The occurrence of a middle left colic artery in a 76-year-old white male cadaver

Guinevere Granite[1], Keiko Meshida[2], Shiloh Jones[3], Natalie May[4]

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A high degree of variation in origin, trajectory, and branching patterns characterizes the anatomy of mesenteric vascular structures. Detailed knowledge of normal and variant anatomy of the abdominal arterial supply serves to improve the outcome of oncologic, surgical, radiological interventions and reduces the likelihood of complications. Such familiarity is equally important for instructors teaching anatomy to students in the various medical disciplines. Case studies highlighting such vascular variations provide anatomical instructors and surgeons with accurate information on the types and prevalence of such alterations. This article highlights an abdominal vascular variation involving the middle colic artery. This vessel, known as the left middle colic artery, was found during anatomical dissection of a 76-year-old White Male cadaver.

Key Words: *Middle colic artery; Middle colic artery variation; Gastrointestinal arterial variation; Anatomical variation*

INTRODUCTION

A high degree of variation in origin, trajectory, and branching patterns characterizes the anatomy of mesenteric vascular structures. Textbooks, however, critically limit the scope of the classic anatomic description of the abdominal arterial pattern [1,2]. Yet, such descriptions serve as the basis upon which many surgeons operate [1]. The occurrence of vascular pattern variations in common surgical sites, such as the abdomen, increases the likelihood of vascular damage by specialists during surgical and diagnostic procedures. Knowledge of variations and preoperative study of the vascular patterning of the abdominal viscera is important; it helps to avoid iatrogenic injuries during intraabdominal operations and when assessing abdominal diseases [1,3-14]. Such knowledge is especially important to reduce the risk of severe hemorrhage and difficulty with postoperative revitalization of the colon [8,9,15-18]. Reports of case studies, thus, are key to providing anatomical instructors and surgeons with accurate information on the types and prevalence of such variations. This article highlights an abdominal vascular variation involving the Middle Colic Artery (MCA), known as the Left Middle Colic Artery (LMCA).

During anatomical dissection of 64 cadavers in the 2017-2018 undergraduate medical and graduate nursing anatomy courses at the Uniformed Services University of the Health Sciences, we found one example of an origin variation of the MCA (1.56% of the studied population). The MCA of a 76-year-old White Male cadaver, provided by the Maryland State Anatomy Board, originated from a common branch with the left ascending branch of the Left Colic Artery (LCA), a branch of the Inferior Mesenteric Artery (IMA), also known as a LMCA (Figure 1).

CASE DESCRIPTION

This 76-year-old White Male (listed cause of death of cerebrovascular accident and advanced dementia) presented with an origin variation of the MCA. Its origin branched from the ascending branch of the LCA (Figure 1). The LCA had three branches: a sigmoid artery branch, and from a common trunk, an ascending branch and the MCA (also known as a LMCA). There was no descending branch of the LCA (Figure 2). Additional variations were found in the Middle Colic Vein (MCV), which drained into the right colic vein, and then drained into the Superior Mesenteric Vein (SMV) (Figure 3).

DISCUSSION

In typical human anatomy, the abdominal aorta gives rise to three ventral

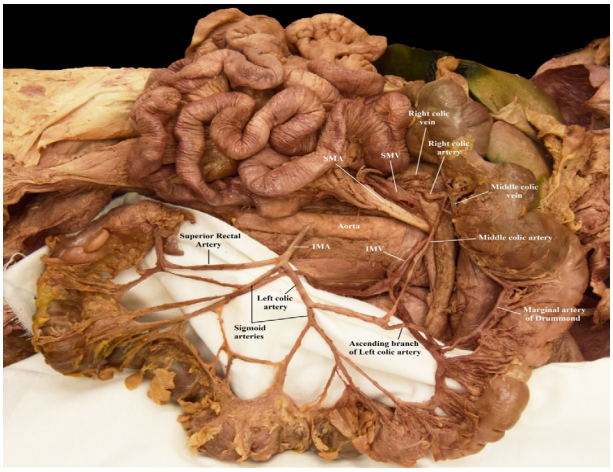

Figure 1) *Facilitated display of the abdominal cavity of the featured case: SMA: Superior Mesenteric Artery; SMV: Superior Mesenteric Vein; IMA: Inferior Mesenteric Artery; IMV: Inferior Mesenteric Vein.*

