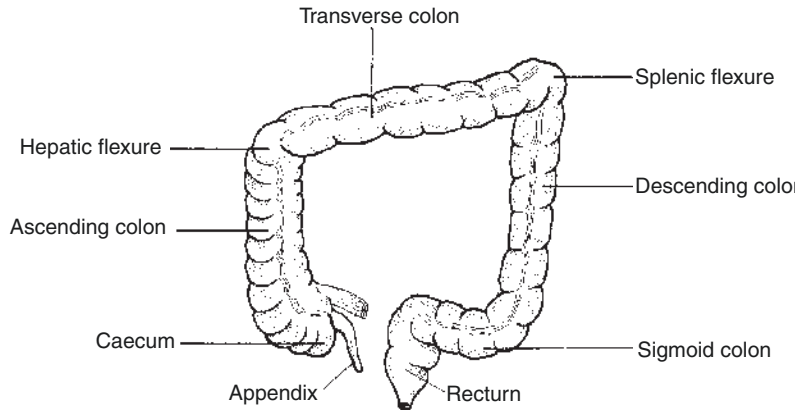

Fig. 6.1 Colorectum (Used with the permission of the Union for International Cancer Control (UICC), Geneva, Switzerland. The original source for this material is from Wittekind et al. (2005))

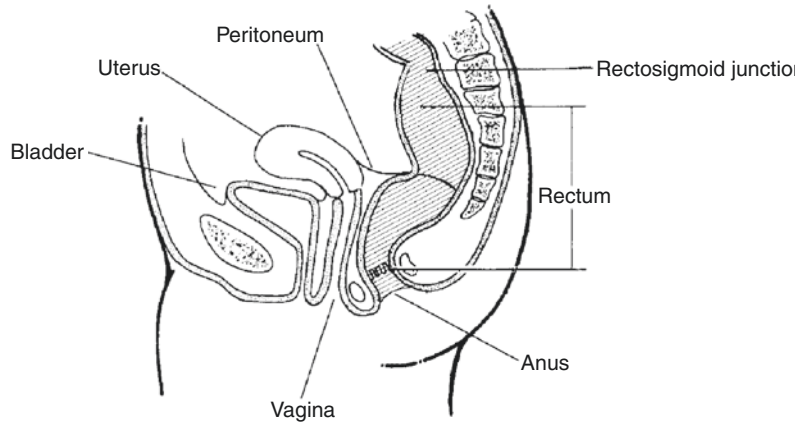

Fig. 6.2 Rectosigmoid and peritoneal reflection (lateral view) (Used with the permission of the Union for International Cancer Control (UICC), Geneva, Switzerland. The original source for this material is from Wittekind et al. (2005))

the junction of the middle and lower third, the peritoneum is reflected onto the posterior surface of the upper vagina in the female to form the rectovaginal pouch (pouch of Douglas) and onto the upper part of the posterior bladder in the male, forming the rectovesical pouch (Fig. 6.2). The extent of serosal covering in the colorectum is illustrated in Fig. 6.3. The rectum is surrounded by a bilobed encapsulated fatty structure which is bulkier posterolaterally than anteriorly—the mesorectum.

The small and large intestines differ in their appearance in a number of ways:

- The longitudinal muscle in the small intestine forms a continuous layer, whereas in the colon it comprises three bands called *taeniae coli*. However, in the rectum, the taeniae coli come together to form a broad band on the anterior and posterior surfaces.
- The wall of the colon is sacculated, whereas the small intestine is smooth.
- The colon has "fatty tags" called *appendices epiploicae*.
- The permanent mucous membrane folds (*plicae circulares*) in the small intestine are not present in the colon.

Microscopically the colonic mucosa is made up of tubular crypts lined by columnar epithelium with mucin-secreting goblet cells and endocrine cells also being present.

Lymphovascular drainage:

Embryologically the gastrointestinal tract is divided into three segments (fore, mid, and hindgut) with each region being supplied by its own artery:

- Coeliac artery supplies the foregut (distal oesophagus to the mid-portion of the second part of the duodenum).

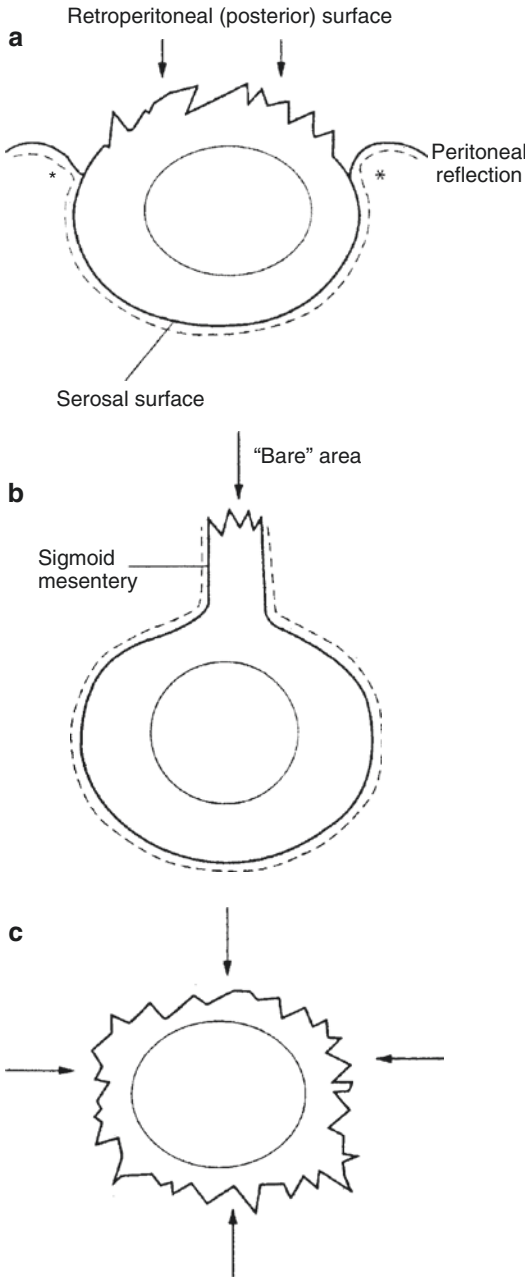

Fig. 6.3 Extent of serosal covering of the large intestine. *Arrows* indicate the "bare" non-peritonealized areas of different levels. (**a**) The ascending and descending colon are devoid of peritoneum on their posterior surface. (**b**) The sigmoid colon is completely covered with peritoneum, which extends over the mesentery. (**c**) The lower rectum lies beneath the pelvic peritoneal reflection. The *asterisks* in (**a**) indicate the sites where serosal involvement by tumour is likely to occur (Reprinted, with permission, from Burroughs and Williams (2000))

- Superior mesenteric artery supplies the midgut (mid-portion of the second part of the duodenum to the junction of the proximal two-thirds and distal third of the transverse colon).
- Inferior mesenteric artery supplies the hindgut (distal third of the transverse colon to the junction of the superior and inferior half of the anal canal).

The rectum is also supplied by branches of the internal iliac artery. The anastomosis of the colic arteries around the concavity of the colon forms the marginal artery. The venous drainage of the colon is to the portal venous system and the rectum to the inferior mesenteric and internal iliac veins.

The lymphatics accompany the colic vessels draining to the superior and inferior mesenteric nodes. Those from the rectum drain into nodes (pararectal nodes) situated in the perirectal connective tissue (mesorectum) and thence to the superior mesenteric and internal iliac nodes (Fig. 6.4).

6.2 Clinical Presentation

There is considerable variability in the clinical presentation of colorectal disease.

Angiodysplasia usually presents with persistent occult bleeding or repeated small bleeds. In colonic ischaemia/infarction there may be a history of arrhythmia or cardiac failure, and it may present acutely with abdominal pain and bloody diarrhoea or less acutely with stricturing and symptoms of obstruction. Infective conditions usually lead to diarrhoea, crampy abdominal pain, and fever. A careful antibiotic drug history should be obtained if pseudomembranous colitis is suspected. Inflammatory bowel disease may have an indolent presentation with lethargy, anorexia, and weight loss. However, more characteristic symptoms of ulcerative colitis include bloody diarrhoea (>10 stools/day), urgency, and abdominal pain. Peritonitis and systemic sepsis may occur with toxic megacolon and perforation.

