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Persistent anastomosis between proper hepatic and replaced right hepatic artery: implications in liver transplantation

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Dear Editors:

Michels described the arterial anatomy of the liver in 1966. Because of the widespread development of liver transplantation, laparoscopic biliary surgery, and interventional radiological procedures, additional studies on hepatic arterial supply have been carried out during the past decade [1, 2]. When performing the above procedures, precise identification and understanding of the anatomy is essential to avoid arterial injuries that could otherwise compromise liver graft revascularization or cause serious morbidity.

In approximately 75% of the cases, the liver receives its blood supply from the hepatic branches of the celiac axis (CA). However, in the remaining 25% of livers, variant patterns may occur in addition to or as replacement of the dominant scheme. These variations include hepatic arterial supply from the superior mesenteric artery (SMA), left gastric artery, aorta, and even other visceral branches [3]. We report a rare anatomical variation of hepatic arterial anatomy and discuss its significance in liver transplantation.

A liver was obtained from a cadaveric donor for orthotopic liver transplantation. At retrieval, the arterial anatomy was found to be of Michels type 3, i.e., the proper hepatic artery (PHA) originated

from the CA, but there was a replaced right hepatic artery (RRHA) originating from the SMA. This RRHA was located on the posterolateral side of the portal vein.

During back-table preparation of the liver graft, we discovered an arterial anastomosis between the PHA and the RRHA, located posterior to the common hepatic duct, but anterior to the portal vein. Interestingly, while the left hepatic artery originated from the PHA, there was an arterial branch to segment IV that originated from the arterial anastomosis between the PHA and the RRHA (Fig. 1). Additionally, the RRHA divided into a right and left branch distal to the anastomosis with the PHA (Fig. 2).

Proper identification and understanding of the hepatic arterial anatomy is mandatory for the safety of the newer surgical and radiological procedures involving the liver, especially with the more frequent use of living-related donors and split-liver transplantation techniques [4, 5, 6].

When Michels described the basic anatomical variation of hepatic arterial blood supply in 1966 based on a series of 200 autopsies, he detailed ten different types that could be either accessory or replaced [1]. In 1986, based on an analysis of 216 arteriographic studies, Rygaard et al. reported seven hepatic arterial

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Fig. 1 Replaced right hepatic artery originating from the superior mesenteric artery with an arterial anastomosis between the proper hepatic artery and the replaced right hepatic artery (*CA* celiac axis, *CHD* common hepatic duct, *GDA* gastroduodenal artery, *LHA* left hepatic artery, *PHA* proper hepatic artery, *PV* portal vein, *RRHA* replaced right hepatic artery, *SA* splenic artery, *SMA* superior mesenteric artery)

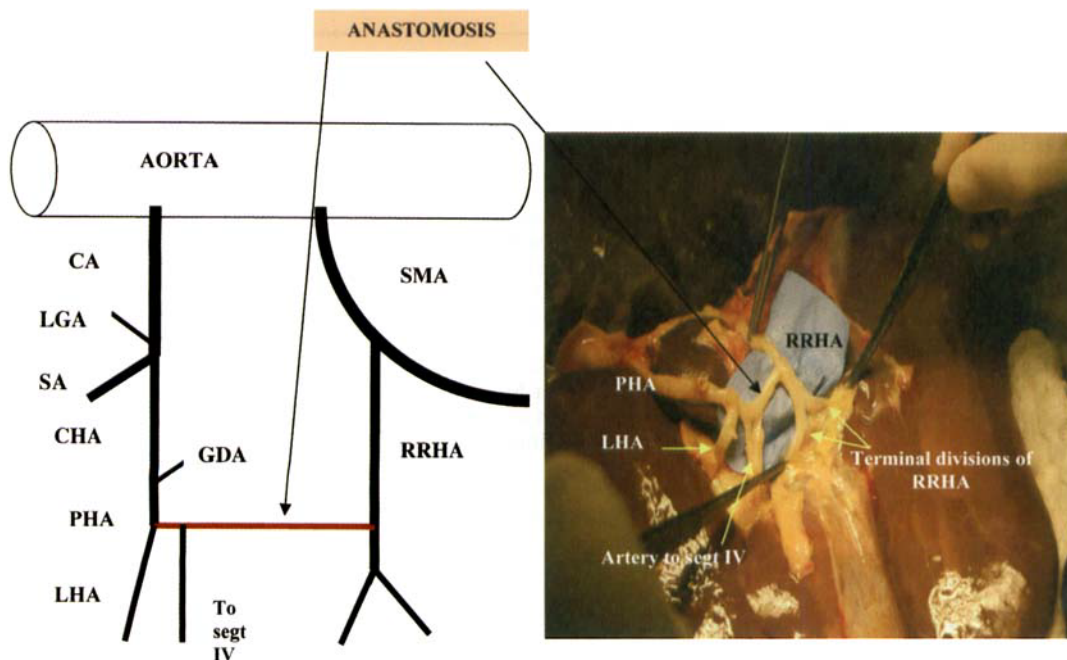
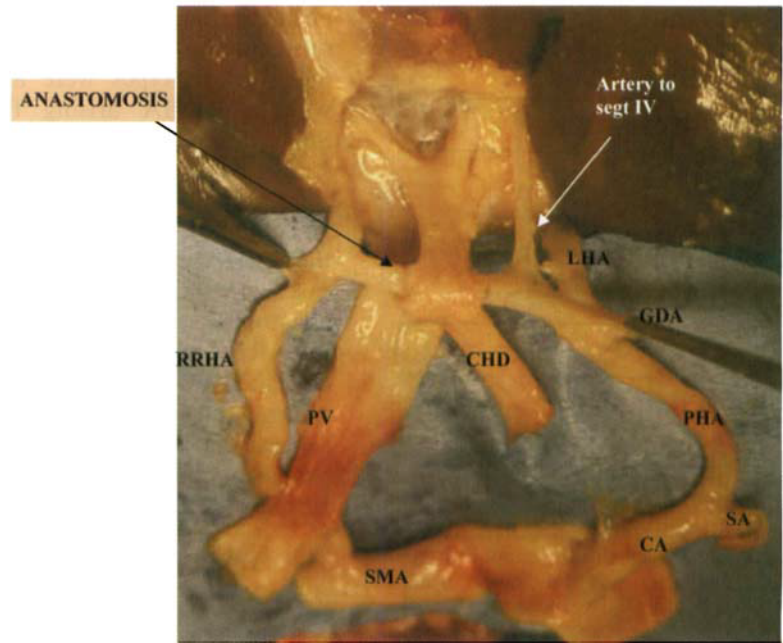


