First Report on Arterial Anastomosis Between Transverse Pancreatic and Left Colic Arteries

Auhtor's Details:

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ABSTRACT

Background: The abdominal aorta is supplying the digestive tract with three unpaired arteries, which are connected during the early intraembryonic development through the longitudinal anastomosis of Tandler. If the anastomotic system does not regress completely, variant connections may remain.

Methods: During routine dissection of a female cadaver an anomalous artery was found.

Results: This artery formed an anastomosis between left colic, and transverse pancreatic arteries. The celiac trunk showed normal trifurcation. The common hepatic artery gave off the right gastric, the proper hepatic and the gastroduodenal branches. The gastroduodenal artery had a bifurcation to transverse pancreatic and right gastroomental arteries. Transverse pancreatic gave origin with a common trunk to the anterior superior pancreaticoduodenal and the anastomosis forming vessel. The anastomosis turned from the front of the superior mesenteric artery to the back of superior mesenteric vein. Superior and inferior mesenteric arteries had primary branches according to normal anatomy.

Conclusion: Occurrence of such variation stresses the importance of preoperative angiography in abdominal surgery. Surgical relevance in pancreatic resections: this variant artery must be ligated to avoid bleeding during intervention. Furthermore, this variant anastomosis can be a hidden source of bleeding in severe necrotizing type of acute pancreatitis due to erosion.

Key words: *anomalous artery, interstem anastomosis, celiac trunk, inferior mesenteric artery, pancreas*

INTRODUCTION

The normal mesenteric vasculature provides the blood supply for the digestive system with three unpaired arteries of the abdominal aorta; these are the celiac trunk (CT), the superior mesenteric (SMA) and the inferior mesenteric artery (IMA). Among these arteries, usually rich collateral intra- (right and left gastric) and intervascular (pancreaticoduodenal arcades) connections are normally present. During the embryonic development, several metameric vitelline arteries arise from the paired, and later fused dorsal aorta, and they form a ventral anastomosis - the so-called Tandler's longitudinal anastomosis [1]. Many of these vascular structures of embryonic origin regress before birth, only 10^{th}, 13^{th} and 21^{st} segmental branches persist as CT, SMA and IMA. The anastomosis between the CT and SMA is formed by the superior and inferior pancreaticoduodenal arteries, while between the SMA and IMA the marginal artery of Drummond establishes vascular communication. If the anastomotic system does not regress completely, variant connections may remain (arch of Bühler, Villemin arcade, intermesenteric artery of Riolan)[2].

METHODS

During routine dissection of a formaldehyde embalmed female Caucasian cadaver in undergraduate anatomy education, an anomalous artery was found. After the opening of the abdomen, the aim was to examine the blood supply of the gastrointestinal tract; therefore visceral peritoneum and mesenteric connective tissue were partly removed. In order to achieve better visualization of the newly found anastomosis, first the superior mesenteric vein was cut through, then the pyloric part of stomach. Later, the stomach was reflected to the left. (Fig. 1.)

RESULTS

The variant artery formed an anastomosis between the left colic, and the transverse pancreatic arteries. The collateral communicating channel was 13 cm long and the outer diameter 2 mm passing approx. 1.5 cm from the antero-inferior edge of the pancreas. No dissectible branches to the pancreas or to the transverse colon could be observed along the anastomotic vessel. Four centimeters from its origin, the IMA gave the left colic artery and 16 cm from its origin, far below the Griffith's point, it gave the anastomosis forming artery (Fig. 1.). The CT showed normal trifurcation (left gastric, splenic and common hepatic arteries), while the common hepatic artery - displaying a trifurcation - gave off beside the proper hepatic and the gastroduodenal arteries, also the right gastric branch. Concerning the gastroduodenal artery, it exhibited an unusual bifurcation to transverse pancreatic and right gastroomental arteries. One cm below the emergence of the transverse pancreatic artery, it gave origin with a common trunk to the anterior superior pancreaticoduodenal and the anastomosis forming vessel. The anastomosis was found at the root of the transverse mesocolon, extending across the head of the pancreas, at the level of L2. In its terminal course it turned from the front of the SMA to the back of superior mesenteric vein. Along the transverse pancreatic artery small short vessels were arising without forming any dissectible anastomoses. At the superodorsal margin of the pancreas, the dorsal pancreatic artery arose from the splenic artery two cm from CT trifurcation (diameter: 1 mm). After a short run it divides into several short branches which showed no apparent anastomoses with other pancreatic vessels. Four cm distal from dorsal pancreatic artery, the great pancreatic artery (diameter: 2 mm) branched off from the splenic artery. Behind the splenic vein it bifurcated and the right branch descended in the parenchyma then in an acute angle joined the transverse pancreatic artery. The transverse pancreatic artery could be traced until the very end of the pancreatic tail (Fig. 2.). According to normal anatomy, the inferior pancreaticoduodenal, jejunal, ileal, right colic and middle colic arteries arose from SMA, and the IMA comprised of the left colic, sigmoid and superior rectal as primary branches.

