Marked Aortic Regurgitation
Without Peripheral Vascular Signs*

M. A. Demany, M.D.** and H. A. Zimmerman, M.D., F.C.C.P.†
Cleveland, Ohio

Surgical correction of aortic insufficiency has become a reality with the introduction of prosthetic valves. For this reason, the detection of all cases with moderate to marked aortic regurgitation has assumed a much greater importance.

According to most authorities, the patient with a small aortic leak presents no peripheral vascular signs or only slight alteration in pulse pressure; on the other hand, the patients with a large leak, causing "free aortic regurgitation" display several distinctive peripheral vascular signs: low diastolic and high pulse pressure, Corrigan pulse, visible arterial pulsations (Corrigan's sign'), "pistol shot" sound over the femoral artery, Durozies's sign, Traube's sign' and capillary pulse.

Recently, we have encountered seven patients with marked aortic regurgitation proved by cineangiography without the usual peripheral vascular phenomena. The object of this paper is to report these cases.

METHODS OF STUDY

Each patient had a thorough history and physical examination, with particular attention paid to the peripheral vascular system; a 12 lead-electrocardiogram, phonocardiogram, vectorcardiogram and right and-left heart catheterization. Cineangiography was done routinely during cardiac catheterization, using 40 ml of 85 per cent methylglucamine diatrizoate (Cardiografin) for each injection in the following sites: the main pulmonary artery, the left ventricle and the ascending aorta. A pressure of 800 pounds per square inch was used for the injections.

The pressures were recorded during cardiac catheterization via Statham strain gauge, and an 8 channel E.F.M. recorder.

Regurgitation across the aortic valve was graded according to the classification of Sellers et al. on a scale of one to four plus.

1+ Evidence of a regurgitant jet of contrast material without opacification of the left ventricle.

2+ Evidence of a regurgitant jet with faint opacification of the left ventricle.

3+ Dense opacification of the left ventricle and no distinct jet is usually visualized.

4+ The left ventricle is opacified more densely than the aorta.

CASE REPORTS

CASE 1

J.G., a 37-year-old white man, gave a history of rheumatic fever at the age of ten. A murmur was detected shortly after. During the past two years, he has had increased fatigability and progressive dyspnea on exertion.

The point of maximum impulse was in the fifth left intercostal space, 1 cm. outside the left midclavicular line. A grade 2-3/6 harsh systolic murmur was heard best over the aortic area; a grade 1/6 early blowing diastolic murmur was audible at the aortic area and at the left sternal border in the third left intercostal space. The radial pulse was not Corrigan in type; there was no pistol-shot sound, capillary pulse, Durozie's sign, Traube's sign, or visible pulsations over the neck vessels.

The electrocardiogram and the vectorcardiogram showed left ventricular overloading. The chest x-ray film revealed 10 per cent cardiac enlargement with prominence of the left ventricle.

During cardiac catheterization, the pressure in the ascending aorta was 114/70 mm.Hg. The left ventricular end diastolic pressure was 5 mm.Hg. There was no systolic gradient across the aortic valve. The pressures in the right cardiac chambers and the pulmonary circuit were normal at rest and during exercise. Cineangiog-
Cineangiography revealed marked aortic regurgitation (grade 3+). The left ventricular chamber and the ascending aorta were markedly dilated. This patient had his aortic valve replaced by a Starr-Edwards prosthesis on November 23, 1964.

CASE 3
N.C., a 28-year-old white woman had had her first attack of rheumatic fever at the age of nine. A cardiac murmur was first noticed when she was 13. Exceptional dyspnea, easy fatigability, palpitations, and tightness across the chest became progressively worse during the ten-month period preceding her admission.

The point of maximum impulse was in the fifth left intercostal space, 2 cm. outside the left midclavicular line. A grade 2/6 harsh systolic murmur was best heard over the aortic area; grade 1-2/6 early blowing diastolic murmur was audible over the aortic area and along the right sternal border. There was no Corrigan pulse, capillary pulse, or pistol-shot sound. Faint pulsations were visible over the neck vessels. A questionable Durriez's sign could be elicited only with great pressure over the femoral artery. Traube's sign was absent.

