Extrinsic sensory innervation of the gut

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Extrinsic sensory nerves to the gut mediate sensations such as fullness, bloating, nausea, distension, urgency, discomfort and pain, as well as activating extrinsic reflex pathways that coordinate motility, secretion and blood flow. While it used to be believed that sensory axons provide only unspecialised free nerve endings within the viscera, studies in the last decade have identified a number of axonal specialisations. Low threshold mechanoreceptors, concentrated at either end of the gastrointestinal tract, typically reach the gut via nerves containing cranio-sacral parasympathetic efferent axons. These fibres have specialised “intraganglionic laminar endings” within the enteric ganglia which are the transduction sites at which mechanical distortion is converted into firing. These fibres are generally not responsive to capsaicin, but may be sensitive to other inflammatory mediators such as ATP and bradykinin. There is also a well-characterised class of vagal chemoreceptors which provide axons that project into the mucosa of the upper gut, where they respond to luminally applied chemicals and mechanical deformation of the mucosa. High threshold mechanoreceptors, which form a major part of the nociceptive pathway from the gut wall, were believed to have endings in the mesenteric or serosal membranes surrounding the gut. Recent studies have shown that their specialised endings correspond to varicose branching axons (VBAs) on mesenteric blood vessels (for “mesenteric” receptors) and on submucosal blood vessels (for “serosal” receptors). These sensory axons respond to strong focal compression with stiff von Frey hairs and to high amplitude distension. The majority of these fibres are activated by capsaicin, consistent with a role in nociception. The gut is innervated by several distinguishable classes of extrinsic afferents, with distinct targets, morphology and function.