DOI: 10.5958/2319-5886.2015.00142.3

International Journal of Medical Research & Health Sciences

www.ijmrhs.com Volume 4 Issue 3 Coden: IJMRHS Copyright @2015 ISSN: 2319-5886

Received: 27th Apr 2015 Revised: 10th May 2015 Accepted: 25th May 2015

Case report

CONCURRENT ORIGIN OF RIGHT GASTROEPIPLOIC AND LEFT COLIC ARTERIES FROM INFERIOR PANCREATICODUODENAL ARTERY: RARE VARIATION OF SPLANCHNIC ANASTOMOSIS

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ABSTRACT

In the present case, inferior pancreaticoduodenal artery, the first branch of superior mesenteric artery, was exceptionally giving rise to right gastroepiploic artery and left colic artery simultaneously. Right gastroepiploic artery is a branch of foregut artery, while left colic artery is a branch of hindgut artery. Concurrent origin of branches of foregut as well as hindgut arteries from a midgut artery i.e. superior mesenteric artery is very rare. Usual left colic artery from inferior mesenteric artery was also present but was supplying smaller area than usual. It can be explained as persistence of unusual channels and obliteration of usual ones along the dorsal splanchnic anastomosis during the embryonic development. The field of vascularization of superior mesenteric artery was extended beyond its usual boundaries both proximally as well as distally, which is clinically important as unawareness of the variations may lead to significant morbidity and mortality.

Keywords: Bypass graft, Colic artery, Gastroepiploic artery, Pancreaticoduodenal artery, Splanchnic anastomosis, Mesenteric artery

INTRODUCTION

Fields of vascularization of celiac trunk (CT), superior mesenteric artery (SMA), and inferior mesenteric artery (IMA), which are ventral branches of abdominal aorta, constitute the basis for dividing the abdominal gastrointestinal tract into three respective embryological regions - foregut, midgut, and hindgut[1]. The midgut forms the third and fourth parts of the duodenum, jejunum, ileum, and two-thirds of the way along the transverse colon[2]. These parts of the gut are usually supplied by SMA. The part of the abdominal gut proximal to it is supplied by CT and distal to it is supplied by IMA. Inferior pancreaticoduodenal artery (IPDA) arises as a first branch of SMA. It usually divides directly into anterior and posterior branches which anastomose with the similar branches of superior pancreaticoduodenal artery which is a branch of gastroduodenal artery (GDA), arising from hepatic branch of CT (foregut artery). It is a site of anastomosis between SMA and CT. Both the branches of IPDA supply the pancreatic head, its uncinate process and the second and third parts of the duodenum[2]. GDA (foregut artery) also gives rise to right gastroepiploic artery (RGEPA), which supplies the stomach by running along it's greater curvature. Left colic artery (LCA) is a first branch of IMA (hindgut artery), which ascends towards left side and immediately divides into ascending and descending braches. Ascending branch anastomoses with left branch of middle colic, while descending one with the highest sigmoid artery[2]. In the present case as both RGEPA and LCA were arising from IPDA simultaneously, this branch of SMA was unusually supplying two distinct parts of the gut and hence field

of vascularization of SMA was extended beyond its usual boundaries both proximally as well as distally. Such variations related to both foregut and hindgut arteries together on a same branch of midgut artery are very rare.

CASE REPORT

The observations were done during routine anatomical dissection for undergraduate students on a formalin-fixed 70-year-old male cadaver while dissecting the abdominal region. During careful dissection of arteries of the gut it was seen that the inferior pancreaticoduodenal artery (IPDA), a first branch of superior mesenteric artery (SMA) was showing an unusual branch near its root. The IPDA then continued further and gave it's usual anterior and posterior branches and further continued as right gastroepiploic artery (RGEPA), running along the greater curvature of the stomach **[Figure 1]**.

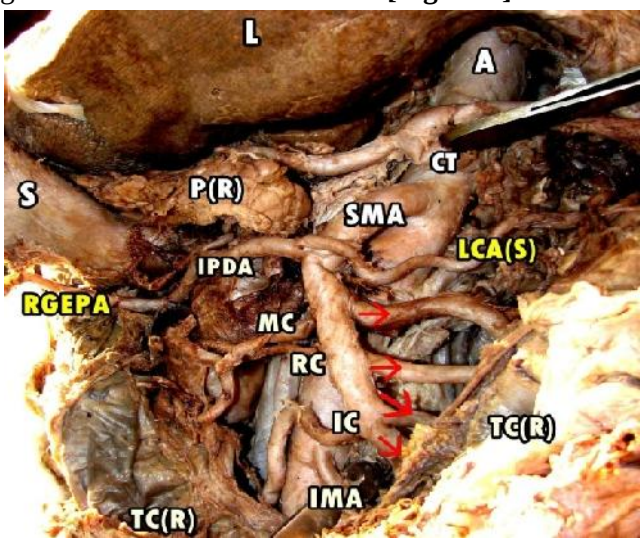

Fig 1: Origin of Right gastroepiploic and accessory left colic arteries from inferior pancreaticoduodenal artery [L: liver; **A**: aorta; **S**: stomach; **P(R)**: reflected pancreas; **CT**: celiac trunk; **SMA**: superior mesenteric artery; **IPDA**: inferior pancreaticoduodenal artery; **RGEPA**: right gastroepiploic artery; **LCA(S)**: accessory left colic artery from SMA**; MC**: middle colic artery; **RC**: right colic artery; **IC**: ileocolic artery; **IMA**: inferior mesenteric artery; **TC(R)**: reflected transverse colon]

