



Fig 2. Postoperative MRI demonstrating the hepatic veins draining into the azygous continuation of the inferior vena cava, posterior to the atrium (arrow).

the pericardium and anastomosed to the opened edges of the azygous vein with a running 5-0 prolene suture. The removal of a large portion of the atrium allowed the hepatic vein-azygous vein connection to lie in an undistorted straight line from the liver to the pulmonary artery (Fig 2).

The postoperative course was long and complicated. The patient spent 30 days in the intensive care unit, with arterial saturations between 60% and 80%. The cyanosis gradually became less evident; 6 months after the surgery, there had been a marked increase in exercise tolerance and the arterial saturation at rest in room air was 92%.

Van Son and Falk have suggested the inclusion of the hepatic venous drainage in the pulmonary circulation via an extra cardiac conduit at the time of the initial repair [8]. A direct anastomosis of the hepatic veins to the azygous vein is effective in establishing hepatic drainage to the pulmonary arteries. It avoids the use of foreign material and allows for growth.

References

1. Cloutier A, Ash JM, Smallhorn JF, et al. Abnormal distribution of pulmonary blood flow after the Glenn shunt or Fontan procedure: risk of development of arteriovenous fistulae. *Circulation* 1985;72:471-9.
2. Srivastava D, Preminger T, Lock JE, et al. Hepatic venous blood and the development of pulmonary arteriovenous malformations in congenital heart disease. *Circulation* 1995;92:1217-22.
3. Kopf GS, Laks H, Stansel HC, Hellenbrand WE, Kleinman CS, Talner NS. Thirty-year follow-up of superior vena cava-pulmonary artery (Glenn) shunts. *J Thorac Cardiovasc Surg* 1990;100:662-71.
4. Shah MJ, Rychik J, Fogel MA, Murphy JD, Jacobs ML. Pul-

monary AV malformations after superior cavopulmonary connection: resolution after inclusion of hepatic veins in the pulmonary circulation. *Ann Thorac Surg* 1997;63:960-3.

5. Knight WB, Mee RBB. A cure for pulmonary arteriovenous fistulas? *Ann Thorac Surg* 1995;59:999-1001.
6. Kreutzer J, Castañeda AR, Keane JF, Mayer JE, Jonas RA, Lock JE. Surgical incorporation of hepatic veins in patients with pulmonary arteriovenous malformations (AVMs) after Kawashima operation. *Cardiology in the Young* 1997;7:125.
7. Lee J, Menkis AH, Rosenberg HC. Reversal of pulmonary arteriovenous malformation after diversion of anomalous hepatic drainage. *Ann Thorac Surg* 1998;65:848-9.
8. Van Son JAM, Falk V. Developments in surgical palliation of univentricular physiology. *Ann Thorac Surg* 1997;63:301-3.

INVITED COMMENTARY

The case report by Baskett and colleagues provides additional support for the role of factors in hepatic venous blood in the development of pulmonary arteriovenous malformation [1]. In their case, diversion of hepatic venous blood into the azygous vein in a patient with interrupted inferior vena cava with azygous continuation and a prior bidirectional cavopulmonary shunt, led to resolution of desaturation due to pulmonary arteriovenous malformations over several months. Their results parallel those of our own group and of others [2, 3].

The techniques described by the authors of connecting the hepatic veins directly to the side of the azygous vein is unique, in that it avoids the technically simpler use of an extra-cardiac conduit or construction of an intra-atrial lateral tunnel. The need for deep hypothermia and circulatory arrest, to accomplish this procedure, would seem to be a drawback. However, the technique does avoid the use of the prosthetic tube grafts and the potentially arrhythmogenic atrial incisions and suture lines necessary to create a lateral tunnel-type Fontan procedure. Longer follow-up of lateral tunnel and extra-cardiac conduit Fontan procedures will be necessary before decisions can be made about the relative advantages and disadvantages of the author's technique versus extra-cardiac or lateral tunnel techniques.

John E. Mayer, Jr, MD

Department of Cardiovascular Surgery
Children's Hospital
300 Longwood Ave
Boston, MA 02115

References

1. Srivastava D, Preminger T, Lock JE, et al. Hepatic venous blood and the development of pulmonary arteriovenous malformations in congenital heart disease. *Circulation* 1995;92:1217-22.
2. Kreutzer J, Castañeda AR, Keane JF, Mayer JE Jr, Jonas RA, Lock JE. Surgical incorporation of hepatic veins in patients with pulmonary arteriovenous malformations (AVMs) after Kawashima operation. *Cardiology in the Young* 1997;7:125.
3. Shah MJ, Rychik J, Fogel MA, Murphy JO, Jacobs ML. Pulmonary AV malformations after superior cavopulmonary connection: resolution after inclusion of hepatic veins in the pulmonary circulation. *Ann Thorac Surg* 1997;63:960-3.