Discrete Subaortic Stenosis
Surgery in Children Based on Two-Dimensional and Doppler Echocardiography
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Twenty pediatric patients underwent surgical resection of a "discrete" subaortic membrane. The diagnosis and the surgical indication were based on two-dimensional and Doppler echocardiography without cardiac catheterization and angiography. In all patients the echocardiographic diagnosis was confirmed at surgery in terms of presence, dimension and location of the membrane and in ten patients in terms of pressure gradients. Two-dimensional and Doppler echocardiography has proved to be a very reliable tool for the diagnosis and surgical indication in pediatric patients with a DSAS. Our criteria for the selection of surgical patients are the following: (1) isolated form of discrete subaortic stenosis with a short base of attachment to the ventricular septum; (2) pressure gradients higher than 25 mm Hg; (3) presence of significant aortic insufficiency. All of this information can be consistently obtained with two-dimensional and Doppler echocardiography.

(The 1989; 96:325-28)

DSAS = discrete subaortic stenosis

The surgical treatment of patients with congenital heart disease is traditionally based on cardiac catheterization and angiography. More recently, in children, cardiac catheterization has been avoided before some types of palliative1-4 or corrective surgery5-10 and the two-dimensional echocardiography and Doppler techniques were used as the definitive preoperative diagnostic method. However, there is little information about the ability of two-dimensional echocardiography and Doppler to replace the invasive study for the diagnosis and surgical indication in children with left-sided obstructive lesions, as aortic valve stenosis.5-10 We report our experience with surgical relief of DSAS in pediatric patients using two-dimensional echocardiography and Doppler techniques for the preoperative evaluation.

MATERIALS AND METHODS

Between March 1986 and August 1988, 20 patients underwent surgical relief of DSAS without cardiac catheterization and angiography, with diagnosis and indication based on two-dimensional echocardiography and Doppler. No patient underwent preoperative cardiac catheterization in our or in other institutions. Fifteen were male and five were female patients, and their ages ranged from 3 to 12 years (mean, 7 years) (Table 1). In all patients, a complete echocardiographic study, including two-dimensional echocardiography, pulsed and continuous Doppler, was performed preoperatively and postoperatively using a Hewlett-Packard 7702 and Aloka SSD 730 sector scanner with 5.0 and 3.5 MHz transducers. Several two-dimensional echocardiography cuts to define the anatomic pattern and the localization of the left ventricular outflow tract obstruction were obtained for each patient.

The position which, at the Doppler study, allowed the maximum flow velocity and the best spectral display, was used for the subsequent measurements. To evaluate the degree of aortic insufficiency, pulsed Doppler samplings were obtained using subxiphoid, apical and left parasternal views. The insufficiency was considered mild if it was registered in the left ventricular outflow tract and significant if it was registered in the left ventricle near the mitral valve.11 In all patients, indications for surgery were: (1) presence of discrete membrane in the left ventricular outflow tract;12-13 shown by two-dimensional echocardiography;14-15 (2) instantaneous pressure gradient at the Doppler higher than 25 mm Hg;16 (3) presence of significant aortic insufficiency;16 (4) absence of additional malformations.

RESULTS

In all patients, two-dimensional echocardiography showed a thin membranous structure16-22 which caused subaortic stenosis (Fig 1). The membrane was implanted on the interventricular septum, the basis of the membrane was wide, not more than 5 mm, and the distance from the aortic valve was no more than 14 mm. The Doppler showed a significant aortic insufficiency in all patients; the mean instantaneous pressure gradient was 48 mm Hg (25 to 105 mm Hg) (Table 1). In all patients, the echocardiographic diagnosis was confirmed at surgery in terms of presence, dimension and location of the membrane.

The left ventricular and aortic pressures simultaneously recorded in the operating room before the cardiopulmonary bypass showed a gradient consistently similar to the preoperative gradient obtained
with Doppler evaluation in the first ten consecutive patients. The fibrous membrane was resected through an oblique aortotomy on cardiopulmonary bypass; the diameter of the aortic valve was measured and it was normal for age and body surface in all cases. At a mean follow-up time of 18.2 months (1 to 29 months), all patients were alive and in good clinical condition. The postoperative two-dimensional echocardiography showed that the membrane was completely removed in 15 patients and that it was a small residual fibrotic tissue (<3 mm) in five patients. The Doppler study showed a mean residual pressure gradient across the valve of 13 mm Hg (0 to 35 mm Hg) (Table 1), and excluded increased aortic insufficiency (Fig. 2).

**Discussion**

Although recent reports described the surgical approach without cardiac catheterization and angio-

**Table 1—Doppler Gradients**

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<th>Patient</th>
<th>Age (yr)</th>
<th>Weight (kg)</th>
<th>Sex</th>
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raphy for patients with left ventricular outflow tract obstruction, no data are reported for children with DSAS.

Previous studies showed the accuracy of morphologic two-dimensional echocardiography diagnosis in various forms of subaortic obstructions\textsuperscript{14-18} and the precise evaluation of pressure gradients and aortic insufficiency by pulsed and continuous Doppler echocardiography.\textsuperscript{11,18} Based on these results we expanded the use of echocardiography not only for the diagnosis but also for the surgical indication in children with DSAS, avoiding invasive procedures as cardiac catheterization and angiography. Our diagnostic results were good without false-positive or false-negative values and the correlation with the surgical findings was complete. The progressive nature of this malformation\textsuperscript{20-22} suggests an early surgical treatment in the presence of initial aortic regurgitation also in patients with low pressure gradients.\textsuperscript{23-27} This approach, by avoiding the progressive damage of the aortic valve due to the blood flow turbulence, significantly reduces the risk of further surgery on the aortic valve, either reconstruction or replacement, in the late follow-up.\textsuperscript{28}

Therefore, our criteria for the selection of surgical patients are the following: (1) presence of isolated form of DSAS with a short base of attachment to the ventricular septum and without associated malformations; (2) instantaneous pressure gradient obtained by Doppler higher than 25 mm Hg; (3) presence of significant aortic insufficiency. All of this information was easily obtained with two-dimensional echocardiography and Doppler.\textsuperscript{11,14-19}

Although two-dimensional echocardiography and Doppler have proved to be in our experience a very reliable tool for the diagnosis and surgical indication in pediatric patients with an isolated form of DSAS, we still prefer the invasive study in patients with suspected associated malformations.\textsuperscript{28-31} The morphologic two-dimensional echocardiography supported by the functional assessment with Doppler and color flow imaging may be extended in the near future to the more complex congenital malformations as the definitive diagnostic approach.

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