Right-to-Left Shunting via Persistent Left Superior Vena Cava Identified by Perfusion Lung Scintigraphy

Richard C. Rosenbaum, Bruce I. Reiner, J. Keith Bidwell, and Gerald S. Johnston

Department of Diagnostic Radiology, University of Maryland Medical System/Hospital, Baltimore, Maryland

A right-to-left shunt was demonstrated following a left antecubital injection of [^{99m}Tc]MAA but was not seen after a right antecubital injection. This was because of the presence of a persistent left superior vena cava draining into the left atrium. Recognition of the presence of this anatomic variant is of importance in perfusion imaging, in patients with otherwise unexplained systemic embolization.

J Nucl Med 30:412–414, 1989

Congenital disorders of the circulation may alter the distribution of blood flow to the lungs. After i.v. administration of technetium-99m macroaggregated albumin ([^{99m}Tc]MAA), the particles are normally distributed as a function of pulmonary arterial blood flow. Right-to-left shunts of more than 10–15% are readily apparent because of activity trapped in organs with high systemic blood flow (brain, kidneys, spleen) as the tracer bypasses the pulmonary capillary network (*1*).

Unsuspected right-to-left shunts may be detected on [^{99m}Tc]MAA perfusion lung scans obtained to exclude pulmonary embolism. We studied a young woman in whom a shunt which was demonstrated following a left antecubital injection was not seen after a subsequent right antecubital injection. This finding indicates the presence of a left superior vena cava (LSVC) draining into the left atrium with normal venous drainage into the right atrium.

CASE REPORT

A 22-yr-old woman who was 28 wk pregnant presented with a chief complaint of chest pain and dyspnea. A history of prior pulmonary embolism and an arterial pO2 of 69% prompted performance of a lung scan. The ventilation scan was normal. The perfusion scan, performed via a left antecubital injection (3 mCi [^{99m}Tc]MAA), showed homogeneous pulmonary perfusion, however, a significant amount of tracer was noted in the thyroid, brain, spleen, and kidneys, indicating a right-to-left shunt (Fig. 1).

Echocardiography and cardiac magnetic resonance imaging (MRI) revealed situs solitus, two atria with an intact atrial septum, and inversion of the AV valves. Since two discrete ventricles could not be definitely identified, either congenitally corrected transposition of the great vessels or tricuspid atresia/single ventricle were the most likely diagnoses.

Following another episode of dyspnea and chest pain, a

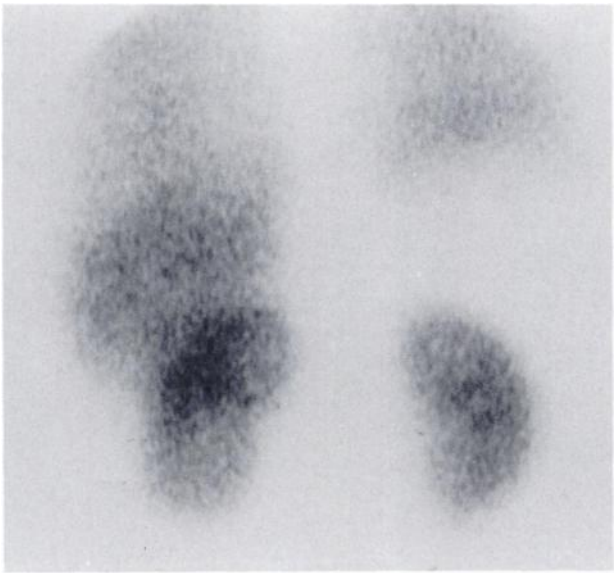

FIGURE 1
[^{99m}Tc]MAA images after a left antecubital i.v. injection. Posterior image-lung perfusion is normal. Kidney and spleen activity is due to right-to-left shunting.

Received June 30, 1988; revision accepted Oct. 27, 1988.

For reprints contact: Richard C. Rosenbaum, MD, Dept. of Diagnostic Radiology, University of Maryland Medical System, 22 South Greene St., Baltimore, MD 21201.

