Left sided–right portal joined round ligament with an anomaly of the intrahepatic portal vein

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ABSTRACT

Anomalous branching of the intrahepatic portal veins and a round ligament variation were encountered in a 70-year-old male cadaver, with a positional variation of the liver. The liver was not extending to the left of the xiphoid process. The fissure for the round ligament was not present at the visceral surface, and the ligament was embedded inside the parenchyma. The round ligament was joining with the anterior branch of the right portal vein instead of the left. Portal blood supply of the quadrate lobe and most of the left lobe was provided by the variative branch of the right portal vein. By considering both settlements of the round ligament according to the gallbladder and the intrahepatic portal joining of it, we termed the case as "left sided-right portal joined round ligament". The clinical importance of similar variations is emphasized as they can cause complications during liver transplantation and lobectomy.

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The liver and gallbladder are formed from the hepatic diverticulum, arising as a ventral outgrowth from the caudal part of the foregut into the ventral mesoderm early in the 4th week.[1] After birth, the left umbilical vein joining the left portal vein obliterates and forms the round ligament. The ductus venosus connecting the portal vein, and the left branch of the hepatic vein obliterates and forms the ligamentum venosum.[2] The hepatic portal vein divides into 2 branches, as the right and left at the porta hepatis. The right portal vein, which is shorter and wider, supplies the right lobe by giving off anterior and posterior branches. The left portal vein has 2 parts such as, the horizontal segment and the umbilical portion. The horizontal segment supplies the caudate lobe by giving off small branches. The umbilical portion joins the round ligament. The ligamentum venosum initiates from this connection point and extends to the left hepatic vein in the fissure for the ligamentum venosum. The umbilical portion gives branches to the quadrate and left lobes (**Figure 1**).[3]

In this study, a case with an anomaly of the position of the liver and gallbladder and ramification of the intrahepatic portal veins were evaluated with their anatomical properties and embryological developmental patterns. The clinical importance of each anomaly is emphasized, which might cause complications at surgical operations of the liver.

Case Report. Positional variations of the liver and gallbladder, anomalies of the ramification of the intrahepatic portal veins and intrahepatic placement of the round ligament were encountered in a 70-year-old male cadaver. The liver was not in direct touch with the anterior abdominal wall in the epigastrium, and the left lobe was not extending the

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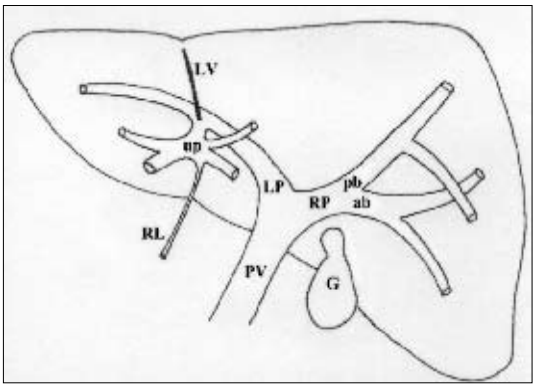

Figure 1 - Diagram of the normal intrahepatic portal venous branching pattern on posterior view. G - Gallbladder, PV - Hepatic portal vein, LP - Left portal vein, RP-Rightportalvein,ab-Anteriorbranch,pb-Posteriorbranch, up - Umbilical portion, LV - Ligamentum venosum, RL - Round ligament of the liver.

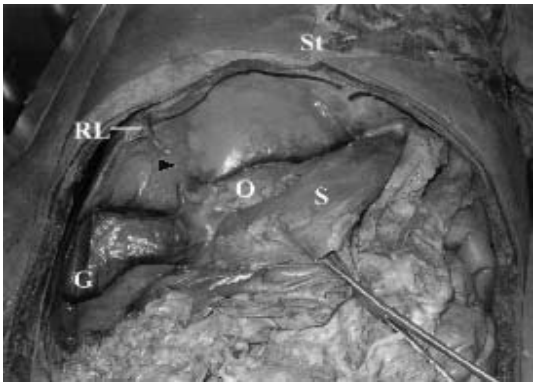

Figure 2 - Inferior view of the intraabdominal liver. G - Fundus of gallbladder, S - Stomach, O - Lesser omentum, St - Sternum, RL - Round ligament of the liver, ▶ - Absence of fissure for the round ligament.

