Natural History of Rheumatic Aortic Regurgitation

Criteria Predictive of Death, Congestive Heart Failure, and Angina in Young Patients

By Mario Spagnuolo, M.D., Howard Kloth, M.D., Angelo Taranta, M.D., Eugenie Doyle, M.D., and Bernard Pasternack, Ph.D.

SUMMARY
The medical courses of 174 young patients with aortic regurgitation were followed prospectively for a median of 10 years. The data were analyzed by life-table methods; congestive failure and angina, as well as death, were considered as end points, since the occurrence of the former is considered sufficient indication for aortic valve replacement. Thirty-one patients developed the triad of moderate or marked left ventricular enlargement, two or three electrocardiographic abnormalities, and abnormal blood pressure. Thirty-three percent of these patients either died or had failure or angina within 1 year, 48% within 2 years, 65% within 3 years, and 87% within 6 years from the acquisition of the triad. The 71 patients with none of the above features had uneventful courses. Of the 71 patients with one or two features only seven either died (three) or became symptomatic. These data are useful for patient selection for surgery before symptoms appear.

Additional Indexing Words:
Rheumatic fever    Rheumatic heart disease

PHYSICIANS have long known that patients with rheumatic aortic regurgitation may remain asymptomatic for years, but that once they become symptomatic they usually follow a rapid, downhill course leading to death in a few years. Moreover, a few patients with aortic regurgitation die suddenly and unexpectedly without premonitory symptoms. As long as the only therapy of aortic regurgitation was medical, the interest in identifying the group of patients most likely to die or to develop symptoms was largely academic. The development of surgical therapy has changed the nature and the extent of this interest. Since the operation has a considerable immediate mortality, since its long-term results are unknown, and since anticoagulant therapy of indefinite duration is needed, the risk of not operating has to be known accurately and in detail.

Since 1952, 174 young patients with aortic regurgitation have been admitted to the Irvington House Prophylaxis Clinic and the Bellevue Hospital Pediatric and Adolescent Cardiac Clinic. We report here an analysis of the natural history of their disease which clarifies their prognosis and may help in the management of this valvular lesion.

Methods

Population
All patients who were admitted to one of the clinics from 1952 through 1966 with clinical evidence of aortic regurgitation (with or without mitral disease) were included in this study. All
patients were referred from the Irvington House and Bellevue Hospitals at the end of an attack of rheumatic fever.

Most patients were examined at least every 2 months, regardless of their cardiac status. They had chest X-ray and ECG at least once a year. Patients with recurrences of rheumatic fever or bacterial endocarditis were treated either at Irvington House or at Bellevue Hospital by the same physicians who followed them in the clinic.

Fifty-one patients dropped out of the clinics. A full-time “case finder” (himself a dropout from the Irvington House Clinic) was hired to trace such patients. He sent letters asking them to fill out a questionnaire about their health and to return for a follow-up visit; he went to the homes of those who did not return the questionnaire. Some patients had moved and their new addresses were found through interviews with old neighbors, follow-up of welfare records, and correspondence with physicians, social workers, and probation officers who had had contacts with them. Five patients living in cities other than New York were examined by a local internist at our request; in all instances we obtained an interval history, a physical examination, a chest X-ray, and an ECG. One of the investigators reviewed the records of four patients followed in other New York clinics and obtained the same items of information.

Data were collected for each year of the patient’s stay in the clinic, transferred to code sheets, and punched on IBM cards. These data concerned: (a) clinical manifestations of the first attack of rheumatic fever and of any rheumatic recurrence or subacute bacterial endocarditis (SBE); (b) symptoms and signs suggesting congestive heart failure (CHF) and angina; (c) physical signs of cardiac disease, such as murmurs, thrills, and blood pressure; (d) abnormalities in the ECG and chest X-ray; (e) cardiotonic and diuretic therapy; (f) cardiac surgery; and (g) death.

