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ABERRANT BLOOD SUPPLY TO LIVER FROM SUPERIOR MESENTERIC ARTERY— A CASE REPORT

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ABSTRACT

The liver has a highly variable vascular anatomy. In the classic vascularization pattern of the liver, the common hepatic artery, a branch of celiac trunk, divides into a right and left hepatic arteries to supply the respective lobes of the liver. The present article reports the origin of the right hepatic artery from the superior mesenteric artery that supply the gallbladder, common bile duct, the caudate and the right lobe of the liver during the routine anatomical dissection in an adult female cadaver. The artery had a close relation with pancreas, common bile duct and gall bladder in its course. The knowledge of the variation is essential for the surgeons and interventional radiologists while doing various procedures on liver, gall bladder and pancreas. The ignorance of the same can lead to intraoperative and postoperative complications including hepatic ischemia.

KEYWORDS: Superior mesenteric artery, bile duct, right hepatic artery, liver, pancreas.

1. INTRODUCTION

The liver has a highly variable vascular anatomy. The classical pattern of vascularization described in 55-60% individuals is by the common hepatic artery, a branch of celiac trunk. The common hepatic artery gives off a proper hepatic artery that in turn divides into a right and left hepatic artery and supplies the whole liver. Variation from this pattern, seen in 40-45% of people, commonly include the origin of the right hepatic artery from the superior mesenteric artery, left hepatic artery from left gastric artery and trifurcation of the common hepatic artery into right, left and gastroduodenal artery.[1]

In the usual presentation, the right hepatic artery is a branch of the proper hepatic artery that ascends anterior to the portal vein and medial to bile duct below the porta hepatis. It further ascends posterior to the common hepatic duct and finally divides into an anterior and posterior division that supply the right lobe of the liver. During its course, it gives off a cystic artery to gall bladder, a branch to the common bile duct and the caudate lobe of the liver.[2]

An artery that originates from a different source and supplies the part of the liver in addition to its normal artery is an accessory artery, whereas, if it is the sole supply, it is called as a replaced or aberrant artery. Replaced right hepatic artery (RRHA) is the most commonly encountered variation in the hepatic arterial structure.[2] Recently, Mugunthan et al., Thangarajah et al. and Surekha et al. reported the incidence of RRHA as 8.3% 9% and 13.49% respectively in Indian population.[3,4,5] The present article reports a similar variation, the knowledge of which is essential for the surgical and interventional procedures concerned with the liver, bile duct and pancreas.

2. CASE REPORT

During routine anatomical dissection of the abdomen, as per the Cunningham's manual, an artery was found in the right free margin of lesser omentum below the porta hepatis of liver apart from the typically seen portal vein, the bile duct and the proper hepatic artery in a 65-year-old female cadaver. The common hepatic artery from the celiac trunk, after giving the gastroduodenal artery, continued as the proper hepatic artery. It gave the right gastric artery and then continued as the left hepatic artery supplying the left lobe of the liver.

The artery was related anteriorly to the right lobe of the liver and gall bladder, posteriorly to the epiploic foramen and inferior vena cava, portal vein and proper hepatic artery on the left side or medially and common bile duct on the right side or laterally. On tracing of the artery for its origin, it was found to be the first branch of the superior mesenteric artery that was given off behind the neck of the pancreas [Fig. 1, Fig. 4]. The neck of the pancreas was resected for better visualisation. The artery was located posterior to the portal vein at the neck of the pancreas [Fig. 2, Fig. 4]. It ascended behind the first part

of the duodenum to reach the right free margin of lesser omentum lateral to the portal vein and medial to the common bile duct. On further tracing, after giving a branch to the caudate lobe of the liver, it ascended posterior to the common hepatic and cystic duct towards the right lobe of the liver.

The liver along with the part of the superior mesenteric artery, celiac trunk, and the duodenum and the head of the pancreas was resected out to describe the branching pattern of the artery in detail. The first branch was given in the free margin of lesser omentum below to supply the caudate lobe of the liver. Later, it gave branches to the bile duct, gallbladder (cystic artery) and finally divided into two terminal branches to supply the right lobe of the liver. The portal vein with its right and left branches and a portion of the right lobe of the liver were resected for better visualisation of the branches [Fig. 3, Fig. 4].

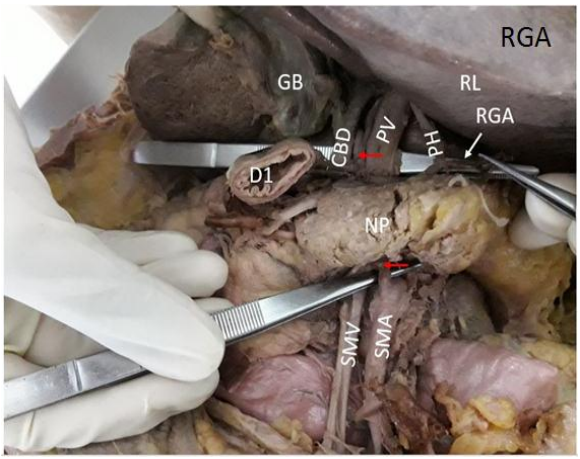

Fig. 1: The replaced right hepatic artery (red arrows) from superior mesenteric artery.
[CBD — common bile duct, D1 — first part of duodenum, GB — gall bladder, NP — neck of pancreas, PHA — proper hepatic artery, PV — portal vein, RGA — right gastric artery (white arrow), RL — right lobe of liver, SMA — superior mesenteric artery, SMV — superior mesenteric vein]

