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POSTOPERATIVE ECHOCARDIOGRAPHIC STUDY OF PATIENTS FOLLOWING VALVULOTOMY FOR CRITICAL VALVULAR AORTIC STENOSIS

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Authors report on long term follow up of 12 patients operated with critical valvular aortic stenosis. They could perform control echocardiography in 11 patients 4-83 (mean 29) months after valvulotomy. The size and function of the left ventricle was found to be satisfactory, with elevated ejection fraction. The cause of the significant pressure gradient between the left ventricle and the aorta is discussed emphasizing the importance of echocardiography in determining the optimal time for valve replacement or homograft implantation.

INTRODUCTION

Valvular aortic stenosis gives about 4-7 % of congenital heart diseases /1, 3/. Looking at the morphology and also the clinical signs of the disease two separate forms can be distinguished. In case of the childhood form the valves are usually soft, semi-transparent. Calcification develops later, depending on the severity of the stenosis, possible endocarditis, calcium metabolism, exercise, and also on sex.

In a few patients (about 5-10 %) the valves are very thick cartilaginoid, with excentric opening occurring already in infancy. This is the characteristic picture of the critical valvular aortic stenosis of infants; it occurs very rarely later in childhood or adolescents; mostly only after valvulotomy. In some cases myxomatous vegetations can be seen on the valves /1, 2, 4, 8/.

Patients of this group usually do not have the classical signs of aortic stenosis; ejection murmur is absent. The pale colour, the weak pulses, dyspnea, tachypnea, the signs of low

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cardiac output are the characteristic features /1, 4, 8/. The prognosis of the patients without surgery is very poor.

Earlier the diagnosis and indication of surgery were possible only on the basis of cardiac catheterization, but most of the patients didn't survive the invasive procedure. Other centers reported small number of operated infants with critical aortic stenosis /9/ too. In the last few years it became possible to operate after non-invasive investigation, too. Since 1984 we have been operating these patients after echocardiography /4/.

PATIENTS AND METHODS

We have had the possibility for infant cardiac surgery with cardiopulmonary bypass since 1979. Between 1979-1981 no baby has reached the operating theatre with aortic stenosis. There are two patients from the period Sept 1981 - June 1984 and 10 from July 1984 - June 1988 under postoperative control. In the latter group the diagnosis was based upon echocardiography (performed partly in the Hungarian Institute of Cardiology, partly in our hospital). One of them had cardiac catheterization without further information, too.

The aim of the study was to investigate the late postoperative state of these 12 patients. In 7 patients the typical clinical signs were discovered in the first few weeks; the youngest baby was 4 days old at the time of the operation, further 6 were under the age of 4 months. Some of them were operated following resuscitation, but all of them were critically ill. In a little better condition have reached the operating theatre 3 other babies at the age of 6-8 months, who were classified in this group on the basis of the valve morphology. 2 other patients were operated at 12 and 24 months of age respectively; the first had pulmonary banding, plastic of the aortic isthmus and ligation of the duct at 1 mth and total correction (valvulotomy, closure of a VSD and debanding) at 12 mths of age. The other patient could not be operated because of repeated respiratory tract infections caused by IgA deficiency before the age of 2 years.

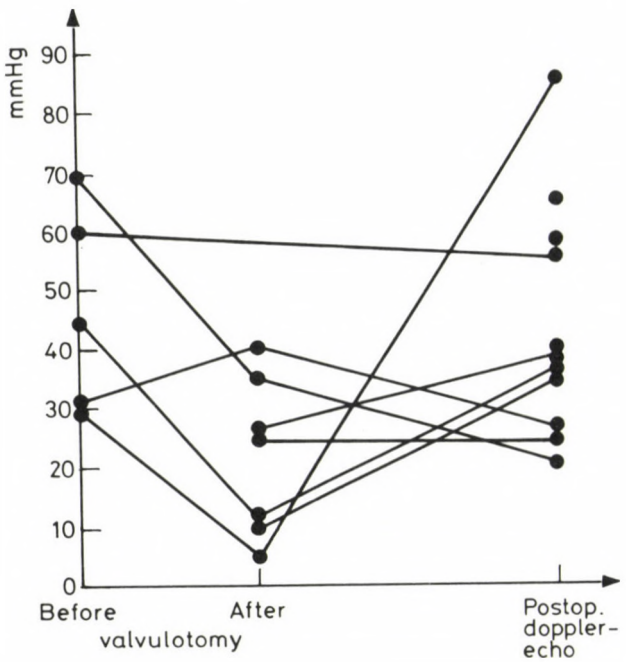
The postoperative echocardiography was performed at the outpatient department of our hospital, using a Picker SE 150 Cardiac Imager. The patients were sedated with chloralhydrat (0.05 g/kg body weight rectal), 4-83 (mean 29) months after surgery.