Assessment and Interpretation of Clinical Data

Radiographic Interpretation

At least one set of chest X-rays (posteroanterior [PA] and laterals with barium swallow) was available in most instances for each year of follow-up. When more than one chest X-ray had been taken in a year the one with the greatest enlargement of the heart was chosen as representative of that year. X-rays were interpreted in chronologic order, without knowledge of concurrent clinical and electrocardiographic findings. Whenever more than one X-ray per year had been taken, however, the observers could not avoid suspecting that an acute illness had intervened, although they had no knowledge of its nature.

Two of the authors interpreted all the X-rays simultaneously and reached a consensus by mutual consultation. Criteria used for the interpretation were:

1. Left ventricular enlargement (LVE). LVE was graded as: (a) absent or questionable; (b) slight; (c) moderate; or (d) marked (since only eight patients had marked LVE initially, this group was added to the one of moderate LVE). The degree of LVE was determined on the basis of the roundness, elongation, and downward displacement of the left cardiac outline in the PA film. The overlapping of the spine by the posterior bulge of the left ventricle in the left anterior oblique position was considered a useful adjunct only in the determination of progressive changes in the left ventricular size in a series of films, and only when there was no evidence that variations in the position of the patients could account for the observed change. Figure 1 shows examples of slight, moderate, and marked LVE.

![Figure 1](http://circ.ahajournals.org/)

Examples of slight (left), moderate (middle), and marked (right) left ventricular enlargement.

_Circulation, Volume XLIV, September 1971_
(2) Left atrial enlargement (LAE). LAE was graded as: (a) absent; (b) slight; (c) moderate; or (d) marked. The degree of LAE was determined on the basis of the presence and the extent of the indentation of both anterior and posterior outlines of the barium-filled esophagus in the left lateral and right anterior oblique views, or a clearly defined double density in the PA film, or both.

Electrocardiographic Interpretation

All yearly ECG’s were interpreted in chronologic order by one observer, who was not aware of the concurrent clinical and radiologic findings. The following findings were considered abnormal: (1) the sum of S in V6 and R in V5 was 51 mm or more (referred to later as “high voltage”); (2) S-T-segment depressions in left ventricular leads; or (3) T-wave inversions in V6, aVF, and aVL. The latter two findings were considered only in patients not receiving digitalis. The duration of the intrinsicoid deflection was also measured, but was not used, because a preliminary analysis showed that it correlated poorly with the prognosis.

Auscultatory Interpretation

A blowing diastolic murmur at the aortic area or the left sternal border or both was considered evidence of aortic regurgitation (AR).

An apical systolic murmur of at least grade II intensity, blowing, high-pitched, loudest at the apex, and transmitted to the axilla was considered evidence of mitral regurgitation (MR).

Mitral stenosis was diagnosed when an apical diastolic murmur with presystolic accentuation was heard. When the diastolic pressure was less than 40 mm Hg an opening snap of the mitral valve was also required.

A harsh, loud, crescendo-decrescendo systolic murmur loudest at the base of the heart and radiating toward the neck, with a thrill, was considered evidence of aortic stenosis unless there was severe aortic regurgitation.

Assessment of Severity of Concomitant Aortic and Mitral Lesions in Patients with Congestive Heart Failure

Whenever a patient with both aortic and mitral lesions developed CHF, an attempt was made to determine the relative severity of each lesion. AR was considered severe when the murmur was grade III or greater, LVE moderate or marked, the systolic pressure greater than 140 mm Hg, and the diastolic pressure less than 40 mm Hg; slight, when the murmur was grade II or III, LVE absent or slight, and the blood pressure was normal.

MR was considered severe when the murmur was grade IV or louder, and LAE was marked; moderate, when the murmur was III or IV and LAE was moderate; slight, when the murmur was grade II or III and LAE was absent or slight. There were two patients who did not fit into these categories because they had a grade IV murmur without LAE; they were arbitrarily assigned to the slight MR category.

