

## MR Angiography of Renal–Hepatic Arteriovenous Malformation

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**A**rteriovenous fistulas secondary to arteriovenous malformations, iatrogenic intervention, and blunt and penetrating trauma have been described as a cause of hyperkinetic heart failure [1]. Cardiac chamber enlargement, systolic–diastolic murmurs, and varicose veins may be the earliest findings. Late complications include thrombosis and pseudoaneurysm. We describe a rare and, to our knowledge, previously unreported arteriovenous malformation arising from the right renal artery, draining into the right hepatic vein, and causing right atrial enlargement.

### Case Report

A 47-year-old man undergoing follow-up for familial dyslipidemia presented with suspected right atrial enlargement initially seen on a chest radiograph 10 years previously (Fig. 1A). Angiography performed to evaluate the extent of atherosclerotic disease in the distal part of the abdominal aorta and lower

limbs incidentally revealed an abnormal vessel arising from the right renal artery and extending in a cephalic direction (Fig. 1B). MR angiography depicted a collateral vessel arising from the right renal artery and entering the right hepatic vein (Fig. 1C). The vessel caused dilatation of the inferior vena cava above the main hepatic vein that measured 3.5 cm in diameter and right atrial enlargement measuring 6 cm from the tricuspid valve to the lateral wall of the atrium (Fig. 1D). The hepatic veins in the right lobe of the liver were dilated, and collateral vessels formed venous–venous connections (Fig. 1C). The patient did not have a history of hepatic cirrhosis or trauma to or instrumentation of the right upper quadrant. These findings support the presence of a right-to-left shunt from a renal–hepatic arteriovenous malformation.

### Discussion

The patient in this case had an arteriovenous malformation that has, to our knowl-

**Keywords:** arteriovenous malformation, cardiovascular imaging, MR angiography

DOI:10.2214/AJR.05.0766

Received May 4, 2005; accepted after revision August 8, 2005.

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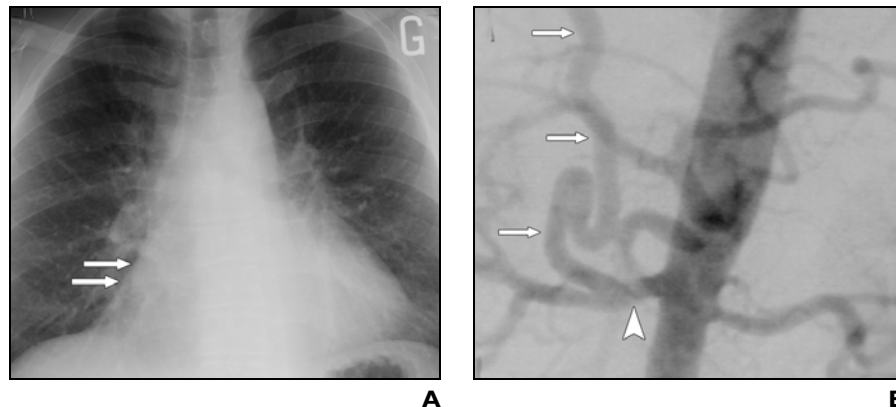
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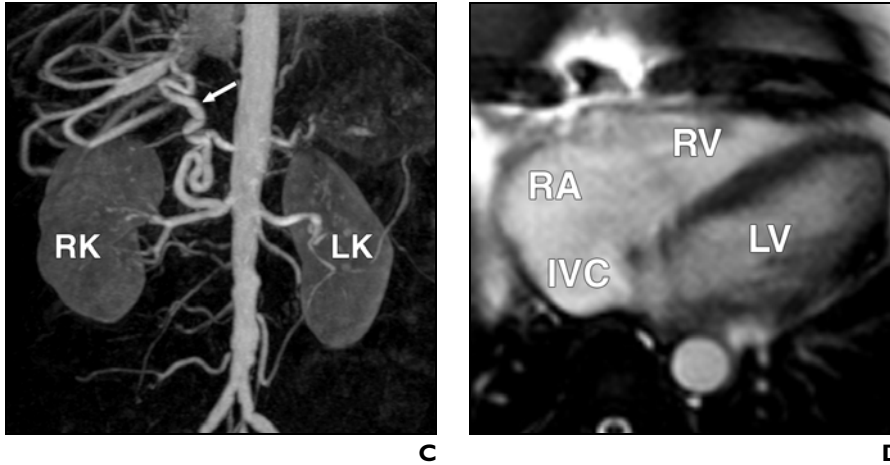
AJR 2007; 189:W111–W112

0361–803X/07/1892–W111

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**Fig. 1**—47-year-old man with renal–hepatic arteriovenous malformation. **A**, Posteroanterior chest radiograph shows prominent right-border cardiac silhouette (*arrows*). **B**, Digital subtraction angiogram of aorta shows abnormal vessel (*arrows*) possibly arising from right renal artery (*arrowhead*) and extending cephalad to right upper quadrant toward liver. (**Fig. 1 continues on next page**)



**Fig. 1 (continued)**—47-year-old man with renal–hepatic arteriovenous malformation.

**C**, Maximum-intensity-projection reconstruction of contrast-enhanced MR angiogram acquired with 25 mL of IV gadoteridol, 5.75 mg of calderidol calcium, and 30.25 mg of tromethamine (ProHance, Bracco Diagnostics) (TR/TE, 5.3/1.5; inversion time, 0 milliseconds; sensitivity encoding; slice thickness, 3.0 mm; gap, 1.5 mm; matrix size, 400 × 253; displayed field of view [DFOV], 35.9 × 35.9 cm; body coil) shows vessel (*arrow*) arising from right renal artery and entering right hepatic vein. Collateral vessels in right lobe of liver form venous–venous connections. Infrarenal abdominal aorta and iliac arteries are diffusely atherosclerotic. RK = right kidney, LK = left kidney.

**D**, Axial T2-weighted balanced turbo fast-echo image (2.8/1.4; inversion time, 152 milliseconds; sensitivity encoding; slice thickness, 10 mm; no gap; matrix size, 192 × 192; DFOV, 39.8 × 39.8 cm; body coil) shows right atrial enlargement measuring up to 6 cm from tricuspid valve to lateral wall of atrium. Enlargement is secondary to increased blood return from renal–hepatic arteriovenous malformation. RA = right atrium, RV = right ventricle, LV = left ventricle, IVC = inferior vena cava.

edge, not been described in the literature. The malformation caused a right-to-left shunt from the right renal artery to the right

hepatic vein. The shunt caused hepatic congestion, increased blood return to the inferior vena cava and right atrium, and right

atrial enlargement, an early sign of hyperkinetic heart failure [2]. MR angiography, which has become a powerful technique for imaging the vascular system, clearly showed vascular abnormalities in a noninvasive and nonnephrotoxic manner [3]. The resolution of conventional angiography remains superior to that of MRI. Technical developments, however, should lead to faster MR image acquisition and to contrast agents that improve the quality and resolution of MR images [4].

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