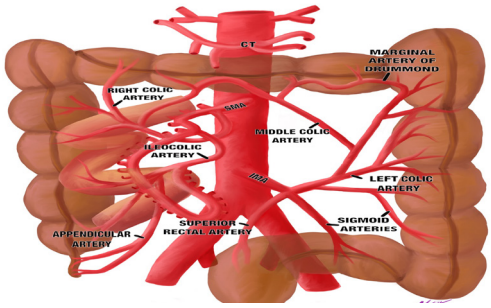

Figure 2) *Illustrative schematic of the abdominal vessels highlighting the branching of the Superior Mesenteric Artery and Inferior Mesenteric Artery of the featured case: CT: Celiac Trunk; SMA: Superior Mesenteric Artery; IMA: Inferior Mesenteric Artery.*

[1]*Department of Surgery, Uniformed Services University of the Health Sciences, Bethesda, MD, USA;* [2]*Department of Anatomy, College of Medicine, Howard University, Washington, DC, USA;* [3]*Department of Biochemistry and Molecular & Cellular Biology, Georgetown University School of Medicine, Washington, DC, USA;* [4]*F. Edward Hebert School of Medicine, Uniformed Services University of the Health Sciences, Bethesda, MD, USA*

Correspondence: *Dr. Guinevere Granite, Department of Surgery, Uniformed Service University Science (USUHS), 4301 Jones Bridge Road Office A3020B Bethesda, MD 20814, USA. Telephone 301-295-1500; e-mail: guinevere.granite@usuhs.edu*

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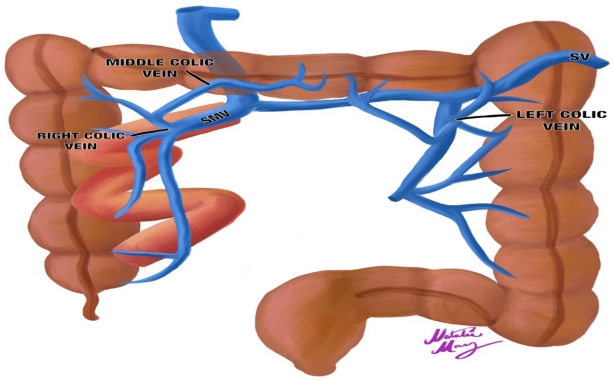

Figure 3) *Illustrative schematic of the abdominal vessels highlighting the branching of the Superior Mesenteric Vein of the featured case: SMV: Superior Mesenteric Vein.*

branches: the Celiac Trunk (CT), Superior Mesenteric Artery (SMA), and the IMA. The CT supplies the foregut, the SMA the midgut, and the IMA the hindgut. The usual branches of the CT are the left gastric artery, the splenic artery, and the common hepatic artery. The normal branching patterns of the SMA from its right concave side are as follows: the inferior pancreatic duodenal artery, MCA, right colic artery and the ileocolic artery. Several ileo-jejunal arteries branch from its left convex side. Usually, the MCA arises from the SMA at the lower border of pancreas and immediately enters the root of transverse mesocolon, dividing into right and left branches. The right branch anastomoses with the ascending branch of Right Colic Artery (RCA) near right colic flexure and the left anastomoses with the ascending branch of the LCA, creating the marginal artery of Drummond [4,6,8,11,14,17-22]. The IMA normally provides the following branches: the LCA, sigmoid arteries, and the superior rectal artery. Venous drainage of the foregut is principally through the portal vein, the midgut the SMV into the portal vein, and the hindgut the Inferior Mesenteric Vein (IMV) into the splenic vein, which joins the portal vein with the SMV.

It must be stated, however, that the "normal pattern" of the colonic vasculature cited in most anatomical textbooks is actually an infrequent variant [2,17]. During their investigation of 50 cadavers, Nelson et al. found only three of the cadavers (6%) demonstrated the classic description of the CT, SMA, and the IMA due to the presence of one or more variants in 94% of the studied population. The standard anatomic description of the CT, SMA, and IMA was confirmed for each in only 24%, 22%, and 16% of the 50 cadavers [1]. Sonneland found the classic description of the SMA in only fourteen out of 600 cadavers (23.8%), and Michels et al. only found it in a third of 200 cadavers [23,24]. Griffiths found the textbook pattern of the IMA in only 15% of 100 cadavers studied [9,25]. Thus, variation is common in the abdominal vasculature. The variation featured with this case study, an LMCA, has a usual incidence of 4% originating as a branch of the left colic artery [1]. One study, however, conducted by Niculescu et al. in 2005, found a LMCA sharing a common trunk with the left superior colic artery in 6 of 50 cadavers studied (12%) [15].