DISCUSSION

Anastomotic arcade which directly connects the transverse pancreatic and left colic artery, linking the vascular network of IMA and the CT have never been published before. The branches of the unpaired, visceral arteries of abdominal aorta can have unusual variant connections with each other (beside the normally existing ones) in two ways: some of these visceral vessels exhibit common origin, or the primordial longitudinal and transverse anastomotic channels fail to close and remain patent from fetal age (Fig. 3.; Fig. 4a.).

A considerable amount of literature has revealed the highly variant nature of the blood supply provided by the CT, SMA and IMA. As far as IMA is concerned, it exhibits much less variations compared to CT and SMA. It's origin from SMA was found during autopsy by a number of authors; Yoo [3] and Yamasaki [4] described it in female, while Gwyn [5], Kitumara [6] and Yi [7] reported it in male cadavers. Osawa [8] also published a variant SMA in male, from which the IMA and the common hepatic artery emerged as accessory branches. Double IMA given off separately from abdominal aorta has been published by Benton et al., [9], which may refer to the two roots of IMA from the 21st and 22nd segmental gut arteries in 9 mm CRL embryos which failed to fuse later in development [1]. Nevertheless, the presented artery could also be considered as a middle mesenteric artery [10], which has been published many times [11]. Tandler [1] in his classical paper suggested that the isolated celiacomesenteric trunk possibly develops by the regression of the first (CT), second, third roots of the embryonic omphalomesenteric artery, the fourth one forms the stem of the celiacomesenteric artery and the ventral longitudinal anastomosis between the roots becomes the CT. This variation has also been observed in the recent decades by Kara [12] during computed tomography angiography; Cadvar [13], Katagiri [14] and Yi [15] described it in cadaveric cases. Celiaco-bimesenteric trunk was identified only in one case during angiography [16].

The persisting anastomoses occur usually between branches of CT and SMA or SMA and IMA, but some connections between branches of CT and IMA were also reported. Gupta [17] and Manoharan[18] described direct anastomosis between CT and left colic in cadaveric dissections, while Stimec [19] found the same during examination with imaging method. Patel [20] described an artery connecting splenic and left colic as an accessory finding of multidetector CT examination. Cases showing variant origin of superior left colic arteries were published by Koizumi [21] and Inoue [22], where the origin of the superior left colic artery could be dorsal pancreatic or inferior pancreatic arteries as well. According to these cases, this newly found anastomosis could be considered as a variant superior left colic artery. Concerning the collaterals anastomosing all the three unpaired branches of the aorta, Jiji [23] published a case displaying an anastomosing channel commencing from the dorsal pancreatic artery that bifurcates and its left branch connects it to the left colic artery, at the point of Griffith and the right branch anastomosed with the middle colic artery. The last authors considered this case as a variant of Bühler's arcade directly connecting all the three levels of mesenteric vascular supply modifying the vascular network of Riolan's arcade. The presented case also fits into this last mentioned series of variant mesenteric vasculatures connecting CT, SMA and IMA (Fig. 3.). In view of all that has been mentioned so far, we may suppose that the linking artery devoid of branches is an embryonic remnant of the ventral longitudinal anastomosing channel (Fig. 4A.; Fig. 4B.).

