Echocardiography in the Diagnosis of Congenital Mitral Stenosis and in Evaluation of the Results of Mitral Valvotomy

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SUMMARY

Seven patients with congenital mitral stenosis have been investigated with echocardiography using reflected ultrasound. In all cases the mitral stenosis was combined with other cardiovascular malformations. The results are compared with those obtained at clinical investigation, cardiac catheterization, and operation and/or autopsy. It is concluded that the method is of definite value in diagnosing congenital mitral stenosis, even when this is combined with other cardiovascular malformations. The method is also found to be of value in assessing the severity of mitral stenosis.

Three patients have been investigated after mitral valvotomy. It is concluded that the findings at echocardiographic examination agree quite well with the clinical findings and with the results of postoperative cardiac catheterization in the evaluation of the result of mitral valvotomy.

Additional Indexing Words:
Child Follow-up studies
Congenital heart defects, diagnosis
Ultrasonics, diagnostic use

Congenital mitral stenosis may occur as an isolated heart malformation but most often it is combined with other malformations of the cardiovascular system. The diagnosis can sometimes present difficulties especially when the mitral stenosis is combined with other cardiovascular malformations. Under these circumstances an evaluation of the severity of the mitral stenosis can also be difficult.

The anatomic variations of congenital mitral stenosis have recently been the subject of an excellent analysis. The clinical findings and hemodynamic consequences of this malformation in all its various combinations have also been thoroughly described previously.

Surgery has been performed in many cases, both with and without replacement of the mitral valve. In the preoperative assessment additional information about the functional state of the mitral valve should be of value.

The use of echocardiography in the diagnosis and evaluation of the severity of acquired mitral stenosis has been reported by many authors. A report on echocardiography in congenital mitral malformations in young infants has been presented. The aim of the present investigation was to evaluate the use of echocardiography in the diagnosis of congenital mitral stenosis in infants and children above the age of 1 month.

Methods

Material

The material consists of all patients above the age of 1 month with congenital mitral stenosis observed during the period 1966-1970 and where
## Table 1

<table>
<thead>
<tr>
<th>Case, sex</th>
<th>Age murmur detected</th>
<th>Age, onset of symptoms</th>
<th>Age at operation</th>
<th>Operation</th>
<th>Age at death</th>
<th>Deg MS*</th>
<th>Mitral malform</th>
<th>Associated malform</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 F</td>
<td>3 days</td>
<td>3 days</td>
<td>—</td>
<td>—</td>
<td>4 months</td>
<td>+</td>
<td>Funnel-shaped nodular thickening</td>
<td>Preductal coarctation + PDA + large VSD</td>
</tr>
<tr>
<td>2 F</td>
<td>4 months</td>
<td>1½ years</td>
<td>3½ years</td>
<td>Resect coa + mitral valvotomy</td>
<td>—</td>
<td>+ +</td>
<td>Diaphragmatic, no commissures</td>
<td>Postductal coarctation</td>
</tr>
<tr>
<td>3 M</td>
<td>7 months</td>
<td>6 years</td>
<td>12 years</td>
<td>Resect coa + mitral valvotomy</td>
<td>—</td>
<td>+ +</td>
<td>Funnel shaped</td>
<td>Postductal coarctation</td>
</tr>
<tr>
<td>4 M</td>
<td>2 months</td>
<td>10 months</td>
<td>1 year</td>
<td>Resect coa</td>
<td>1½ year</td>
<td>+ +</td>
<td>Funnel-shaped; short, fused chordae</td>
<td>Postductal coarctation</td>
</tr>
<tr>
<td>5 M</td>
<td>3 months</td>
<td>6 months</td>
<td>8 months</td>
<td>Lig PDA</td>
<td>—</td>
<td>+ +</td>
<td>Diaphragmatic, no commissures</td>
<td>PDA + persistent LSVC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1½ year</td>
<td>Lig PDA + mitral valvotomy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 M</td>
<td>2 weeks</td>
<td>1 month</td>
<td>4 months</td>
<td>Resect coa + explor mitral valve</td>
<td>—</td>
<td>+</td>
<td>Normal-shaped, slightly thickened leaflets</td>
<td>Postductal coarctation</td>
</tr>
<tr>
<td>7 F</td>
<td>6 months</td>
<td>6 years</td>
<td>7 years</td>
<td>Replace mitral valve</td>
<td>—</td>
<td>+ +</td>
<td>Diaphragmatic, short, fused chordae</td>
<td>Postductal coarctation</td>
</tr>
</tbody>
</table>

*Degree of mitral stenosis based on findings at operation or autopsy: + slight mitral stenosis, ++ severe mitral stenosis.

