GROSS ANATOMY OF THE STOMACH AND DUODENUM

Arteries

The stomach has an arterial supply on both the lesser and greater curves. On the lesser curve, the left gastric artery, a branch of the coeliac axis, forms an anastomotic arcade with the right gastric artery, which arises from the common hepatic artery. The gastroduodenal artery, which is also a branch of the hepatic artery, passes behind the first part of the duodenum. Here it divides into the superior pancreaticoduodenal artery and the right gastroepiploic artery. The superior pancreaticoduodenal artery supplies the duodenum and pancreatic head, and forms an anastomosis with the inferior pancreaticoduodenal artery, a branch of the superior mesenteric artery. The right gastroepiploic artery runs along the greater curvature of the stomach, eventually forming an anastomosis with the left gastroepiploic artery, a branch of the splenic artery. The fundus of the stomach is supplied by the vasa brevia (or short gastric arteries), which arise near the termination of the splenic artery.

Veins

In general, the veins are equivalent to the arteries, ending in the portal vein.

Lymphatics

The lymphatics of the stomach are of considerable importance in the surgery of gastric cancer and are described in detail in that section.

Nerves

As with all of the gastrointestinal tract, the stomach and duodenum possess both intrinsic and extrinsic nerve supplies. The extrinsic supply is derived mainly from the vagus nerves, Vagal fibres are both afferent (sensory) and efferent. The efferent fibers are involved in the receptive relaxation of the stomach and the stimulation of gastric motility, as well as having a secretory function. The sympathetic supply is derived mainly from the coeliac ganglia.

MICROSCOPIC ANATOMY OF THE STOMACH AND DUODENUM

The gastric epithelial cells are mucus producing and are turned over rapidly. In the pyloric part of the stomach, and also the duodenum, mucus-secreting glands are found. The specialized cells of the stomach (parietal and chief cells) are found in the gastric crypts. There is also numerous endocrine cells.

Parietal cells

These are in the body (acid-secreting portion) of the stomach, being. They are responsible for the production of hydrogen ions used to form hydrochloric acid. The hydrogen ions are actively pumped by the proton pump, a hydrogen–potassium-ATPase, which exchanges intraluminal potassium for hydrogen ions. The potassium ions enter the lumen of the crypts passively, but the hydrogen ions are pumped against an immense concentration gradient.
Chief cells

These lie in the gastric crypts and produce pepsinogen. Pepsinogen is activated in the stomach to produce pepsin, the active enzyme.

Endocrine cells

The stomach has numerous endocrine cells.

- In the gastric antrum the mucosa contains G cells which produce gastrin.
- Throughout the body of the stomach, enterochromaffin-like (ECL) cells are abundant and produce histamine, a key factor in driving gastric acid secretion.
- There are also large numbers of somatostatin-producing D cells throughout the stomach.

Duodenum

The duodenum is lined by a mucus-secreting columnar epithelium. In addition, Brunner’s glands lie beneath the mucosa.

Endocrine cells in the duodenum produce cholecystokinin and secretin.

INVESTIGATION OF THE STOMACH AND DUODENUM

Flexible endoscopy

Flexible endoscopy is now the ‘gold standard’ for diagnosis. The most use is a solid-state camera mounted at the instrument’s tip. Other members of the endoscopy team are able to see the image and this is useful when taking biopsies or performing interventional techniques. Flexible endoscopy is more sensitive than conventional radiology in the assessment of the majority of gastro duodenal conditions. This is particularly the case with peptic ulceration, gastritis, duodenitis and upper gastrointestinal bleeding, endoscopy is far superior to any other investigation and, in most circumstances is the only imaging required. Careless and rough handling of the endoscope during intubation of a patient may result in perforations of the pharynx and oesophagus. The endoscopy is normally carried out under sedation, Bleeding from the stomach and duodenum can be treated with a number of haemostatic measures. These include injection with various substances, diathermy, heater probes and lasers.

Contrast radiology

Upper gastrointestinal radiology is now less frequently used as endoscopy is a more sensitive investigation for most gastric problems. Computerized tomography (CT) imaging with oral contrast has also replaced contrast radiology in areas where anatomical information is sought, e.g. large hiatus hernias of the rolling type and chronic gastric volvulus.