Fig. 2 Arterial anastomosis between the proper hepatic artery and the replaced right hepatic artery (*CA* celiac axis, *CHA* common hepatic artery, *GDA* gastroduodenal artery, *LGA* left gastric artery, *LHA* left hepatic artery, *PHA* proper hepatic artery, *RRHA* replaced right hepatic artery, *SA* splenic artery, *SMA* superior mesenteric artery)

variations different from those previously reported by Michels [2].

More recently, the widespread use of liver transplantation, extensive experience with both cadaveric and living liver donor surgery,

laparoscopic biliary surgery, and hepatic arterial radiological procedures have provided a unique opportunity to observe virtually all possible hepatic arterial variations. Hiatt et al. reported their experience

with 1000 cadaveric liver retrievals and described six types of hepatic arterial variations [3]. More recently, Tarazov reported two new variations [7].

Ibukuro et al. reported radiological findings of an anastomosis between the PHA and RRHA with an incidence of 1.38% in 720 angiographic examinations [8]. They found two forms of this variant

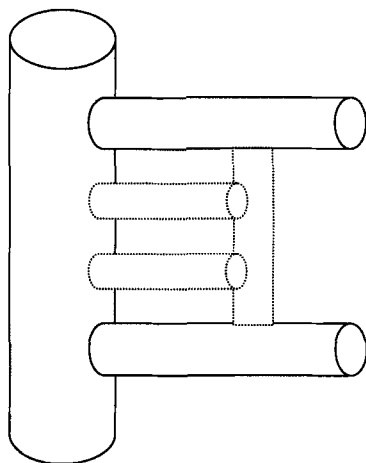


Fig. 3 The arch of Bühler: the 10th to 13th ventral segmental arteries. Persistent anastomosis between the 10th and 13th ventral segmental arteries is at the origin of hepatic arterial anatomical variation

occurring equally often, one tortuous and the other a direct anastomosis. Both types were associated with a RRHA arising from the SMA. Eight patients (80%) in their study were classified as Michels type 3, and the incidence of an anastomosis between the PHA and the RRHA was 16% in these type-3 cases. In our case we found the anastomosis between the PHA and the RRHA to be of the direct type as described by Ibukuro et al. In considering the anatomical variation, we suggest that it can be explained by a persistent anastomosis between the 10th and 13th ventral segment of the

arch of Bühler (Fig. 3), where the 10th artery results in the CA and the 13th artery in the SMA [9].

A variety of procedures have been recommended for revascularization of the liver graft when faced with a Michels type-3 variation [10]. When, however, there is an anastomosis between the PHA and the RRHA, such procedures are not required.

An anastomosis between the PHA and the RRHA is uncommon. When this variant does occur, arterial reconstruction of the RHHA is unnecessary, thus simplifying the liver transplant procedure.

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