Abbreviations: PDA = patent ductus arteriosus; coa = coarctation of aorta; VSD = ventricular septal defect; lig = ligation; resect = resection; malform = malformation; explor = exploration; LSVC = left superior vena cava.
Echocardiography was performed. Some clinical data on the patients, including age at detection of murmur, age at onset of symptoms, age at operation, and type of operation performed are given in table 1. Four patients showed signs of congestive heart failure (cases 1, 2, 4, and 5), while the remaining three patients had slighter symptoms such as fatigue and dyspnea on exertion.

**Cardiac Catheterization**

Cardiac catheterization was performed in all patients. The investigation was carried out after premedication but without general anesthesia. The findings at these investigations are shown in table 2. The additional malformations found at angiocardiography are presented in table 1.

Cardiac catheterization was performed after resection of a coarctation of the aorta in one patient (case 4), and after ligation of a patent ductus arteriosus in another patient (case 5).

**Findings at Operation of the Mitral Valve**

An operation or an exploration of the mitral valve was performed in five patients (cases 2, 3, and 5–7). In case 2 a valvotomy under direct vision and in case 3 a closed valvotomy were performed. The experiences gained from these two operations have been reported earlier. In case 5 a closed valvotomy was performed together with a religation of a patent ductus arteriosus. After resection of a coarctation of the aorta the mitral valve was explored with a finger in case 6. A slight widening effect on the mitral valve possibly results from this exploration. A valvotomy under direct vision was attempted in case 7. The valve clearly had restricted mobility, and since mitral regurgitation occurred immediately the valve was excised and replaced with a disc valve. The surgeon's estimation of the severity of the mitral stenosis is shown in table 1 together with the type of mitral valve malformation found at operation and the age of the patient at operation.

**Findings at Autopsy**

Two patients died, and an autopsy was performed on both (cases 1 and 4). The age at death, type of malformation, degree of mitral stenosis estimated by the pathologist, and associated malformations found at autopsy are presented in table 1.

**Findings at Investigation after Mitral Valvotomy**

Four patients have been investigated after mitral valvotomy (cases 2, 3, and 5) or exploration of the mitral valve (case 6). As can be seen in table 1, the valvotomy was performed simultaneously with other surgical procedures. All patients were without symptoms and lived normal active lives. A right ventricular hypertrophy was suspected on the electrocardiogram in case 2, but of much lesser degree than before operation. In the other cases no signs of right ventricular hypertrophy were found.

A postoperative cardiac catheterization was performed on three patients (cases 2, 3, and 6), and the results are presented in table 2. Based on these postoperative investigations, the results of the mitral valvotomy were regarded as being satisfactory in all cases. Thus there were no signs of mitral stenosis of clinical significance and only a slight mitral regurgitation in one case and no mitral regurgitation in another. Since no postoperative cardiac catheterization has been performed after valvotomy in case 5, it is not known whether a mitral regurgitation exists, but the auscultatory findings do not suggest this. The exploration of the mitral valve in case 6 has presumably induced a slight mitral regurgitation.

**Echocardiographic Examination**

These were performed with an ultrasonoscope (Smith Kline Eskoline 20). This instrument produces 1000 pulses/sec, and a 2.25-MHz transducer of 1.9-cm (0.75-in) diameter was used. The technic of this examination in infants and children has been described in a previous paper. The patients were examined while in supine position during normal respiration and without premedication. A water-soluble gel was used to obtain airless contact between the transducer and the skin.

The echo from the anterior mitral leaflet is best obtained in the fourth left intercostal space and with the transducer placed about halfway between the sternal border and the midclavicular line or slightly more lateral and in the anteroposterior direction. The influence of the transducer's position and direction on the echo obtained from the anterior mitral leaflet has been discussed earlier. Great care was taken therefore to obtain an echo from the anterior mitral leaflet with as large a total amplitude of movement as possible (fig. 1). When the optimal position of the transducer for obtaining a good echo from the anterior mitral leaflet was established, registrations of at least 10–20 heart cycles were made. The registrations were made on Polaroid film or on a direct-writing electrocardiograph. Simultaneously recorded electrocardiogram and/or phonocardiogram was used as reference. From the recorded echocardiograms a minimum of five and usually 10 heart cycles were used for measurements.