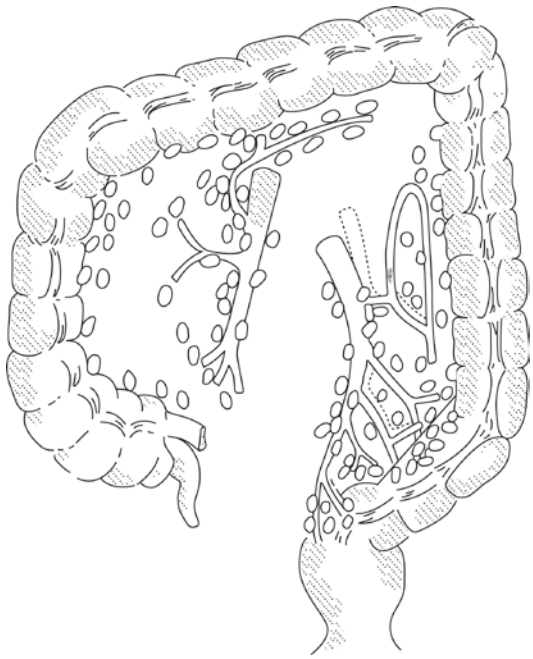

Fig. 6.4 Colorectum: regional lymph nodes are the pericolic, perirectal and those along the ileocolic, right colic, middle colic, left colic, inferior mesenteric, superior rectal (haemorrhoidal) and internal iliac arteries. (Used with permission of the Union for International Cancer Control (UICC), Geneva, Switzerland. The original source for this material is from Wittekind et al. (2005))

Colorectal Crohn's disease characteristically presents with diarrhoea. Obstruction due to stricturing may occur and fistulae leading to specific symptoms (e.g., colovesical—pneumaturia and recurrent urinary infection; rectovaginal—fecal discharge per vagina). Perianal fissures/fistulae and anorectal sepsis are relatively common in Crohn's disease. Extragastrointestinal manifestations of inflammatory bowel disease include finger clubbing and erythema nodosum. Diverticular disease may present insidiously with lower abdominal pain or fistula formation (e.g., colovesical), or acutely as acute diverticulitis (abdominal pain, diarrhoea, and localized peritonitis), pericolic abscess, obstruction (due to stricturing), perforation (generalized peritonitis), or haemorrhage (relatively rare).

Adenomatous polyps are usually asymptomatic, but large villous adenomas in the rectum may elicit an alteration in bowel habit, mucus per rectum (may cause pruritis ani), tenesmus (a sensation of incomplete evacuation), and electrolyte loss (particularly potassium). Colorectal carcinoma is usually asymptomatic early in its existence and later may present with nonspecific symptomatology such as an alteration in bowel habit, mucus PR, abdominal mass or discomfort, and PR bleeding (may be occult and can lead to iron-deficiency anaemia). As a rule, the more proximal the tumour, the darker the blood. Tumours in the right colon are more likely to be ulcerated and so tend to present with PR bleeding, whereas tumours of the left colon are often constrictive and present with obstruction—this is compounded by the fact that the faecal material is more solid in the distal colon. Perforation may occur either through the tumour itself or distant and proximal to it due to obstruction and back pressure, e.g., in the caecal pouch. Rectal tumours can lead to tenesmus and local invasion may produce back pain and sciatica (involvement of the sacral plexus), rectovaginal fistula, etc. Liver metastases may cause clinical jaundice.

6.3 Clinical Investigations

- FBP—iron-deficiency anaemia as a result of PR bleeding.
- U&E—electrolyte disturbance in diarrhoea/mucus PR.
- LFTs—deranged in liver metastases or in the hepatobiliary manifestations of Crohn's disease.
- C-reactive protein/ESR—allows the activity of inflammatory bowel disease to be monitored.
- Stool culture—rule out infective colitis.
- Faecal occult blood—will detect occult bleeding.
- CXR—will detect pulmonary metastases.
- AXR—will show signs of colonic obstruction. Any dilatation of the colon >6 cm in diameter heralds the onset of toxic megacolon. In ischaemic colitis, there will be dilated colon with characteristic "thumbprinting." In colovesical fistula, gas is present in the bladder. Free intraperitoneal gas will be seen in colonic perfora-

tion. In patients being investigated for chronic constipation, radio-opaque markers are ingested and an AXR is taken 5 days later with passage of <80% of the markers considered abnormal.

- Barium enema—still used in investigation of colorectal disease. There will be characteristic "thumbprint" filling defects caused by oedematous mucosa in ischaemia/infarction. The extent of ulcerative colitis can be assessed and in Crohn's disease it will show skip lesions, areas of stricturing, and any fistulae. It will reveal the presence of diverticula. Barium enema is useful in the detection of large polyps and carcinomas with constricting tumours producing a characteristic "apple core" lesion. However, it will not reliably define rectal lesions.
- CT scan—will detect a pericolic abscess (can be drained under CT guidance) and is useful in showing the site of a tumour and any metastatic spread. CT colonogram and barium enema can be of use in a medically unfit patient or where there is a distal stricture not passable by the colonoscope.
- MRI scan and ELUS—allow assessment of local pelvic tumour spread in rectal carcinoma for staging purposes and selection for neoadjuvant therapy.
- PET CT scan—helps to distinguish recurrent carcinoma from post-radiotherapy fibrosis in the pelvis and to detect occult distant metastases.
- Angiography—will demonstrate a bleeding point, e.g., in angiodysplasia if there is active bleeding >2 mL/min.
- Cytology—examination of ascitic fluid or peritoneal washings.
- Endoscopy and biopsy—inspection and biopsy of the mucosa, determination of disease distribution, solitary or multiple lesions. Allied to CT imaging if a mass lesion is detected.
- Laparoscopy—staging laparoscopy may be undertaken and any peritoneal deposits biopsied.
- CEA serum levels—elevated in colorectal neoplasia particularly in metastatic or recurrent disease.

6.4 Pathological Conditions

6.4.1 Non-neoplastic Conditions

These comprise inflammatory (acute or chronic), mechanical, ischaemic, and iatrogenic disorders.

6.4.1.1 Inflammatory Disorders

Acute proctocolitis: Infective or drug-induced, e.g., antibiotics, there is preservation of the mucosal architecture and acute inflammation with biopsies only being submitted if symptoms persist beyond several weeks. Infective cases (campylobacter, shigella, salmonella) are usually self-limited and culture positive in only 40% of cases. Drug-induced inflammation often responds to its withdrawal.

Chronic proctocolitis: Characterized by disturbance of the mucosal architecture and a chronic inflammatory cell infiltrate ± foci of active inflammation. Commonly due to idiopathic chronic inflammatory bowel disease (CIBD) but also seen overlying diverticulosis and pneumatosis coli, in infection (shigella, amoebiasis, schistosomiasis), obstructive enterocolitis, and with drugs. Microbiological culture and travel and drug history should always be ascertained in patients with chronic diarrhoea.

CIBD—ulcerative colitis and Crohn's disease: The latter has been discussed previously (see Chap. 5) but can present either as isolated colonic disease or associated with ileitis. It is a segmental, transmural chronic inflammatory condition and there is often rectal sparing but anal disease (fissure, fistula, abscess) present. The segmental distribution, focality of inflammation, presence of granulomas, and ileal component are all useful diagnostic pointers in colonoscopic biopsy or resection specimens. Recurrence elsewhere in the gut is not uncommon despite surgical resection, and, because of this, Crohn's disease is a contraindication to pouch formation in restorative proctocolectomy. Occasionally it presents isolated to the appendix or sigmoid colon coexisting with diverticulitis.

In contrast to this ulcerative colitis is a diffuse, chronic active mucosal inflammatory condition involving the rectum and a contiguous length of

large intestine, e.g., left-sided proctocolitis or pancolitis. It is of variable severity with episodic exacerbations and remissions—acute fulminant colitis may be complicated by severe haemorrhage, toxic dilatation or megacolon, perforation, and peritonitis. Other complications include mucosal dysplasia and malignancy (usually adenocarcinoma) in extensive disease of long-standing duration (pancolitis >10 years). Villiform or polypoid DALMs (dysplasia-associated lesions or masses) can be difficult to distinguish from the much more common inflammatory mucosal polyps and may harbour underlying adenocarcinoma. Alternatively dysplasia may occur in flat mucosa, and colonoscopic surveillance of chronic colitis involves sequential mucosal sampling as well as target biopsy of any macroscopic abnormality. Biopsy orientation onto a polycarbonate strip aids subsequent localization of any histological abnormalities. Macroscopically ulcerative colitis shows mucosal granularity, linear or confluent ulceration, and polyps of varying size. The terminal ileum is only involved in severe pancolitis over a length of 1–2 cm (backwash ileitis) and although there is usually proctitis, the rectum may be spared due to treatment effects, e.g., predsol enemas. Extraintestinal effects include arthritis, iritis, and, in the liver, primary sclerosing cholangitis which can lead to cirrhosis and cholangiocarcinoma.

