Arteriovenous Fistula in the Neonate*

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Arteriovenous fistulas have long intrigued cardiologists, in part because they are uncommon but also because of their physiologic effects, both local and general. For instance, a fistula in an extremity in children enhances growth of that extremity, whereas a fistula located in the kidney can cause systemic hypertension. Besides local effects, systemic arteriovenous fistulas, if large, have major systemic effects. They decrease systemic vascular resistance, increase cardiac output and are associated with an expanded blood volume. The magnitude of these physiologic changes depends directly on the size of the fistulous communication or communications and results in the clinical findings of sharp arterial pulses, widened pulse pressure, tachycardia and cardiomegaly.

Arteriovenous fistula in neonates. In this issue of the Journal, Musewe and associates (1) describe 10 neonates with either an intracranial arteriovenous fistula or one involving a subclavian artery and vein. Their article emphasizes some of the unique aspects of arteriovenous fistulas in the neonate and the contribution of echocardiography to an understanding of the hemodynamics of this condition in this age group. Because of the fetal and transitional circulations, arteriovenous fistulas have particular features in neonates that are not present in infants, children or adults.

In an arteriovenous fistula, the decreased systemic arterial resistance is coupled with an increased cardiac output. Therefore, an increased volume of systemic venous blood returns to the chambers of the right side of the heart. In the neonate, the increased venous return has major consequences that lead to a right to left shunt at both the atrial and the ductal levels. In the neonate, the pulmonary vascular resistance is elevated and, with the fistula reducing systemic resistance, a right to left shunt occurs through the ductus arteriosus. Indeed, catheterization studies (2-6) of these neonates have shown pulmonary hypertension and right to left ductal shunt. Furthermore, the right ventricle is hypertrophied and has reduced compliance. Catheterization data have also shown elevated right atrial pressure (7); previous echocardiographic studies have shown bulging of the atrial septal defect toward the left (7) and Doppler studies a right to left shunt through the foramen ovale (8,9).

In neonates, additional studies have examined the distribution of the blood that flows right to left through the ductus arteriosus. Cumming (6), using angiography and indicator-dilution studies, showed in one of two neonates with a cerebral arteriovenous fistula, that there was retrograde flow into the left carotid artery from the ductus arteriosus and that the entire flow to the descending aorta was through the ductus arteriosus. Furthermore, weak femoral pulses and catheterization evidence of coarctation of the aorta have been found in neonates with an intracranial arteriovenous fistula (3,10). Relative hypoplasia of the aortic isthmus has been found, suggesting that left ventricular blood is diverted to the head and the fistula, whereas right ventricular blood is the major source of blood to the descending aorta.

Value of echocardiography in differential diagnosis and hemodynamic study. The current echocardiographic study of neonates reported by Musewe et al. (1) was intended to show the value of echocardiography in distinguishing arteriovenous fistula from other conditions, such as coarctation of the aorta or Ebstein’s malformation of the tricuspid valve, with which it might be confused clinically. However, the study also provides additional insight into the hemodynamics of this condition. The investigators studied 10 neonates and compared measurements of vessel diameter and pattern of blood flow with those of 29 normal control neonates. They demonstrated a significant increase in the size of the ascending aorta and of the arteries supplying the fistula, but a significant decrease in the size of the descending aorta at the level of the left subclavian artery; this demonstration further substantiated previous studies that showed the marked division of systemic blood into two compartments, one supplied by the ascending aorta and the other by the descending aorta.

Furthermore, the investigators showed retrograde blood flow in the descending aorta proximal to the ductus arteriosus. This observation further documents the hemodynamic pattern indicated by previous studies, such as those of Cumming (6). Our knowledge of the hemodynamics and volume of blood flow through this fistula is expanded by the observation that anterograde diastolic blood flow occurred that exceeded 27% of systolic flow and represented a marked difference from the pattern in normal neonates. This pattern of diastolic blood flow provides insight into the magnitude of blood flow through the fistula.

The study describes three clinically useful echocardio-
graphic criteria to aid in identifying cerebral arteriovenous fistulas: 1) dilated brachiocephalic vessels; 2) diastolic retrograde flow in the aortic isthmus; and 3) diastolic anterograde flow in the brachiocephalic vessels. Armed with these findings, the echocardiographer can then direct attention quickly to ultrasound examination of the skull to define more precisely the intracranial abnormality.

Whether one is interested in the hemodynamics of neonatal cerebral arteriovenous fistulas or the expeditious diagnosis of this condition, this study is of considerable interest.

References