The Prognosis in Aortic Dissection
(Dissecting Aortic Hematoma or Aneurysm)

By Randolph M. McCloy, M.D., John A. Spittell, Jr., M.D., M.S., and Dwight C. McGoon, M.D.

REVIEWS of collected series of cases of aortic dissection (dissecting aneurysm or hematoma of the aorta) have clearly shown high early mortality.1, 2 Studies also have shown a relatively low rate of accuracy of diagnosis (50 to 60 per cent). These two factors indicate the present inadequacies of treatment for this condition. In the past, the only treatment available was supportive. More recently, technics for the surgical treatment of aortic dissection have been developed, and the results of surgical treatment reported by De Bakey and his associates3 and by Hume and Porter4 appear favorable compared to the natural course of the disease as determined from reviews of collected cases.1, 2

Analysis of the experience of a single institution to determine the prognosis and of certain other relevant data in medically treated aortic dissection seemed desirable to elucidate further the natural history of the disease, to delineate if possible the factors affecting the prognosis, and also to provide a background against which the need and efficacy of surgical therapy can be evaluated.

Material and Methods

Between 1945 and 1961, 50 patients with aortic dissection were seen at the Mayo Clinic. The symptoms, physical findings, laboratory data, and course of these patients were reviewed in detail. In addition, follow-up of those patients who survived the acute phase of their illness was carried out. Survival data were available on 45 patients, 40 of whom had received no surgical therapy for their aortic dissection. The records of these 40 patients constitute the material for survival figures presented in this study.

Results

Clinical and Laboratory Data

The clinical features of the 50 patients are given in Table 1. Males predominated in a ratio of 4 to 1. The ages of the patients ranged from 32 to 79 years, averaging 57 years. The presenting complaint in 43 of the 50 patients was pain, typically of a severe ripping or tearing character, that began in the chest anteriorly or posteriorly and frequently extended to the lower part of the back. Four patients had pain in unusual locations; for example, three patients had pain beginning in both jaws and the throat and developing later in the chest or back; the fourth had bilateral postauricular pain that progressed to the anterior part of the neck, the throat, and later to the chest, both arms, and thighs. A fifth patient had pain in the right temporal region in association with an-

Table 1

<table>
<thead>
<tr>
<th>Clinical Features of Aortic Dissection</th>
<th>Cases</th>
<th>Per cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain</td>
<td>43 of 50</td>
<td>86</td>
</tr>
<tr>
<td>Anterior chest</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>Back</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>Abdomen</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>Other site</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Hypertension (&gt;160/90)</td>
<td>25 of 37</td>
<td>68</td>
</tr>
<tr>
<td>Heart murmur</td>
<td>25 of 42</td>
<td>60</td>
</tr>
<tr>
<td>Aortic diastolic</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Aortic systolic</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>Decreased pulses</td>
<td>20 of 42</td>
<td>48</td>
</tr>
<tr>
<td>Upper extremity</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Lower extremity</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Both</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Neurologic changes</td>
<td>14 of 40</td>
<td>35</td>
</tr>
<tr>
<td>Coma or convolution</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Paraplegia</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Confusion</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Hemiparesis</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Slurred speech</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

From the Mayo Clinic and the Mayo Graduate School of Medicine, Rochester, Minnesota.

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terior thoracic pain. Five patients were in shock on admission. Adequate data on blood pressure were available on 37 patients, 25 of whom were hypertensive, that is, had blood pressures of more than 160 mm. of mercury systolic and 90 diastolic. Some alteration of the peripheral arterial pulsations was noted in 48 per cent (20 of 42 patients examined), the upper extremity being most frequently involved. Six patients gave evidence of an acute arterial occlusion in their extremities. Cardiac murmurs were noted in 25 of 42 patients; the diastolic murmur of aortic incompetence was heard in eight and a systolic murmur in the aortic area in 17. Neurologic changes dominated the clinical picture in 35 per cent of cases (table 1).

Of some interest is the activity of the patient at the time the dissection began. Activities of 39 patients could be determined at the time of the onset of the dissection (table 2). Only seven were working or lifting. Indeed, five patients were asleep at the time their dissection started, and four additional patients were lying down at the time of onset. It is interesting to compare these with Hirst's series. Thirty per cent of Hirst's patients were at rest at the time of their dissection, and 51 per cent were involved in minimal to moderate exertion such as walking, standing, light housework, or dressing. Only 13 per cent of Hirst's patients gave a history of strenuous exercise such as lifting, changing tire chains, or playing tennis.

Roentgenograms of the chest most commonly showed some alteration of the aortic shadow and such a finding was noted in 27 cases.

