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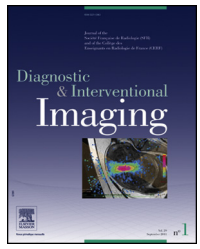

REVIEW / *Cardiovascular imaging*

Anatomy of liver arteries for interventional radiology

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Abstract The availability of intra-arterial hepatic therapies (radio and/or chemo-embolisation, intra-arterial hepatic chemotherapy) has convinced radiologists to perfect their knowledge of the anatomy of the liver arteries. These sometimes, complex procedures most often require selective arterial catheterization. Knowledge of the different arteries in the liver and the peripheral organs is therefore essential to optimize the procedure and avoid eventual complications. This paper aims to describe the anatomy of the liver arteries and the variants, applying it to angiography images, and to understand the implications of such variations in interventional radiological procedures.

Recent progress in the endovascular treatment of liver tumours gives interventional hepatic radiology a preponderant place in the therapeutic possibilities. The administration of drugs and/or embolising agents most often requires supra-selective catheterization of the feeding arteries of the tumour in order to optimize the treatment and spare the non-tumoral liver [1].

These procedures (radio-embolisation, chemo-embolisation, intra-arterial hepatic chemotherapy) require a perfect understanding of the conventional anatomy of the arteries and its variants in order to plan and obtain the best approach possible as well as minimize the risks of intra and post-interventional complications. Therefore, embolisation of the wrong arterial branches may lead to incomplete treatment of the target lesion or the toxic exposure of the liver parenchyma or healthy organs.

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This didactic article is above all intended for radiology interns who would like to perform interventional hepatic radiology. The purpose of this paper is to describe the anatomy of liver arteries and their variants, apply it to angiography images and understand the implication of such variations on the interventional radiology procedures.

Celiac artery and arterial branches to the liver

Conventional anatomy of the celiac artery

(Fig. 1) The supramesocolic arterial irrigation arises from the celiac artery, running from the anterior side of the aorta at the level of the 12th thoracic vertebra (indication for catheterization). It generally comprises three main branches: left gastric artery, coronary stomach artery, spleen artery and common hepatic artery.

Common hepatic artery

It arises from the celiac artery, runs obliquely forward and towards the right, thereby forming a concave curve from the aorta. The common hepatic artery runs to the right, along the upper border of the pancreas to the left side of the portal vein. It then splits at the omental foramen into the gastroduodenal artery and the proper hepatic artery.

Proper hepatic artery

Terminal branch of the common hepatic artery, it rises towards the liver in the hepatoduodenal ligament, running upwards and to the right, along the anterior edge of the omental foramen. The proper hepatic artery splits into a right branch and left branch of the hepatic artery. Therefore, the terms ''right hepatic artery'' and ''left hepatic artery'' are reserved for the description of the anatomic variants of the hepatic artery.

Splenic artery

The splenic artery joins the upper border of the body of the pancreas, and then runs towards the left either behind or above the pancreas to join the splenic hilum. One of its terminal branches gives rise to the left gastroepiploic artery to feed the greater curvature of stomach. The latter forms the arterial circle of the greater curvature of stomach by anastomosis with the right gastroepiploic artery arising from the gastroduodenal artery.

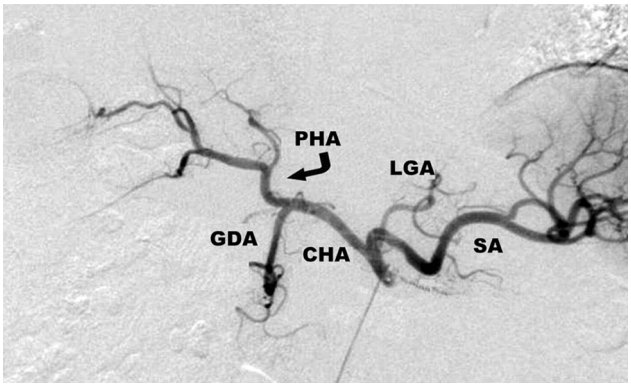

Figure 1. Conventional arterial anatomy of the celiac artery: left gastric artery (LGA), splenic artery (SA), common hepatic artery (CHA), proper hepatic artery (PHA) and gastroduodenal artery (GDA).

Left gastric artery [2]

Originating at the upper side of the celiac artery, it forms an arch until reaching the right border of the cardia. This specific anatomy requires the use of catheters (for example, Simmons, SOS catheters, etc.) whose curvature allows the catheterization. The left gastric artery then splits into two terminal branches (anterior and posterior) running towards the lesser curvature of stomach. The posterior branch anastomoses with its homologue arising from the right gastric artery to form the arterial circle of the lesser curvature of stomach. It is therefore possible to catheterize the right gastric artery *via* the posterior branch of the left gastric artery.

The lack of visualisation of the left gastric artery often results from an overly distal position of the catheter within the celiac artery, beyond its opening. If the injection flow rate is low during the arteriography, the contrast reflux is insufficient, not allowing for the opacification of the left gastric artery.

Anatomic variations of the celiac artery

(Fig. 2a—f) Celiac trifurcation is found in 89% of the cases in the series by Michel et al. [3]. According to this study, 15 types of variations are described. Three of them are major [4]: a hepatosplenic trunk (4.5%), a hepatomesenteric and gastrosplenic trunk (2.5%), a cœliomesenteric trunk (1%).

Hepatic artery variations

Right hepatic artery

(Fig. 3) A right hepatic artery is found in 10 to 30% of the population. It originates in the superior mesenteric artery (96% of the cases), or the pancreatico-duodenal trunk (4%). It runs within the space between the pancreas and the vena cava (Fig. 4). The right hepatic artery is the first large artery to emerge from the superior mesenteric artery. When present, it almost always gives rise to the main or accessory cystic artery.

Left hepatic artery

(Fig. 5) It is found in 12 to 21% of the population. It originates in the left gastric artery and runs within the groove of Arantius. When a vascular structure is present within this groove in the CT-scan or MRI (Fig. 6), this indicates non-conventional hepatic arterial vascularisation with the presence of at least one left hepatic artery. The left hepatic artery gives rise to small branches leading to the stomach and oesophagus. In 70% of the cases, it is accompanied by another arterial variation: right hepatic artery (RHA), middle hepatic artery leading to segment IV.