Definition of gastro-duodenal junction in healthy subjects

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Summary To study the appearance and distribution of the normal mucosa at the gastroduodenal junction in man, 14 specimens of normal mucosa, eight obtained during pyloroplasty, and "relatively" normal specimens from the distal stomach and whole duodenum were examined microscopically. Three histologically distinct types of normal duodenal mucosa were found at this junction. These were termed antral type duodenal mucosa, transitional type duodenal mucosa (which is also referred to as gastric surface epithelial metaplasia), and jejunal type duodenal mucosa. Antral type duodenal mucosa appeared as a series of finger-like processes 1-3 mm long, circumferentially located around the junction of the antrum and duodenum; transitional type duodenal mucosa extended 2-3 mm beyond this; and the rest of the mucosa was jejunal type duodenal mucosa.

The mucosa of the pyloric antrum can therefore lie adjacent to antral type duodenal mucosa, or adjacent to either of the components of transitional type duodenal mucosa.

Knowledge of the histology of the normal duodenum in man is limited, long lengths of healthy duodenal mucosa that cross this junction are difficult to obtain. Necropsy material is of little value because of early autolysis,12 and specimens removed for fibre optic endoscopy are minute.

Material and methods

Normal Mucosa

Twelve mucosal strips were obtained during pyloroplasty when the normal stomach was used to replace or bypass the oesophagus, resected because of carcinoma. Two specimens were removed from the distal stomach and whole duodenum following a Whipple type resection, one from a cadaver for renal transplantation and one for trauma due to a gunshot wound of the pancreas.

Relatively Normal Mucosa

Eight specimens were removed from the distal stomach and whole duodenum during a Whipple type procedure, three for carcinoma of the ampulla of Vater and five for carcinoma of the pancreas.

All Whipple type specimens were opened by an incision along the greater curvature of the stomach, which was continued into the inferior border of the duodenum. The specimens were kept flat and were fixed in 10% formol-saline solution. After fixation long strips of mucosa were excised from the anterior and posterior walls of the stomach and duodenum, and from the superior and inferior borders of the duodenum that was continuous with the mucosa from the lesser and greater curvatures of the stomach. It was convenient to cut appropriate lengths of mucosa, marking the proximal end on each occasion with waterproof black ink. Biopsy material from the anterior wall of the pyloric antrum and duodenum was fixed in the same way. All specimens were prepared for light microscopy using conventional histological techniques and staining methods.

Results

The duodenum was defined as that part of the upper small bowel in which Brunner's glands occurred. A clear description of these glands has been given elsewhere.3

There are three clearly distinct histological types of mucosa at the gastroduodenal junction, and I have used the terms antral type duodenal mucosa (ATDM), jejunal type duodenal mucosa (JTDM), and transitional type duodenal mucosa (TTDM).

Antral Type Duodenal Mucosa (ATDM)

The mucosa resembled that of the pyloric antrum in all respects (fig 1). The crypts were well formed and were
the same depth as those seen in the pyloric antrum. Under the crypts there were normal mucus secreting glands extending to the lamina muscularis mucosa. Mitotic activity was normal, about one mitotic figure every three or four high powered fields could be seen (×400). Brunner’s glands were visible below the muscularis mucosa.

Fig 2 details the appearance of the surface epithelium.

JEJUNAL TYPE DUODENAL MUCOSA (JTDM)
The mucosa resembled that of the normal jejunum in all respects, and again Brunner’s glands were present below the lamina muscularis mucosa (fig 3). Goblet cells could be seen even under low power. The villi were well defined, with crypts of Lieberkühn that were not as deep as those more distally occurring in true jejunal mucosa. Mitotic activity was the same as that of the jejunum, about one to two mitotic figures in every high power field (×400). The detail of the appearance of the surface epithelium of JTDM is shown in fig 2. The most characteristic feature was the presence of goblet cells which appear as large clear circular cells in the surface epithelium.

Cell membranes were not clearly visible, and the cytoplasm usually contained two well defined areas—a darker eosinophilic area on the luminal side, and a lighter basophilic area immediately above the nucleus.

TRANSITIONAL TYPE DUODENAL MUCOSA (TTDM)
This type of mucosa was positioned between ATDM and JTDM. In the same field, adjacent villi showed the features of both ATDM and JTDM, and often all of these features could be seen on the same villi (figs 2 and 4). Fig 4 shows that even under low power the apex of the central villus is covered by antral type epithelium. Goblet cells, characteristic of JTDM, were seen on either side of the apical antral epithelium on the same villus.

Macroscopically the junction between the lower end of the stomach and the duodenum is a well defined straight line. Microscopically, however, the junction was less well defined (fig 5). The junction was crenated with finger-like processes of ATDM extending 1–3 mm into the duodenum. These processes were present circumferentially around the whole gastro-duodenal junction. Adjacent to the projections of ATDM, there was a narrow area of TTDM 2–3 mm in length (fig 5), and more distally all the mucosa was of the jejunal type. Mucosa of the pyloric antrum of the stomach can therefore lie adjacent to either ATDM or to either of the components of TTDM.
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Fig 3  Jejunal type duodenal mucosa. Mucosa resembles that of jejunum in all respects. Brunner’s glands indicated (arrow).

**Discussion**

In the material described as relatively normal care was taken to examine mucosa that was at least 2 cm apart from any obvious lesion. The findings in the normal and relatively normal groups were identical as far as observations using conventional light microscopy were concerned. It is therefore suggested that all the material examined did, in fact, represent normal duodenal mucosa. Conventional textbook descriptions of human duodenal mucosa refer only to the appearance of a single type of mucosa, and no reference is made to the three well defined types of mucosa that we observed. When long strips of mucosa that extended from the pyloric antrum into the duodenum were studied, the presence and distribution of the three types of mucosa became apparent.

The appearance of villi in the duodenum covered by an epithelium resembling that of the stomach has been extensively reported, and has been termed “gastric epithelium”, and “gastric surface epithelial metaplasia”. The authors appear to be describing identical histological types of mucosa, and this mucosa is also identical with that described here and referred to as TTDM (figs 2 and 4).

Clearly, ATDM, TTDM, and JTDM all occur in the normal duodenum and have a characteristic distribution that would account for the fact that both ATDM and TTDM have often been seen in biopsy specimens taken circumferentially from the area of the gastroduodenal junction.

Whether TTDM is a normal occurrence or indicative of gastric surface epithelial metaplasia is of particular importance. In their description of the histology of chronic duodenitis, Whitehead *et al*...
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maintained that gastric surface epithelial metaplasia is never seen if the biopsy specimen is entirely normal. Their view that this is an abnormal finding is widely supported, and it has been claimed that this type of epithelium can be produced experimentally. From my results, however, changes in the surface epithelium of villi, corresponding in every way to the description of gastric surface epithelial metaplasia do, in fact, occur in normal duodenal mucosa. In a study also based on the examination of duodenal mucosa from normal subjects, an incidence of 64% of gastric surface epithelial metaplasia has been reported.

The histological distinction between normal and abnormal duodenal mucosa remains difficult, but improved methods for the techniques of differential cell counts and quantitative immunocytochemistry may become increasingly more important.

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References

5 Patrick WJA, Den_ham D, Forrest APM. Mucus changes in the human duodenum; a light and electron microscopic study and correlation with disease and gastric acid secretion. Gut 1974;15:767-76.

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