In a minority of cases, clear distinction cannot be made between ulcerative colitis and Crohn's disease on macroscopic/colonoscopic and microscopic examination—so-called indeterminate colitis (in a resection specimen) or CIBD, unclassified (in biopsy material).

Diversion proctocolitis: Follows faecal stream diversion, e.g., after ileostomy or colostomy for tumour, trauma, or CIBD. The defunctioned segment develops florid reactive lymphoid hyperplasia which can be mucosal or transmural, mimicking or superimposed on an underlying inflammatory disorder such as CIBD. Persistent severe symptoms may necessitate surgical excision of the segment, e.g., the rectal stump following colectomy for ulcerative colitis.

Microscopic colitis: Minimal inflammation may be apparent grossly or histologically for various reasons, e.g., treated CIBD, postinfection, drug ingestion, uraemia, stercoral trauma, etc. However, microscopic colitis which causes chronic, voluminous watery diarrhea is radiologically and colonoscopically normal, or near normal, with recent recognition of subtle endoscopic abnormalities relating to fragility of the colonic mucosa. It occurs in middle-aged to elderly women and has variable associations with HLA type, autoimmune diseases, and NSAID ingestion. Diagnosis is by histology with a normal architecture and transmucosal infiltrate of chronic inflammatory cells. Its main variants, collagenous and lymphocytic colitis, show a thickened subepithelial collagen band and excess surface intraepithelial lymphocytes, respectively. Not infrequently there is spontaneous resolution or response to anti-inflammatory therapy, depending on underlying cause.

Infective proctocolitis: Investigation includes microbiological culture with microscopy for cysts (amoebiasis) and ova (schistosomiasis). Infection should be considered particularly where there is a history of travel or immunosuppression, e.g., HIV-AIDS, chemotherapy or post-transplant. In immunosuppression, infection with unusual opportunistic organisms can occur, e.g., cryptosporidiosis, atypical mycobacteria.

6.4.1.2 Mechanical Disorders

Melanosis coli: Characterized by pigmented macrophages in the lamina propria that impart a dusky mucosal appearance mimicking ischaemia. The pigment is lipofuscin and degenerative in nature thought to relate to cellular apoptosis. There is an association with use of laxatives and bowel dysmotility.

Volvulus: Usually comprises a markedly dilated atonic sigmoid colon in either Africans (due to a high-fibre diet with bulky stools) or constipation-related acquired megacolon in the elderly. The sigmoid loop twists on its mesentery, obstructs, and may become secondarily ischaemic. Resection specimens are often dilated, thinned, and featureless. Melanosis coli may be present.

Pneumatosis coli: Submucosal gas cysts lined by macrophages and giant cells with overlying

mucosal chronic inflammation or pseudolipomatosis. There is an association with volvulus, constipation, diverticulosis, and chronic obstructive airways disease. Pathogenesis relates to retroperitoneal tracking of air into the bowel mesentery, abnormal luminal gas production linked to the increased intraluminal pressure seen in the above disorders, and introduction of gas during endoscopy. About 50% of cases resolve, but recurrent or severe lesions may require colectomy of the involved segment.

Obstructive enterocolitis: Continuous or segmental areas of inflammation or ulceration adjacent to or distant from an obstructing distal lesion, e.g., annular carcinoma or diverticulosis. Small bowel may also be involved with mimicry of Crohn's disease. A dilated, thinned caecal pouch can become ischaemic and perforate.

Diverticulosis: Very common in Western society due to a low-fibre diet, high intraluminal pressure, and subsequent transmural mucosal herniation in the sigmoid colon through points of vessel entry from the mesentery. Presentation is with altered bowel habit, per rectum bleeding, left iliac fossa pain or a mass. The latter implies diverticulitis with possible perforation and pericolonic reaction/abscess formation. Portal pyaemia, liver abscesses, and peritonitis can ensue. The diverticular segment is thickened and contracted with muscle coat hypertrophy and visible diverticular pouches in the muscularis and mesenteric fat. They may be filled and obstructed with faecal or vegetable debris, and ulcerated with a coating of pericolonic exudate and abscess. The concertina-like redundant mucosal folds can show crescentic colitis due to abrasion of their tips by the passing faecal stream. Occasionally the chronic inflammation may be transmural and granulomatous mimicking or coexisting with Crohn's disease. Treatment is often conservative, e.g., by diet alteration, but severe or complicated cases require colectomy. Co-presentation with an occult carcinoma within the strictured segment must be excluded by careful pathological examination.

Mucosal prolapse: A mechanism producing reactive mucosal changes of crypt hyperplasia, smooth muscle thickening of the lamina propria, and variable surface erosion. It is common to a number of situations including solitary rectal ulcer syndrome (SRUS), inflammatory cloacogenic polyp, diverticular-related crescentic colitis, mucosa adjacent to a polyp, stricture or tumour, stercoral trauma, and the mucocutaneous junction of stomas. In SRUS, there is a history of abnormal anterior rectal wall descent due to straining at defecation. This results in induration of the wall that can mimic a plaque of tumour on palpation and rectoscopy. Biopsy is diagnostic and treatment is usually conservative, related to better stool habit—occasional cases require resection of the involved sleeve of mucous membrane (mucosectomy) with apposition and plication of the intervening muscle (Delorme's procedure).

6.4.1.3 Ischaemic Disorders

The pathogenesis of intestinal ischaemia has been previously discussed and in the large intestine is often due to mesenteric vascular insufficiency because of systemic hypotension (myocardial infarction, cardiac arrhythmia, blood loss) or mesenteric atheroma/thrombosis/embolism. Acute lesions may resolve if mucosa-confined but are potentially fatal if transmural. Late or chronic ischaemia has a predilection for the splenic flexure and rectosigmoid watershed areas of vascular supply. This can result in non-specific ulceroinflammatory and stricturing lesions—end-stage changes that can be produced by various other conditions, e.g., CIBD, infection (*E. coli* 0157:H7 bacterium), pseudomembranous colitis due to Clostridium difficle overgrowth, obstructive enterocolitis, and stercoral trauma. Rare cases are due to vasculitis or amyloid infiltration. Assessment of resection limit viability and mural/mesenteric vessels is necessary in ischaemia.

A vascular abnormality that can present with iron-deficiency anaemia in elderly patients is colonic angiodysplasia. Thought to be degenerative in nature due to increased intraluminal pressure compressing mural vessels, the commonest site is the caecum. Operative injection of radio-opaque contrast may be needed to demonstrate areas of vascular ectasia so that targeted blocks

can be sampled. The ectatic vessels involve the submucosa and lamina propria.

6.4.1.4 Iatrogenic Disorders

These include drugs, radiation therapy, and graft versus host disease.

Drugs: NSAIDs should always be considered in the presence of any unusual colitis, localized ulceration, stricture, perforation, or mucosal diaphragm formation. Antibiotics can commonly cause dysfunctional diarrhoea, an acute proctocolitis, or, particularly in the elderly, pseudomembranous colitis. The latter is due to the production of Clostridium difficile toxin leading to ischaemic-type lesions with yellow surface plaques of acute inflammatory and fibrinous pseudomembrane. Severe cases result in end-stage ulceration and colectomy may be indicated although initial treatment is with appropriate antibiotics.

Radiation therapy: Acute and chronic phases with the potential for mucosal healing and usually produced by radiotherapy for pelvic (uterine cervix, rectum, prostate) or retroperitoneal cancer. Acute radiation proctocolitis is normally self-limited and seldom biopsied. Chronic changes result in mucosal atrophy, hyaline fibrosis, vascular thickening, and strictures.

Graft versus host disease: Immunosuppressed bone marrow transplant patients risk developing a range of acute and chronic changes similar to those seen in radiation damage.

6.4.2 Neoplastic Conditions

Serrated polyps: Simple hyperplastic or metaplastic polyps are benign and more prevalent in the left colon/rectum with increasing age. Sessile serrated lesions (also referred to as sessile serrated polyps/adenomas) are typically larger and more architecturally complex than hyperplastic polyps and predominantly located in the proximal colon. They are now considered to be precursors of right-sided microsatellite instability pathway carcinomas, typically in elderly females. Traditional serrated adenomas are more commonly distal and share some morphological features and cancer risk of conventional adenomas.

