Patent ductus venosus:
diagnosis by MR angiography

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Abstract We report a 15-year-old boy with patent ductus venosus in whom the diagnosis was made by
MR angiography. A patent ductus venosus Arantius is a rare form of
portosystemic shunt. Only a few
cases have been reported in adults
and children. The diagnosis is usually made by US and digital subtraction angiography. In our patient, the
diagnosis was first made by MR angio-
graphy. This demonstrates the excellent diagnostic potential of
the method in pediatric patients.

Introduction

During fetal life the ductus venosus carries oxygenated
blood from the umbilical vein via the left portal vein
into the inferior vena cava, bypassing the fetal liver.
The ductus venosus closes at birth and normal portal cir-
culation becomes established. Persistent patency of
the ductus venosus is extremely rare and is considered
either to be a primary developmental abnormality or to
occur secondary to established liver cell failure [1].

Only a few cases in both adults [2] and children [1, 3–6] have been reported so far. We report a 15-year-old
boy with a patent ductus venosus and serious parenchymal liver disease in whom the diagnosis was established
by MR angiography (MRA). To our knowledge, this is
the first reported case where contrast-enhanced MRA
was used to diagnose a patent ductus venosus.

Case report

A 15-year-old boy was referred to our MRI unit to be assessed
prior to liver transplantation. The patient was delivered after a
normal pregnancy. The first 2 years of his life were uneventful;
thereafter he had repeated episodes of hypoglycaemia with levels
down to 14 mg/dl. Galactose and fructose tests were normal. At
the age of 12 years he had episodes of occasional nausea and
vomiting, not related to food ingestion, and repeated attacks of
abdominal pain. Over the next years, the patient was admitted to
various hospitals on numerous occasions. Blood transaminases
and bilirubin were slightly raised and serum ammonia levels...
MRI was performed on a 1.5-T scanner (Magnetom Vision, Siemens Medical Systems, Erlangen, Germany) with 25 mT/m gradients and 600 ms time rate using a phased-array body coil. Abdominal MRA was performed in the coronal plane using an untriggered, breath-hold, contrast-enhanced, three-dimensional gradient-echo (GRE) sequence (TR/TE/flip angle 4.4/1.4/30°, 192 × 512 matrix, FOV 330 × 440 mm, one acquisition, slab thickness = 96 mm, 24 partitions). With the interpolation algorithm implemented in the ultrafast MRA sequences we apply, an effective slice thickness of 2 mm was achieved. The sequence was performed prior to contrast administration to ensure that the area of interest was included within the slab and that the patient could tolerate the breath-hold period.

Prior to starting the contrast-enhanced sequence, we measured the transit time by administering a 2-ml test bolus. Repeated images at the level of the abdominal aorta were acquired in order to determine peak blood enhancement. This was done with a T1-weighted (T1-W) magnetization-prepared gradient-echo sequence (TR/TE/flip angle 7.7/4.2/15°).

The contrast-enhanced breath-hold (20 s) MRA sequence was started after a scan delay of 15 s, determined by the transit time to ensure peak bolus enhancement in the center of the acquisition. The contrast agent (gadopentetate dimeglumine, Magnevist, Schering, Berlin, Germany; 0.2 mmol/kg body weight) was injected using a power injector (Spectris, Medrad, Pittsburgh, Pa., USA) at a rate of 2 ml/s, followed by 20 ml of normal saline through the antecubital vein. Two back-to-back measurements were performed with an interscan delay of 15 s to allow enhancement of both the inferior vena cava and the portal vein. The study was displayed as a maximum intensity projection (MIP) and as multiplanar reconstruction (MPR) images and was interpreted from source and reformatted images. Contrast-enhanced MRA clearly identified the anomalous portocaval shunt representing the patent ductus venosus Arantii that connects the left branch of the portal vein to the inferior vena cava (Fig. 2). The right branch of the portal vein was

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**Fig. 1** Longitudinal colour Doppler US of the liver showing the large communication (arrow) between the portal vein and the inferior vena cava (arrowhead)

were variably elevated to levels as high as 140 μmol/l (normal 11–35 μmol/l).

A liver needle biopsy revealed changes of hepatoporal sclerosis with absence of visible venules in the portal areas. Repeated US showed an inhomogeneous liver parenchyma without visualization of the portal vein. One US demonstrated a portocaval shunt (Fig. 1). MRI was performed for evaluation of the abdominal vessels and the sonographically demonstrated portocaval shunt.

**Fig. 2a–c** MPR images from the MRA. **a** Sagittal and **b** axial planes during venous transit of the contrast medium (delayed-phase images) showing the ductus venosus (arrow) and the inferior vena cava (arrowhead). **c** In the coronal plane the ductus venosus is shown connecting the left branch of the portal vein (straight arrow) to the inferior vena cava