The Risk of the Development of Aortic Stenosis in Patients With “Benign” Aortic Valve Thickening

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**Background:** Aortic valve thickening (AVT) without aortic stenosis (AS) is common and was often considered benign. However, it has recently been found to be associated with increased morbidity and mortality. It is unknown whether patients with AVT are at risk for the development of AS.

**Methods:** Our echocardiography database from 1987 to 1993 was searched for cases of AVT with at least 1 year of echocardiographic follow-up. The risk of the development of AS was compared in patients with and without AVT.

**Results:** There were 2131 patients with AVT and at least 1 year of echocardiographic follow-up. Aortic stenosis developed in 338 patients (15.9%) (mild, 10.5%; moderate, 2.9%; and severe, 2.5%). Multivariate analysis, including age, left ventricular hypertrophy, and mitral annular calcification, revealed that only mitral annular calcification was independently and significantly associated with progression to AS.

**Conclusions:** Aortic valve thickening without stenosis is common, and it may progress to significant AS. It is possible that this development of AS may be responsible for some of the increased morbidity and mortality in patients with AVT.

Arch Intern Med. 2002;162:2345-2347
Over the 6-year period from 1987 to 1993, we found 2131 patients with AVT and at least 1 year of echocardiographic follow-up. These patients made up the study group. Aortic stenosis of any degree developed in 338 patients (15.9%) with AVT. This was a significantly higher incidence of AS than we found in the subjects with normal valves (without AVT), among whom just 1 patient (1%; \( P < .001 \)) developed only mild AS (Figure 1). These 2 groups were matched for age (69.3 years vs 69.7 years) and time of follow-up (7.3 years vs 7.4 years).

Mild AS developed in 223 patients (10.5%) with AVT; moderate AS developed in 61 patients (2.9%); and severe AS developed in 54 patients (2.5%). The mean ± SD time to follow-up of the 115 patients with AVT who developed moderate or severe AS was 7.4 ± 2.4 years, and this follow-up time was matched to that of the patients with AVT who did not develop any AS (7.4 ± 2.3 years, \( P = .84 \)). The 2 groups were compared and the findings are presented in the Table. The years at which moderate and severe AS developed are shown in Figure 2 and Figure 3. The largest number of patients who developed moderate AS were observed to do so at 6 years; severe AS was observed most often with 2 more years of follow-up (ie, at 8 years).

There was no significant difference in sex between the 115 patients and the 115 controls: 66 (57%) male vs 70 (61%) male (\( P = .60 \)). There was a trend toward older age in the patients compared with the controls (70.8 ± 7.8 [mean ± SD] years vs 68.6 ± 10.9 years), but it was not statistically significant (\( P = .08 \)). Mitral annular calcification was found in significantly more patients (those with AVT who developed AS) than controls (AVT with no development of AS): 42 (36.5%) vs 22 (19.1%) (\( P = .003 \)). Left ventricular hypertrophy was also found in significantly more patients than controls: 40 (34.8%) vs 24 (20.9%) (\( P = .02 \)). Moderate or severe mitral regurgitation was found in 16 patients (13.9%) and 18 controls (15.6%) (\( P = .71 \)). Decreased left ventricular function was found in 10 patients (8.7%) and 8 controls (6.9%) (\( P = .62 \)).

Multivariate analysis using a model that included age, MAC, and LVH revealed that only MAC (\( P = .02 \)) was significantly and independently associated with a progression from AVT to significant AS when age and LVH were controlled for. Age (\( P = .44 \)) and LVH (\( P = .10 \)) were not independently associated with progression of AVT to AS.