Congestive Heart Failure

All patients at each clinic visit were asked whether they had symptoms suggestive of CHF or angina. Throughout the years of follow-up the examining doctors had been instructed to note symptoms and signs suggestive of CHF, independently of their conclusion as to whether they represented CHF or not. These symptoms and signs were noted in the patients’ code sheets: exertional dyspnea, dyspnea at rest, paroxysmal nocturnal dyspnea, orthopnea, pulmonary edema, hepatomegaly, hepatic tenderness, and peripheral edema.

Early in the course of this study it became apparent that a critical interpretation of these signs and symptoms was needed. Specifically, four patients had persistent hepatic enlargement (without tenderness) in the absence of any other sign of CHF and heart disease. Three patients had exertional dyspnea, but only at the time of their anginal attacks; one patient had exertional dyspnea during the last months of her pregnancy. None of the above episodes was considered indicative of congestive failure. The charts were then reviewed again, and it was found that the examining physicians also had disregarded CHF in their interpretations of these episodes.

Angina

The examining doctors noted the characteristics of any chest pain reported to occur since the previous visit. On review, the pains described as a constriction or pressure behind the sternum, sometimes radiating to the upper limits, and provoked by exertion or occurring during sleep were considered evidence of angina.

Surgical Correction of the Aortic Valve

Nine patients underwent surgery for correction of the aortic lesion. All of them had been in CHF prior to the operation. Therefore, cardiac surgery in the present series affected the course of the disease subsequent to the appearance of CHF, not prior to it.
Statistical Methods

In order to determine prognosis of groups of patients we used "survival curves" with death, congestive failure, and angina as end points. Whenever these events coincided with a rheumatic recurrence or with bacterial endocarditis, they were disregarded, because they were considered dependent not only on the extent of the preexisting heart disease, but, of course, also on random variations in the severity of the recurrence, promptness of treatment, and occurrence of embolization. We chose angina and congestive failure as prognostic end points, in addition to death, because it is widely accepted that their occurrence in a patient with aortic regurgitation usually indicates a grave prognosis, and is sufficient indication for cardiac surgery. The "survival curve" indicates the percentage of patients in each group who did not have the event under study (death, CHF, or angina) up to and including the noted year of follow-up. In addition, the number of patients in each group entering each year of follow-up is shown. The reader, therefore, can judge by himself the point at which the size of the sample becomes too small for valid inferences.

Any patient who suffered the event under study (death, CHF, or angina) was taken irreversibly out of the group, not only in the obvious case of death, but also in the case of CHF or angina. Each episode of CHF and angina, therefore, is a new event in a patient who did not have it before.

In addition to determining the prognosis of patients grouped according to single clinical features present at the end of the index attack, we also determined the year-by-year prognosis of patients in two selected groups: a low-risk group, comprising patients with no cardiomegaly, no ECG abnormality, and normal blood pressure (systolic not above 140 and diastolic not below 40 mm Hg), and a high-risk group, comprising patients who had (a) moderate or marked left ventricular enlargement, (b) two or three major electrocardiographic abnormalities, and (c) abnormal blood pressure (either a systolic pressure above 40 mm Hg, or a diastolic pressure below 40 mm Hg, or both). These groups were "cumulative" in that each patient entered his group whenever he became eligible (including, of course, those who were eligible at the end of their index attack), and his follow-up started from that point. A patient remained in his group unless during subsequent years he satisfied the requirements for entry into the other group, at which time he was transferred.

We also determined the year-by-year prognosis of a third group of patients—those who were never “low-risk” or “high-risk.” Their clinical status ranged from patients with mild abnormalities (slight LVE only, for instance) to patients with two of the three high-risk criteria (a patient with moderate LVE and abnormal blood pressure, for instance). This group will be referred to as the “intermediate risk group.”

