



Complex liver resection in the absence of portal vein bifurcation

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The knowledge of the anatomy of the liver and its variants is mandatory before any procedure on this organ. Absence of portal vein bifurcation is extremely rare ranging from 0.03 to 2% of cases depending on the type of study [1,2]. This anomaly may have hazardous consequences if not detected especially during resection of the right liver. In this anatomic variation, the portal vein runs thorough an intrahepatic path until reach the left liver segments. A left hemihepatectomy may not have any consequence while a right hemihepatectomy may compromise the portal perfusion of the entire left liver. There are only three cases of liver surgery in patients with this anomaly in the literature [3–5]. The first case was a left hepatectomy that did not pose any major difficulty [3]. In 2012, Spampinato et al. [4] described a successful right hepatectomy. In 2016, Teraoku et al. described a right hepatectomy which was complicated by postoperative portal vein thrombosis [5]. In both right liver resection cases, the technique used was opening the liver at the Cantlie's line until the plane of the intrahepatic portal vein. This video presents an alternative technique in which the portal vein is dissected from the hepatic hilum, following its intrahepatic path. A right posterior sectionectomy, resection of the liver segments 6 and 7, was performed in a patient with intrahepatic cholangiocarcinoma and absence of portal vein bifurcation. A 61-year-old man with one-month history of back pain underwent ultrasound that disclosed a tumor in the right liver. CT scan and MRI showed a 5 cm tumor in the right liver between the segments 6 and 7. Imaging disclosed absence of portal vein bifurcation (Fig. 1). Hepatic artery originates directly from Aorta while left hepatic artery originates from the left gastric artery but only correspond to segments 2 and 3 arteries. Arteries to segment 4 and segment 1 originate from the common hepatic artery as well the right hepatic artery (Fig. 2). PET-CT confirmed the liver as the only site of

malignancy. Patient was initially considered as non resectable due to the proximity of the tumor with the portal vein in the presence of this rare anomaly. He was then referred to us for treatment and our multidisciplinary team decided for open surgery. Resection of the right posterior liver sector (S6–S7) was proposed, and consent was obtained. Operation begins with cholecystectomy and intraoperative cholangiogram to study the biliary tree anatomy. Usually, intraoperative cholangiogram is only performed before liver resection in cases with known or suspected anatomical variation, or to check biliary leakage after liver resection. Cholangiogram shows hilar bifurcation of the bile ducts but the bile duct from segment 4 drains to the right anterior sector (Fig. 3A). Next step was to perform hepatic hilum lymphadenectomy with complete skeletonization of the hepatic artery and portal vein. Common bile duct was dissected and encircled (Fig. 3B). Hepatic artery to segment 4 is identified and preserved (Fig. 3B). The portal vein is encircled and dissected towards the right fissure (RF). Biliary and artery branches from right posterior sector are found and ligated. Portal vein from right posterior sector (S6–S7) is divided resulting in ischemic delineation of segments 6 and 7. Liver is then transected following the ischemic demarcation area using the intrahepatic portal vein path as main reference, under intermittent Pringle maneuver with total ischemic time of 40 minutes. During liver transection the intrahepatic portal vein makes an arc towards the left. At this point we follow the plane of transection of the right hepatic vein through the right fissure (Fig. 3C). Right hepatic vein is divided with stapler and right posterior sectionectomy is completed (Fig. 3D). Operative time was 280 minutes and estimated blood loss was 340 mL. There was no need for transfusion. Pathology revealed a well differentiated cholangiocarcinoma with free surgical margins and one positive lymph node. Recovery was uneventful and patient was discharged on

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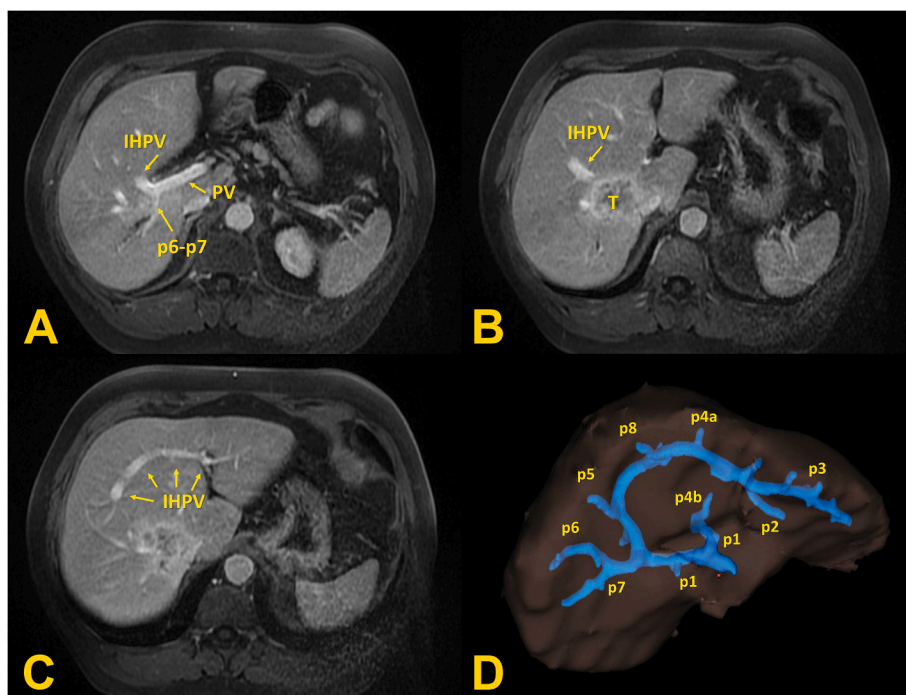