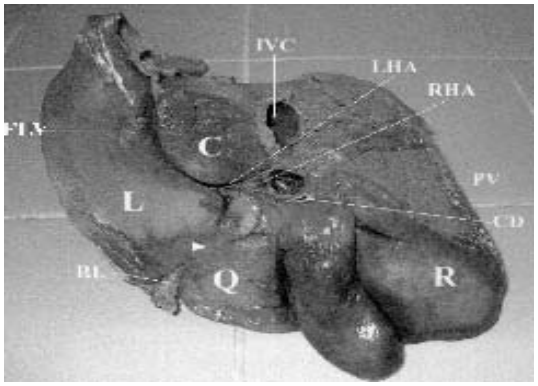

Figure 3 - Inferior view of the extracted liver. C - Caudate lobe, L - Left lobe, R - Right lobe, Q - Quadrate lobe, CD - Cystic duct, IVC - Inferior vena cava, RHA - Right hepatic artery, LHA - Left hepatic artery, PV - Hepatic portal vein, RL - Round ligament of the liver, FLV - Fissure for ligamentum venosum, white head arrow - Absence of fissure for the round ligament.

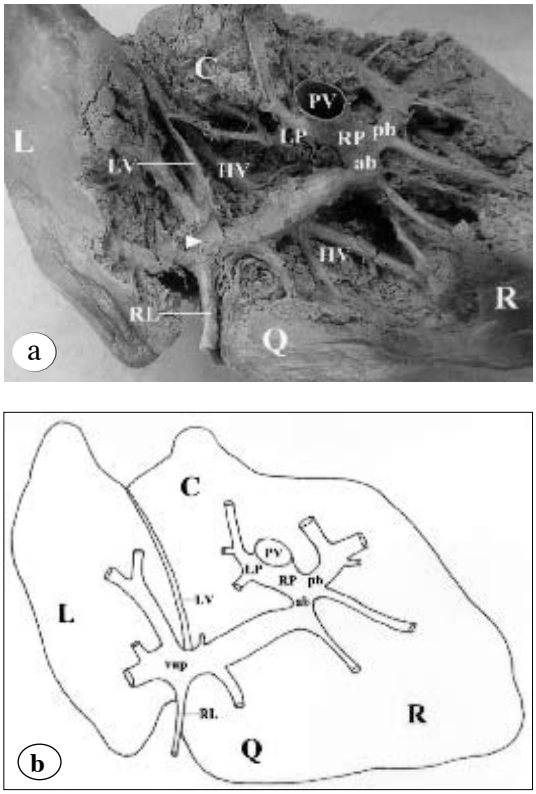

Figure 4 - Intrahepatic portal venous/vein in the present case. **a)** branching pattern, view from inferior aspect. C - Caudate lobe, L - Left lobe, R - Right lobe, Q - Quadrate lobe, PV - Hepatic portal vein, LP - Left portal vein, RP - Right portal vein, ab - Anterior branch, pb - Posterior branch, RL - Round ligament of the liver, LV - Ligamentum venosum, HV - Hepatic vein, white arrow head- Variative umbilical portion. **b)** Diagram of the branching anomaly, view from inferior aspect. G - Gallbladder, PV - Hepatic portal vein, LP - Left portal vein, RP - Right portal vein, ab - Anterior branch, pb - Posterior branch, vup - Variative umbilical portion, LV - Ligamentum venosum, RL - Round ligament of the liver.

left of the median plane. The projection of the fundus of the gallbladder was on the right midaxillary line **(Figure 2)**. The falciform ligament was initiating from the anterior abdominal wall at the midsagittal plane, and attaching the liver at the intersection of the right midclavicular line and the costal arch. The round ligament was embedded inside the liver parenchyma at the visceral surface, and fissure for the round ligament was not present **(Figures 2 & 3)**.