The RGEPA was not originating from its usual artery i.e. gastroduodenal artery (GDA). The unusual branch arising near the root of IPDA crossed SMA anteriorly, approached splenic flexure, and terminated into two branches, ascending and descending **[Fig 2]**. The ascending branch was running along splenic flexure and the adjacent transverse colon and the descending branch along the upper part of descending colon and continued further by forming marginal artery **[Figure 3].** We found that it was an extra left colic artery as we also found the usual LCA arising from IMA, hence we called this branch of IPDA as an accessory LCA.

The inferior mesenteric artery (IMA) was giving its usual three branches i.e. left colic, sigmoid, and superior rectal arteries. Here the left colic artery (LCA) was directed downwards towards lower part of descending colon **[Figure 2].** In the present case, the LCA from IMA was not branched, was running downwards, and near the lower part of the descending colon it terminated by joining with the lower part of the marginal artery **[Figure 3]**. The above observations showed that the colon on the left side was supplied by two left colic arteries having different origins. One LCA was arising from IMA as usual, but with smaller area of distribution. However, another artery originated from IPDA near its root was supplying distal part of transverse colon, splenic flexure, and upper part of descending colon, which we called as (was) an accessory LCA.

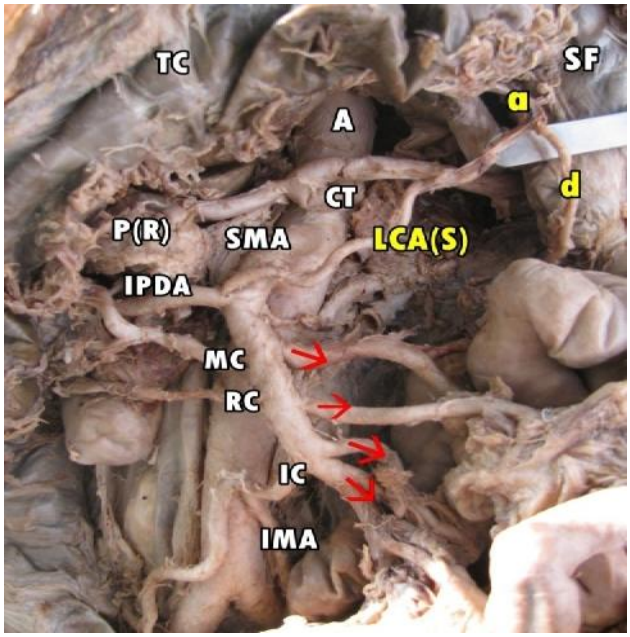

Fig 2. Accessory left colic artery supplying splenic flexure and upper left colon [TC: transverse colon; **SF**: splenic flexure; **A**: aorta; **P(R)**: reflected pancreas; **CT**: celiac trunk; **SMA**: superior mesenteric artery; **IPDA**: inferior pancreaticoduodenal artery; **LCA(S)**: accessory left colic artery from SMA**; a**: ascending branch of LCA (S); **d**: descending branch of LCA (S); **MC**: middle colic artery; **RC**: right colic artery; **IC**: ileocolic artery; **IMA**: inferior mesenteric artery]