FIGURE 2
[^{99m}Tc]MAA posterior image after a right antecubital i.v. injection. Lung perfusion is normal. No evidence of right-to-left shunting.

repeat V/Q scan was performed. Perfusion study was performed via a right antecubital injection (4 mCi [^{99m}Tc]MAA i.v.). Lung perfusion was again homogeneous but, surprisingly, no systemic shunting occurred (Fig. 2). A second, smaller dose (500 μCi [^{99m}Tc]MAA) was then administered via a left antecubital vein which did result in systemic shunting.

The disparity between left and right arm injections indicated shunting via anomalous systemic venous communication with the left heart, such as a left superior vena cava (SVC), and not intracardiac shunting which was initially suggested.

Subsequently, the patient experienced episodes of tachycardia and dizziness but otherwise did well. After normal delivery of her baby, cardiac catheterization was performed. This revealed corrected transposition of the great vessels with no evidence of atrial or ventricular septal defects. A left superior vena cava was demonstrated which drained systemic venous blood (73% saturated) into the 98% saturated left atrium. A small communicating vein connected the left and right SVC (Fig. 3A and B). Review of the MRI performed prior to delivery showed a vertically oriented vessel entering the left atrium (Fig. 4).

DISCUSSION

Resulting from persistence of the left anterior cardinal vein, left superior vena cava is the most common systemic venous anomaly (0.5% of the general population) (*2*). It is much more frequently encountered (3–10%) in patients with congenital heart disease, especially in cases of cardiac or visceral transposition.

Two vena cavae are most often present with communication of the LSVC with the right, usually through a smaller-than-normal left innominate vein. The LSVC empties into the right atrium via the coronary sinus in 92% of cases and into the left atrium in 8% (*3*).

