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Review Article

Anatomic and radiologic review of chronic mesenteric ischemia and its treatment

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ABSTRACT

Chronic mesenteric ischemia (CMI) is a vascular occlusive disease process that generally affects the elderly population. Clinical presentation occurs when two of the three mesenteric arteries are affected and includes non-specific abdominal pain and weight loss. The most common cause of CMI is atherosclerotic arterial occlusion. The aim of this review is to present the vascular anatomy of the mesenteric arterial circulation including the different collateral pathways. The imaging findings and the different treatment options with a brief review of the literature is presented.

1. Introduction

CMI is a rare condition characterized by chronic episodic or continuous intestinal hypoperfusion resulting from stenosis or occlusion of 2 of the 3 mesenteric arteries. The true incidence of mesenteric arterial disease is unknown. A study utilizing duplex ultrasound imaged the mesenteric vessels of asymptomatic patients over the age of 65 years old and discovered that 17.5% of this population had a critical stenosis of one or more mesenteric vessel [1].

The mesenteric circulation receives 20% of the cardiac output in the resting state. After a meal, the blood flow to the intestines increases to 35% [2]. The normal circulation to the bowel includes blood supply from the celiac artery, the superior mesenteric artery, and the inferior mesenteric artery. Most patients with CMI are asymptomatic secondary to good collateral circulation between the three mesenteric arteries. Symptoms arise when there is a fixed stenosis or occlusion of two of the three main mesenteric arteries. Atherosclerotic disease is the commonest cause (35–75%) and characteristically occurs in elderly smokers. Other less common causes occur in young women with fibromuscular dysplasia or vasculitides such as Takayasu arteritis [3] or in patients who have undergone trauma, dissection, or radiation therapy for cancer treatment.

Clinical diagnosis is based on symptoms and characteristic anatomical findings. Chronic mesenteric ischemia usually occurs in the elderly population. Women are three times more likely to be affected. Most of the patients are asymptomatic. Clinical symptoms of chronic mesenteric ischemia range from weight loss and non-specific abdominal pain to severe debilitating aversion to food resulting in cachexia. A classic presentation is a patient who develops epigastric abdominal pain shortly after a meal which lasts for 1 to 3 h. Additional clinical symptoms that are atypical include nausea, vomiting, and diarrhea. Physical examination and basic laboratory studies are predominantly unremarkable.

2. Anatomy of the mesenteric vessels with collaterals

2.1. Main mesenteric vessels and their branches: [4]

The celiac artery (Fig. 1) arises from the aorta at about T12 and divides into three arterial branches: left gastric artery, splenic artery, and common hepatic artery. The common hepatic artery gives off the gastroduodenal artery (GDA) and continues on as the proper hepatic artery which divides into the right and left hepatic arteries. The cystic artery branches off of the right hepatic artery. The right gastric artery branches off of either the left or middle hepatic artery (40%) or proper hepatic artery (40%). The GDA branches to become the superior pancreaticoduodenal artery and right gastroepiploic artery (terminal branch). The splenic artery gives off numerous branches to supply the stomach, spleen, and pancreas such as the short gastric arteries, dorsal pancreatic artery, and left gastroepiploic artery.

There are many variations of the celiac artery and its branches. Variants of the celiac trunk include the origin of the inferior phrenic artery as a fourth arterial branch (35%) or common origin of the celiac artery and superior mesenteric artery from the aorta (<1%). Uflacker classified additional variants into 8 different types (classic[1], hepatosplenic trunk[2],

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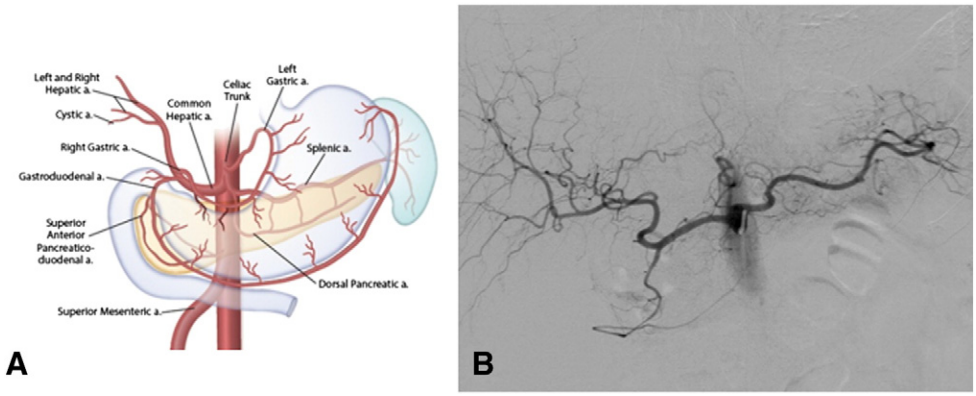

Fig. 1. (A) Illustration of celiac artery and its branches. (B) A normal selective celiac angiogram showing the normal anatomy of the celiac vessels and its branches.

hepatogastric trunk[3], hepatosplenicmesenteric trunk[4], gastrosplenic trunk[5], celiac-mesenteric trunk[6], celiac-colic trunk[7], and no celiac trunk[8]) [5].