The echo from the anterior mitral leaflet (fig. 1) is characterized by a slow anterior movement during ventricular systole interrupted in the beginning of diastole by a rapid anterior opening.

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**Table 2**

*Cardiac Catheterization Findings*

<table>
<thead>
<tr>
<th>Case</th>
<th>Age at catheterization</th>
<th>Preop</th>
<th>Postop (Yr)</th>
<th>Qp/Qs</th>
<th>PA</th>
<th>PCW</th>
<th>LA</th>
<th>LV</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1½ months</td>
<td></td>
<td></td>
<td></td>
<td>115/57 M = 84</td>
<td></td>
<td></td>
<td></td>
<td>Right-left shunt through PDA</td>
</tr>
<tr>
<td>2</td>
<td>3½ years</td>
<td>1:1</td>
<td></td>
<td></td>
<td>54/24 M = 33</td>
<td>a = 33 M = 27</td>
<td>119</td>
<td>135 0/10</td>
<td>Severe coarctation of aorta</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>36/15 M = 25</td>
<td>v = 21 M = 15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>10½ years</td>
<td>1:1</td>
<td></td>
<td></td>
<td>55/33 M = 38</td>
<td>M = 23</td>
<td>a = 38 M = 26</td>
<td>150</td>
<td>Severe coarctation of aorta</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>45/38 M = 40</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>2 months</td>
<td>1:1</td>
<td></td>
<td></td>
<td>42/16 M = 26</td>
<td>M = 15</td>
<td></td>
<td>125</td>
<td>No mitral insufficiency</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>40/8 M = 19</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>8 months</td>
<td>1½:1</td>
<td></td>
<td></td>
<td>56/25 M = 36</td>
<td>M = 25</td>
<td></td>
<td>135</td>
<td>Slight coarctation of aorta</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3:1</td>
<td></td>
<td></td>
<td>78/50 M = 63</td>
<td></td>
<td></td>
<td>95</td>
<td>Large PDA</td>
</tr>
<tr>
<td>6</td>
<td>3 weeks</td>
<td>1½:1</td>
<td></td>
<td></td>
<td>47/29 M = 33</td>
<td>M = 21</td>
<td></td>
<td>120 0/5</td>
<td>Small PDA</td>
</tr>
</tbody>
</table>
| 7    |                        |       |             | 1:1   | 25/12 M = 17 | a = 22 M = 18 |          |                      | 1        | Severe coarctation. At operation 3 months later normal pressure (systolic 20-25 mm Hg) in PA before resection of coarctation of aorta. Coarctation of aorta | 47

Note: 3 months later normal pressure (systolic 20-25 mm Hg) in PA before resection of coarctation of aorta.

Abbreviations: Qp = pulmonic blood flow; Qs = systemic blood flow; PA = pulmonary artery; PCW = pulmonary capillary wedge; LA = left atrium; LV = left ventricle; a = a wave; v = v wave; M = mean; MI = mitral insufficiency; PDA = patent ductus arteriosus.
movement toward a fully open position. In normal subjects (fig. 1A) the leaflet then immediately moves in a posterior direction toward a semiopen position. In atrial systole the echo moves once more in an anterior direction to a more open position, and then a closing posterior movement occurs toward a fully closed position at the beginning of ventricular systole.

In patients with mitral stenosis (fig. 1B) the deviation from normal consists mainly in a slower posterior movement in the early part of diastole so that the echo remains in a more anterior position during the entire diastole. The atrial systole, therefore, causes only a slight further opening. The speed of movement of the echo from the anterior mitral leaflet in posterior direction during the early part of diastole (fig. 1B) in adults with acquired mitral stenosis has been found to correlate well with the severity of mitral stenosis.\textsuperscript{13–17, 24} The lower limit of this speed of movement in normal adult subjects is 80–90 mm/sec.\textsuperscript{14–16, 19} In normal infants and children the corresponding lower limit has been found to be 90 mm/sec (unpublished data). With a fast heart rate (more than about 120 beats/min) the part of diastole before atrial systole is too short to allow any measurement of the speed of movement in early diastole.

The measurements made on the recordings of the echo from the anterior mitral leaflet in the present material were: total amplitude of movement, amplitude of opening movement in the beginning of diastole, and speed of movement in posterior direction during the early part of diastole (fig. 1B).