Three patients could not be classified into any of the three risk groups because their X-ray films had been lost. Two patients were considered twice because they moved from the low-risk to the high-risk group. The total number of patients included in the three risk groups, therefore, is 173 (174 − 3 + 2 = 173).

Results

Of the initial 174 patients admitted to the study, 107 continued to attend the clinics throughout the period of this study; an additional 15 died (three of them after surgical correction of their aortic disease and one during an episode of subacute bacterial endocarditis; these four patients are not included as deaths in the life-table computation of survival rates). The remaining 52 dropped out of the clinics. Thirty-six of these returned for a follow-up visit; nine left New York, but sent us information about their state of health in 1966; seven left the clinic and could not be contacted. Therefore, we obtained information on the life or death of the patients in 96% (167/174) of the total population. Complete data (physical examination, ECG, and X-rays) were available in 93% (161/174). Additional general information is summarized in table 1.

Persistence of Aortic Regurgitation and Mitral Regurgitation

Figure 2 shows the percentage (on the total number of patients for that year; see table 1) of patients who had aortic regurgitation only, aortic and mitral regurgitation, mitral regurgitation only, and no valvular disease at the end of 1, 5, 10, and 15 years after the index attack of rheumatic fever. (All the 13 patients with mitral or aortic stenosis had associated regurgitant lesions and were distributed according to the latter. As expected, the stenotic lesions tended to appear late in the course of the follow-up.)

As shown in figure 2 the percentage of patients with only aortic regurgitation increased from 20% in the first year to 86% in the
Table 1
Number of Years of Follow-up from Index Attack

<table>
<thead>
<tr>
<th>Years follow-up</th>
<th>No. of patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>174</td>
</tr>
<tr>
<td>2</td>
<td>174</td>
</tr>
<tr>
<td>3</td>
<td>170</td>
</tr>
<tr>
<td>4</td>
<td>164</td>
</tr>
<tr>
<td>5</td>
<td>156</td>
</tr>
<tr>
<td>6</td>
<td>146</td>
</tr>
<tr>
<td>7</td>
<td>133</td>
</tr>
<tr>
<td>8</td>
<td>118</td>
</tr>
<tr>
<td>9</td>
<td>104</td>
</tr>
<tr>
<td>10</td>
<td>90</td>
</tr>
<tr>
<td>11</td>
<td>82</td>
</tr>
<tr>
<td>12</td>
<td>73</td>
</tr>
<tr>
<td>13</td>
<td>66</td>
</tr>
<tr>
<td>14</td>
<td>47</td>
</tr>
<tr>
<td>15</td>
<td>20</td>
</tr>
</tbody>
</table>

Total number of patients = 174 (124 men, 50 women; 153 from Irvington House, 21 from Bellevue Clinic).

Index attack (first attack), 133 patients; index attack (recurrence), 41 patients.

Average age at index attack, 11 years (range, 5–22).

Figure 2

Persistence of valvular lesions. AR = aortic regurgitation; MR = mitral regurgitation.

fifteenth year. The percentage of patients with combined lesions decreased from 49% to 7%. The percentage of patients with only mitral regurgitation decreased from 21% to 0. The percentage of patients with no valvular lesions changed little over the years.

Prognosis According to Single Criteria Present at the End of the Index Attack

Figures 3 to 11 show survival curves for the three end points (death, CHF, and angina) according to each clinical criterion present at the end of the index attack. Thus, figures 3, 4, and 5 show survival according to presence and severity of LVE, blood pressure abnormalities, and ECG abnormalities; figures 6, 7, and 8 show absence of CHF according to the same criteria; and figures 9, 10, and 11 show absence of angina according to the same criteria.

The curves confirm the expected (i.e., worse prognosis in those with an initial abnormality), but do not refine the prognosis sufficiently for present-day needs. It will be noted that death, CHF, and angina did not occur in a large percentage of patients with an initial abnormality; and that death, CHF, and angina occurred also in patients without an initial abnormality. This type of analysis was therefore supplemented by the following.