Fig. 2: Relation of portal vein to the replaced right hepatic artery (red arrows) after resecting the neck of pancreas. [PV — portal vein, SMA — superior mesenteric artery, SMV — superior mesenteric vein, SV — splenic vein]

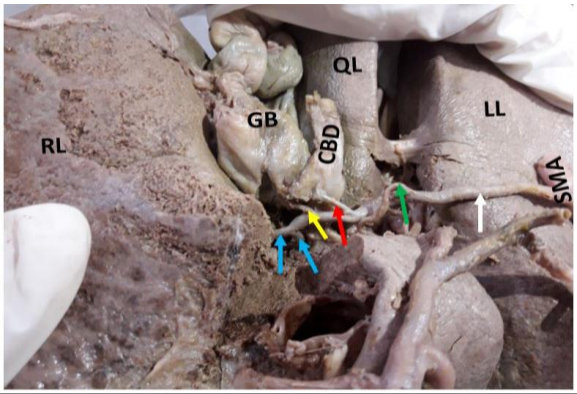

Fig. 3: Branches of the replaced right hepatic artery. Branch to the caudate lobe of liver (green arrow), common bile duct (CBD; red arrow), cystic artery (yellow arrow) and the two terminal branches (blue arrows). [GB — gall bladder, LL — left lobe of liver, QL — quadrate lobe of liver, RL — right lobe of liver, SMA — dissected superior mesenteric artery]

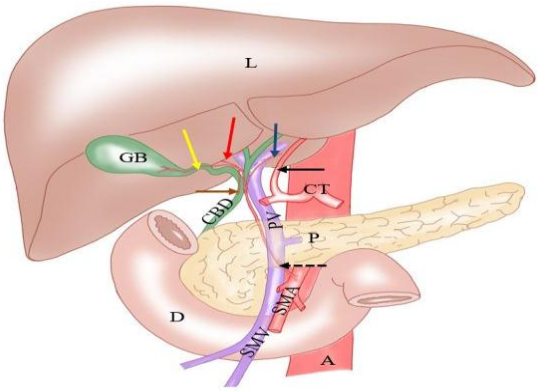

Fig.4: Schematic diagram of the course and branches of RRHA (dotted black arrow). The left hepatic artery (black arrow) is given by celiac trunk (CT). Branches of RRHA: cystic artery (yellow arrow), branch to common bile duct (brown arrow), caudate lobe (blue arrow) and right lobe of the liver (red arrow). [A — abdominal aorta, CBD — common bile duct, D — duodenum, GB — gall bladder, L — liver, P — pancreas, PV — portal

vein, SMA — superior mesenteric artery, SMV — superior mesenteric vein].

DISCUSSION

Michel, after dissecting 200 cadavers, classified the hepatic vascularization pattern into ten different types in 1955.[6] In 1994, Hiatt et al. modified this classification after studying 1000 donor livers used for orthoptic transplantation.[7] The present variation is classified as type III based on the classification as per the authors. The differences in the hepatic arterial pattern can be explained on the embryological basis. During the fourth week of development, the liver bud arises from the ventral floor of distal foregut close to the opening of the hepatopancreatic ampulla. The artery to foregut is the celiac trunk, and the midgut is the superior mesenteric artery.[2] During embryonic life, the liver receives its blood supply from three different sources; a left hepatic artery from the left gastric artery (a branch of the celiac trunk); a middle hepatic artery from the common hepatic artery and a right hepatic artery from the superior mesenteric artery. Later, the left and right hepatic arteries disappear, and the common hepatic artery supplies the whole liver after dividing into right and left branches, the classical adult pattern of vascularization.[8] The variations in hepatic arterial supply can occur if there is a deviation from the typical scenario. The present variation can be attributed to the persistence of right hepatic artery in addition to the common the right hepatic artery.

Haller first published the presence of a replaced right hepatic artery (RRHA) in 1756.[9] On its course, Stankiewicz et al. classified the replaced artery as three types; type 1 — RRHA posterolateral to pancreatic head, type 2 — RRHA traversing through the head of the pancreas and type 3 — RRHA located within the groove of the superior mesenteric vein. According to the author, type 1 was the commonest variant and type 3 the least.[10] The variation reported in this article is type I as per the author. Its close relation with the pancreas makes it highly vulnerable to injury in pancreaticoduodenectomy, thus resulting in ischemia of the right lobe.[10,11] More significant is its contribution to the blood supply of bile duct. The bile duct receives its main blood supply from the retroduodenal branch of the gastroduodenal artery, which is usually severed in pancreaticoduodenectomy. Then the primary supply is from the right hepatic artery that can be compromised in the presence of the concerned variation.[12] Compression of the bile duct by the replaced right hepatic artery can result in obstructive jaundice, called as the right hepatic syndrome.[13] The RRHA is prone to injury during cholecystectomy due to its close relation with the cystic artery and cystic duct in the Calot's triangle. Hence, patients should be radiologically screened for such variations that can cause inadvertent intraoperative bleeding or hepatic ischemia.[14]

4. CONCLUSION

The knowledge on the variant hepatic vascularization patterns is essential since it occurs in almost half of the individuals. From previous literature, the presence of a replaced right hepatic artery from the superior mesenteric artery is quite common, that can lead to various complications. Hence surgeons and gastroenterologists should be aware of such variations.

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