\section*{Results}

\textbf{Before Mitral Valvotomy}

The results of echocardiographic examinations of the anterior mitral leaflet are presented in table 3. The total amplitude of movement and the amplitude of opening movement in the beginning of diastole were within normal limits for age in cases 1–3, 5, and 6. The values were, however, in the lower range of normal. In cases 4 and 7 the total amplitude of movement and the amplitude of opening movement in the beginning of diastole were 2–3 mm below the lower limit of corresponding normal values. The mobility of the anterior mitral leaflet was therefore suspected to be restricted in cases 4 and 7. At autopsy in case 4, short, fused chordae tendineae were found, and it seemed likely, therefore, that the mobility of the mitral valve had been restricted. At operation in case 7, short, fused chordae tendineae were found. The mobility of the mitral valve was restricted and a valvotomy was not considered possible. A replacement of the valve was therefore performed.

The speed of movement of the echo from the anterior mitral leaflet in the early part of diastole was much slower than the lower normal limit (90 mm/sec) in all cases (figs. 1B, 2, 3). Two patients had a speed of movement between 30 and 40 mm/sec (cases 1 and 6) and the others below 25 mm/sec. In three patients (cases 4–6) the examinations were repeated within an interval of 3–18

\begin{figure}[h]
\centering
\includegraphics[width=0.8\textwidth]{figure1.png}
\caption{Line drawings of two recordings of echoes from the anterior mitral leaflet. In this and all subsequent echocardiograms, the top of the picture represents the anterior direction. (A) A 10-year-old boy without heart disease. a = total amplitude of movement (29 mm); b = amplitude of opening movement in the beginning of diastole (20 mm); c = amplitude of movement during ventricular systole (9 mm); d = distance moved in 0.5 sec during the early part of diastole giving a speed of movement of 150 mm/sec. (B) A 15-year-old boy with congenital mitral stenosis and postductal coarctation of the aorta (case 4). The same abbreviations as in A. a = 14 mm; b = 9 mm; c = 5 mm; d = 7 mm giving a speed of movement of 14 mm/sec.}
\end{figure}
### Table 3

**Echocardiographic Findings before and after Mitral Valvotomy**

<table>
<thead>
<tr>
<th>Case</th>
<th>Age at exam</th>
<th>Total ampl (mm)</th>
<th>Ampl of opening movement (mm)</th>
<th>Speed of movement in diast (mm/sec)</th>
<th>Before valvotomy</th>
<th>After valvotomy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Total ampl (mm)</td>
<td>Amplitude of opening movement (mm)</td>
<td>Speed of movement in diast (mm/sec)</td>
<td>Age at exam</td>
<td>Time after op</td>
</tr>
<tr>
<td>1</td>
<td>1/2 months</td>
<td>13</td>
<td>10</td>
<td>33</td>
<td>30–35</td>
<td>4 years</td>
</tr>
<tr>
<td>2</td>
<td>3 1/2 years</td>
<td>20</td>
<td>16</td>
<td>22</td>
<td>20–24</td>
<td>5 1/2 years</td>
</tr>
<tr>
<td>3</td>
<td>12 1/2 years</td>
<td>26</td>
<td>21</td>
<td>18</td>
<td>16–20</td>
<td>9 years</td>
</tr>
<tr>
<td>4</td>
<td>2 months</td>
<td>10</td>
<td>7</td>
<td>13</td>
<td>11–15</td>
<td>13 years</td>
</tr>
<tr>
<td>5</td>
<td>9 months</td>
<td>12</td>
<td>10</td>
<td>18</td>
<td>16–20</td>
<td>14 1/2 years</td>
</tr>
<tr>
<td>6</td>
<td>6 1/2 years</td>
<td>18</td>
<td>11</td>
<td>19</td>
<td>17–22</td>
<td>17 1/2 years</td>
</tr>
<tr>
<td>7</td>
<td>2 weeks</td>
<td>9</td>
<td>7</td>
<td>37</td>
<td>35–38</td>
<td>20 months</td>
</tr>
<tr>
<td>8</td>
<td>1 month</td>
<td>9</td>
<td>7</td>
<td>40</td>
<td>39–42</td>
<td>3 years</td>
</tr>
<tr>
<td>9</td>
<td>4 months</td>
<td>11</td>
<td>9</td>
<td>36</td>
<td>33–38</td>
<td>6 months</td>
</tr>
<tr>
<td>10</td>
<td>1 year</td>
<td>12</td>
<td>10</td>
<td>19</td>
<td>17–22</td>
<td>1 year</td>
</tr>
</tbody>
</table>
months, and only small variations in the speed of movement were obtained. In one patient (case 4) a tight postductal coarctation of the aorta was resected between the two examinations without significant change in the speed of movement.