Ultrasonography

Standard ultrasound imaging can be used to investigate the stomach, but used conventionally it is less sensitive than other modalities. In contrast, endoluminal ultrasound and laparoscopic ultrasound are probably the most sensitive techniques available in the preoperative staging of gastric cancer.

Enlarged lymph nodes can also be identified. Finally, it may be possible to identify liver metastases not seen on axial imaging. Laparoscopic ultrasound is also very sensitive and is one of the most sensitive methods of detecting liver metastases from gastric cancer.
**Computerised tomography scanning and magnetic resonance imaging**

The CT is of increasing value in the investigation of the stomach, especially malignancies. The presence of gastric wall thickening associated with a carcinoma of any reasonable size can be easily detected by CT, it is possible to detect nodal involvement with tumour. However, Microscopic tumour deposits cannot be detected when the node is not enlarged.

The detection of small liver metastases is improving in diagnosis of gastric cancer. Magnetic resonance imaging (MRI) scanning does not offer any specific advantage in assessing the stomach, although it has a higher sensitivity for the detection of gastric cancer liver metastases than conventional CT imaging.

**Computerised tomography/positron emission tomography**

Positron emission tomography (PET) is a functional imaging technique that relies on the uptake of a tracer, in most cases by metabolically active tumour tissue. CT/PET is now used universally. It is increasingly being used in the preoperative staging of gastro-oesophageal cancer.

**Laparoscopy**

This technique is now well used in the assessment of patients with gastric cancer. Its particular value is in the detection of peritoneal metastases, which is difficult by any other technique. Laparoscopy is usually combined with peritoneal cytology. Laparoscopic ultrasound provides an accurate evaluation of lymph node and liver metastases.

**Angiography**

Angiography is used most commonly in the investigation of upper gastrointestinal bleeding that is not identified using endoscopy. Therapeutic embolisation may also be of value in the treatment of bleeding in patients in whom surgery is difficult or inadvisable.

**PEPTIC ULCERS**

The name ‘peptic’ ulcer suggests an association with pepsin. Common sites for peptic ulcers are the duodenum, stomach, but they also occur on the stoma following gastric surgery, the oesophagus and even Meckel’s diverticulum, which contains ectopic gastric epithelium.

Ulcer occurs in the epithelium least resistant to acid damage, ulcers can be healed in the absence of acid, it is clear that acid is an important aetiological factor, but this is not the case in the majority of patients. As with many diseases, genetic factors may be involved to a limited degree and social stress. It is now widely accepted that infection with H. pylori is the most important factor in the development of peptic ulceration. The other factor of major importance at present is ingestion of NSAIDs. Cigarette smoking predisposes to peptic ulceration and increases the relapse rate after treatment with gastric antisecretory agents or, as carried out in the past, elective surgery. Multiple other factors may be involved in the transition between the superficial and the deep penetrating chronic ulcer, but they are of lesser importance.
Duodenal ulceration

Incidence

In west with the introduction of H2-receptor antagonists, the incidence of duodenal ulceration and the frequency of elective surgery for the condition were falling. This may relate to the widespread use of gastric antisecretory agents. The peak incidence is now in a much older age group than previously although it is still more common in men, the difference is less marked. These changes in part is in the epidemiology of H. pylori infection. In Eastern Europe the disease remains common and, although previously uncommon, it is now observed more frequently in some developing nations. Again, the relationship with H. pylori appears convincing.

Pathology

Most duodenal ulcers occur in the first part of the duodenum, chronic ulcer penetrates the mucosa and into the muscle coat, leading to fibrosis. The fibrosis causes deformities such as pyloric stenosis. Sometimes there may be more than one duodenal ulcer. The situation in which there is both a posterior and an anterior duodenal ulcer is referred to as ‘kissing ulcers’. Anteriorly placed ulcers tend to perforate and, in contrast, posterior duodenal ulcers tend to bleed, sometimes by eroding a large vessel such as the gastro-duodenal artery. Malignancy in duodenal ulcer so rare that, surgeons can be confident that they are dealing with benign disease, but in the stomach the situation is different. Malignancy is much more in gastric ulcers.

Gastric ulceration

Incidence

As with duodenal ulceration, H. pylori and NSAIDs are the important aetiological factors in gastric ulceration. Gastric ulceration is also associated with smoking; other factors are of lesser importance.