Survival According to Presence and Degree of Left Ventricular Enlargement (LVE) at the End of Index Attack.

Figure 3

Survival according to presence and degree of left ventricular enlargement (LVE) at the end of index attack.
Survival according to blood pressure determinations taken at the end of the index attack. Syst. = systolic pressure; Diast. = diastolic pressure.

**Figure 4**

Prognosis of Cumulative High-Risk and Cumulative Low-Risk Groups

Unlike the preceding figures which showed the prognosis of patients according to the clinical features considered individually and at the time of admission to the study, figures 12 to 15 show the year-by-year prognosis of patients who had a combination of clinical features (low-risk or high-risk) either on admission or acquired later. Although it might have been more desirable to determine the

**Figure 5**

Survival according to number of electrocardiographic abnormalities (ABN.) (high voltage, ST-changes, and T-wave inversions) present at the end of the index attack.

*Circulation, Volume XLIV, September 1971*

Absence of congestive heart failure according to presence and degree of left ventricular enlargement at the end of the index attack.

**Figure 6**

Absence of congestive heart failure and blood pressure determinations taken at the end of the index attack.

**Figure 7**

Absence of congestive heart failure according to blood pressure determinations taken at the end of the index attack.
Absence of congestive heart failure according to number of electrocardiographic abnormalities (high voltage, ST-changes, and T-wave inversions) present at the end of the index attack.

Absence of angina according to presence and degree of left ventricular enlargement at the end of the index attack.

initial five, three died within 4 years, and another had CHF after 1 year.
RHEUMATIC AORTIC REGURGITATION

Survival in selected groups (low-risk, CLR, and high-risk, CHR).

Absence of congestive heart failure in selected groups (low-risk and high-risk).

Absence of angina in selected groups (low-risk and high-risk).

fall of the survival curve within the first 3 years. Seven patients died; in four of them death was sudden and unexpected. In the other three it occurred after the onset of CHF.

In the cumulative low-risk group (72 patients) only one patient died, and this patient had acquired two of the three risk factors prior to death. Thus, no deaths occurred in patients who remained free of all three risk factors.

Congestive Heart Failure in the Absence of a Recurrence or Subacute Bacterial Endocarditis

Ten of the 31 patients in the high-risk group developed CHF; again, as for deaths, most episodes occurred within the first 3 years (fig. 13).

Of the 31 patients in the high-risk group only one had an episode of CHF before he acquired all three factors. All other patients who became symptomatic in the absence of recurrences or subacute bacterial endocarditis did so in the same year they joined the high-risk group or afterward. There was, therefore,
Survival, absence of congestive heart failure, and angina in selected groups (low-risk and high-risk).

A clear pattern of symptoms appearing for the first time after the acquisition of all three factors.

Three of the 72 patients in the low-risk group developed CHF. One of these patients had severe mitral stenosis which by itself accounted for the CHF; the other two patients had acquired two of the three risk factors by the time they developed CHF.

Angina in the Absence of a Recurrence or Subacute Bacterial Endocarditis

Figure 14 closely resembles figure 13, and the same comments apply. The one patient in the low-risk group who had angina was the same one who had severe mitral stenosis and CHF.

Death, Congestive Heart Failure, or Angina in the Absence of a Recurrence or Subacute Bacterial Endocarditis

Because CHF and angina are thought to mark the beginning of a rapidly downhill course, their appearance is considered sufficient indication for surgical repair. We thought it useful, therefore, to determine the chances of these patients to reach either one of the three end points: death, CHF, or angina (fig. 15). Twenty-two of the 31 patients in the high-risk group reached at least one of them. By the sixth year only 13% of the patients had not died, and had not had an episode of CHF or angina. These untoward events, again, occurred early: of the 31 patients initially at risk, 10 had reached one of the end points within the first year of follow-up and 18, within the first 3 years. Four of the 72 patients in the low-risk group reached one of the end points.

