The Use of Metaraminol in the Evaluation of Mitral Insufficiency*,**

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This paper presents a simple technique which is useful in evaluating the degree of mitral insufficiency. The pulmonary capillary peak V pressures before and after the intravenous injection of 1 mg of metaraminol were studied by right and left heart catheterization in 61 patients. The presence of an increase in the V-wave over 10 mm Hg indicated mitral insufficiency in all patients if a cardiomyopathy was excluded. If the left atrium is enlarged, a small degree of insufficiency is likely to be missed, but when the insufficiency is marked, the size of the atrium and its increased compliance is not so likely to attenuate the peaked V-wave. The absence of a rise, however, may be seen in patients with all combinations of insufficiency and left atrial enlargement.

Left atrial pressure abnormalities are expected and often found in mitral valve incompetence. The presence of normal pressures in a large number of patients with grossly insufficient valves has led to the use of pressor amines to “bring out” abnormalities in the left atrial pressure curve. When peripheral resistance is increased, the left ventricular systolic pressure rises, and the tendency for blood to regurgitate across an incompetent valve would be expected to alter the left atrial pressure accordingly. Data supporting this view have been presented by Elliaish and co-workers,8 Braunwald and associates,9 and Stanfield and Yu using metaraminol, levarterenol, and methoxamine, respectively.

This study was undertaken to evaluate further this approach to the detection of mitral valve insufficiency and to determine if the size of the left atrium would predictably alter the significance of this finding. One would expect the more distensible giant left atrium to “dampen” the higher pressures resulting from the insufficiency jet, as described by Liu and others.8 If one could reliably predict the presence or absence of mitral insufficiency from pulmonary capillary wedge pressure, many patients might be spared the more dangerous and often expensive left ventricular angiogram.

Material and Method

This study included 61 patients in whom right and left heart catheterizations revealed different degrees of mitral incompetence. Their ages ranged from 9 to 71 years.

Right and left heart catheterization was done in the usual manner. The left ventricular pressures and cineangiograms were obtained by the retrograde approach across the valve. Simultaneous left ventricular and pulmonary artery wedge pressures were recorded with equisensitive transducers (Statham p23D). After control pressures were recorded, 1 mg of metaraminol was injected through the right heart catheter and a second recording was made at the time that left ventricular pressure was seen to increase 20 mm or more, usually within 5 to 30 seconds. When respiratory variations in the pressure curves were present, the averages were recorded from several maximum and minimum complexes.

The cineangiograms of the left ventricle were recorded in the right anterior oblique with 75 percent diatrizoate (Hypaque) on 35 mm film taken at 60 frames per second. They were classified in four groups according to the degree of mitral insufficiency present as estimated by the left ventricular cineangiograms and further subdivided as to the size of the left atrium.

Group 1 consisted of 19 patients with no mitral insufficiency, some of whom had other cardiac lesions. Group 2 included 16 patients with a mild degree of mitral insufficiency (plus 1). Six of these had a confirmation of their mitral insufficiency at surgery. Group 3 was composed of 18 patients with a moderate degree of mitral insufficiency (plus 2), with six being confirmed at surgery. Group 4 included eight patients with a severe degree of mitral insufficiency (plus 3). Two were confirmed at cardiac surgery.

The size of the left atrium was estimated by evaluation of chest roentgenograms from different views and also

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METARAMINOL IN EVALUATION OF MITRAL INSUFFICIENCY

Table 1—Mean increase in pulmonary capillary peak V pressure after metaraminol in four groups of patients with different sizes of left atria. Note that the mean V wave elevation is greater in patients with a small left atrium when the insufficiency is only plus one. However, the opposite obtains in those with a significant insufficiency.