There are marked differences between the populations affected by chronic gastric ulceration and those affected by duodenal ulceration. First, gastric ulceration is substantially less common than duodenal ulceration. The incidence of gastric ulcers is equal between the sexes and the population with gastric ulcers tends to be older. They are more prevalent in the developing world than in the west.

Pathology

The pathology of gastric ulcers is essentially similar to that of duodenal ulcers, except that gastric ulcers tend to be larger. Fibrosis, when it occurs, may result in the now rarely seen hourglass contraction of the stomach. Large chronic ulcers may erode posteriorly into the pancreas and, on other occasions, into major vessels such as the splenic artery. Less commonly, they may erode into other organs such as the transverse colon. Chronic gastric ulcers are much more common on the lesser curve than on the greater curve.

Malignancy in gastric ulcers

Chronic duodenal ulcers are not associated with malignancy but, in contrast the incidence of malignancy is high in gastric ulcers. there is the situation in which a benign chronic gastric ulcer undergoes malignant transformation. So if the patient identified as having an ulcer in the stomach, either endoscopically or on contrast radiology, biopsies should be taken to exclude malignancy.
Clinical features of peptic ulcers

Pain

The pain is epigastric, may radiate to the back. Eating may sometimes relieve the discomfort. The pain is normally intermittent rather than intractable.

Periodicity

Symptoms may disappear for weeks or months to return again. This periodicity may be related to the spontaneous healing of the ulcer.

Vomiting

Although this occurs, it is not a notable feature unless stenosis has occurred.

Alteration in weight

Weight loss or, sometimes, weight gain may occur. Patients with gastric ulceration are often underweight but this may precede the occurrence of the ulcer.

Bleeding

All peptic ulcers may bleed. The bleeding may be chronic and presentation with anaemia is not uncommon. Acute presentation may be haematemesis and melaena.

Clinical examination

Examination of the patient may reveal epigastric tenderness but, except in extreme cases (for instance gastric outlet obstruction), there is unlikely to be much else to find.

Investigation of the patient with suspected peptic ulcer

Gastroduodenoscopy

This is the investigation of choice in the management of suspected peptic ulceration and is highly accurate. In the stomach, any abnormal lesion should be multiply biopsied and, in the case of a suspected benign gastric ulcer, numerous biopsies must be taken to exclude the presence of a malignancy. Commonly, biopsies of the antrum will be taken to see whether there is histological evidence of gastritis and a CLO test performed to determine the presence of H. pylori.

Treatment of peptic ulceration

The majority of uncomplicated peptic ulcers are treated medically. Surgical treatment of uncomplicated peptic ulceration has decreased markedly and is now seldom performed.

Surgical treatment was aimed principally at reducing gastric acid secretion and, in the case of gastric ulceration, removing the diseased mucosa. Medical treatment also aimed to reduce gastric acid secretion, initially using highly successful H2-receptor antagonists and, subsequently, proton pump inhibitors.
**Medical treatment**

It is reasonable that a doctor managing a patient with an uncomplicated peptic ulcer should suggest modifications to the patient’s lifestyle, particularly the cessation of cigarette smoking.

H2-receptor antagonists and proton pump inhibitors H2-receptor antagonists revolutionized the management of peptic ulceration; most duodenal ulcers and gastric ulcers can be healed by a few weeks of treatment with these drugs provided that they are taken and absorbed. There remain, however, a group of patients who are relatively refractory to Conventional doses of H2-receptor antagonists. This is largely now irrelevant as proton pump inhibitors can effectively render a patient achlorhydric and all benign ulcers will heal using these drugs, the majority within 2 weeks. Symptom relief is impressively rapid, most patients being asymptomatic within a few days. Like H2-receptor antagonists, proton pump inhibitors are safe and relatively devoid of serious side-effects. The problem with all gastric anti-secretory agents is that, following cessation of therapy, relapse is almost universal.

**Surgical treatment of uncomplicated peptic ulceration**

The incidence of surgery for uncomplicated peptic ulceration has fallen markedly, to the extent that peptic ulcer surgery is now of little more than historical interest.

A description of operations used in the treatment of peptic ulcers is still necessary because surgery is commonly employed for the complicated ulcer and, in addition, many patients are left suffering from the consequences of the more destructive operations