Fig. 1. Portal vein anatomy in patient without portal vein bifurcation.
 A. MRI shows the main portal vein (PV) and its intrahepatic path (IHPV). The right posterior pedicle (p6-p7) is involved by the tumor causing segmental biliary dilation.
 B. MRI: Initial path of IHPV. Intrahepatic cholangiocarcinoma is shown (T).
 C. MRI shows the intrahepatic path of the portal vein (IHPV). Note that the portal vein (IHPV) runs through the right liver (arrows) and ends in the left liver where it enters the left lateral segment (segments 2 and 3).
 D. 3D reconstruction of the liver and the portal vein. Intrahepatic portal vein (IHPV) makes an arc towards the left. Segmental portal veins are direct branches from the IHPV. Note that the portal vein to segment 4b originates from the hepatic hilum.

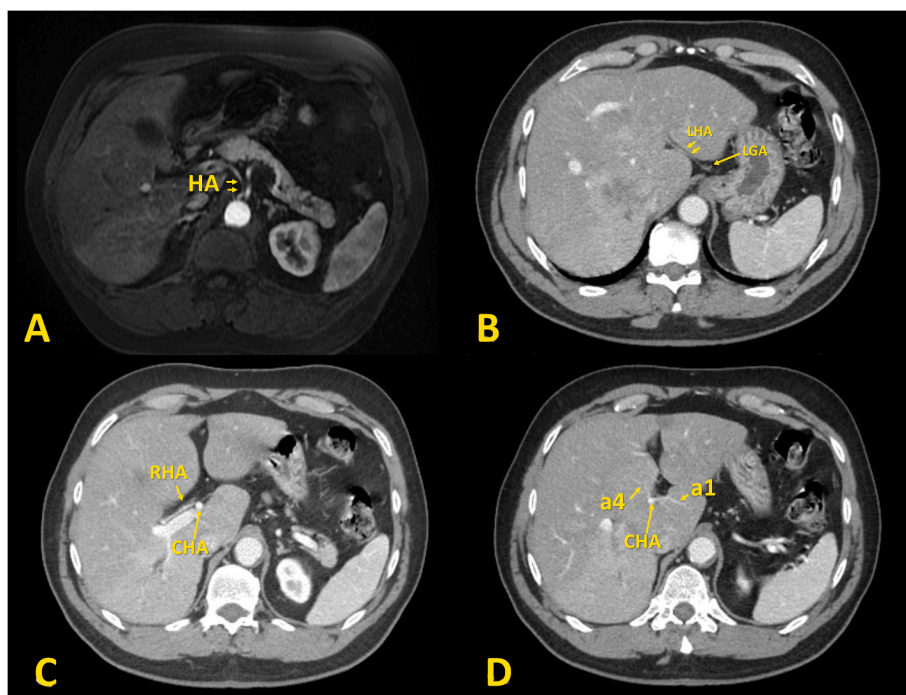


Fig. 2. Hepatic artery anatomy in patient without portal vein bifurcation.
 A. MRI. Hepatic artery (HA) originates direct from the Aorta at the same level of the celiac axis.
 B. CT scan. The left hepatic artery (LHA) originates from the left gastric artery.
 C. CT scan. The right hepatic artery (RHA) originates from the common hepatic artery.
 D. CT scan. The hepatic artery to segment 1 (a1) and to segment 4 (a4) originates from the common hepatic artery (CHA).

the 6th postoperative day. Patient then underwent 6-months of adjuvant chemotherapy with capecitabine.

In Conclusion, absence of portal vein bifurcation is rare but is not an absolute contraindication for liver resection. Preoperative and intraoperative study of portal, arterial and biliary anatomy was essential for the success of this procedure. This video shows the different steps necessary to perform this complex operation.

Authorship statement

All authors have made substantial contributions to all of the following: (1) the conception and design of the study, or acquisition of data, or analysis and interpretation of data, (2) drafting the article or revising it critically for important intellectual content, (3) final approval of the version to be submitted.