<table>
<thead>
<tr>
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<th>Mean Increase in V-Wave Amplitude (mm. Hg.)</th>
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<tr>
<td></td>
<td>NORMAL L.A.</td>
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<tr>
<td>Group 1</td>
<td>6</td>
</tr>
<tr>
<td>Group 2</td>
<td>10.8</td>
</tr>
<tr>
<td>Group 3</td>
<td>0</td>
</tr>
<tr>
<td>Group 4</td>
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(Group 1 = no mitral insufficiency)
(Group 2 = plus 1 or mild mitral insufficiency)
(Group 3 = plus 2 or moderate mitral insufficiency)
(Group 4 = plus 3 or severe mitral insufficiency)

by observing its opacification during the cineangiographic studies. They were arbitrarily called normal, medium-sized and giant left atria.

RESULTS

An increase in the amplitude of the V-wave higher than the control by 10 mm was roughly correlated with the degree of mitral insufficiency as can be seen in Table 1.

Those patients with a normal valve all had less than this much increase except the two who had cardiomyopathy (Fig 1). In the group with mild mitral insufficiency (group 2) only six responded with a characteristic rise in the V-wave; the other ten were negative. In group 3 with moderate or plus 2 insufficiency, ten (55 percent) were positive and in group 4 with severe disease, five (62.5 percent) of the eight were positive. It is clearly evident that the absence of this response is common in patients with all degrees of mitral insufficiency, but the presence of this sign is only seen with mitral insufficiency if cardiomyopathy is excluded.

When the size of the left atrium is enlarged in those with minimal mitral insufficiency (group 2) the response to metaraminol (Aramine) decreases. Eight of the 18 patients had left atrial enlargement and only three of this group could be recognized by a rise in pressure. In groups 3 and 4 there were no normal-sized left atria and the degree of enlargement was not well correlated with the rise in pressure nor was there a significant inverse relationship.

It would appear, then, that with a small insufficiency jet a larger left atrium may mask the positive response to this maneuver, and while this may also be true in patients with a major degree of insufficiency, we were unable to document this in our material.

The relationship between left atrial size and the degree of mitral insufficiency is shown in Figure 2. A normal left atrial size is present in 78.9 percent

Figure 1. Metaraminol potentiated pulmonary capillary V waves in four groups of patients. (Group 1, no mitral insufficiency; group 2, plus 1 or mild mitral insufficiency; group 3, plus 2 or moderate mitral insufficiency; group 4, plus 3 or severe mitral insufficiency.) There is a trend of augmenting the peak V-wave amplitude following metaraminol with increasing degrees of mitral insufficiency.

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Figure 2. Correlation of left atrial sizes in the four groups of patients with the degree of mitral insufficiency. Groups 1 and 2 revealed predominantly normal-sized left atria while groups 3 and 4 revealed predominantly moderate to very large left atria, respectively.
of the patients in group 1 with no mitral insufficiency. An enlarged left atrium is present in all patients in groups 3 and 4. A moderately enlarged left atrium is found in 21.1 percent of the patients in group 1, 31.3 percent in group 2, 78 percent in group 3 and 37.5 percent in group 4. A very large left atrium is present in 18.7 percent of group 2, 22 percent in group 3 and 62.5 percent in group 4.

The average change in pulmonary capillary peak V pressures after metaraminol in each group of patients with different left atrial sizes is shown in Table 1. In groups 1 and 2 there is a gradual decrease in the average change in pulmonary capillary peak V pressures after metaraminol as the left atrium becomes larger; whereas, in groups 3 and 4 the changes are the opposite of the changes in groups 1 and 2; that is, the average change in pulmonary capillary peak V pressure is increasing as the left atrial size becomes larger. This indicates that as the left atrium becomes larger, a small insufficiency jet causes less and less effect. However, when the insufficiency is of considerable magnitude, the tall V-waves are brought out by the metaraminol in spite of a very large left atrium.