Although usually thought of as a common, benign valvular condition, AVT has been shown by 3 independent

### Table

<table>
<thead>
<tr>
<th>Patients (n = 115)</th>
<th>Controls (n = 115)</th>
<th>( P ) Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean ± SD, y</td>
<td>70.8 ± 7.8</td>
<td>68.6 ± 10.9</td>
</tr>
<tr>
<td>Male sex</td>
<td>66 (57.0)</td>
<td>70 (61.0)</td>
</tr>
<tr>
<td>MAC</td>
<td>42 (36.5)</td>
<td>22 (19.1)</td>
</tr>
<tr>
<td>MR</td>
<td>16 (13.9)</td>
<td>18 (15.6)</td>
</tr>
<tr>
<td>Low EF</td>
<td>10 (8.7)</td>
<td>8 (6.9)</td>
</tr>
</tbody>
</table>

*AVT indicates aortic valve thickening; AS, aortic stenosis; MAC, mitral annular calcification; LVH, left ventricular hypertrophy; MR, mitral regurgitation; and EF, ejection fraction. Values other than age are given as number (percentage).
investigations to be associated with increased morbidity and mortality. In a study by Otto et al, there was a 50% increase in the risk of cardiovascular mortality and myocardial infarction in patients with AVT.

Exactly how AVT influences cardiovascular morbidity and mortality has not been determined. Aortic valve thickening has been associated with risk factors for cardiovascular disease, such as increasing age, male sex, smoking, hypertension, hypercholesterolemia, diabetes mellitus, increased levels of lipoprotein(a), and reduced levels of high-density lipoprotein. These associations may partially explain the increased risk for cardiovascular disease in patients with AVT.

We have found that AVT may develop in a significant number of patients with AVT. Although we did not have natural history data available, it is possible that the development of AVT may also be an important element in the increased cardiovascular morbidity and mortality. Aortic stenosis and AVT appear to represent different stages in a continuum of aortic valve disease.

Predictors of the progression of established AS have been identified: age, coronary artery disease, left ventricular dysfunction, left ventricular wall thickness, valvular calcification, mitral regurgitation, and worsening symptoms. However, the factors that may predict the progression of AVT to AS are unknown. We analyzed some of the factors that are known to predict the progression of established AS to determine whether they may also serve to predict the progression of AVT to AS. On univariate analysis, the development of AS from AVT was associated with LVH and MAC, and there was a trend for an association with age. A similar association was not demonstrated for left ventricular dysfunction or mitral regurgitation. However, our multivariate analysis model revealed only MAC, not age or LVH, as independently predictive of progression to AS.

The process of aortic valve calcification has similarities to that of atherosclerosis. Therefore, calcification of the aortic valve and coronary arteries as well as of the mitral annulus may represent a unified process of inflammation and/or degeneration, and the association of the progression of AVT to AS with MAC may be a manifestation of this process. Although further investigation is needed to firmly link the pathogenesis of these entities, the presence of a common pathway of tissue injury leading to sclerosis and calcification would imply that calcific aortic valve disease is an active process that might be modified by treating associated risk factors.

The major limitation of this study was its retrospective nature. Because all of our patients were referred to the echocardiography laboratory for various indications, this is a source of bias. Furthermore, we were limited to the examination of available follow-up echocardiograms, and therefore could not identify the exact time at which AS developed. There is also selection bias in the referral of patients for echocardiographic follow-up, and patients who developed AS may have been more likely to have been referred for echocardiographic follow-up. However, the large size of the population studied would tend to offset some of these limitations.

Gradient, rather than valve area, was used to grade the severity of AS. Therefore, some patients may have developed more or less severe AS than the degree reported. However, the low prevalence of left ventricular dysfunction and the large number of patients both offset this limitation.

We do not have other clinical information about these patients, such as their history of risk factors for, or clinical manifestations of, atherosclerosis. We also do not have information about subsequent morbidity and mortality, which have been previously evaluated by others.

CONCLUSIONS

Aortic valve thickening is a common echocardiographic finding, and it may progress to hemodynamically significant AS. The presence of MAC may serve to predict which patients with AVT are at risk of developing AS. A prospective study of the progression of AVT to AS would be important.

It remains to be seen whether or not the development of AS is responsible for part of the increase in complications seen in patients with AVT. Further investigation may focus on the duration of time between the appearance of AVT and the development of AS. Finally, the possible impact of risk factor modification (to reduce the risk of AS) on the large numbers of patients with AVT is a question for future study.

Accepted for publication April 3, 2002.

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REFERENCES