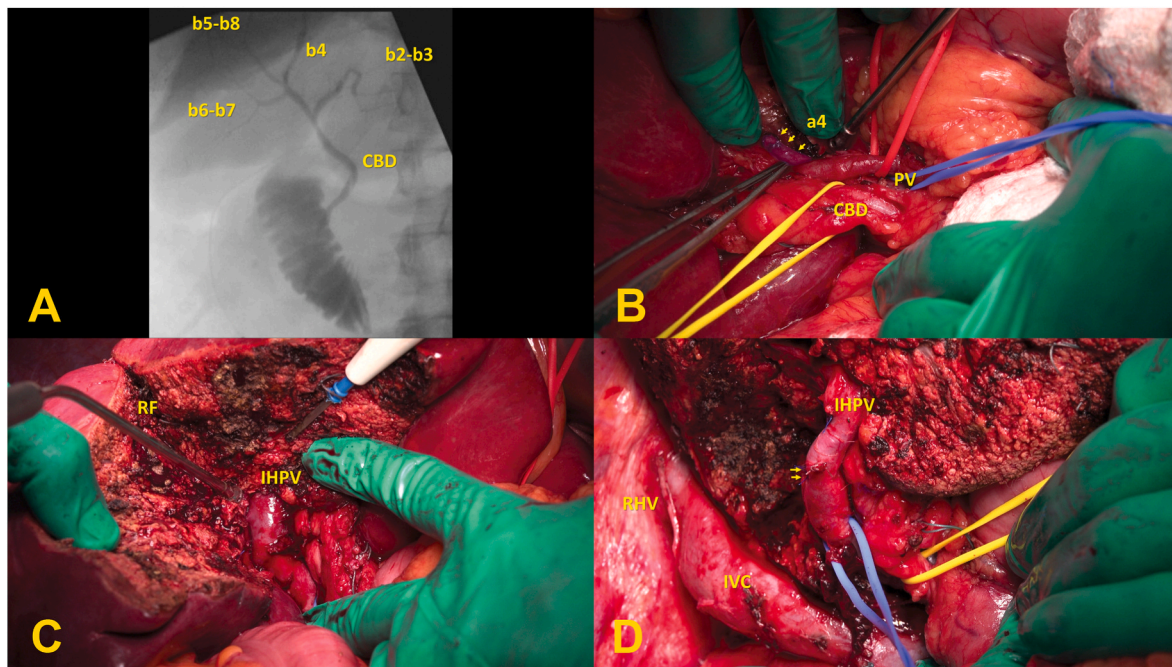


Fig. 3. Right posterior sectionectomy in patient without portal vein bifurcation.

A. Intraoperative cholangiogram. Biliary tree divides in left and right at the level of the hilar plate. The left bile duct is formed by bile ducts from the segments 2 and 3 (b2-b3). The bile duct from segment 4 (b4), from the right anterior sector (b5-b8) and from the posterior sector (b6-b7) forms the right bile duct. CBD, common bile duct.

B. Intraoperative view shows hepatic hilum after lymphadenectomy. Common bile duct (CBD) is encircled in yellow. Portal vein (PV) is encircled with blue tape. Hepatic artery is encircled with red tape. Hepatic artery to segment 4 (a4) is highlighted.

C. Intraoperative view shows the intrahepatic portal vein arc to the left. Liver is transected at the level of the right fissure (RF).

D. Intraoperative view shows the liver surface after right posterior sectionectomy. Arrows shows the site of the tumor contact with the IHPV that was suture ligated. RHV, right hepatic vein. IVC, inferior vena cava. IHPV, intrahepatic portal vein. . (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

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Declaration of competing interest

Drs. Machado, Mattos, Lobo Filho and Makdissi have no conflicts of interest or financial ties to disclose.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.suronc.2021.101698>.

References

- [1] E. Chaib, Absence of bifurcation of the portal vein, *Surg. Radiol. Anat.* 31 (2009) 389–392.
- [2] N. Cheynel, E. Arnal, P. Rat, et al., Absence of the portal bifurcation at the hilum of the liver due to intrahepatic origin of the left branch of the portal vein, *Surg. Radiol. Anat.* 23 (2001) 355–357.
- [3] H. Yamamoto, M. Nagino, Y. Kawabata, et al., Resection of a hilar cholangiocarcinoma in a patient with absent portal bifurcation, *Hepato-Gastroenterology* 47 (2000) 362–364.
- [4] M.G. Spampinato, G. Baldazzi, M. Polacco, et al., Right hemihepatectomy in presence of congenital absence of portal vein bifurcation: a challenging but feasible procedure, *J. Am. Coll. Surg.* 215 (2012) e1–4.
- [5] H. Teraoku, Y. Arakawa, M. Yoshikawa, et al., Complication of portal vein thrombosis after right hemihepatectomy in a patient lacking the portal vein bifurcation, *J. Med. Invest.* 63 (2016) 315–318.