Duodenal bicarbonate secretion contributes to a surface microenvironment at the epithelial surface

Subha L. Amatya, Andrea L. Matthis Ph.D., Marshall H. Montrose Ph.D.

Department of Molecular and Cellular Physiology,
University of Cincinnati College of Medicine, Cincinnati, OH 45267

The duodenum has an important role of bicarbonate secretion to neutralize the incoming acidic gastric chyme. In addition, there is impaired duodenal bicarbonate secretion in the development of peptic ulcers, which may occur in the stomach or duodenum. It has been hypothesized that duodenal bicarbonate secretion creates an alkaline microenvironment in the region immediately surrounding the villus compared to the inter-villus lumen. Furthermore, the alkaline microenvironment would serve to protect tissue integrity against the acidic gastric chyme. Our aim was to measure pH differences between the lumen immediately adjacent to the villus (surface pH) versus inter-villus lumen pH. pH measurements were made using filleted open duodenum of anesthetized, live mice. To visualize pH measurements, SNARF-4F, a ratiometric, dual emission dye was used. We induced bicarbonate secretion using the drug forskolin. Forskolin increases levels of cyclic adenomonophosphate (cAMP), which then leads to an increase in duodenal bicarbonate secretion. We found that the surface pH did maintain a more alkaline environment compared to inter-villus lumen pH in response to forskolin challenge. Moreover, we found a pH gradient existed from the surface pH towards the inter-villus lumen, a distance of about 100 μm.

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