CONCLUSION

Occurrence such vascular variation stresses the importance of preoperative angiography in abdominal surgery. The presence of intermesenteric artery of Riolan (also known as the meandering mesenteric artery) [24] is essential in left hemicolectomy or abdominal aortic aneurysmectomy performed without IMA re-implantation [25]. In Riolan anastomosis insufficiency, the newly observed anastomosis may provide sufficient blood supply to the region originally supplied by IMA. During advanced laparoscopic colon resections bleeding from an unintentional damage of the newly described anastomotic artery can be the cause of the conversion. Mobilization of the splenic flexure can also be very difficult because the anastomotic route is promptly in its position, the reconstruction of the continuity of the bowels can be a delicate point of the operation if that anastomosis persists. In pancreatic resections the surgical relevance of such variant is worth considering since this variant artery must be ligated to avoid bleeding during pancreatic intervention, missing that part of the operation can lead to anastomotic dehiscence, intraabdominal hematoma and abscess formation as a consequence. And sometimes, this variant anastomosis can be a hidden source of bleeding in severe necrotizing type of acute pancreatitis due to erosion. In atherosclerotic obstructive disease, if occlusion is forming on IMA, this artery could provide blood flow to the descending colon through the marginal artery of Drummond.

REFERENCES

[1] Tandler, J., 1903. Zur Entwickelungsgeschichte der menschlichen Darmarterien. Anat. Hefte. 23, 188-210.

[2] Walter, T.G., 2009. Mesenteric Vasculature and Collateral Pathways. Semin. Intervent. Radiol. 26(3), 167-174.

[3] Yoo, S.J., Ku, M.J., Cho, S.S., Yoon, S.P., 2011. A Case of the Inferior Mesenteric Artery Arising from the Superior Mesenteric Artery in a Korean Woman. Korean Med. Sci. 26, 1382-1385.

[4] Yamasaki, M., Nakao, T., Ishizawa, A., Ogawa, R., 1990. A rare case of the inferior mesenteric artery and some colic arteries in man. Anat. Anz. 171(5), 343-349.

[5] Gwyn, D.G., Skilton, J.S., 1966. A Rare Variation of the Inferior Mesenteric Artery in Man. Anat. Rec. 156, 235-238.

[6] Kitumara, S., Nishiguchi, T., Sakai, A., Kumamoto, K., 1987. Rare Case of the Inferior Mesenteric Artery Arising from the Superior Mesenteric Artery. Anat. Rec. 217, 99-102.

[7] Yi, S.Q., Li, J., Terayama, H., Naito, M., Iimura, A., Itoh, M., 2008. A rare case of inferior mesenteric artery arising from superior mesenteric artery, with a review of the literature. Surg. Radiol. Anat. 30, 159-165.

[8] Osawa, T., Feng, X.Y., Sasaki, N., Nagato, S., Matsumoto, Y., Onodera, M., Nara, E., Fujimura, A., Nozaka, Y., 2004. A Rare Case of Inferior Mesenteric Artery and the Common Hepatic Artery Arising From the Superior Mesenteric Artery. Clin. Anat. 17, 518-521.

[9] Benton, R.S., Cotter, W.B., 1963. A hitherto undocumented variation of the inferior mesenteric artery in man. Anat. Rec. 145, 171-173.

[10] Milnerowicz, S., Milnerowicz, A., 2012. A middle mesenteric artery. Surg. Radiol. Anat. 34, 973-975.

[11] Kacklik, D., Laco, J., Turyna, R., Baca, V., 2009. A very rare variant in colon supply - arteria mesenterica media. Biomed. Pap. Med. Fac. Univ. Palacky Olomouc Czech Repub. 153(1), 79-82.

[12] Kara, E., Celebi, B., Yildiz, A., Ozturk, N., Uzmansel, D., 2011. An unsual case of a tortuous abdominal aorta with a common celiacomesenteric trunk: demonstrated by angiography. Clinics. 66(1), 169-171.