Correlation of Prognosis with Selected Parameters Among High-Risk Patients

As noted earlier, high-risk patients, by definition, had (a) moderate or marked LVE; (b) either a systolic blood pressure greater than 140 mm Hg, or a diastolic blood pressure less than 40 mm Hg, or both; and (c) two or three ECG abnormalities. Some of these parameters, however, may be associated with death more often than others.

Table 2 shows the correlation of prognosis with the severity of abnormality of blood pressure in the 31 patients of the high-risk group. There were 11 patients who had an abnormality of the systolic or the diastolic pressure, but not of both. One of them died, three had CHF, one had angina, and six reached none of these end points. Conversely, of the 20 patients with abnormalities of both the systolic and the diastolic blood pressures, six died, seven had CHF, four had angina, and only three escaped all of these end points.

A breakdown according to type and number of ECG abnormalities showed a less clear-cut correlation. The presence of all three abnormalities had a worse prognosis than the presence of any two; the combination of high voltage and T-wave inversion was accompanied by death more frequently than other combinations, but the numbers were too small for valid conclusions.

Circulation, Volume XLIV, September 1971
The worst combination of signs in asymptomatic patients was: (1) moderate or severe LVE; (2) systolic blood pressure greater than 140 and diastolic less than 40 mm Hg; and (3) all three ECG abnormalities. There were nine patients with this combination: four died, three had CHF, and the remaining two had angina.

**Prognosis of Patients in the Intermediate Risk Group**

Seventy-one patients did not fulfill the criteria for entering either the high-risk or the low-risk groups. As mentioned earlier, patients in this group differed greatly in the extent of abnormalities they had at the time of admission to the study, and could not be considered as a single group. We subdivided them according to the presence or absence of abnormal blood pressure at the time of admission to the clinic.

Table 3 shows the occurrence of death, or CHF, or angina according to this subdivision. Thirty-five patients had abnormal blood pressure and one other abnormal parameter (either LVE or ECG abnormalities); one of them died, suddenly and unexpectedly. Three more patients in this group had CHF or angina. Of the 10 patients with abnormal blood pressure only, one died, suddenly and unexpectedly. Of the 26 who initially had normal blood pressure, the one who died had severe mitral regurgitation. The one episode of angina occurred in a patient who complained frequently of several kinds of "pains," one of which fulfilled our criteria for anginal pain.

In summary, therefore, among the 45 patients with abnormal blood pressure (but not in the high-risk group) there were two deaths, both sudden (4.4% incidence of sudden death during a median follow-up of approximately 10 years). Among the 26 patients with normal blood pressure, one died, most likely because of an associated mitral lesion.

**Follow-up of Patients with Congestive Heart Failure**

Nineteen patients had congestive failure at least once. The fate of these patients is summarized in table 4. Of the 11 patients who had severe AR only (eight) or mild or

### Table 2

<table>
<thead>
<tr>
<th>Blood pressure (mm Hg)</th>
<th>No. of patients</th>
<th>Prognosis</th>
<th>Death</th>
<th>CHF only</th>
<th>Angina only</th>
<th>Neither death nor CHF nor angina</th>
</tr>
</thead>
<tbody>
<tr>
<td>Either systolic &gt;140 or diastolic &lt;40</td>
<td>11</td>
<td></td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Both systolic &gt;140 and diastolic &lt;40</td>
<td>20</td>
<td></td>
<td>6*</td>
<td>7</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>31</td>
<td></td>
<td>7</td>
<td>10</td>
<td>5</td>
<td>9</td>
</tr>
</tbody>
</table>

*In three patients death was preceded by CHF.