Judged from these examinations the mitral stenosis was considered to be slight in cases 1 and 6 and severe in all the other cases. The degree of mitral stenosis as estimated by the surgeon at operation or by the pathologist at autopsy is compared with the speed of movement of the echo from the anterior mitral leaflet in diastole in figure 4. This comparison indicates that a speed of movement below 20–25 mm/sec is found in patients with a severe congenital mitral stenosis regardless of the age of the patient. A speed of movement of more than 30 mm/sec is found in patients with a slight mitral stenosis without significant hemodynamic consequences.

After Mitral Valvotomy

Echocardiographic examinations of the anterior mitral leaflet were performed after mitral valvotomy in three patients (cases 2, 3, and 5) and after exploration of the mitral valve in one patient (case 6). The results of these investigations together with the age at examination and time after valvotomy are presented in table 3. The total amplitude of movement and the amplitude of opening movement in the early part of diastole were within normal limits in all these patients. In those three patients where a valvotomy had been performed, the speed of movement of the echo from the anterior mitral leaflet increased after operation (fig. 3). The values for the speed of movement were now in or above the range (30–40 mm/sec) supposed to indicate a slight mitral stenosis without significant hemodynamic consequences. At a follow-up examination 1–5½ years after operation the values were not significantly altered (table 3). The findings indicate a satisfactory result of the operations, agreeing quite well with the results of the (postoperative) clinical investigations and cardiac catheterizations.

In one patient only an exploration of the mitral valve was performed (case 6). The postoperative investigations on this patient show a mitral regurgitation, and a widening effect caused by the exploration therefore seems likely. The speed of movement of the echo from the anterior mitral leaflet increased after operation even in this patient. A follow-up investigation 6 months after the operation showed the same results, despite the fact that the patient had a recoarctation of the aorta.

Discussion

The present material differs from previously published experiences on congenital mitral stenosis 1–7, 9, 10 in that it does not contain any case of isolated congenital mitral stenosis. No obvious reason for this has been found. The combination of mitral stenosis with other severe congenital cardiovascular malformations makes an evaluation of the severity of the
mitral stenosis difficult when based only upon clinical investigations and cardiac catheterization. Even the value of angiocardiography in the diagnosis of congenital mitral stenosis has been questioned, and an evaluation of the severity of mitral stenosis by this technic is difficult. For these reasons the severity of mitral stenosis in the present material has been based upon the findings at operation or autopsy. As an exact determination of the severity of mitral stenosis is difficult to obtain even at operation or autopsy, the material has been divided into two groups only: slight mitral stenosis, presumably without hemodynamic consequences; and severe mitral stenosis, with obvious hemodynamic consequences. There has been no difficulty in placing the patients into one of these two categories.

Echocardiography in the Diagnosis of Mitral Stenosis

The value of echocardiography in the diagnosis and evaluation of severity of acquired mitral stenosis has been established by many investigations. A much reduced total amplitude of movement has been found in cases with restricted mobility of the anterior mitral leaflet and especially in cases with severe calcifications of the mitral valve. No calcifications of the mitral valve occurred in the present material. It is, however, interesting to note that in the two

Figure 3
Echocardiogram of the anterior mitral leaflet after valcotomy (case 5). Recording on Polaroid film made 1 year after valcotomy. Speed of movement in the early part of diastole 35–38 mm/sec.

Figure 4
Comparison between speed of movement of the echo from the anterior mitral leaflet during the early part of diastole in patients with severe and slight congenital mitral stenosis (MS) and congenital mitral stenosis after mitral valcotomy. The lower limit of speed of movement in normal subjects and in patients with a normal mitral valve but with a severe obstruction to left ventricular outflow is indicated.
patients on whom, at autopsy or operation, the mitral valve was found to have a clearly restricted mobility because of short, fused chordae tendineae, the total amplitude of movement as well as the amplitude of opening movement in diastole was clearly below the lower normal limit for that age. The findings in the present material seem thus to agree with those found in patients with acquired mitral stenosis and indicate a possibility for evaluating the mobility of the mitral valve before operation. This could be of value in the decision whether to carry out valvotomy or to replace the mitral valve.