DISCUSSION

In the past decade many investigators have studied the relationship of the left atrial pressure to mitral insufficiency. Braunwald and Awe have described a group of patients in whom a considerable degree of mitral insufficiency was associated with normal pressures in the left atrium. All of these patients had long standing mitral valve disease. The discrepancy between left atrial size and pressure was reported to be related to the disturbance in the compliance of the left atrial wall. The fact that Roberts, Braunwald and Morrow and Gould and Lyon described normal left atrial size in the presence of acute mitral insufficiency after bacterial endocarditis suggests that the size of the left atrium is probably partly related to the duration of the lesion. The studies done by Sauter and co-workers have shown no definite correlation between left atrial volume and left atrial pressures in patients with mitral insufficiency.

Many investigators have suggested different mathematical computations and other diagnostic criteria for evaluating the severity of mitral valve disease from left atrial pressures. Among them are Libanoff and Rodbard, Sandler and associates, Morch and co-workers, Morrow, Braunwald, Haller and Sharp, Korner and Shillingford and Novack and co-workers. Most of these investigators do not take into consideration left atrial size and compliance, which probably explains some of their inaccuracies.

Pressure Response after Injection of Metaraminol

Metaraminol, by increasing peripheral resistance would be expected to increase left ventricular systolic pressure and thereby augment the degree of mitral insufficiency, if present. Figure 3 demonstrates the absence of pulmonary capillary V-wave augmentation following metaraminol in an individual having no evidence of mitral insufficiency. Figure 4 demonstrates the effect of metaraminol in augmenting V-wave amplitude in an individual having a moderate degree of mitral insufficiency. As the degree of mitral insufficiency increases, the postmetaraminol augmentation of V-wave amplitude likewise increases as shown in Figure 5. The results of this study are similar to those described by Braunwald and associates and Stanfield and Yu who used norepinephrine and methoxamine, respectively.

Left Atrial Size in Relation to Degree of Mitral Insufficiency

Our study would suggest that in patients with
chronic mitral valve disease there is a direct correlation between the degree of mitral insufficiency and the size of the left atrium. When there is a conspicuous increase in the amplitude of the pulmonary capillary V-wave after metaraminol in a patient with a small left atrium, it may indicate only a small degree of mitral insufficiency. The more severe the degree of mitral insufficiency, the more the amplitude of the V-wave increases even if the left atrium is very large. This occurs in spite of the increasing compliance demonstrated in an enlarging left atrium. In patients who had normal left atria, excluding patients with cardiomyopathies, an increase of more than 10 mm Hg in pulmonary capillary peak V pressure after metaraminol indicated mitral insufficiency in 100 percent.

Patients with a greatly enlarged left atrium and a moderate to large degree of mitral insufficiency may exhibit a significant elevation of pulmonary capillary peak V pressure following metaraminol, but the absence of this finding is common and is probably due to the marked increase in compliance. A cardiomyopathy may produce a falsely elevated V-wave response to metaraminol, and in some cases of significant mitral insufficiency the V-wave response to metaraminol will be in the normal range if the left atrium is only moderately enlarged.

One must, therefore, be cautious in interpreting the results of metaraminol potentiated pulmonary capillary V-wave responses without correlating left atrial size. A mild degree of insufficiency may not be detectable by metaraminol response if a patient has a moderate to greatly enlarged left atrium. If the patient has a greatly enlarged left atrium, a metaraminol induced V-wave amplitude increase of over 10 mm Hg would indicate a moderate to severe degree of mitral insufficiency if the sign were present.

REFERENCES
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1) Complete application form in duplicate, have original copy signed by the dean of the medical school, and return original copy at once to the American College of Chest Physicians, 112 East Chestnut Street, Chicago, Illinois 60611.
2) Five copies of the manuscript, typewritten in English (double spaced) must be submitted to the American College of Chest Physicians offices in Chicago not later than April 15, 1969.
3) The length of manuscripts is optional; 2500–4500 words suggested.
4) The only means of identification of the author shall be a motto or other device on the title page.

A sealed envelope bearing the same motto on the outside and enclosing the name and address of the author must accompany the essay. (Motto may be a word or brief phrase which has a significant meaning to the author.)

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