Adenoma (*conventional*): Designated as tubular, tubulovillous, or villous, depending on the relative proportions of glands and fronds present and composed of low- or high-grade dysplastic epithelium. Increasing in frequency with age, and in the left colon, the risk of malignancy relates to the size (>2 cm = 40–50% risk), degree of villous morphology, and grade of dysplasia. Tubular adenomas are polypoid and larger tubular adenomas tend to develop a distinct stalk, whereas villous lesions are typically sessile. Stalked adenomas can twist and prolapse (typically in the sigmoid colon) resulting in glandular herniation (epithelial misplacement) into the submucosa that mimics invasive carcinoma—the low power lobular configuration, the presence of accompanying lamina propria haemosiderin and lack of stromal fibrous desmoplasia are useful histological clues to benignity. This differential diagnosis is a particularly common problem with the introduction of bowel cancer screening programs based on detection of faecal occult blood (FOB), as these large sigmoid polyps often ulcerate and bleed, resulting in a positive FOB test. Invasive carcinoma is defined by the presence of neoplastic epithelium infiltrating submucosa, and in stalked adenomas, polypectomy may be considered therapeutic if the tumour is well or moderately differentiated and does not show lymphatic or venous invasion, tumour budding or involvement of the diathermied polyp base. Otherwise colonic resection may be indicated and, therefore, good orientation of the adenoma to its stalk and assessment of the base are crucial, at polypectomy handling and dissection in the laboratory. In contrast, invasion in a sessile adenoma accesses true mural submucosa, and colonic resection is usually considered more appropriate based on greater risk of lymph node metastases, unless the patient is very elderly or medically unfit. Local mucosal resection is an option, but in such cases further radical surgery is required if the cancer involves muscle coat, the base of the specimen, lymphovascular channels, or is poorly differentiated.

It is not unusual for patients to have several sporadic adenomas, but in familial adenomatous polyposis (FAP), there are hundreds or thousands with progression to colorectal cancer 20–30 years earlier than average, indicating a need for prophylactic colectomy. There is also a strong association of FAP with duodenal adenomas and periampullary carcinoma. Attenuated FAP and MYH-associated polyposis present with smaller numbers of colorectal polyps, but also predispose to colorectal cancer.

Flat adenomas are less common and difficult to identify macroscopically without the use of magnification or dye spray technique. They have proportionately higher grades of dysplasia and frequency of carcinoma and may account for a proportion of the 30% of carcinomas without an identifiable adenoma at their edge.

In the UK, National Bowel Cancer Screening Programs in each nation target the detection of early colorectal cancers and of adenomas in asymptomatic patients in an attempt to prevent cancer formation. These programs invite the populations aged 60–74 years to participate in 2-yearly FOB testing. About 2% have a positive result and are referred for colonoscopy (or CT colonogram, depending on fitness and availability of local resources) and 50% of these will have a detectable abnormality (10% cancer, 70% adenomas, 20% other diagnoses, e.g., CIBD). Initial results have shown a significant yield of precancerous adenomas and a shift towards a higher frequency of early stage (Dukes' A) cancers. There are plans to move from FOB to faecal immunochemical testing (FIT), which is a more specific test and the English Bowel Cancer Screening Program has added one-off flexible sigmoidoscopy screening at age 55 years.

Adenocarcinoma: Comprising the vast majority of colorectal malignancies, 80–85% are moderately differentiated adenocarcinoma of no special type. A minority are mucinous, signet ring cell, or poorly differentiated. Distribution is throughout the colorectum—although rectosigmoid is the commonest site (50% of cases), 10–15% of sporadic cases are multiple, occurring either synchronously or subsequently (metachronously). Predisposing conditions are chronic ulcerative colitis, FAP, Lynch syndrome (formerly known as hereditary nonpolyposis colorectal cancer [HNPCC]) and rarer polyposis syndromes. In Lynch syndrome, there is a tendency for right-sided cancers, which may be multiple, mucinous, or poorly differentiated and with a family history of cancer at a younger age (<50 years), also involving other sites, e.g., uterus, stomach, ovary, ureter, and small intestine. Lynch syndrome cancers are genetically different from typical chromosomal instability pathway sporadic colorectal cancer and are caused by a heritable germline mutation resulting in deficiency in one of the DNA mismatch repair (MMR) proteins, resulting in microsatellite instability (MSI). Importantly, sporadic MSI pathway colorectal cancers are more common than Lynch syndrome and share similar morphological and immunohistochemical features, but are almost invariably caused by somatic inactivating promoter hypermethylation of the MMR gene MLH1, resulting in loss of immunohistochemical expression and MSI. Distinction from Lynch syndrome may require further molecular investigation including germline mutation screening.

As previously noted, the cancer site and its macroscopic growth pattern influence clinical presentation. Important prognostic indicators are the extent of local tumour spread, a circumscribed or infiltrative margin, involvement of the serosa, longitudinal or mesocolic/mesorectal resection margins, and tumour perforation. Tumour present within ≤1 mm defines involvement of the mesenteric margin irrespective of whether it is nodal, lymphovascular, direct or discontinuous spread. Generally a macroscopic clearance of 2–3 cm from a longitudinal margin is satisfactory unless histology shows the cancer to be unusually infiltrative or poorly differentiated. All mesenteric lymph nodes should be identified, counted, and sampled (aiming for a departmental median count of at least 12 nodes per specimen) and a suture tie limit node identified—in some colectomy specimens this may mean more than one limit node. Involvement of

adjacent organs or structures (e.g., abdominal wall) is documented and predisposing lesions such as adenoma(s) or colitis represented. Multiple tumours are dissected and staged individually with respect to mural and nodal spread.

Other cancers: Carcinoid tumours are usually small incidental mucosal rectal polyps, GISTs are rare, and malignant lymphoma can complicate ulcerative colitis or HIV-AIDS.

Prognosis: Relates mainly to the depth of tumour spread, lymph node involvement, and adequacy of local excision with overall 5-year survival 35–40%. Cancers confined to the mucous membrane or wall do much better than those that invade beyond this or show nodal disease. Adverse prognostic indicators also include a mucinous character, poor differentiation, tumour perforation, obstruction, and resection margin involvement. It is estimated that about 50% of patients are cured, 10% die from local recurrence and 40% from lymphatic and vascular spread. Treatment is typically surgical excision with adjuvant chemotherapy considered for cancers showing poor differentiation, nodal, peritoneal, and/or extramural vascular spread, tumour perforation, or resection margin involvement. Rectal cancers often receive 5-day short-course preoperative radiotherapy in an attempt to downstage the lesion or facilitate resection. This usually does not produce the marked macroscopic and histological features of regression that can be seen with the alternative 6-week-long course of neoadjuvant chemoradiotherapy. The latter is given to patients with clinically fixed tumours that show significant spread on MRI scan into the mesorectum, its nodes, or near its investing fascia (circumferential radial margin: CRM).

6.5 Surgical Pathology Specimens: Clinical Aspects

6.5.1 Biopsy Specimens

A number of procedures can be undertaken to obtain biopsy specimens from the colorectal mucosa:

Proctoscopy is used to inspect the distal rectum and anal canal.

Sigmoidoscopy can be carried out by using either a rigid or flexible sigmoidoscope. Rigid sigmoidoscopy is usually done without bowel preparation at the bedside or in the outpatient clinic. A hollow rigid plastic tube measuring 25 cm in length with an attached light and air supply is inserted into the rectum up to the distal sigmoid colon. Forceps can be passed through the tube to biopsy any lesion visualized. The scope is also used to assess tumour fixation and its distance from the anus. Flexible sigmoidoscopy (and colonoscopy) involves formal bowel preparation. A flexible fibre-optic endoscope is inserted and works in the same way as an upper GI endoscope, with a controllable tip and ports for inserting instruments, e.g., forceps, snare, etc. This should visualize up to the proximal sigmoid colon.

Colonoscopy is carried out using a colonoscope which is essentially a longer sigmoidoscope, with scopes of different lengths available (ranging from 140 to 185 cm). An experienced endoscopist should be able to pass the endoscope through the ileocaecal valve to visualize the terminal ileum. Intraoperative endoscopy can be used during a laparotomy to, for instance, locate lesions, e.g., polyps found by barium enema/CT scan that require localized resection and which cannot be palpated by the surgeon.

Biopsy specimens can be taken from the colonic mucosa by forceps passed through the endoscope in much the same way as that used in upper GI endoscopy. The colonoscopic management of polyps is important and depends on the size and type of polyp:

- Large pedunculated polyps can be removed by "snaring." A circular wire is passed over the polyp onto its stalk. An electrical current is passed along the wire to coagulate the vessels in the base of the stalk, which is then transected by closing the wire. If the stalk is large, adrenaline can be injected into the base to minimize bleeding. The polyp is retrieved by using the snare, a Dormia basket or suction.
- Smaller polyps (5–7 mm) can also be snared and removed by suction.
- Polyps <5 mm can be removed by "hot biopsy." Biopsy forceps grasp the polyp and a current is applied to electrocoagulate the base, and then the head of the polyp is pulled off by

the forceps. This procedure is used less now, especially for right colonic polyps, because of an increased risk of perforation.