[13] Cadvar, S., Sehirli, Ü., Pekin, B., 1997. Celaicomesenteric trunk. Clin. Anat. 10, 231-234.

[14] Katagiri, H., Ichimura, K., Sakai, T., 2007. A case of celiacomesenteric trunk with some other arterial anomalies in a Japanese woman. Anat. Sci. Int. 82, 53-58. [25] Douard, R., Chevallier, J.M., Delmas, V., Cugnenc, P.H., 2006. Clinical interest of digestive arterial trunk anastomoses. Surg. Radiol. Anat. 28, 219-227.

[15] Yi, S.Q., Terayama, H., Naito, M., Hayashi, S., Moriyama, H., Tsuchida, A., Itoh, M., 2007. A common celiacomesenteric trunk, and a brief review of the literature. Ann. Anat. 189, 482-488.

[16] Nonent, M., Larroche, P., Forlodou, P., Senecall, B., 2001. Celiac-Bimesenteric Trunk: Anatomic and Radiologic Description. Radiology. 220, 489-491.

[17] Gupta, M., Agarwal, S., 2013. A Direct Anastomosis Between the Stems of Celiac Trunk and Left Colic Artery by An Anomalous Fourth Celiac Trunk Branch. Clin. Anat. 26, 984-986.

[18] Manoharan, B., Aland, R.C., 2010. Atypical Coeliomesenteric Anastomosis: The Presence of an Anomalous Fourth Coeliac Trunk Branch. Clin. Anat. 23, 904-906.

[19] Stimec, B.V., Terraz, S., Fasel, J.H.D., 2011. The Third Time Is the Charm—Anastomosis Between the Celiac Trunk and the Left Colic Artery. Clin. Anat. 24, 258-261.

[20] Patel, A.A., Kadakia, J., Hamirani, Y.S., Dailing, C., Budoff, M.J., 2010. A meandering mesenteric artery. Journal of Cardiovascular Computed Tomography. 4, 213-214.

[21] Koizumi, M., Horiguchi, M., 1990. Accessory Arteries Supplying the Human Transverse Colon. Acta Anat. 137, 246-251.

[22] Inoue, K., Yamaai, T., Odajima, G., 1986. A Rare Case of Anastomosis Between the Dorsal Pancreatic and Inferior Mesenteric Arteries. Okajimas Folia Anat. Jpn. 63, 45-46.

[23] Jiji, P.J.,Nayak, S., D'Costa, S., Prabhu, L., Pai, M., Rai, R., 2008. An Anomalous Digestive Arterial Anastomosis Connecting Foregut, Midgut and Hindgut. Trakya Univ. Tip. Fak. Derg. 25(3), 241-244.

[24] Lange, J.F., Komen, N., Akkerman, G., Nout, E., Horstmanshoff, H., Schlesinger, F., Bonjer, J., Kleinrensink, G.J., 2007. Riolan's arch: confusing, misnomer, and obsolete. A literature survey of the connection(s) between the superior and inferior mesenteric arteries. The American Journal of Surgery. 193, 742-748.

