

Right Hepatic Artery Anomalies

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Introduction

The hepatic artery proper (also proper hepatic artery) is the artery that supplies the liver and gallbladder. It arises from the common hepatic artery, a branch of the celiac artery. The Right Hepatic Artery (RHA) is one of the primary vessels responsible for supplying oxygenated blood to the right lobe of the liver, an essential part of the body's metabolic and detoxification functions. It typically originates from the common hepatic artery, which itself is a branch of the celiac trunk. However, in some individuals, the anatomy of the right hepatic artery may vary from the standard pattern, resulting in right hepatic artery anomalies. These anatomical variations are important for clinicians to recognize, as they can have significant implications during diagnostic procedures, surgical interventions and organ transplantation.

Description

Structure

The hepatic artery proper arises from the common hepatic artery and runs alongside the portal vein and the common bile duct to form the portal triad. A branch of the common hepatic artery-the gastroduodenal artery gives off the small supraduodenal artery to the duodenal bulb. Then the right gastric artery comes off and runs to the left along the lesser curvature of the stomach to meet the left gastric artery, which is a branch of the celiac trunk. It subsequently bifurcates into the right and left hepatic arteries.

Variant anatomy

Of note, the right and left hepatic arteries may demonstrate variant anatomy. A misplaced right hepatic artery may arise from the Superior Mesenteric Artery (SMA) and a misplaced left hepatic artery may arise from the left gastric artery. The cystic artery generally comes from the right hepatic artery.

Other variants of right hepatic artery includes: Arising directly from the proximal or middle part of common hepatic artery, gastroduodenal artery, superior mesenteric artery, celiac axis, aorta, splenic artery, or left gastric artery instead of arising from proper hepatic artery.

Unusual anatomy of the right hepatic can itself affect the path and form of the cystic artery, with the most frequent variation resulting from an aberrant origin of the right hepatic artery which is described in between 2%-16% of cases.

Generally this anomalous source is the superior mesenteric artery or more rarely the abdominal aorta, producing what has been described as a "replacing right hepatic artery", passing through the hepatobiliary triangle and running posterior and parallel to the cystic duct.

Because of the close proximity to the gallbladder to the (replacing) right hepatic artery a "caterpillar" or "Moynihan's" hump may form and this artery generally produces multiple short cystic branches rather than a single cystic artery.

Understanding right hepatic artery anomalies

In normal anatomical development, the right hepatic artery arises directly from the common hepatic artery. However, in certain cases, it may take an alternative route, and these variations are generally categorized based on their origin and course. The most common right hepatic artery anomalies include:

Accessory right hepatic artery: This is one of the most frequently encountered anomalies. In this case, the right hepatic artery arises not only from the common hepatic artery but also from another source, such as the Superior Mesenteric Artery (SMA) or the aorta. The accessory artery usually runs alongside the normal right hepatic artery and provides additional blood supply to the liver. In some individuals, the accessory artery may even be the dominant vessel supplying the right lobe.

Replaced right hepatic artery: A replaced artery occurs when the right hepatic artery is entirely absent from its usual origin (the common hepatic artery) and instead originates from a different source, such as the Superior Mesenteric Artery (SMA) or aorta. This anomaly can be a potential risk during liver surgeries or liver transplants, as surgeons may not expect a major artery to be arising from an unusual location.

Aberrant right hepatic artery: The aberrant right hepatic artery is another form of anomaly where the right hepatic artery arises from an unusual vessel but is still present. This can be a variant in the branching pattern, and it may sometimes pass through unusual routes, such as through the gallbladder fossa or behind the duodenum.

Duplicated right hepatic artery: In rare cases, individuals may have two right hepatic arteries arising from different origins, leading to redundancy in the blood supply to the right lobe of the liver.

Clinical implications of RHA anomalies

Anomalies of the right hepatic artery are not necessarily symptomatic, but their clinical significance becomes apparent primarily during surgery, imaging procedures or liver transplantation.

Surgical considerations: During surgeries like cholecystectomy (gallbladder removal), hepatectomy (liver resection), or liver transplantation, variations in the right hepatic artery need to be carefully considered. If the anomaly is not identified preoperatively, accidental injury to an aberrant or accessory artery may result in ischemia or necrosis of the liver tissue, leading to complications.

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Diagnostic imaging: Anomalies in the hepatic artery often become evident through imaging modalities such as CT angiography, MRI or ultrasound. Precise knowledge of the vascular anatomy is critical for radiologists and surgeons to interpret these images correctly, avoid misdiagnosis and plan surgeries accordingly.

Liver transplantation: The presence of an anomalous right hepatic artery can complicate liver transplant procedures. Surgeons must be aware of these anomalies to ensure proper vascular anastomosis (connection of blood vessels), particularly if a replaced or accessory artery is involved. If the artery is not properly managed, it may lead to biliary complications or liver graft failure.

Diagnosis and management

Right hepatic artery anomalies are often asymptomatic but can be detected incidentally during imaging studies for unrelated conditions. In some cases, preoperative imaging is required, especially if there is a need for liver surgery or transplantation. CT angiography or MR angiography is typically used to map out the hepatic arterial anatomy before procedures, ensuring that any variants are identified.

When an anomaly is detected, management largely depends on the clinical context. In many cases, no immediate treatment is needed unless the anomaly poses a risk during surgery or transplantation. Surgeons may take additional precautions, such as meticulous dissection or intraoperative imaging, to avoid damaging the anomalous vessel.

Conclusion

Right hepatic artery anomalies, though uncommon, are crucial for clinicians to recognize due to their potential impact on surgical outcomes, liver transplantation and diagnostic accuracy. While many individuals with these anomalies remain asymptomatic, those undergoing liver surgery or transplantation require careful preoperative planning to avoid complications. A thorough understanding of hepatic arterial anatomy, including its variations, is essential for ensuring the best possible patient care and avoiding life-threatening complications during interventions involving the liver.