### Table 3

**Death, Congestive Heart Failure, and Angina in the Intermediate Risk Group**

<table>
<thead>
<tr>
<th></th>
<th>No. of patients</th>
<th>Death</th>
<th>CHF only</th>
<th>Angina only</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abnormal blood pressure and one other high-risk factor</td>
<td>35</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Abnormal blood pressure alone</td>
<td>10</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Normal blood pressure</td>
<td>26</td>
<td>1*</td>
<td>0</td>
<td>1†</td>
</tr>
<tr>
<td>Total</td>
<td>71</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

*This patient had severe mitral regurgitation and developed abnormal blood pressure by the time of his death. He died after several years of CHF.
†Angina in this patient was doubtful (see text).
moderate MR (three), five died and four were operated upon. Another has had persistent CHF, quite well controlled medically, for 7 years. Of the seven patients with severe AR and MR, two died and five were operated on. The one patient with severe MS and moderate AR (the only patient with severe MS in the series) was operated upon. Most of the patients who died went into CHF before aortic valve surgery became available with an acceptable risk.

**Discussion**

The option of replacing the deformed aortic valve with a prosthesis puts a premium on detailed knowledge of the natural history of aortic regurgitation. The replacement is effective but risky; only those patients who are at a great risk of dying of their disease should be advised to undergo surgery.

Traditional long-term follow-ups determine the prognosis of patients with rheumatic heart disease according to physical signs, X-ray, and ECG findings present at the end of the acute attack. In this study figures 3 to 11 show the prognosis of patients along this line.

Other studies have reconstructed the prognosis of patients with severe rheumatic heart disease from a retrospective analysis of the clinical course of patients referred to cardiac clinics for surgical evaluation—a selected population. Thus, in one study\(^2\) patients with severe aortic regurgitation and, in most instances, CHF were found to survive for several years after the onset of CHF; but

patients who died suddenly and unexpectedly were perforce not considered, nor were patients who died shortly after their episode of failure.

To be useful for selection of patients for surgery, therefore, a study on prognosis must include most of the patients at risk, and should take into account year-by-year changes in clinical status. Both requirements are met by this study. On the other hand, consideration of events (CHF, angina, or death) due to a recurrence of rheumatic fever or to bacterial endocarditis might obscure, by their randomness, the relation of clinical status to subsequent course. Fifty-five patients in the present series had one or more recurrences of rheumatic fever or an episode of bacterial endocarditis (unpublished data); some of these episodes were associated with CHF or angina and one, with death. Because of the above considerations, these events were excluded from the present analysis.

It is widely agreed that patients with symptomatic aortic regurgitation (i.e., with CHF or angina) should be operated upon because of their poor prognosis. In one series\(^3\) 13 of the 14 patients with congestive failure died within 2 years. This is confirmed by our follow-up of patients who developed CHF. Of 19 such patients, seven died (mostly in presurgical days) and 10 were operated upon. Clearly for these patients the risk of surgery, high as it is at present, is less than the risk of conservative treatment.

---

**Table 4**

<table>
<thead>
<tr>
<th>Type of lesion</th>
<th>No. of patients</th>
<th>Deaths</th>
<th>Persistent CHF</th>
<th>Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severe AR only</td>
<td>8</td>
<td>3</td>
<td>1*</td>
<td>4</td>
</tr>
<tr>
<td>Severe AR; mild or moderate MR</td>
<td>3</td>
<td>2</td>
<td>1†</td>
<td>0</td>
</tr>
<tr>
<td>Severe AR; severe MR</td>
<td>7</td>
<td>2</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Severe MS; moderate AR</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1‡</td>
</tr>
<tr>
<td>Total</td>
<td>19</td>
<td>7</td>
<td>2</td>
<td>10</td>
</tr>
</tbody>
</table>

Abbreviations: AR = a trial regurgitation; MR = mitral regurgitation; MS = mitral stenosis.


†Extreme obesity discouraged surgery.