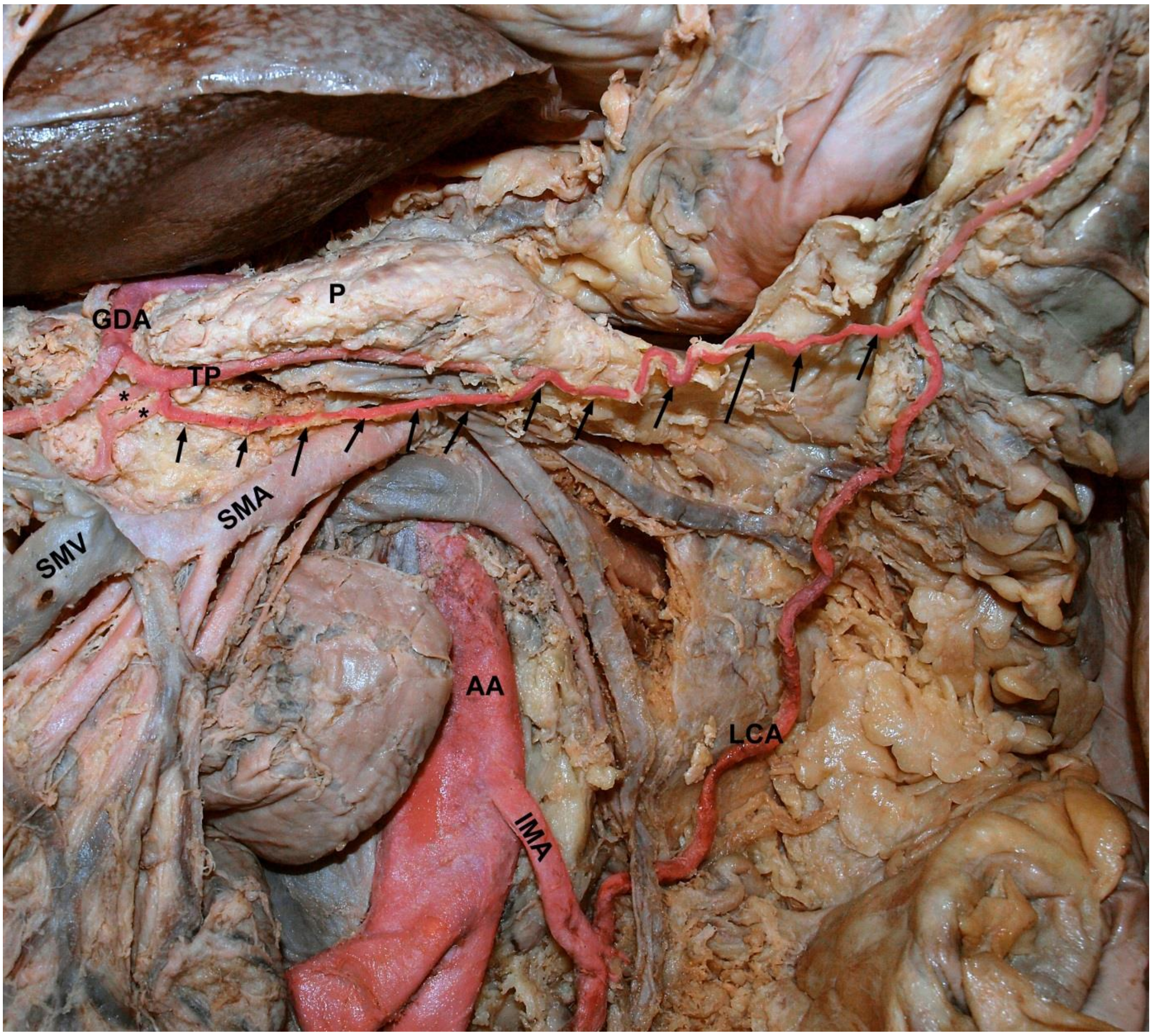

Figure 1. Photograph of the dissected area demonstrating the vascular anastomosis connecting the transverse pancreatic and the left colic arteries. AA: abdominal aorta; IMA: inferior mesenteric a.; LCA: left colic a.; SMA: superior mesenteric a.; SMV: superior mesenteric v.; GDA: gastroduodenal a.; TP: transverse pancreatic a; *: anterior superior pancreaticoduodenal a.; P: pancreas; variant anastomosis shown by black arrows (the original photo was modified by Adobe Photoshop CS3 program for better visibility of the arteries)