- Broad-based sessile polyps can either be removed piecemeal using the snare or by injection polypectomy. This involves injecting saline or adrenaline solution into the submucosa around the polyp, raising it, and allowing it to be snared completely. This method can be used for polyps up to 5 cm in diameter.
- In patients with multiple small polyps, these can be highlighted by spraying dye onto the mucosa. This will reveal polyps 0.5 mm and larger as pale areas on a blue background.
- If the endoscopist is concerned that a polyp may be malignant, the site of polypectomy can be marked by tattooing the bowel mucosa with India ink. This allows the site to be revisited at a later date.

Submucosal lesions can be sampled by endoscopic FNA. Colonoscopy may also be used as a therapeutic tool, e.g., foci of angiodysplasia may be coagulated using hot biopsy forceps.

6.5.2 Resection Specimens

Resection of the colon and rectum is performed for a wide variety of both non-neoplastic and neoplastic conditions (Table 6.1), the type of procedure depending on the site and nature of the lesion, e.g., a malignant tumour, will require a more extensive resection than that for a large adenomatous polyp. Likewise the extent of mesenteric resection will depend on the type of lesion, i.e., wide mesenteric resection for neoplastic lesions and limited resection for non-neoplastic conditions. It also depends on the "intention" of the surgery for a malignant condition, i.e., a wide mesenteric resection with proximal ligation of vessels and, hence, removal of lymph node groups if the intention is curative, or limited, if the disease is advanced and the intention is palliative. The variety of terms used to describe the different types of colonic resection (colectomy) is depicted in Fig. 6.5. Choice is also determined by the distribution or multiplicity of lesions detected at preoperative colonoscopy. Planned elective laparoscopic surgery is the preferred option—open abdominal surgery (laparot-

Table 6.1 Colorectal resections

Specific	Diverticular disease
	Volvulus
	Pneumatosis coli
	Colonic angiodysplasia
	Rectal stump (CIBD, diversion proctitis)
	Rectal mucosa (prolapse)
Ulceroinflammatory	Ulcerative colitis
	Crohn's disease
	Pseudomembranous colitis
	Ischaemia
Neoplasia	Large or multiple adenomas
	Carcinoma
	Malignant lymphoma

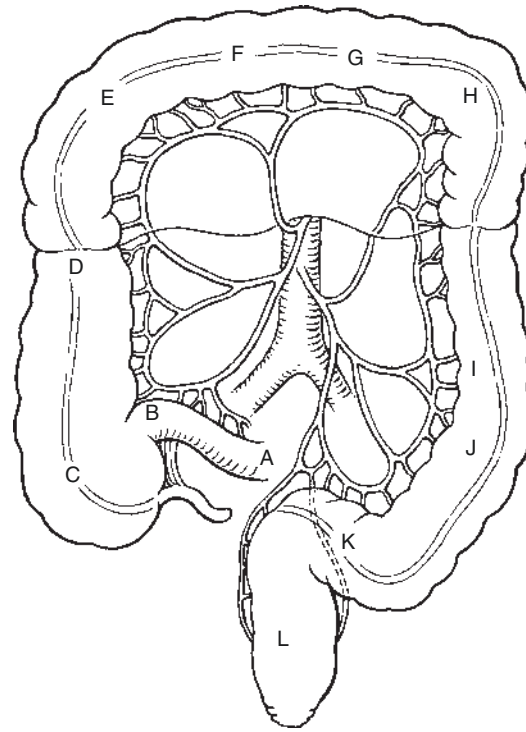

Fig. 6.5 Types of colonic resection. $A \rightarrow C$ Ileocaecectomy; $\pm A + B \rightarrow D$ Ascending colectomy; $\pm A + B \rightarrow F$ Right hemicolectomy; $\pm A + B \rightarrow G$ Extended right hemicolectomy; $\pm E + F \rightarrow G \pm H$ Transverse colectomy; $G \rightarrow I$ Left hemicolectomy; $F \rightarrow I$ Extended left hemicolectomy; $J + K$ Sigmoid colectomy; $\pm A + B \rightarrow J$ Subtotal colectomy; $\pm A + B \rightarrow L$ Total colectomy; $\pm A + B \rightarrow L$ Total proctocolectomy; L Proctectomy (Reprinted, with permission, from Fielding and Goldberg (2002))

omy) may be necessary for extensive disease, or if the patient presents as an acute emergency.

6.5.2.1 Resection in Neoplastic Conditions

Adenomatous polyps—As discussed above, the majority of adenomatous lesions can be removed by endoscopic techniques. However, large sessile polyps >5 cm in diameter and occupying more than one-third of the colon circumference should be removed by a localized resection. Sessile adenomas in the rectum can be removed by *transanal submucosal resection*. In this procedure, adrenaline solution is infiltrated into the submucosa around the lesion and the mucosa is incised by scissors 1 cm from the lesion. This can then be easily lifted off the circular muscle in a single piece and the mucosal defect is closed by sutures. This "advanced" polypectomy with submucosal infiltration is termed endoscopic mucosal resection (EMR). Extensions of this are endoscopic submucosal dissection (ESD) and transanal endoscopic microsurgery (TEMS) providing complete mucosectomy to full-wall-thickness specimens. Alternative descriptors are transanal resection of tumour (TART) or transanal microsurgery (TAMIS). These "big biopsy" specimens are both diagnostic (benign vs. malignant) and potentially therapeutic, allowing assessment of risk factors that might necessitate subsequent radical surgery (substaging of submucosal invasion, poor differentiation, lymphatic invasion, venous invasion or tumour "budding"), or repeat endoscopy and possible further local excision (margin involvement). Occasionally large rectal polyps may require formal proctectomy or anterior resection.

Malignant lesions—The type of resection for colonic tumours will depend on the site of the lesion and the intent of the surgery. As previously stated, the colonic lymphatics accompany the main blood vessels and the extent of resection depends on the lymphatic clearance required. In cancer operations of curative intent, the affected colon with its lymphovascular mesenteric pedicle is resected. Continuity is restored by either an ileocolic or colocolic end-to-end anastomosis. However, on occasion, an end ileostomy/colostomy may be required if the surgeon thinks that primary anastomosis would be compromised (e.g., if there is extensive intraperitoneal contamination).

The curative resection of rectal tumours may be carried out by one of two methods:

- *Anterior resection of rectum*—In this procedure, the rectum is mobilized by entering the fascial plane around the mesorectum. This allows the rectum to be removed *en* bloc with the mesorectum which contains the initial draining lymphovascular channels and nodes (low anterior resection and total mesorectal excision—TME) (Fig. 6.6a). Continuity is reestablished by a stapling device forming an end-to-end colorectal anastomosis. Occasionally, in low anastomoses, a protective loop colostomy/ileostomy may be fashioned to divert the faecal stream. This can be closed at a later date. To obtain an adequate length of colon to form a safe anastomosis, the splenic flexure will usually need to be mobilized. On occasion, the spleen may be damaged during this mobilization and a splenectomy would then have to be performed. In cases where the tumour is in the proximal rectum, a high anterior resection and mesorectal division can be employed. This entails division of the rectum and mesorectum 5 cm distal to the tumour and allows a larger rectal stump for anastomosis.
- *Abdominoperineal* (*AP*) *excision of rectum* (*APER*)—In this procedure, the rectum is mobilized as above and the colon is divided at the apex of the sigmoid. The anal canal and distal rectum are then resected from below via the perineal route (Fig. 6.6b). The entire rectum (and mesorectum) and anus are then removed *en bloc*. The perineal wound is closed and a permanent end colostomy is fashioned in the left iliac fossa using the transected end of the sigmoid colon.