‡Mitr al commissurotomy only.
If one can predict which patients will become symptomatic or die suddenly, then it might be desirable to operate on them before those events, not only in the obvious instance of death, but also if the event is CHF or angina. Further myocardial deterioration may be prevented, and the operative mortality may therefore be lowered.3

The data presented show that a chest X-ray, an ECG, and a blood pressure determination are sufficient for a fairly accurate prognosis in young persons with rheumatic aortic regurgitation. Figure 15 shows that patients in the high-risk group (with the triad of moderate or marked LVE, abnormal blood pressure, and two or three electrocardiographic abnormalities) had such a poor prognosis that 87% of them either died or developed symptoms within 6 years from the time they fulfilled the “high-risk” criteria. The deterioration was particularly rapid within the first 3 years. Even mortality was high, 29% within 6 years (fig. 12). Further analysis (table 2) showed that within this high-risk group patients with both a high systolic and a low diastolic pressure had the poorest prognosis. All patients in the high-risk group (and particularly those with both high systolic and low diastolic pressures) should therefore be considered for surgery even if asymptomatic. The decision, of course, should be influenced also by the operative risks at each particular medical center and by the availability of skillful follow-up care.

At the other end of the clinical spectrum, low-risk patients (no LVE, normal blood pressure, and normal ECG) have a very small risk of dying or of becoming symptomatic; in fact, the few who did either, had developed one or two risk factors by that time. These patients, therefore, can be realistically reassured and should not be considered for valve replacement.

Of the 71 patients in the intermediate risk group, 45 had abnormal blood pressure, indicative of a hemodynamically significant lesion. Both deaths in this group were sudden, and three more patients developed CHF or definite angina. Patients in this group, therefore, had a 4.4% chance of dying suddenly and 6.6% chance of developing symptoms (within approximately 10 years). Clearly their outlook is not sufficiently bleak to risk the short- and long-term hazards of surgery at the present time.

Patients with aortic regurgitation at the end of a rheumatic fever attack are very likely to retain this valvular deformity, even though a concomitant mitral lesion may disappear (fig. 2). This finding is consistent with a previous one that patients with residual heart disease at the end of the attack are quite likely to lose it if they have mitral regurgitation only, but not if they have aortic valve disease.6

The present study has not taken into consideration the results of cardiac catheterization and angiography, even though both were performed in the patients who were operated on. These procedures are useful for determination of the degree of the lesion and especially the presence of associated lesions, so that they continue to be necessary presurgical procedures. The data that cardiac catheterization and angiography provide could also be useful for prognosis if a large number of unselected patients underwent these procedures and were then followed for years without surgery. To our knowledge this has not been done, nor is it likely that it will be done in the near future because the cost, discomfort, and risk entailed by these procedures effectively limit their use to presurgical and postsurgical evaluation. The information provided by this study, therefore, is of a different kind from that currently available from hemodynamic studies, and cannot be substituted by them.

References


Natural History of Rheumatic Aortic Regurgitation: Criteria Predictive of Death, Congestive Heart Failure, and Angina in Young Patients
MARIO SPAGNUOLO, HOWARD KLOTH, ANGELO TARANTA, EUGENIE DOYLE and BERNARD PASTERNACK

Circulation. 1971;44:368-380
doi: 10.1161/01.CIR.44.3.368

The online version of this article, along with updated information and services, is located on the World Wide Web at:
http://circ.ahajournals.org/content/44/3/368

Permissions: Requests for permissions to reproduce figures, tables, or portions of articles originally published in Circulation can be obtained via RightsLink, a service of the Copyright Clearance Center, not the Editorial Office. Once the online version of the published article for which permission is being requested is located, click Request Permissions in the middle column of the Web page under Services. Further information about this process is available in the Permissions and Rights Question and Answer document.

Reprints: Information about reprints can be found online at:
http://www.lww.com/reprints

Subscriptions: Information about subscribing to Circulation is online at:
http://circ.ahajournals.org//subscriptions/