The electrocardiogram and the vectorcardiogram showed left ventricular overloading. The chest x-ray film showed a prominent ascending aorta and marked elongation of the left ventricle.

Cardiac catheterization revealed the pressure in the ascending aorta was 109/55 mm.Hg; there was no systolic gradient across the aortic valve. The pressures were normal in the right cardiac chambers and in the pulmonary circuit. They rose only slightly during exercise.

Cineangiography revealed marked (grade 3+) aortic regurgitation. The ascending aorta was moderately dilated.

CASE 2
C.S., a 55-year-old white man had rheumatic fever when he was 16; he was first told of a "heart condition" when he was 19. Easy fatigability and mild exertional dyspnea appeared about six months before admission along with episodes of tightness across the anterior chest wall, precipitated by exertion.

The point of maximum impulse was in the fifth left intercostal space, 2 cm. outside the left mid-clavicular line. A grade 3/6 harsh systolic murmur was best heard over the aortic area; grade 1-2/6 early blowing diastolic murmur was audible over the aortic area and along the right sternal border. There was no Corrigan pulse, capillary pulse, or pistol-shot sound. Faint pulsations were visible over the neck vessels. A questionable Durriez's sign could be elicited only with great pressure over the femoral artery. Traube's sign was absent.

The electrocardiogram and the vectorcardiogram showed left ventricular overloading. The chest x-ray film showed a prominent ascending aorta and marked elongation of the left ventricle.

Cardiac catheterization revealed the pressure in the ascending aorta was 109/55 mm.Hg; there was no systolic gradient across the aortic valve. The pressures were normal in the right cardiac chambers and in the pulmonary circuit. They rose only slightly during exercise.

CASE 3
N.C., a 28-year-old white woman had had her first attack of rheumatic fever at the age of nine. A cardiac murmur was first noticed when she was 13. Exceptional dyspnea, easy fatigability, palpitations, and tightness across the chest became progressively worse during the ten-month period preceding her admission.

The point of maximum impulse was in the fifth left intercostal space, 2 cm. outside the left mid-clavicular line. A grade 2/6 early diastolic murmur was best heard over the aortic area and the left sternal border (third left intercostal space). A grade 2/6 mid and late diastolic rumble was heard over the apex when the patient was in the left lateral decubitus position. There was no Corrigan pulse, capillary pulse, pistol-shot, Traube's sign, Durriez's sign, or visible pulsations of the neck muscles.

The electrocardiogram showed left ventricular overloading, but the vectorcardiogram was interpreted as normal. The chest x-ray film revealed moderate elongation of the left ventricle.

Cardiac catheterization revealed the pressure in the ascending aorta to be 117/70 mm.Hg. The left ventricular end-diastolic pressure was 10 mm. Hg. There was no systolic gradient across the aortic valve. The pressures were normal at rest in the right cardiac chambers and in the pulmo-
nary circuit. They rose slightly during exercise. There was a diastolic gradient of 8 mm.Hg across the mitral valve. Cineangiography revealed marked aortic regurgitation (grade 3+) (Fig. 1), slight dilatation of the ascending aorta and moderate enlargement of the left atrium and of the left ventricle.

The patient had an aortic valve prosthesis placed on December 1, 1964.

CASE 4

P.R., a 34-year-old white man, had had "swollen joint" over a period of two months at the age of 14. Easy fatigability and exertional dyspnea had appeared a few months before admission.

The point of maximum impulse was in the fifth left intercostal space at the mid-clavicular line. A grade 2/6 early blowing diastolic murmur was heard over the aortic area and the left sternal border (third left intercostal space). There was no Corrigan pulse, capillary pulse, pistol-shot sound, Traube or Duroziez's sign, or visible pulsations over the neck vessels.

The electrocardiogram was interpreted as normal and the vectorcardiogram showed slight left ventricular overloading. The chest x-ray film showed slight cardiac enlargement and prominence of the left ventricle.