A comparison between the severity of acquired mitral stenosis in adults and the speed of movement in posterior direction of the echo from the anterior mitral leaflet in the early part of diastole has been made by several authors.\(^{14-17, 24, 26}\) Edler\(^{15}\) found in 15 patients with acquired mitral stenosis, which was judged to be slight and giving no symptoms, a speed of movement of 27-45 mm/sec. At a comparison with the findings at operation he found a fairly good correlation between the mitral valve area estimated at operation and the speed of movement. In the patients with acquired mitral stenosis, where a mitral valvotomy was indicated, Joyner\(^{14}\) found a speed of movement less than 20-25 mm/sec. Effert\(^{16}\) could divide his material of patients with mitral stenosis into various groups of different severity based on the speed of movement of the echo from the anterior mitral leaflet.

A correlation between echocardiography, hemodynamics, and surgical findings in a material of acquired mitral stenosis has been performed by Gustafson.\(^{24}\) He found a statistically significant correlation between estimated mitral valve area on the one hand and the speed of movement of the echo from the mitral leaflet on the other hand in patients with sinus rhythm and a normal amplitude of movement of the echo from the anterior mitral leaflet.

Segal et al.\(^{18}\) have pointed out that a slight degree of mitral regurgitation together with a mitral stenosis does not alter the findings at echocardiography from those found in isolated mitral stenosis.

The findings in the present material regarding the relation between the degree of mitral stenosis and the speed of movement of the echo from the anterior mitral leaflet during diastole (fig. 4) agree quite well with the findings in adults with acquired mitral stenosis. With this method it thus seems possible to be able to separate reasonably well the group of patients with a mitral stenosis without significant hemodynamic consequences from those of clinical significance.

In some patients with a severe degree of obstruction to left ventricular outflow without mitral stenosis, the speed of movement of the echo from the anterior mitral leaflet in posterior direction during the early part of diastole has been found to be lower than normal.\(^{23, 26}\) This has been attributed to a reduced compliance of the left ventricular wall. The speed of movement in these cases has, however, never been found to be less than about 40 mm/sec.\(^{25, 26}\) It is unlikely, therefore, that the reduced speed of movement of the echo from the anterior mitral leaflet found in the present material could be explained by the associated cardiovascular malformation causing obstruction to left ventricular outflow (coarctation of the aorta). Furthermore, it is evident that even patients with a slight mitral stenosis have a speed of movement of the echo from the anterior mitral leaflet lower than that found in patients with severe obstruction to left ventricular outflow without mitral stenosis (fig. 4).

**Echocardiography after Mitral Valvotomy**

The possibility of evaluating the results of mitral valvotomy in adults with acquired mitral stenosis by echocardiography has been described by several authors.\(^{14-16, 24, 26}\) Joyner\(^{14}\) found an increase in the speed of movement of the echo from the anterior mitral leaflet after mitral valvotomy up to values above 25 mm/sec in most cases. Edler\(^{15}\) also found an increase in the speed of movement after valvotomy, especially in the group of patients in whom the mobility of the mitral...
valve was good. The value of echocardiography in detection of restenosis after valvotomy was also stressed by Edler. In the investigation presented by Effert the mean increase in speed of movement of the echo from the mitral leaflet after valvotomy was 24.5 mm/sec, and in a few cases an increase to above 70 mm/sec was found. Gustafson found the best results of mitral valvotomy in the group of patients with a good mobility of the mitral valve. He also concluded that the total amplitude of movement of the echo from the anterior mitral leaflet was a good measurement of this mobility.

The findings in the present material agree well with the findings after mitral valvotomy in adults. The findings at postoperative echocardiography in this material are also in good agreement with the findings at postoperative cardiac catheterization or clinical investigation.

It has been pointed out that there is a lack of postoperative investigations after mitral valvotomy in cases with congenital mitral stenosis. The present material can contribute with at least a fairly long follow-up in two cases and a shorter observation period in another patient after mitral valvotomy. In selected cases of congenital mitral stenosis, a mitral valvotomy can provide satisfactory results lasting several years after operation and without severe mitral regurgitation. Due to the wide variations in anatomic findings in congenital mitral stenosis, the possibility of performing a satisfactory valvotomy is difficult to predict before the surgical procedure has begun. The finding of a normal total amplitude of movement of the echo from the anterior mitral leaflet at echocardiography indicates a good mobility of the anterior mitral leaflet, and this information should therefore be of value in the preoperative assessment.

Conclusions

The investigation reported here shows that echocardiography is of definite value in the diagnosis of congenital mitral stenosis even when this is combined with other cardiovascular malformations. Echocardiography can also be used in assessing the severity of mitral stenosis and in the evaluation of the results of mitral valvotomy. Since the method is harmless, noninvasive, and easy to repeat, it should be of value as a complementary method in the overall evaluation of the functional state of the mitral valve.

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Reference

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