Short-chain fatty acids augment rat duodenal mucosal barrier function

Abstract

Short-chain fatty acids (SCFAs) are produced by bacterial fermentation in the large intestine, particularly from diets containing fibres and carbohydrates. The small intestinal epithelium is exposed to SCFAs derived mainly from oral bacteria or food supplementation. Although luminal nutrients are important in regulation of intestinal functions, the role of SCFAs in regulation of small intestinal mucosal barrier function and motility has not been fully described. The aim of the present study was to elucidate the effects of acetate and propionate on duodenal mucosal barrier function and motility. Rats were anaesthetized with thiobarbiturate, and a 30 mm segment of proximal duodenum with an intact blood supply was perfused. The effects on duodenal bicarbonate secretion, blood-to-lumen clearance of 51Cr-EDTA, motility and transepithelial net fluid flux were investigated. Perfusion of the duodenum with acetate or propionate significantly decreased mucosal paracellular permeability and transepithelial net fluid flux and significantly increased bicarbonate secretion. Acetate or propionate administered as an i.v. infusion decreased the mucosal paracellular permeability, but significantly decreased bicarbonate secretion. Luminal SCFAs changed the duodenal motility pattern from migrating motor complexes to fed patterns. Systemic administration of glucagon-like peptide-2 induced increases in both bicarbonate secretion and net fluid absorption, but did not change motility. Glucagon-like peptide-2 infusion during luminal perfusion of SCFAs significantly reduced the motility. In conclusion, SCFAs decreased duodenal paracellular permeability and net fluid flux. Short-chain fatty acids induced opposite effects on bicarbonate secretion after luminal and i.v. administration. Presence of SCFAs in the lumen induces fed motility patterns. Altered luminal chemosensing and aberrant signalling in response to SCFAs might contribute to symptoms observed in patients with suppressed barrier function.