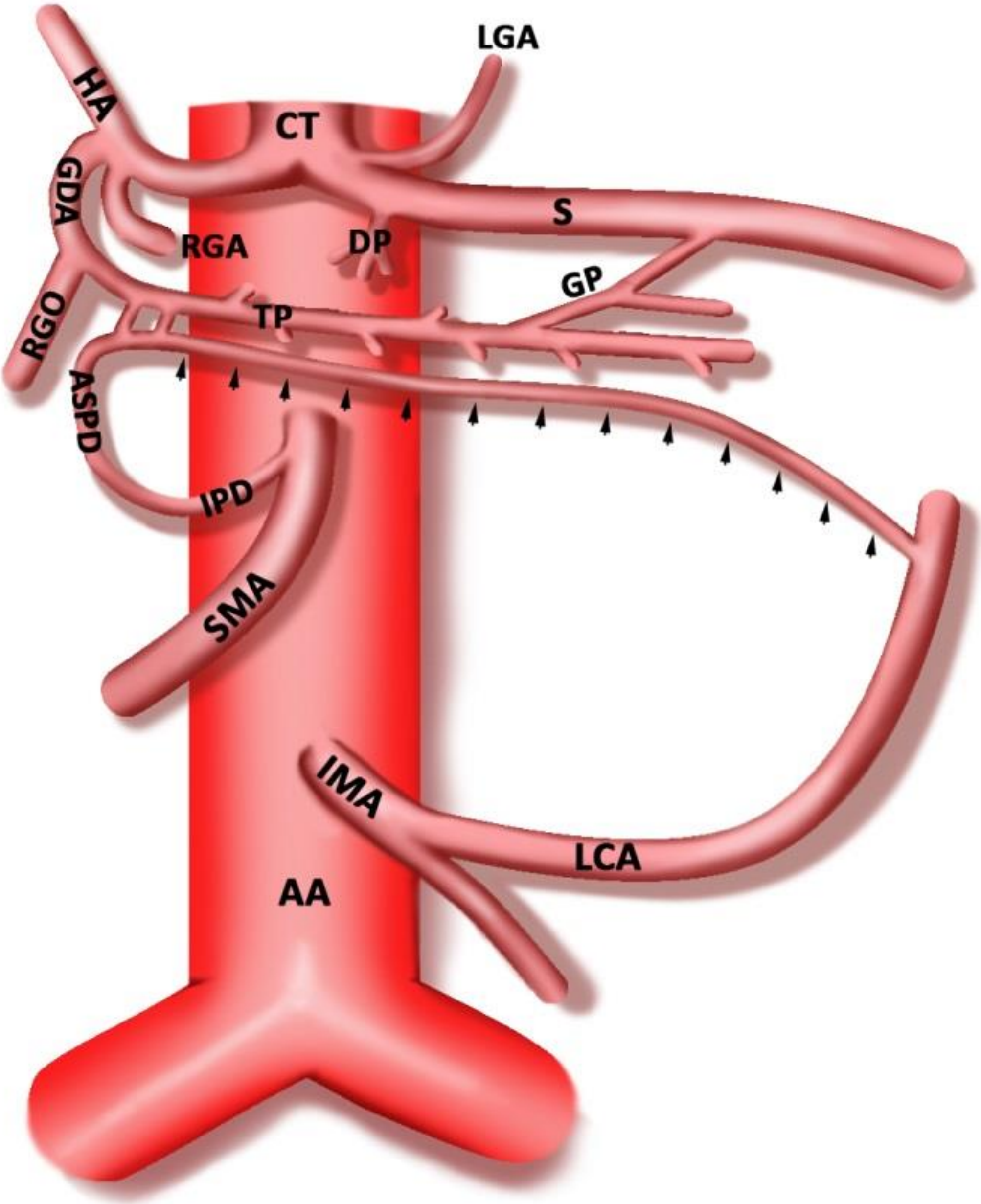

Figure 2. Schematic drawing of the branching pattern of the unpaired visceral abdominal arteries illustrating the newly found anastomosis. AA: abdominal aorta; CT: celiac trunk; LGA: left gastric a.; S: splenic a.; DP: dorsal pancreatic a.; GP: greater pancreatic a.; HA: proper hepatic a.; GDA: gastroduodenal a.; RGA: right gastic a.; RGO: right gastroomental a.; TP: transverse pancreatic a; ASPD: anterior superior pancreaticoduodenal a.; SMA: superior mesenteric a.; IPD: inferior pancreaticoduodenal a.; IMA: inferior mesenteric a.; LCA: left colic a.; variant anastomosis shown by black arrows

