Persistence and restoration of the patency of the left duct of Cuvier

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Abstract

The increased pressure in the portal circulation due to chronic liver disease favors the redistribution of the flow to the systemic circulation. Although rare, reperfusion of embryonic venous channels may be a possibility. Our aim is to report the persistence and patency of the ductus venosus, called the left duct of Cuvier, and to show its presentation in images.

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Keywords: Left Cuvier duct patency; Collateral circulation; Restoration of embryonic veins patency

Case Report

Sixty-seven year-old female patient with cryptogenic cirrhotic disease. Clinical findings included esophageal varices and hepatic encephalopathy resulting in repeated hospitalizations. Doppler examination of the liver did not reveal signs of portal hypertension, and the flow direction in the portal vein and the hepatic artery was hepatopetal. The left portal vein showed collateral circulation towards the systemic circulation from its posterior branch. No ascites was observed and the echocardiogram showed no signs of cardiac overload.

During hospitalization, the patient was placed on the waiting list for liver transplant. Therefore, for an early detection of hepatocellular carcinoma (HCC), the patient underwent a contrast-enhanced magnetic resonance imaging (MRI) of the abdomen, as well as an abdominal computed tomography (CT) in the arterial, portal and late phases to evaluate the hepatic gland, and a CT scan of the chest in the portal venous phase. We report this case to describe and learn about the imaging presentation of persistence of an embryologic venous system known as the “left duct of Cuvier” (LC). This system normally involutes.

In our patient, the LC had its patency restored by cirrhosis (the patient’s baseline disease), playing the role of a portocaval anastomosis. The abdominal scan revealed a 35-mm HCC in the hepatic segment VII. The scan also showed that the left branch of the portal vein joined a vascular structure of identical diameter, with a tortuous path inside the liver segments II and III (fig. 1). Then, it coursed towards the chest alongside the posterior wall of the left ventricle, outside the pericardium (figs. 2 and 3). This finding corresponded to the left duct of Cuvier, which ascended to the left cardiac venous sinus (without penetrating it) leading into the ipsilateral jugular-subclavian venous confluence (fig. 4).

Figure 1. 2D Reconstruction, axial maximum intensity projection image shows patent anastomosis between the left branch of the portal vein (red arrow) and the left duct of Cuvier (white arrow).
The embryologic duct of Cuvier generally drains into the left cardiac venous sinus. Embryologically, the right and left ducts of Cuvier anastomose and blood from the left side of the body is channeled to the right side, forming in the anterior region the left brachiocephalic vein and the left superior intercostal vein (drains the 2nd and 3rd intercostal veins) (fig. 5).

**Discussion**

The heart and blood vessels develop from the mesoderm as isolated masses and cords of mesenchymal cells in order to rapidly deliver the necessary nutrients to the exponentially proliferating cells and dispose of waste products through the connection with the maternal blood vessels in the placenta.

**Cuvier ducts: an embryologic review**

The term “Cuvier ducts” refers to the common (right and left) primitive cardinal veins that during embryologic development are used by the human circulatory system together with umbilical and vitelline veins to drain the sinus venosus. At fifth week of gestation, three sets of large-sized veins can be distinguished (fig. 6):
- Vitelline veins, which carry blood from the yolk sac to the sinus venosus.
- Umbilical veins, which originate in the chorionic villi and carry oxygenated blood to the embryo.
- Cardinal veins, which drain the body of the embryo. The anterior cardinal veins drain the cephalic portion of the embryo, while the posterior cardinal veins drain the remaining...
part of the body of the embryo. The anterior and posterior cardinal veins join and form the common cardinal veins, also called right and left ducts of Cuvier, which anastomose, allowing the passage of blood from the left to the right\(^1\). The right common cardinal vein and the proximal portion of the right anterior cardinal vein form the superior vena cava\(^2,3\) (fig. 7). When the Cuvier ducts anastomose, blood from the left flows to the right, forming the left brachiocephalic vein and the left superior intercostal vein in the anterior region\(^4,6\). Persistence and/or restoration of the patency of this venous structure causes direct communication between the portal venous system and the systemic veins, forming a porto-systemic anastomosis\(^7,8\).

**Porto-systemic anastomosis**

The portal system is not absolutely closed, but communicates with venous networks that are tributary to the vena cava.

- Esophageal anastomoses: anastomoses exist between the left gastric (coronary) vein and the inferior esophageal veins through the submucosal plexuses, which are often very thin. Increased pressure causes varicose dilatation of the esophageal veins.
- Rectal anastomoses: superior rectal veins (portal tributaries) anastomose with the middle and inferior rectal veins (branches of the internal iliac veins).
- Peritoneal anastomoses: these anastomoses have been called Retzius’ veins or system. This third group of anastomoses exists along the sides of the intestinal walls, where

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\(a\) b

\(c\) d

Figure 3. Axial views of the lower chest. Path of the duct of Cuvier, (a) entering the chest (arrow) and (b) passing behind the left ventricle (arrow), in (c) towards the left atrium where embryologically it should drain (arrow). However, it does not drain into it, but forms a vascular curl and continues ascending. (c and d) Emergence of an intercostal branch towards the chest wall (arrow).
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Mesenteric veins communicate with small-sized tributaries of the inferior vena cava, forming what is clinically known as “caput medusae”.

- Fetal anastomosis: patency of umbilical, paraumbilical veins and ductus venosus connecting the left branch of the portal vein with the inferior vena cava.
- Accessory portal veins: the liver does not only receive blood from the portal vein, but also from other veins known as accessory portal veins. These small groups of vessels include: gastroepiploic veins, cystic veins, hilar veins or group of nutrient venules, diaphragmatic veins, suspensory ligament veins, and paraumbilical or round ligament veins.

Being aware of the possibility of patent embryological venous ducts that serve as portocaval anastomoses is essential for the evaluation and treatment of patients awaiting liver transplantation, in order to prevent intraoperative complications that increase morbidity and mortality⁹¹¹.

Addendum

Although we performed a literature search, we have not found pictorial reports.

Conflicts of interest

The authors declare no conflicts of interest.
References

Figure 6. Embryological development of cardinal veins.

Figure 7. Left cardinal vein regressing and right cardinal vein forming the Superior Vena Cava.