Chapter 5

The ductus venosus: proposal for a uniform anatomical definition

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LETTER TO THE EDITOR

The ductus venosus is a shunt between the intra-abdominal umbilical vein and the inferior vena cava. The function of the ductus venosus is to direct well-oxygenated blood from the placenta in the right atrium. The acceleration of the blood flow velocity directs the blood towards the left atrium, thereby primarily oxygenating the fetal heart and brain. Ultrasound examination of the ductus venosus is an important instrument in daily prenatal obstetrical practice. As ductus venosus flow velocity waveforms are a direct reflection of intracardiac pressure it is used to assess the fetal hemodynamic performance. The identification of abnormal ductus venosus flow velocity waveforms reflects impaired right atrial contraction and increased end-diastolic pressure in the right ventricle, which can be a sign of cardiac decompensation. This involves fetuses with increased nuchal translucency, cardiac defects, arrhythmia, hydrops, intra-uterine growth restriction (IUGR) and complications in monochorionic twin pregnancies. Thus, Doppler assessment of the ductus venosus assists in monitoring high-risk fetuses.

Pulsed Doppler recordings of the ductus venosus reveal a characteristic triphasic waveform with high blood flow velocities. The ductus venosus is therefore easily identified by ultrasound. Previous reports described inconsistent evidence on the presence or absence of a sphincter at the ductus venosus inlet. In the analysis of histomorphological studies on the ductus venosus we found a remarkable difference in anatomical definitions of the ductus venosus. Different anatomical structures were considered as the ductus venosus. Ductus venosus definitions included (i) the vessel that continued from the intra-abdominal umbilical vein directly to the heart without connection to the inferior vena cava, (ii) the vessel that connected to the left hepatic vein before entering the inferior vena cava, instead of a direct connection to the inferior vena cava and (iii) the vessel that continued into the inferior vena cava immediately before continuation into the right atrium, instead of connection to the inferior vena cava at the level of its junction with the hepatic veins.

Most histomorphological experiments described no distinct demarcation between the intra-abdominal umbilical and portal veins and the ductus venosus, resulting in unintentional examination of the intra-abdominal umbilical or portal veins instead of the intended ductus venosus. Also, not all reports defined the precise anatomical location of the ductus venosus in relation to its adjacent vessels. Furthermore, several reports misinterpreted the intra-abdominal umbilical vein as the ductus venosus. These inconsistencies might result in reported conflicting evidence on the morphology of the ductus venosus, including the presence or absence of a sphincter at its inlet. Given the relevance of the ductus venosus in clinical prenatal care and to relate clinical findings – such as abnormal ductus venosus flow velocities – to fundamental research, a clear, anatomical demarcation of the ductus venosus is essential.

Originally, the ductus venosus was defined as a direct, branchless shunt between the intra-abdominal umbilical vein and inferior vena cava. The ventral-caudal part was continuous with the junction of the intra-abdominal umbilical vein and the left branch of the portal vein. The dorsal-cranial part was connected separately to the inferior vena cava, at the level of the continuation of the hepatic veins to the inferior vena cava. A systematical examination of ductus venosus development – including three-dimensional reconstructions of the ductus venosus area – showed similar results and thus confirms this definition.

Using a three-dimensional approach the precise anatomical location of the ductus venosus, portal and umbilical veins and inferior vena cava can be established accurately. This allows for a uniformly defined ductus venosus and will direct towards consistent outcomes of ductus venosus examinations.

In conclusion, we strongly support the use of the correct anatomical ductus venosus definition: a branchless direct shunt between the junction of the left portal and intra-abdominal umbilical veins and the separate connection to the inferior vena cava.
REFERENCES