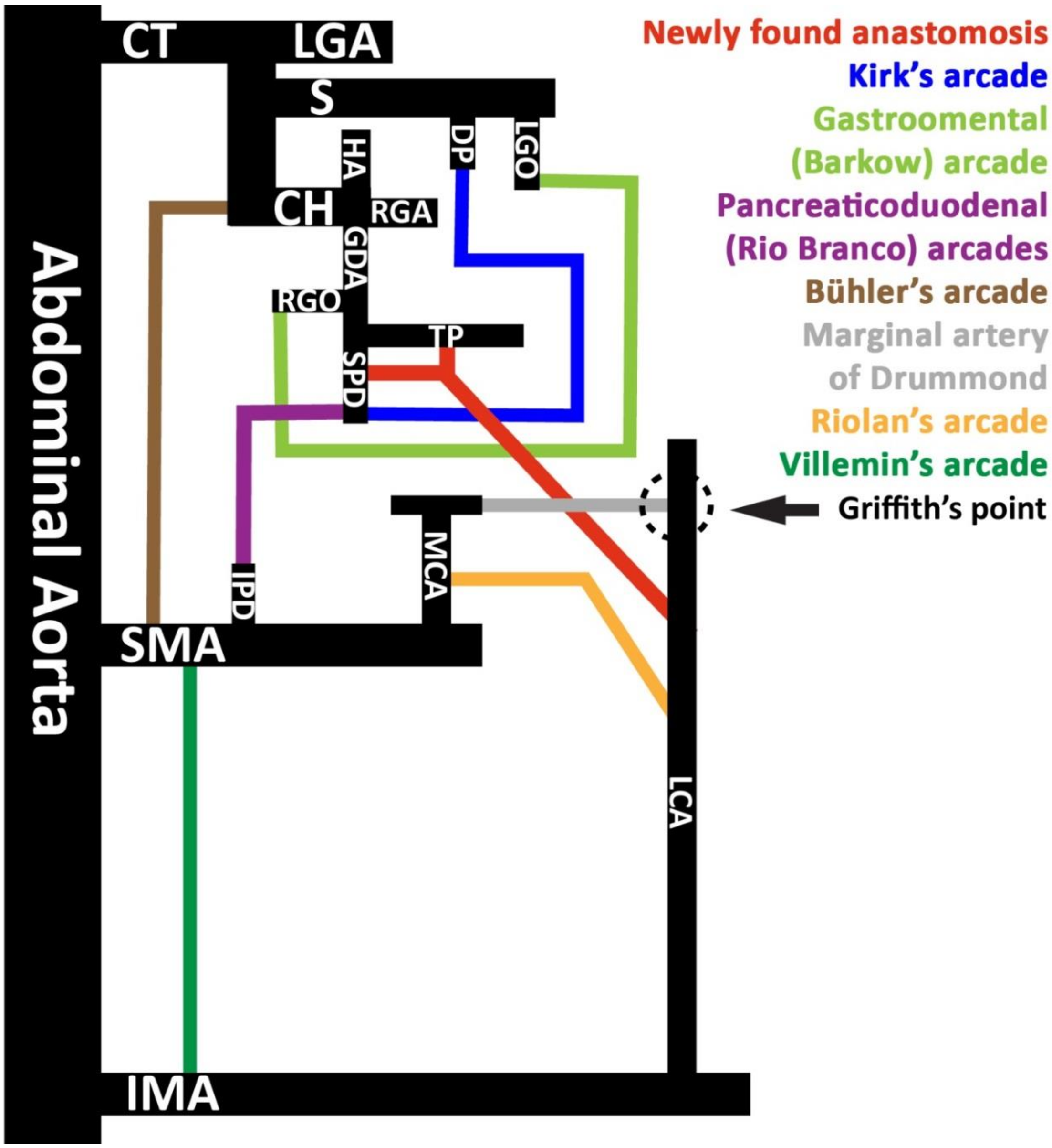

Figure 3. Summary displaying the connections of the unpaired abdominal visceral arteries. CT: celiac trunk; LGA: left gastric a.; S: splenic a.; DP: dorsal pancreatic a.; LGO: left gastroomental a.; CH: common hepatic a.; HA: proper hepatic a.; RGA: right rastic a.; GDA: gastroduodenal a.; RGO: right gastoomental a.; TP: transverse pancreatic a.; SPD: superior pancreaticoduodenal a.; SMA: superior mesenteric a.; IPD: inferior pancraticoduodenal a.; MCA: middle colic a.; IMA: inferior mesenteric a.; LCA: left colic a.