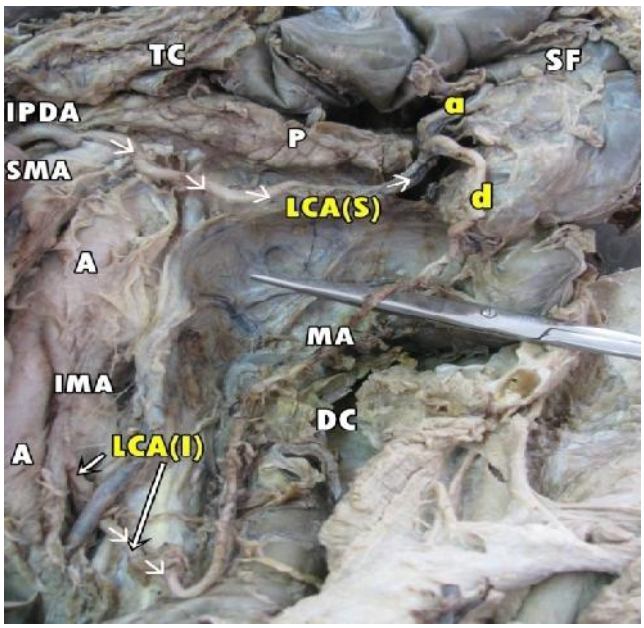

Fig 3: Accessory left colic artery and usual left colic artery [TC: transverse colon; **SF**: splenic flexure; **A**: aorta; **P**: pancreas; **SMA**: superior mesenteric artery; **IPDA**: inferior pancreaticoduodenal artery; **LCA(S)**: left colic artery from **SMA; a**: ascending branch of LCA (S); **d**: descending branch of LCA (S); **IMA**: inferior mesenteric artery; **MA**: marginal artery; **DC**: descending colon; **LCA(I)**: usual left colic artery from **IMA]**

The peculiarity of the case was one artery i.e. the IPDA (midgut artery) was giving rise to two unusual arteries concomitantly and those arteries were supplying to two completely different parts of the gut - RGEPA proximally, supplying greater curvature of stomach (a foregut derivative) and an accessory LCA distally, supplying distal part of transverse colon, splenic flexure, and upper part of the descending colon (hindgut derivatives).

DISCUSSION

Variations in the branching pattern of superior mesenteric artery are commonly seen and well documented. It may be a source of the common hepatic, gastroduodenal, accessory right hepatic, and accessory pancreatic or splenic arteries[2]. Bergman et al mentioned that SMA may give rise to branches which are usually derived from other sources, like – hepatic or its branches, cystic, gastroduodenal or its right gastroepiploic, left gastric, and accessory left colic arteries. Inconstant branches also have been noted. These are the dorsal pancreatic (21% of cases studied), inferior pancreatic, right hepatic (accessory or replacing, 14%), common hepatic, and accessory middle colic. In some cases, the inferior mesenteric, splenic, gastroduodenal, right gastroepiploic, or even the cystic artery arise from the superior mesenteric[3].

Origin of right gastroepiploic artery (RGEPA) from SMA[4,5]or accessory left colic artery from SMA[6,7] have been observed and mentioned in literature, but they always occurred as separate events. To the best of our knowledge, the concurrent origin of both the arteries from SMA has not been reported.

The embryological events occurring during the establishment of the vasculature of gut may form the basis of this variation. Each primitive dorsal aorta on each side gives off many paired segmental branches to the digestive tube. After fusion of the dorsal aortae, they merge as unpaired trunks that are distributed to the primitive digestive tube. Longitudinal anastomotic channels connect these branches along the dorsal and ventral aspects of the tube, forming dorsal and ventral splanchnic anastomoses. These vessels obviate the need for so many arteries and are reduced to three – CT, SMA, and IMA. Some of the channels in the anastomosis persist according to the blood supply of the region while remaining channels disappear. The dorsal splanchnic anastomosis persists in the gastroepiploic, pancreaticoduodenal, and primary branches of the colic arteries, whereas the ventral splanchnic anastomosis forms the right and left gastric and the hepatic arteries. The variations are due to modifications of the usual processes by which the vessels are developed[8]. The uncommon origin of RGEPA and LCA from IPDA found in the present case can be explained as persistence of unusual channels and obliteration of usual ones along the dorsal splanchnic anastomosis.

Prior knowledge of branching pattern of these arteries is essential to successfully accomplish surgical and other interventional procedures. RGEPA is one of the arteries used for coronary artery bypass graft (CABG) [9,10]. The RGEPA is also used as an alternative inflow source in acute mesenteric ischemia[11]. This suggests the significance of verification of origin of RGEPA before it could be used in any procedures. Yoshihara et al have mentioned an anomalous right gastroepiploic artery graft arising from SMA[5]. Similarly the knowledge of variations in the origin of left colic artery will be useful in procedures or surgeries related to colon. In a situation like a present case, where a large territory is supplied by SMA,

injury or thrombosis of the artery may lead to significant morbidity or mortality.

CONCLUSION

In the present case, the SMA, a midgut artery was crossing its usual boundaries both proximally as well as distally to supply parts of foregut and hindgut i.e. a large visceral territory was supplied by a single vessel. Such occurrence can be explained as the variation in the formation of dorsal splanchnic anastomosis during embryonic development. The dominance of the SMA found in the present case was remarkable. Though most of the times such variations remain asymptomatic, in cases like injury or thrombosis of SMA, surgical procedures on the gut or intended use of RGEPA in coronary artery bypass graft (CABG) unawareness of the variations may lead to significant morbidity and mortality.

Conflict of interests: The author declares that there is no conflict of interests.

Acknowledgments: The author is thankful to Dr Garud, Dr Reddy, Dr Shinde, and Mrs Anandi of Anatomy Department, Bharati Vidyapeeth Medical College, Pune, India.

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