Until the early 1980s, anterior resection was used in less than 50% of patients with rectal tumours, i.e., those in the proximal rectum. However, it is now used for approximately 90%

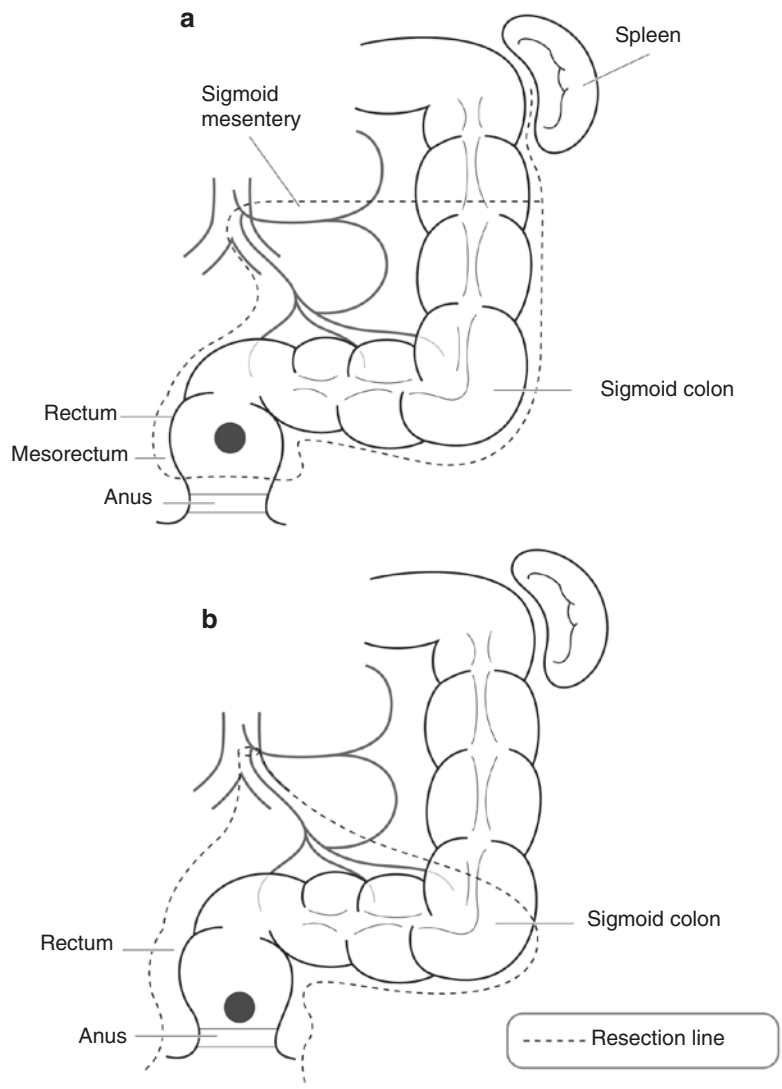

Fig. 6.6 (**a**) Resection in low anterior resection and total mesorectal excision; (**b**) resection in abdominoperineal excision (Reproduced, with permission, from Allen and Cameron (2013))

of tumours in the rectum. Initially it was feared that because less tissue is excised and the clearance of the distal margin is not as great during anterior resection, there would be increased local recurrence rates if anterior resection was used for low rectal tumours. However, it appears that the degree of lateral clearance is similar in the two procedures and that a distal clearance of 2 cm is adequate to prevent local recurrence. Given the physical and psychological problems associated with a permanent colostomy, and the higher incidence of bladder and sexual problems in patients undergoing AP resection, it is felt that a sphincter-saving procedure (i.e., anterior resection) should be employed whenever possible. However, tumours extending to less than 2 cm from the anorectal junction (i.e., less than 6 cm from the anal verge) should be treated by AP resection. Extra-levator abdominoperineal excision (ELAPE), performed partially with the patient in the prone position, is a more radical operation, removing a greater bulk of surrounding muscle, with the aim of creating a cylindrical specimen without a 'waist' in order to minimize the risk of CRM involvement by tumour and thereby the risk of recurrence.

Occasionally, in a medically unfit patient, localized resection is used for a well-differentiated, pT1 rectal cancer that is <3 cm in diameter. Accurate preoperative staging is crucial in selection of these patients and some may then need to proceed to salvage resection if adverse pathological features are identified in the pathological specimen, e.g., poor differentiation, lymphovascular involvement, or invasion of the deep margin or muscle coat. Sometimes patients with obstructing cancers undergo piecemeal resection (essentially palliative and non-curative), partial laser ablation, or stenting to restore intestinal continuity and avoid the risk of perforation. This may allow resection to be carried out more safely at a later date.

6.5.2.2 Resection in Non-neoplastic Conditions

Hartmann's procedure—This is one of the most commonly used emergency operations for colorectal disease. Although this was initially devised for the elective treatment of proximal rectal tumours, it is now usually used in the emergency setting to treat conditions such as perforated diverticular disease (most commonly), perforated tumour, etc. The procedure itself is defined as resection of the sigmoid colon (and a variable length of proximal rectum if required) with the fashioning of a terminal-end colostomy and closure of the rectal stump. The colostomy may be reversed at a later date by forming an end-to-end colorectal anastomosis.

Non-acute presenting diverticular disease is usually treated surgically by either sigmoid colectomy or left hemicolectomy depending on the extent of the disease.

Surgery in colorectal inflammatory bowel disease—The surgical management of colorectal Crohn's disease is similar to that in the small intestine (see Chap. 5). Namely surgical intervention is reserved for those in whom medical management has failed (i.e., minimal resection of the diseased segment) or who are suffering complications, e.g., obstruction, pericolic abscess, fistula, etc.

As in Crohn's disease, close liaison between surgeons and physicians is required in the management of ulcerative colitis. Emergency surgery is needed in cases of acute severe colitis and/or toxic megacolon. The procedure of choice is a subtotal colectomy and end ileostomy with the proximal end of the rectum brought to the surface in the form of a mucus fistula. This spares an already sick patient the added trauma of pelvic surgery and, if ulcerative colitis is confirmed by histological examination, allows an ileoanal pouch procedure to be considered in the future. Prior to the mid-1970s, patients with refractory ulcerative colitis underwent a panproctocolectomy (removal of the colon, rectum, and anus) with a permanent end ileostomy. However, in 1976, the procedure of *restorative proctocolectomy* was introduced and removed the need for a permanent ileostomy in suitable patients. In this procedure, the entire colon and rectum are removed and the mucosa may be stripped from the upper anus above the dentate line (some surgeons prefer to leave this mucosa intact as it is thought to improve future continence). An ileal reservoir (pouch) is formed (Fig. 6.7) and an ileoanal anastomosis is fashioned. A protective loop ileostomy is formed as close to the ileal pouch as possible and this can be closed at a later date

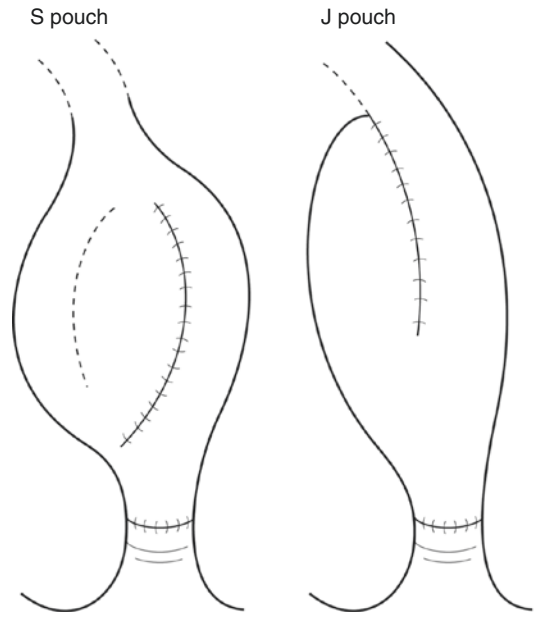

Fig. 6.7 Two popular designs of ileal pouch (Reproduced, with permission, from Allen and Cameron (2013))

(usually 2–3 months) after healing has been completed. A proportion of these patients (approximately 10%) may develop "pouchitis"—increased frequency of stool and feeling generally unwell. The exact aetiology of this is unknown but some feel it may be due to bacterial overgrowth in the pouch.

Angiodysplasia—If bleeding is severe enough to require surgical intervention, and if conservative treatment such as endoscopic coagulation has been unsuccessful, the procedure of choice will be dictated by the site of the bleeding point(s). However, if the site of bleeding cannot be discovered, a total colectomy with ileorectal anastomosis (or end ileostomy, rectal mucus fistula, and reversal at a later date) may be required.

6.6 Surgical Pathology Specimens: Laboratory Protocols

6.6.1 Biopsy Specimens

For biopsy specimens and local mucosal resections see Sect. 1.3.3 and Fig. 1.2.

6.6.2 Resection Specimens

Specimen:

- Colorectal specimens are for a range of either specific, ulceroinflammatory, or neoplastic conditions (Table 6.1). These can be complicated by obstruction with or without associated enterocolitis or perforation or show evidence of background disease such as CIBD or FAP. The resection specimen is dictated by the site and nature of the abnormality and extent of any complications or predisposing lesions that are present.