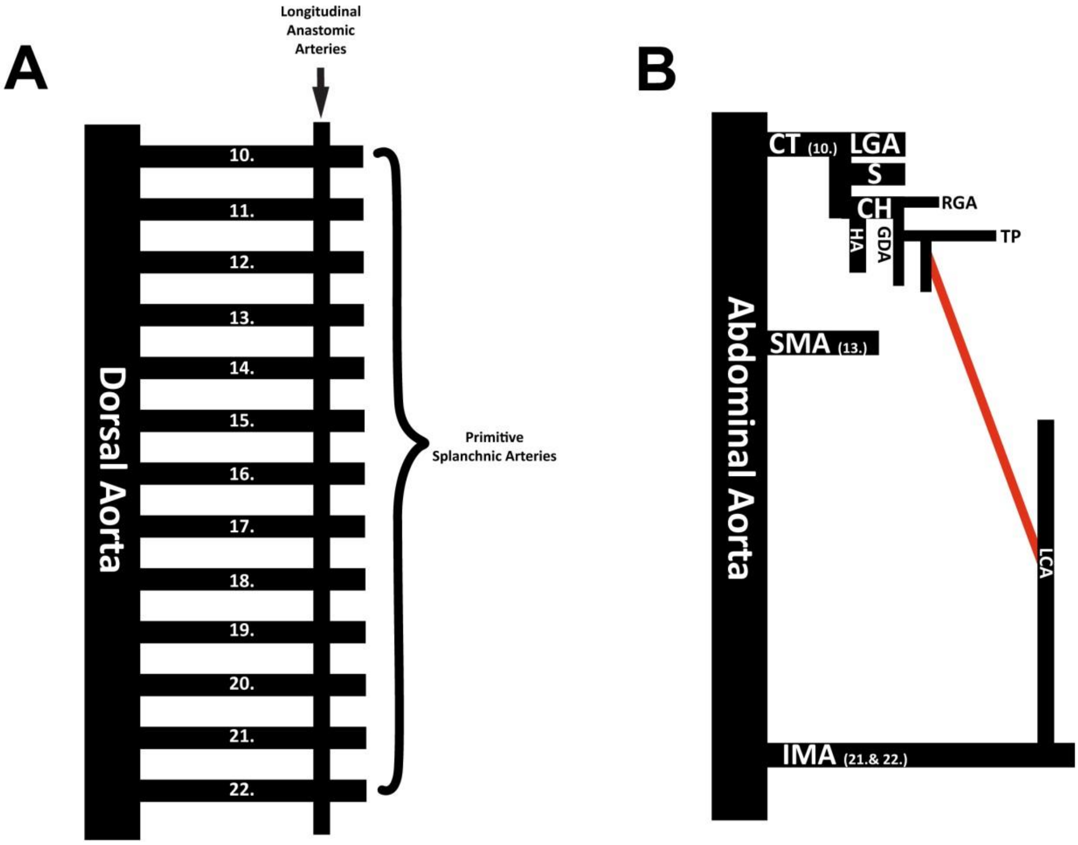

Figure 4. (a) Schematic illustration of the late embryonic development of the abdominal vascular system showing the Tandler's longitudinal anastomosis connecting the metameric vitelline arteries arise from the dorsal aorta. (b) Our variant related to the embryologic development of the segmental splanchnic arteries. CT: celiac trunk; LGA: left gastric a.; S: splenic a.; CH: common hepatic a.; HA: proper hepatic a.; RGA: right rastic a.; GDA: gastroduodenal a.; TP: transverse pancreatic a.; SMA: superior mesenteric a.; IMA: inferior mesenteric a.; LCA: left colic a.; variant anastomosis shown by a red line