Cardiac catheterization showed the pressure in the ascending aorta was 112/63 mm.Hg. The left ventricular end diastolic pressure was 10 mm.Hg. There was a small systolic gradient across the aortic valve (18 mm.Hg). The pressure in the right cardiac chambers and the pulmonary circuit were normal at rest and during exercise. Cineangiography revealed marked aortic regurgitation (grade 3+).

CASE 5

G.D., a 57-year-old white man, had had "swollen ankles" when he was a child. In March, 1964, he had an attack of extremely severe crushing pain across the anterior chest wall and passed out. He was hospitalized for several weeks and told that he had had a heart attack. Since then, he had experienced retrosternal pain with small amounts of exertion or emotional upsets relieved by rest or nitroglycerin sublingually.

The point of maximum impulse was in the sixth left intercostal space, one cm. outside the left midclavicular line. A grade 3/6 early blowing diastolic murmur was heard at the aortic valve and along the left sternal border. There was no Corrigan pulse, capillary pulse, pistol-shot sound, Traube's or Duroziez's sign, or visible pulsations over the neck vessels.

The electrocardiogram showed left ventricular overloading and myocardial ischemia. The vectorcardiogram revealed left ventricular overloading. Chest x-ray film showed 10 per cent cardiac enlargement with moderate prominence of the left ventricle.

At cardiac catheterization, the pressure in the ascending aorta was 140/68 mm.Hg. The left ventricular end-diastolic pressure was 14 mm.Hg. There was a very small systolic gradient (6 mm. Hg) across the aortic valve.

The pressures were very slightly elevated in the pulmonary circuit during exercise (postero-anterior pressure 38/19 mm.Hg; PC pressure end-diastolic 13 mm.Hg). Cineangiography revealed marked aortic regurgitation (grade 3+) and almost complete obstruction of the left coronary artery from its origin. The right coronary artery was a very large vessel.

These findings were confirmed at surgery, performed on January 25, 1965. The aortic valve was replaced by a Starr-Edward prosthesis.

CASE 6

R.P., a 42-year-old colored man, had no history of rheumatic fever. Since September, 1963, he had experienced progressive dyspnea on exertion.

The point of maximum impulse was in the sixth left intercostal space 1 cm. outside the left midclavicular line. A grade 1-2/6 early blowing diastolic murmur was heard along the left sternal border (third left intercostal space). There was no Corrigan pulse, capillary pulse, pistol-shot sound, Traube's or Duroziez's sign, or visible pulsations over the neck vessels.

The electrocardiogram showed left ventricular overloading and myocardial ischemia. The vectorcardiogram revealed left ventricular overloading. Chest x-ray film showed moderate cardiac enlargement with slight prominence of the left ventricle and of the ascending aorta.

During cardiac catheterization, the pressure in the ascending aorta was 122/92 mm.Hg. The left ventricular end-diastolic pressure was 7 mm. Hg. There was no gradient across the aortic valve. The pressure in the right cardiac chambers and the pulmonary circuit were normal at rest and during exercise. Cineangiography revealed marked aortic regurgitation (grade 3+), and moderate sized aneurysm of the anterior wall of the left ventricle, in the territory irrigated by the anterior descending artery, which had a markedly narrowed lumen shortly after its origin.

CASE 7

R.R., a 39-year-old white man, had had rheumatic fever when he was seven. A heart murmur had been heard shortly after. Easy fatigability had appeared a few months before the present evaluation.

The point of maximum impulse was in the fifth left intercostal space, 2 cm. outside the left midclavicular line. A grade 3/6 early blowing
Diastolic murmur was heard at the aortic area and along the left sternal border. There was no Corrigan pulse, capillary pulse, pistol-shot sound, Traube's or Duroziez's sign, or visible pulsations over the neck vessels.

The electrocardiogram and the vectorcardiogram showed left ventricular overloading. Chest x-ray film revealed slight cardiac enlargement with slight prominence of the left ventricle and moderate enlargement of the ascending aorta.

During cardiac catheterization, the pressure in the ascending aorta was 111/60 mm.Hg. The left ventricular end-diastolic pressure was 9 mm.Hg. There was no systolic gradient across the aortic valve. The pressure in the right cardiac chambers and the pulmonary circuit were normal at rest and during exercise.

