Circulation, Overview

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acinus Smallest functional unit of the liver, which receives blood flow from the portal vein and hepatic artery.
angiogenesis Growth of new blood vessels.
ascites Collection of serous fluid (derived from liver and/or intestine) in the peritoneal cavity.
ischemia A reduction in blood flow of such magnitude as to cause tissue hypoxia.
reperfusion The restoration of blood flow following a period of ischemia.

The gastrointestinal (GI) circulation accounts for over 25% of cardiac output under resting conditions. Blood flow to the GI tract is dynamic, however, with tissue-specific increases caused by the ingestion of a meal and profound reductions in flow elicited by stresses that threaten to deprive the vital organs (e.g., brain, heart) of their normal blood supply. Although the different organs perfused by the GI circulation share common stimuli and mechanisms of blood flow regulation, significant differences related to tissue function have been described. As seen in most other vascular beds, impaired blood perfusion of GI organs can lead to profound organ dysfunction and tissue injury. The stomach, liver, intestine, and pancreas provide excellent examples of the unique and diverse anatomical features and regulatory mechanisms that distinguish the GI circulation from other regional vascular beds.

GASTRIC CIRCULATION

Introduction

Gastric blood flow plays an important role in sustaining the normal physiologic functions of the stomach and it helps to protect the gastric mucosa against ulcer formation. Intrinsic regulatory mechanisms ensure that blood flow is adjusted to meet the energy-demanding processes of gastric secretion and motility. Gastric blood flow also helps to maintain a barrier against back-diffusion of lumenal acid, thereby preventing mucosal damage and ulceration. Impairment of gastric blood flow renders the mucosa vulnerable to the damaging actions of gastric juice as well as ingested agents, such as ethanol, aspirin, and bacteria (e.g., *Helicobacter pylori*).

Anatomy

Oxygenated blood is provided to the stomach via the celiac artery, with deoxygenated blood drained by the portal vein. Small branches of the celiac artery give rise to arterioles in the external muscle layers and the submucosa. Some of the submucosal arterioles pierce the muscularis mucosae to produce the capillary network that supplies the mucosa. Hence, the tone of the submucosal arterioles determines the magnitude of mucosal blood flow. The mucosal capillaries drain into a central vein that begins just beneath the surface epithelial cells. These venules coalesce to form a dense venous plexus in the submucosa. The submucosal venous drainage penetrates the external muscle layers where additional venous blood is provided by the muscle microvasculature.

Hemodynamics

The parallel-coupled capillary networks of the gastric muscular layer and the mucosa are under separate control, responding independently to tissue metabolism, other local factors, and extrinsic neural input. Between meals, blood flow in the mucosal layer is approximately six times higher than that of the muscle layer, and approximately 75% of total gastric blood flow is distributed to the mucosa, with 25% directed to the muscle layer. This intramural distribution of blood flow is altered when either of the two layers becomes functionally active; i.e., when the mucosa is stimulated to produce acid, mucosal blood flow (and its percentage of total flow) preferentially increases.

Blood Flow Regulation

Gastric blood flow is controlled by neural, humoral, and metabolic factors. Sympathetic activation elicits reductions in total gastric blood flow and mucosal flow through arteriolar constriction. Parasympathetic nerves exert a tonic vasodilatory influence on gastric arterioles,