The hepatic portal vein and its branches, the cystic and the common hepatic ducts, and the right and left hepatic arteries were evaluated by dissecting porta hepatis. The hepatic portal vein (12.7 mm in caliber) was diverging into right (9.55 mm) and left (7.0 mm);

then the right portal vein was diverging into the posterior (7.5 mm) and anterior (9.15 mm) branches. A branch originating from the right anterior branch, which had a diameter of 8.7 mm initially and 11.1 mm at the distal end, was curving 90º to the left as a variative umbilical portion and then joining the round ligament of the liver. Thus, the umbilical portion was formed by the right portal vein, instead of the left one. A large part of the left lobe and the quadrate lobe was supplied by the variative branch of the right portal vein. After giving rise to small branches supplying the caudate lobe, the left portal vein was supplying a small part of the left lobe surrounding the ligamentum venosum **(Figures 4a & 4b)**. Arterio-biliary distribution of the case was observed as normal.

Discussion. A case with misplacement of the umbilical portion on the right portal vein accompanying the rotational anomaly of the liver and associated structures has not been reported in the literature. An absence of the fissure for the round ligament, which separates the left lobe and the quadrate lobe of the liver was also reported by Ricklan et al.[4] It is reported that hypersegmentation of the liver usually accompanied reduction of the external lobation, which is a rare condition. Round ligament and positional anomaly of the gallbladder, are reported to be associated with the anomalies of the intrahepatic portal veins. Nagai et al[5] reported the accompanying intrahepatic portal venous branching anomaly in all the 18 cases, in which the round ligaments were right-sided and the gallbladders were located to the left of this ligament. In 4 cases with the anomaly of intrahepatic portal venous branching, Maetani et al[2] reported that the round ligament was reaching the liver by passing above the gallbladder that was situated in its normal location, which is different from the present case.

It is important to define the anatomy of the round ligament clearly as it is a surgical landmark. In the literature, the round ligament is defined to be as right-sided or left-sided according to its position to the gallbladder. But, if it is requested to point out the joining of the round ligament in the various cases like ours, this definition might be inadequate. Thus, we termed the present case as ''left sided-right portal joined'' considering its settlement to the gallbladder and intrahepatic portal junction. During the development, some of the vitello-umbilical vessels enlarge and later in some places are joined by other channels becoming defined in already established capillary plexus. Simultaneously, hepatic rudiment expands and invades - anastomoses, vitelline and umbilical veins.[6] We suggest that the left umbilical vein connects with the right portal venous capillary plexus, instead of the left one either in the present case or the similar cases. Moreover, an over-rotation of the organ might also contribute to such a fault joining in the present case. Intrahepatic portal venous branching anomaly is not rare.[2] The prevalence of the anomaly of the right-sided round ligament accompanying the anomaly of intrahepatic portal venous branching is reported as 1.2%.[2] Hiramatsu et al[7] reported a case with the absence of the umbilical portion and the curved right portal vein mimicking the right-sided umbilical portion. The only difference of the present case from the above mentioned is that, the umbilical portion formed by the curved right portal vein was left-sided. Hardy and Jone,[8] reported the bifurcation of the hepatic portal vein did not exist in their case. The main branch was curving to the right like the right portal vein of our case, then curving to the left at clockwise direction to form the umbilical portion beneath the caudate lobe. In the same case, the hepatic portal vein was giving off a posterior segmental branch to the right, and a branch to the caudate lobe at the hilum. The main branch was supplying the entire segments by curving from right to left. The difference of this case from ours is the absence of a left portal vein diverging from the hepatic portal vein.[8]

Knowing the anatomy of liver, portal venous system, frequently seen variations and congenital, and acquired anomalies well is vital for the operations of liver.[2,5] Particularly, the liver transplantation where the chronic shortage of cadaveric livers has led, many surgeons propose the surgical innovations and alternative approach such as, reduced-size, split and living-related transplantation, which is now routinely performed in both adult and pediatric populations. Besides, prior to lobectomy or segmentectomy, the branching pattern, course, and connections of the portal veins should be identified. During the surgery of a similar case, most of the left lobe of the liver would become ischemic with the ligation of the right portal vein.

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