Variation in the number and branching pattern of the abdominal vasculature may correlate with embryonic development [4,26]. The arteries of the gut begin as ventral segmental branches of the paired dorsal aortae. These ventral branches are initially paired and distributed to the developing gut and yolk sac. With the growth in length and rotation of the gut tube, accompanied by migration of the associated viscera, the dorsal aortae fuse. As they fuse, so do the paired ventral branches to form unpaired segmental arteries. These segmental arteries supply the dorsal gut mesentery and divide into ascending and descending branches, forming a continuous longitudinal anastomotic channel. They provide arterial supply to the primitive digestive tube. Over time, several ventral branches regress. This reduces the number of the main abdominal aortic artery branches to the three unpaired midline vessels: the CT (the 10th segmental artery), the SMA (the 13th segmental artery), and the IMA (the 22nd segmental artery). Thus, alterations both in fusion and regression result in branching variation of the three major abdominal aortic branches. In addition, because their embryonic origins are closely related, persistence of interconnections or overlapping of the territories of the CT, SMA, and IMA are common [3,8,13,27,28]. The persistence of the ventral longitudinal anastomoses connecting the ventral segmental arteries destined to become the CT, the SMA, or the IMA reasonably explains the occurrence of the MCA as a branch of the left colic artery [1].

Middle colic artery

The Middle Colic Artery (MCA) originates from the SMA in 78%-99% of cases and serves as the main blood supply for the transverse colon [1,9,12,13,17,23,28-30]. It is quite variable in number, origin, and course. Typically, it arises from the SMA below the origin of the Inferior Pancreaticoduodenal Artery (IPDA), inferior to the uncinate process of the pancreas and anterior to the third part of the duodenum [7,8,12,13,17,31]. It descends through the transverse mesocolon, dividing into right and left anastomotic branches. Typical course variations include a high origin from the SMA and descending between the duodenum and pancreas, or the MCA passing through the pancreas (Indrajit et al.). The MCA may arise independently or in the company of other colic arteries from the SMA. The most prevalent pattern (58%-94.6%) involves the MCA as a direct independent branch of the SMA [1,17,23]. Sonneland et al. described the following origin patterns of the MCA in 600 cadavers: arising directly from the SMA (59.7%); sharing a common stem with: the right colic artery (RCA) (12% to 52%), the Ileocolic Artery (ICA) and RCA (1.0%); and the RCA and Left Colic Artery (LCA) (0.2%) [6,16,23,32,33]. In a special variation, known as the 'middle mesenteric artery' or 'third mesenteric artery', the MCA originates directly from the aorta, between the SMA and IMA [7,8,12,13,28,32,33,34]. The MCA can also originate from the CT or one of its branches in 0.02-4.8% of cases, and then it is known as the colonic artery [1-3,6-9,12-14,16,17,21,22,32-34]. Other variant sources of the MCA include the Splenic Artery (SA), replaced right hepatic artery, common hepatic artery, inferior pancreaticoduodenal artery, dorsal pancreatic artery, gastroduodenal artery, IMA, as well as the LCA [1,3,7,8,12,13,16,17,34,38-47].

Rarely, the MCA is absent (3%-5%), but this may vary (0%-22%) [4,7,8,17,23,28,29,31,34,37,40,48,49]. Steward and Rankin found that in 5% of specimens with no MCA, a large branch of the LCA serves as its replacement [29].

An accessory MCA originating from the SMA may serve as additional arterial blood supply to the transverse colon, varying in incidence from 3.6% to 18% [1,3,14,15,17,20,23,29,31,48]. Duplication (2%-8%) and triplication (1.6%) of the MCA also occur, with reported instances of origins from the CT and the SMA [12-14,16,17,23,31].

Left colic artery

Typically, the LCA originates directly from the IMA (30%-60% of cases) [1,10,15]. Most commonly, this occurs *via* a common trunk with the sigmoid arteries (53%-56%) [1,9,25]. The LCA can originate as a branch of the MCA [1] or the SMA [11,15]. It may also be absent (0.7%-12%) [1,21,23,25,50,51]. Branches of the LCA include the ascending and descending branches, also known as the superior and inferior left colic arteries [52]. The third branch of LCA, the left middle colic artery (LMCA), is found in 38% of cases [9,11]. Niculescu et al. found the LMCA in 50% of their 100 cases. The LMCA was either a direct branch off of the IMA (12% of the 50 cases) or *via* a common trunk (88%) with the left superior colic artery (84%) or the left inferior colic artery (4%) [15].

CONCLUSION

Detailed knowledge of the myriad of anatomical variations in the gastrointestinal vasculature is an essential prerequisite in abdominal surgical intervention and disease assessment. Such awareness serves to improve the outcome of oncologic, surgical, radiological interventions and to reduce the likelihood of complications. Such familiarity is equally important for instructors teaching anatomy to students in the various medical disciplines.

DISCLAIMER

The opinions or assertions contained herein are the private ones of the author/speaker and are not to be construed as official or reflecting the views of the Department of Defense, the Uniformed Services University of the Health Sciences or any other agency of the U.S. Government.

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