Variants of the hepatic artery include aberrant origin of a replaced right or left hepatic artery from the superior mesenteric artery (10–17%) or left gastric artery (10–12%) respectively. Additionally, there have also been described accessory right or left hepatic arteries that also may arise from the superior mesenteric artery (6–8%) or left gastric artery (8–13%) respectively. The right gastric artery may arise from any number of arteries including the left or middle hepatic artery (40%), right hepatic artery (10%), proper hepatic artery (40%), or GDA (8%). The GDA may arise from the right or left hepatic arteries (18%) as well. A classification method for variant hepatic arterial anatomy was proposed by Michel et al. in 1966 [6] which divided the variant anatomy into 10 different types. Hiatt modified that same system in 1994 [7] to divide the variant anatomy to 6 different types of variant anatomy.

The superior mesenteric artery (SMA) (Fig. 2) arises from the aorta at L1-L2 level. The first branch is the anterior and posterior inferior pancreaticoduodenal artery. The SMA then gives off jejunal, ileal, middle colic, right colic, and ileocolic arteries. The middle colic artery has a left and right branch. The terminal branch of the SMA is the ileocolic artery. In a rare few, the middle colic artery may arise from the dorsal pancreatic, splenic, or hepatic arteries (1%), all of which arise from the celiac artery.

The inferior mesenteric artery (IMA) (Fig. 2) arises from the aorta at L3-L4 level. The first branch is the left colic artery. There are multiple other smaller branches of the artery that give off descending colic and sigmoid branches. The superior rectal artery is the terminal branch and has right and left branches.

2.2. Collateral Vessels

The pancreato-duodenal arcade (PDA) connects the celiac artery (superior pancreatoduodenal arcade) to the superior mesenteric artery (inferior pancreatoduodenal arcade). The gastroduodenal artery arising from the common hepatic branch of the celiac artery gives rise to anterior and posterior branches of superior pancreatoduodenal arteries around the head of the pancreas. These anastomose with the anterior and posterior branches of the inferior pancreatoduodenal arteries which arise from the superior mesenteric artery (Fig. 3).

The dorsal pancreatic artery represents the first large branch of the splenic artery (39%) [8]. However, the origin of this artery is variable from person to person with origins from the right hepatic artery (12%), SMA (14%), or celiac artery (22)% [8]. A dorsal pancreatic artery that has its origin from the SMA is important in collateral circulation between the SMA and celiac artery. The dorsal pancreatic artery has 4 branches of its own. There are 2 right branches with one that joins the pancreaticoduodenal arcade and another that becomes the artery to the uncinate process of the pancreas. A left branch becomes the transverse pancreatic artery. An inferior branch descends to communicate with the SMA or one of its branches. This inferior branch is an important collateral pathway between the celiac artery and SMA if the dorsal pancreatic arises from the celiac axis. This is termed a longitudinal pathway. There are two transverse pathways with one to the splenic artery

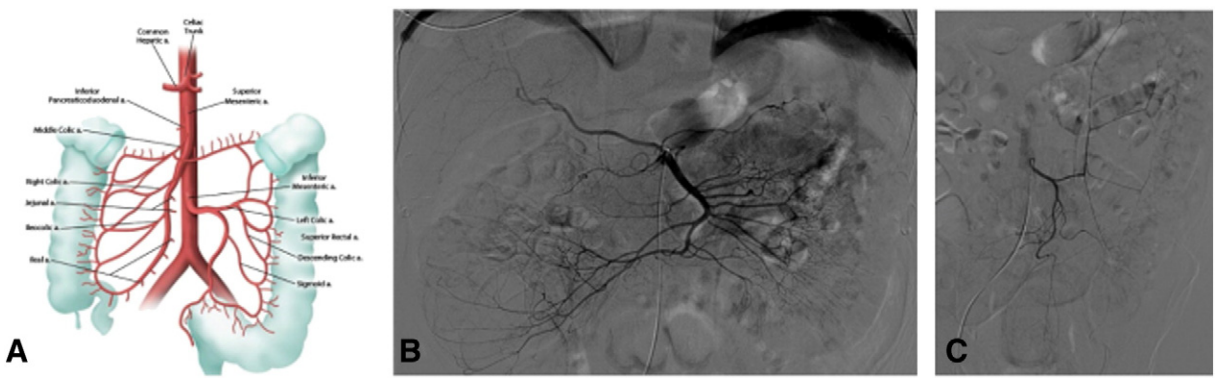

Fig. 2. (A) Illustration of SMA and IMA and their branches. (B) A normal selective superior mesenteric artery angiogram showing the anatomy of the superior mesenteric artery and its branches. (C) A normal selective inferior mesenteric artery angiogram showing the anatomy of the inferior mesenteric artery and its branches.