Mucus and gastroduodenal mucosal protection

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MUCUS IN VIVO

A layer of water-insoluble mucus gel, adherent to the gastroduodenal mucosal surface acts as a protective barrier between a susceptible epithelium and the aggressive factors in luminal juice. An understanding of the structure and properties of this adherent mucus gel secretion is the key to elucidating the role of mucus in gastroduodenal mucosal protection and changes in the mucus barrier associated with ulcer pathogenesis. The adherent mucus can be observed in situ on unfixed mucosal sections as a thin layer of translucent gel which completely covers the mucosal surface. In the stomach and duodenum the mucus layer is continuous but of variable thickness ranging between 50 to 450 $\mu$m on human stomach (median thickness 180 $\mu$m) and 10 to 400 $\mu$m on rat stomach or duodenum (median thickness 70 $\mu$m and 80 $\mu$m respectively). The thickness of the adherent mucus layer is the result of a dynamic balance between new secretion from the epithelium and erosion at the luminal aspect of the mucus layer (Fig. 6.1). Mucus erosion results from the mechanical forces associated with the digestive processes and mucolysis by proteolytic enzymes, in particular pepsin.

The extracellular adherent mucus gel layer, although clearly visible on unfixed mucosal sections is either absent or very much reduced on mucosal sections that have been fixed and stained for histological observation. An explanation for this effect is that mucus is 95% water and fixatives such as...
ethanol and glutaraldehyde will dehydrate mucus causing denaturation and an overall shrinkage of the gel. In contrast, presecreted mucus contained within intracellular vesicles remains after histological processing to give the mucus-secreting epithelia its characteristic neutral mucin and basophilic staining properties. Stimulation of the various mucus-secreting cell types (surface epithelial and mucus neck cells of the stomach and Brunner's glands of the duodenum) by prostaglandins results in the release of mucus stores increasing the thickness of the barrier by up to three-fold. Luminal mucus, since it mixes freely with the gastric juices, is unlikely to have significant protective functions, although a plentiful output of soluble mucus will act as a lubricant preventing excessive depletion of the adherent mucus gel layer and damage to the mucosa from mechanical forces.

ADHERENT MUCUS GEL

The rheological properties of adherent mucus obtained from the human stomach, pig stomach and pig duodenum as measured by mechanical spectroscopy are characteristic of a weak, viscoelastic gel that is water-insoluble. The adherent mucus is a relatively stable gel and will only show flow characteristics over a relatively long time scale of 0.5 to 1 hour. The mucus gel is resistant to a variety of mucosal damaging agents: for example prolonged exposure of gastric or duodenal mucus to hypertonic sodium chloride, ethanol (up to 40% v/v), bile or acid (pH 1) does not alter its measured mechanical properties. The absence of effect of acid on gastroduodenal mucus gel structure