Initial procedure:

- In general, specimens are measured, opened with blunt-ended scissors along the antimesenteric border, and then blocked longitudinally (but see diverticular disease and tumour) following gentle washing out of faecal debris, pinning out with avoidance of unnecessary traction, and immersion in 10% formalin fixative for 48 h. Photographs may be taken before and after dissection.
- When opening avoid areas of perforation or tumour. Tumour segments may either be left unopened for fixation and subsequent transverse slicing or carefully opened—the latter gives better fixation, but the cut should be guided by palpation with the index finger to avoid disturbing the relationship of the tumour to the circumferential margin.

6.6.2.1 Diverticular Disease

- Measurements: length × diameter (cm) of the thickened colonic segment
- Inspect and describe: perforation, fistula, pericolonic exudate, or abscess
- Open and fix
- Serially transverse specimen at 5 mm intervals
- Sample (four blocks minimum) the diverticula, any associated inflammation, or thickened mucosa that might represent segmental colitis, mucosal prolapse, or tumour
- Sample mesenteric lymph nodes

6.6.2.2 Volvulus, Pneumatosis Coli, Rectal Stump, Rectal Mucosa in Prolapse

- Measurements: length × maximum diameter (cm)
- Open and fix
- Inspect and describe
  Volvulus—dilatation, thinning, melanosis, stercoral ulceration, ischaemia, perforation
  Pneumatosis—mucosal cobbling, blebs or gas cysts, inflammation, ulceration, perforation
  Rectal stump—mucosal granularity, ulceration, polyps, fistulae, tumour
  Rectal mucosal prolapse—mucosal granularity, thickening, induration, ulceration
- Sample (four blocks minimum) macroscopically normal and abnormal areas as indicated
- Sample mesenteric lymph nodes

6.6.2.3 Ulceroinflammatory and Neoplastic Conditions

- Open and inspect
- Measurements:
  Lengths and maximum diameter (cm) of the parts present—terminal ileum, appendix, colon, rectum, anus
  Lengths (cm) of ischaemic, inflamed, or strictured segments
  Maximum dimensions (cm) of any perforation(s), ulcer(s), polyp(s) or tumour(s)
  Distances (cm) of the abnormality from the proximal and distal resection limits
  Distances (cm) of the polyp/tumour/ulcer from the anorectal dentate line and relationship to the peritoneal reflection (above/straddling/below) and colorectal circumference (anterior/posterior/right or left lateral)
  Distances (mm) of tumour from the nearest aspect of the mesocolic/mesorectal CRM
- Grade the plane of mesorectal excision (mesorectal fascia, intramesorectal, muscularis propria) for anterior resection and APE specimens.
- Grade the plane of excision of the levators/sphincters (extralevator, sphincteric, intrasphincteric) for APE specimens.
- Photograph
- Paint any aspect of the mesocolic/mesorectal margin adjacent to or overlying tumour
  Gently pin out and fix for 48 h

Description:

- Tumour
  - Site
    Ileocaecal valve/caecum/colon (which segment, flexure)/rectum (above, straddling, or below the peritoneal reflection and upper, mid, or lower, anterior, posterior, or lateral)/anus
    Lumenal/mural/extramural/mesenteric
  - Size
    Length × width × depth (cm) or maximum dimension (cm)
  - Appearance
    Polypoid/nodular—adenoma, carcinoma, carcinoid, multiple lymphomatous polyposis, GIST
    Ulcerated/stricture—carcinoma, malignant lymphoma, metastatic carcinoma
    Fleshy/rubbery—malignant lymphoma, GIST
    Multiple—adenomas, carcinoma (primary or metastatic), malignant lymphoma
  - Edge: Circumscribed/irregular
    Perforation
    Adjuvant therapy changes: necrosis, ulceration, fibrosis
- CIBD—ulcerative colitis: continuous/diffuse mucosal distribution, granularity, ulceration (linear/confluent), inflammatory polyps, synechiae, nodular or sessile DALMs, tumour, mucosal reversion with healing and atrophy, backwash ileitis, treatment-related rectal sparing
  - Crohn's disease: discontinuous/segmental and transmural distribution, cobblestone mucosa, ulceration (aphthous/linear/confluent), stricture, fat wrapping, fistulae, polyps or tumour, lymphadenopathy, adhesions, abscess formation, ileal/anal disease
- Ischaemia—serosal hyperaemia/constriction band, mucosal hyperaemia/haemorrhage/ulceration/necrosis, wall thinning/perforation/stricture
- Pseudomembranous colitis—pseudomembranes (adherent/yellow), mucosal granularity/erosion/ulceration, stricture
- Obstructive enterocolitis—ulceration or stricture (contiguous or distant, diffuse or segmental), dilatation, wall thinning, perforation, ileal component

Blocks for histology:
Ulceroinflammatory conditions (Fig. 6.8)

- Sample by circumferential transverse sections the proximal and distal limits of resection
- Sample macroscopically normal bowel
- Sample representative longitudinal blocks (a minimum of four) of any focal abnormality that is present to include its edge and junction with the adjacent mucosa, e.g., ulceration, stricture, fistula, perforation, pseudomembranes, inflammatory polyps, serosal adhesions or constriction bands. Also

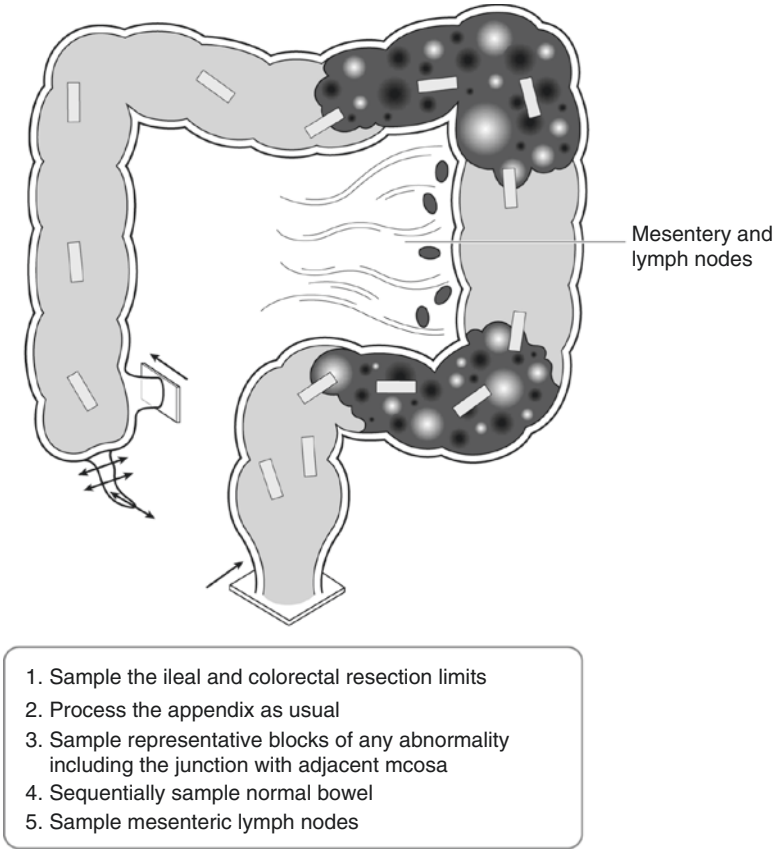

Fig. 6.8 Ulceroinflammatory colorectal conditions (Reproduced, with permission, from Allen and Cameron (2013))

  - CIBD: Sequential labeled samples at 10 cm intervals from caecum to anus and additional blocks from any unusual nodular or sessile abnormality (DALM)
  - Ischaemia: Sample the mesenteric vessels
- Sample mesenteric lymph nodes and any other structures, e.g., appendix or terminal ileum.