Cineangiography revealed marked aortic regurgitation (grade 3+) (Fig. 2). Both coronary arteries were large and appeared normal.

RESULTS

Except for faint visible pulsations of the neck vessels and a questionable Duroziez's sign in one patient (case 2), the classic peripheral vascular phenomena were absent in these patients.

The Corrigan pulse, capillary pulse, Traube's sign and pistol-shot sound were not found by different observers despite a diligent search.

The intra-thoracic pulse pressure (Table 1) was between 30 and 54 mm.Hg in six of these patients; the value of 72 mm. Hg in the other patient (case 5) is somewhat higher than normal, yet not what one usually expects with marked aortic insufficiency.

The lowest diastolic aortic pressure was 55 mm.Hg, a reading not very striking for the type of valvular disease under consideration.

The aortic diastolic pressure was between 60 and 90 mm.Hg in the other cases. This is within the normal range.

Significant stenosis of the aortic valve was absent. We believe that the small systolic gradient (18 mm.Hg), found in one patient (case 4) was due to a very mild degree of stenosis, of questionable hemodynamic significance. We doubt very much that it was responsible for the normal pressures found in this patient. Another patient (case 3) had a definite diastolic pressure gradient across the mitral valve. Cineangiography confirmed the presence of mitral stenosis. It is logical to believe that the mitral valve disease will dampen or mask the manifestations of aortic valve disease. This might account for the normal aortic diastolic and pulse pressures in this case, but cineangiography showed that the leak across the aortic valve was notwithstanding very marked.

![Figure 2: Aortogram of case 7. Left oblique projection. The left ventricular chamber is completely opacified after injection of dye in the ascending aorta.](http://journal.publications.chestnet.org/pdfaccess.ashx?url=/data/journals/chest/21427/ on 06/25/2017)
The left ventricular end-diastolic pressure was normal in five patients (Table 1). It was very slightly elevated in the two others (cases 2 and 5).

The pressures in the right cardiac chambers and the pulmonary circuit were normal at rest in all the seven cases (Table 1); they rose very slightly during exercise in three patients; i.e. in the two who had slight elevations of their left ventricular end-diastolic and in the patient with mitral stenosis. This may be interpreted as early evidence of cardiac failure. Physical signs of right-sided heart failure (enlarged neck veins, hepatomegaly, ascites, edema) were absent in all the patients. None of them had auscultatory or roentgenologic evidence of left ventricular failure. We doubt that this could explain the complete absence of peripheral vascular phenomena expected with marked aortic regurgitation.

Mitral stenosis can readily explain the slight rise in pulmonary pressure during exercise in the third patient. Her left ventricular end-diastolic pressure was normal.

Coronary artery disease was present in two patients. One of them had no sign of congestive failure (case 6); the other had slightly elevated left ventricular end-diastolic pressure (case 5).

A serologic test was negative in each case. Four patients gave a definite history of rheumatic fever. Two other patients remembered episodes of "swollen joints" during childhood.

**Comments**

Patients with marked aortic insufficiency usually have low diastolic pressure and wide pulse pressure. Friedberg states that these patients have diastolic pressure of 50 mm.Hg or lower and pulse pressure greater than 80 mm.Hg.

Before the advent of cineangiography, great importance was given to the presence of peripheral vascular phenomena for the classification of aortic regurgitation as severe; in their absence, the degree of regurgitation was thought to be mild, or moderate at the most.

In the last six months, however, with the use of cineangiography, we were able to discover no less than seven patients with a marked degree of aortic insufficiency (grade 3 of Seller's et al. classification) and in whom the almost complete absence of the classic peripheral vascular signs was thusly definitely misleading.

None of these patients was incapacitated, but they had become symptomatic over a relatively short period of time before their evaluation.