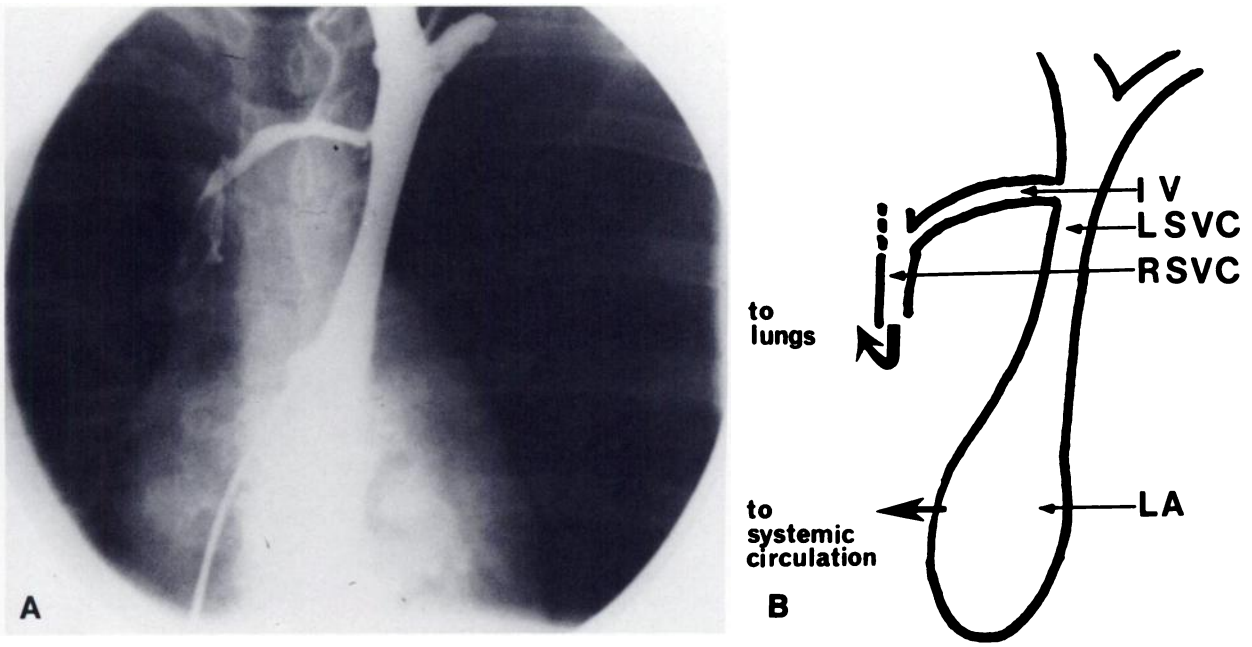

FIGURE 3
A: Angiogram showing left superior vena cava draining into the left atrium. LSVC communicates with the right SVC via small innominate vein.
B: Line-drawing depicting the angiographic anatomy in Figure 3A. IV = innominate vein, LSVC = left superior vena cava, RSVC = right superior vena cava, LA = left atrium.

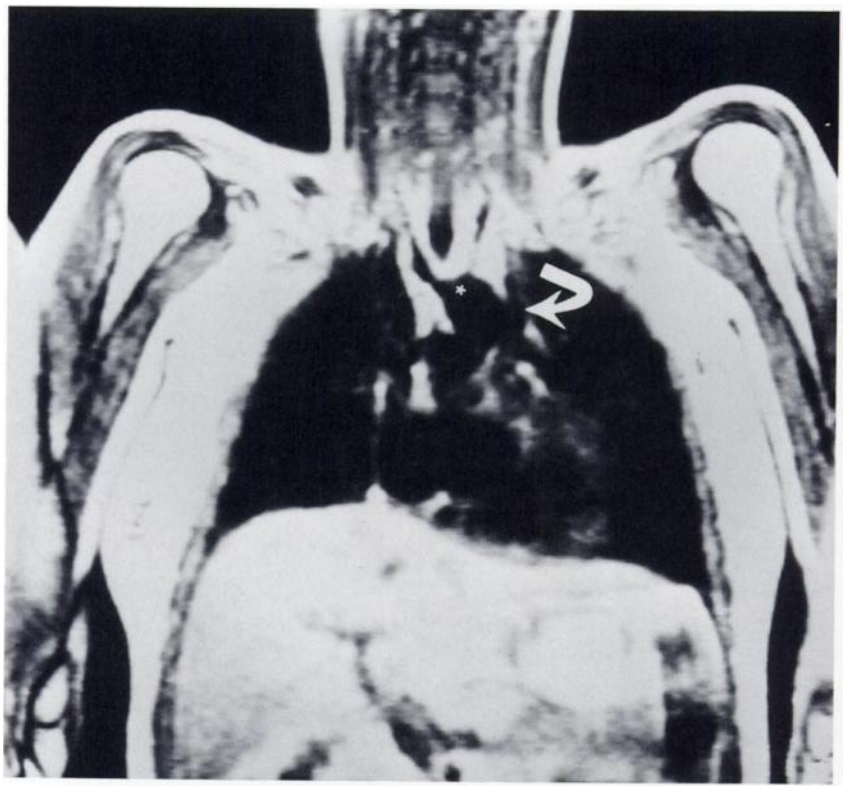

FIGURE 4
T-1 weighted coronal MRI shows LSVC (arrow). The brachiocephalic and left common carotid arteries are seen arising from the aortic arch (asterisk).

LSVC is of little consequence when present as an isolated anomaly in which the vessel communicates with the right atrium. When there is left atrial communication, however, peripheral cyanosis may be present (*4*). This can be cured, if necessary, by ligation of the LSVC if there is adequate communication with the RSVC.

Recognition of the presence of this anatomic variant might have consequence for cardiac catheterization or cardiac surgery and should be considered in patients with otherwise unexplained systemic embolizations (*5*). Verzijlbergen et al. have stressed the importance of a second injection in the contralateral arm in cases of strongly suspected right-to-left shunts when the first injection fails to reveal activity in the systemic circulation (*6*).

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