Neoplastic conditions (Fig. 6.9)

- Sample the nearest longitudinal resection margin if tumour is present to within <3 cm of it.
- Sample macroscopically normal bowel and representative blocks of other mucosal lesions that are present, e.g., adenomatous polyps (if multiple particularly those >1 cm diameter).
- Serially section the bulk of the tumour transversely at 3–4 mm intervals.
- Lay the slices out in sequence and photograph.
- Note and measure the relationship of the deep aspect of the tumour to the nearest site-orientated point of the serosa and the CRM. Note serosal tumour perforation or CRM involvement (≤1 mm).
- Note that in some resections the CRM may comprise an adherent or involved adjacent structure eg a cuff of peritonealised anterior abdominal wall soft tissue or posterior vaginal wall. Its deep aspect should be painted and sampled appropriately.
- In general, sample (four blocks minimum) tumour and wall to demonstrate these relationships. With bulky mesentery/mesorectum, the block may have to be split and appropriately labeled for loading in the cassettes.
- Count and sample all lymph nodes and identify a suture tie limit node. Take care to count the nodes in the tumour slices and also those

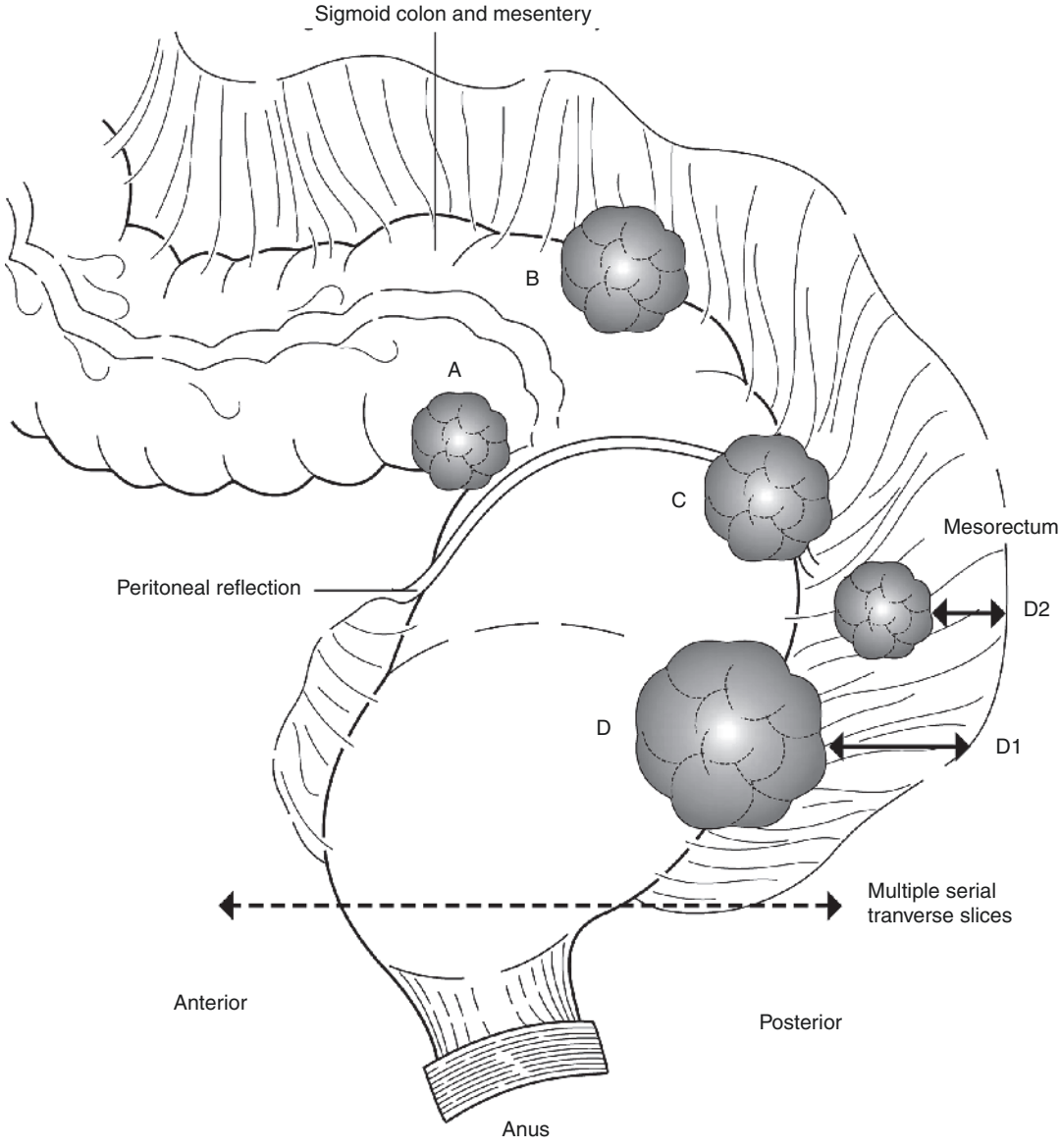

Fig. 6.9 Rectal carcinoma. The upper anterior rectum is invested in peritoneum. The anterior mesorectum is thinner (0.75–1 cm) than the posterior mesorectum (1.5–3 cm). Cut the resection specimen into multiple serial transverse slices about 3–4 mm thick. Blocks for histology are: Above the reflection: *A* tumour, rectal wall, and serosa; *B* tumour, rectal wall, and serosa; tumour, rectal wall, and mesentery; At the reflection: C tumour, rectal wall, and serosa; tumour, rectal wall, and mesorectum; Below the reflection: *D* tumour, rectal wall, and mesorectum; *D1* distance (mm) of the deepest point of continuous tumour extension to the nearest point of the painted CRM; *D2* distance (mm) of the deepest point of discontinuous tumour extension (or in a lymphatic, node, or vessel) to the nearest point of the painted CRM (Reproduced, with permission, from Allen (2013))

in the mesentery away from the tumour, e.g., sigmoid mesocolon in a rectal cancer. Separate soft tissue deposits in the mesocolon/mesorectum are submitted for microscopy so that the pathologist can determine whether they are lymph nodes replaced by tumour, discontinuous tumour extension, tumour in a vascular or perineural space, or, tumour satellites.

- Sample multifocal serosal seedlings and omental deposits (pM disease) as indicated by inspection and palpation.

Histopathology report:

- Ulcerative colitis—site-related disease activity (healed/quiescent/mild/moderate/severe), rectal sparing, appendiceal and caecal skip lesions, backwash ileitis, toxic dilatation, superimposed infection (e.g., CMV), DALMs, carcinoma, or lymphoma
- Crohn's disease—chronic transmural inflammation, granulomas, fissures/fistulae, abscess formation, segmental distribution/appendiceal/ileal disease, malignancy
- Ischaemia—necrosis (mucosal/transmural/gangrenous), resection limits (ischaemic/viable), mesenteric vessels (thrombosis/embolism/vasculitis), miscellaneous (constriction band/volvulus/stricture)
- Pseudomembranous colitis—pseudomembranes, ulceration, necrosis, perforation, strictures
- Obstructive enterocolitis—note ulceration/perforation/stricture/distribution and features specific to the aetiological abnormality

Neoplastic conditions

- Tumour type—adenocarcinoma/malignant lymphoma/other
- Tumour differentiation
  - Adenocarcinoma
    Well/moderate or poor
  - Malignant lymphoma
    MALT/mantle cell/follicular/Burkitt lymphoma/other
    Low grade/high grade
- *Extent of local tumour spread: TNM 8: for carcinoma*

pTis	Carcinoma in situ: intraepithelial (within basement membrane) or invasion of lamina propria (intramucosal) with no extension through muscularis mucosae into submucosa
pT1	Tumour invades submucosa
pT2	Tumour invades muscularis propria
pT3	Tumour invades through the wall into subserosa or non-peritonealized pericolic/perirectal tissues
pT4	Tumour pT4a. perforates visceral peritoneum, or, pT4b. invades other organs or structures

- Distance of infiltration beyond muscularis propria (for sub-staging pT3 cancers)
- Venous invasion—present/not present and deepest (extramural, intramuscular or submucosal)
- Regional lymph nodes
  - Pericolic, perirectal, those located along the ileocolic, colic, inferior mesenteric, superior rectal and internal iliac arteries; a regional lymphadenectomy will ordinarily include 12 or more lymph nodes

pN0	No regional lymph node metastasis
pN1	1–3 involved regional lymph node(s): pN1a = 1node, pN1b = 2–3 nodes, pN1c = soft tissue deposit(s)/satellite(s) with no involved nodes
pN2	4 or more involved regional lymph nodes:p N2a = 4–6 nodes, pN2b = 7 or more nodes
Dukes' stage	
A	tumour limited to the wall, node negative
B	tumour beyond the wall, node negative
C_1	nodes positive, apical node negative
C_2	apical node positive
D	distant metastases

- Excision margins
  Proximal and distal longitudinal (cm) and mesocolic/mesorectal circumferential (mm) limits of tumour clearance
  Deep and peripheral margin clearance (mm) assessed in local excision specimens (see section "Resection in Neoplastic Conditions" for other adverse factors).
- Other pathology
  Tumour regression grade in response to neoadjuvant therapy, adenoma(s), FAP, ulcerative colitis, Crohn's disease, diverticular disease
- MMR protein immunohistochemistry (to detect Lynch syndrome or sporadic MSI pathway colorectal cancer, based on age of diagnosis and/or morphological suspicion).
- Molecular testing for prediction of response to anti-epidermal growth factor receptor (EGFR) therapy, if clinically indicated (K-RAS, N-RAS and BRAF mutation status).
- Block index facilitates slide interpretation at case review (for MDM or any other purpose) and selection of suitable tumour block (without need for slide review) for retrospective immunohistochemical or molecular testing.

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