Aortic insufficiency was diagnosed by auscultation alone in each patient. The electrocardiogram, the vectorcardiogram and the chest roentgenogram gave evidence

**Table 1—Hemodynamic Data**

<table>
<thead>
<tr>
<th>Case</th>
<th>ASC Aorta Pressure</th>
<th>Pulse Pressure</th>
<th>Left Ventricular End-Diastolic Pressure</th>
<th>Systolic Gradient Across Aortic Valve</th>
<th>Pulm. Artery and Pulm. Capillary Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>114/70</td>
<td>44</td>
<td>5</td>
<td>0</td>
<td>Normal</td>
</tr>
<tr>
<td>2</td>
<td>109/55</td>
<td>54</td>
<td>13</td>
<td>0</td>
<td>Normal at rest very slight elevation with exercise</td>
</tr>
<tr>
<td>3</td>
<td>111/770</td>
<td>47</td>
<td>10</td>
<td>0</td>
<td>Normal at rest; very slight elevation with exercise</td>
</tr>
<tr>
<td>4</td>
<td>112/63</td>
<td>49</td>
<td>10</td>
<td>18</td>
<td>Normal</td>
</tr>
<tr>
<td>5</td>
<td>140/68</td>
<td>72</td>
<td>14</td>
<td>6</td>
<td>Normal at rest; very slight elevation with exercise</td>
</tr>
<tr>
<td>6</td>
<td>122/92</td>
<td>30</td>
<td>7</td>
<td>0</td>
<td>Normal</td>
</tr>
<tr>
<td>7</td>
<td>111/60</td>
<td>51</td>
<td>9</td>
<td>0</td>
<td>Normal</td>
</tr>
</tbody>
</table>
of mild to moderate overloading of the left ventricle in all of them, but still failed to reveal the exact degree of severity of their aortic insufficiency. Only cineangiography showed the large amount of regurgitation taking place across the aortic valve.

Despite the fact that aortic insufficiency is probably well-tolerated for many years, we believe that it is far from being a "benign" condition. When decompensation takes place, we have often been impressed by the rapidity of the deterioration of its victims.

For this particular reason, the necessity of detecting early cases of marked aortic regurgitation cannot be overemphasized and since surgical correction has become available, this is not simply an academic matter. The importance of a more accurate assessment of the severity of aortic regurgitation far outweighs the very small risk accompanying cineangiography. In our opinion, the complete evaluation of a patient with aortic insufficiency should include cineangiography. If the leak visualized by the technic is small, then we think we are on more secure grounds to classify a case as "mild aortic regurgitation."

The importance of cineangiography for the correct evaluation of aortic insufficiency has also been stressed recently by Segal et al. These authors reported a series of 16 patients who did not have the diastolic murrum of aortic regurgitation, but in whom cineangiography demonstrated a moderate aortic leak (grade 2+). These patients had coexistent mitral stenosis, aortic stenosis or a combination of mitral stenosis and insufficiency. The presence of aortic insufficiency was suspected by unusual clinical and/or roentgenologic signs inconsistent with mitral valvular disease or pure aortic stenosis, but cineangiography was necessary for its confirmation and the correct evaluation of its severity.

**Summary**

We have recently encountered seven patients with marked aortic insufficiency but without the classic peripheral vascular signs usually associated with this condition. Cineangiography was the only technic affording a more accurate assessment of the degree of regurgitation.

This report emphasizes the importance of cineangiography for a thorough evaluation of all cases of aortic insufficiency.

**Resumen**

Hemos observado recientemente siete pacientes con insuficiencia aórtica pronunciada, pero sin los signos periféricos clásicamente asociados con esta afeción. La cineartografía resultó ser el único método eficaz para valorar el grado de regurgitación. Este reporte destaca el valor de la cineartografía para la evaluación completa de los casos de insuficiencia aórtica.

**Résumé**

Nous avons récemment observé 7 malades avec insuffisance aortique importante, mais n'ayant pas les signes périphériques vasculaires classiques habituellement présents dans cette affection. La cinéartographie a été la seule technique permettant l'évaluation précise du degré de régurgitation.

Ce travail insiste sur l'importance de la cinéartographie pour une évaluation précise de tous les cas d'insuffisance aortique.

**References**


For reprints, please write Dr. Zimmerman, 250 Hanna Building, Cleveland.