From the measurements the most important parameters are the following: the diameter of the left atrium and the aorta, the enddiastolic diameter of the left ventricle, the ejection fraction from the M-mode and from 2-dimensional picture, the fractional shortening; and the pressure gradient between the

left ventricle and the aorta calculated on the basis of the Bernoulli equation from continuous wave Doppler study.

RESULTS

The most important parameter of the severity of the valvular stenosis is usually the pressure gradient between the left ventricle and the aorta. In our cases we compared the gradient measured before valvulotomy on the table,(measurement was possible only in part of the patients because of the very poor clinical condition), immediately after valvulotomy, and the late postoperative gradient measured with continuous wave Doppler echocardiography (Fig. 1).



From the M-mode measurements we consider as important the size of the previously small left ventricular enddiastolic diameter (EDD), the left ventricular function and the development of the left atrium and the aorta. Table I shows

TABLE I

Left ventricular enddiastolic diameter (EDD)

	BSA (m^2)	EDD (mm)	% of normal mean value	MI	AI
1.	0.9	35	92.6	-	-
2.	0.6	38	114	-	+
3.	0.72	38	108	+	-
4.	0.7	37	106	-	-
5.	0.75	31	87	+	-
6.	0.75	32	90	-	+
7.	0.55	28	90	-	-
8.	0.5	33	108	+	-
9.	0.4	25	86	-	-
10.	0.35	24	86	-	-
11.	0.4	23	79	-	-

MI: mitral incompetence
AI: aortic incompetence

the left ventricular EDD of the patients in mm and in per cent of the normal values according to body surface area, (indicated whether mitral or aortic insufficiency are present or not) investigated with pulsatile Doppler.

Table II contains the results of left ventricular function measurements: the fractional shortening (FS) in percent and the ejection fraction (EF) calculated from the 2-D picture using planimetry and from the M-mode picture using the mean of the calculations according to Gibson, Pombo and Teichholz. Table III shows the diameter of the left atrium in mm and in per cent of the normal value and the ratio of the diameter of the left atrium and the aorta /2, 7/.

DISCUSSION

From the results of the gradient measurements we can establish, that these values are not easy to appreciate. Before valvulotomy the patients are in very bad condition, the left ventricle is unable to eject properly through the critical

TABLE II

Left ventricular function at the postoperative control

	FS (%)	EF (2D) (%)	EF (M-m) (%)
1.	40	65.4	75.4
2.	55.3	65.0	88.4
3.	44.7	74.8	80
4.	40.5	57.0	75.1
5.	48.4	69.0	83.3
6.	53.1	-	85.4
7.	50.	-	82.9
8.	36.4	62.6	71.2
9.	44.0	68.5	78.5
10.	50.	-	83.9
11.	52.2	-	87.1

FS: fractional shortening
EF: ejection fraction

TABLE III

Diameter of the left atrium (LA) and aorta (AO) (in mm and % of the normal mean value)

	BP	%	AO	%	BP/AO
1.	24	104	22	105	1.1
2.	21	101	18	97	1.2
3.	23	105.5	22	113	1.0
4.	23	106.5	19	98.5	1.2
5.	23	104.5	20	101.5	1.15
6.	23	104.5	20	101.5	1.15
7.	15	74	19	105.5	0.8
8.	24	120.5	17	96.5	1.4
9.	19	100	18	108	1.05
10.	18	97.5	14	86	1.3
11.	15	79	17	102	0.9

stenosis and to maintain normal pressure. Therefore the measured preoperative gradient in some cases did not reach the value of indication for surgery in classical terms. After

valvulotomy both the left ventricular output and pressure rises, and the gradient will not necessarily be less than before the operation. At the late postoperative Doppler-echo control the majority of the patients have a gradient above 30 mmHg. Other teams have reported on similar results /5, 10/. However the general condition of the patients is perfect, usually do not need medical treatment.

The most important question is the future of the patients. The operation resulted in survival of the critically ill patients being now in a good condition. The previously hypoplastic left ventricles are now usually of normal size, the EDD is above 100 % of the normal mean mainly in patients with mitral or aortic incompetence. The ratio of the left atrium and aorta is also near normal in all patients, neither the aorta is hypoplastic. We have to mention that we could have performed control investigation only in late surviving patients.

The left ventricular EF was in all cases above the normal value. Other left ventricular function measurements, e.g. Doppler-echo we were not able to perform on the restless patients at the outpatient clinic, however they could have given more reliable results /6/, than the EF values calculated from M-mode and 2D-methods with rather great differences.

It is still not clear what and when should be done with our patients. A second valvulotomy on these severely pathologic valves which are already incompetent in some cases will not give a good result. We suggest that some patients will need valve replacement or homograft implantation. To determine the optimal time for a second operation is a very difficult problem. Echocardiography can help to follow up these patients. We have to beware of valve replacement in childhood, but we have to define the time when the operation cannot be delayed any more because of the increase of left ventricular hypertrophy or dilatation, endocardial fibroelastosis or pressure gradient.

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