Less frequently (that is, in three cases) the findings of hemothorax were seen. Electrocardiographic changes were consistent with the diagnosis of acute coronary insufficiency or myocardial infarction in nine of 39 patients on whom electrocardiograms were made.

A correct clinical diagnosis of aortic dissection was made in 22 cases (58 per cent of 38 cases) after exclusion of those patients considered to have chronic dissection or those patients who were dead on arrival at the hospital. The diagnoses that were most frequently confused with aortic dissection were myocardial infarction (seven cases), cerebral vascular accident (three cases), acute pancreatitis (one case), spinal cord lesion (two cases), and acute arterial occlusion (three cases).

**Site of Primary Tear**

In the 40 cases reviewed for prognostic purposes, an attempt was made to determine the location of the primary tear. In 22 cases necropsy data provided this information, while in the remaining 18 cases it was necessary to attempt the localization from clinical and roentgenographic findings. The primary tear was considered to be in the ascending or the arch portion of the aorta or both in 30 cases (75 per cent) and in the descending portion of the thoracic aorta, that is, distal to the origin of the left subclavian artery in 10 cases (25 per cent). Physical signs considered indicative of involvement of the ascending aorta, aortic arch, or both were changes in pulse or blood pressure in the upper extremities or neck, the presence of the murmur of aortic incompetence, neurologic changes such as mental confusion, hemiplegia, or convulsions, or the presence of a pericardial friction rub. Electrocardiographic changes of myocardial ischemia or pericarditis, as well as definite widening of the mediastinal shadow on chest roentgenogram, also point to dissection in the proximal aorta. Primary tear located distal to the origin of the left subclavian artery was presumed when none of the above findings was present and frequently when the initial pain began in the back or abdomen. In Burchell's review, 16 of 22 patients with

### Table 2

**Activity at Onset of Aortic Dissection**

<table>
<thead>
<tr>
<th>Activity at onset</th>
<th>Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walking</td>
<td>9</td>
</tr>
<tr>
<td>Standing</td>
<td>4</td>
</tr>
<tr>
<td>Sitting</td>
<td>8</td>
</tr>
<tr>
<td>Eating</td>
<td>2</td>
</tr>
<tr>
<td>Working, lifting</td>
<td>7</td>
</tr>
<tr>
<td>Lying down</td>
<td>4</td>
</tr>
<tr>
<td>Sleeping</td>
<td>5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>39</strong></td>
</tr>
</tbody>
</table>

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AORTIC DISSECTION

Table 3
Time of Death of 36 of the 40 Patients with Aortic Dissection*

<table>
<thead>
<tr>
<th>Time of death after onset</th>
<th>Patients</th>
<th>Per cent dead (cumulative)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minutes</td>
<td>7</td>
<td>18</td>
</tr>
<tr>
<td>&lt; 6 hr.</td>
<td>3</td>
<td>25</td>
</tr>
<tr>
<td>6-12 hr.</td>
<td>0</td>
<td>25</td>
</tr>
<tr>
<td>12-24 hr.</td>
<td>2</td>
<td>30</td>
</tr>
<tr>
<td>24-48 hr.</td>
<td>5</td>
<td>43</td>
</tr>
<tr>
<td>48-72 hr.</td>
<td>2</td>
<td>48</td>
</tr>
<tr>
<td>4-7 days</td>
<td>2</td>
<td>53</td>
</tr>
<tr>
<td>8-14 days</td>
<td>4</td>
<td>63</td>
</tr>
<tr>
<td>15-21 days</td>
<td>2</td>
<td>68</td>
</tr>
<tr>
<td>3 wk.-3 mo.</td>
<td>1</td>
<td>70</td>
</tr>
<tr>
<td>3 mo.-1 yr.</td>
<td>5</td>
<td>83</td>
</tr>
<tr>
<td>1-2 yr.</td>
<td>1</td>
<td>85</td>
</tr>
<tr>
<td>2-3 yr.</td>
<td>1</td>
<td>88</td>
</tr>
<tr>
<td>&gt; 3 yr.</td>
<td>1</td>
<td>90</td>
</tr>
</tbody>
</table>

*Four patients still living; 1 1/2, 3 1/2, 5 1/3, and 8 years after the aortic dissection.

dissection of the aorta beyond the left subclavian artery had pain originating in the abdomen or back or both. In the present series, only one of 10 patients with lesions distal to the left subclavian artery had initial pain in the anterior part of the thorax, whereas 14 of the 23 patients with more proximal tears had pain in the anterior part of the chest.

Survival Data

The survival figures are shown in table 3. More than half the patients were dead within 1 week and 63 per cent had died within 2 weeks after the dissection. Of even more significance is the fact that of the 15 patients who survived the initial 2 weeks, eight (53 per cent) were dead within a year. Thus, 33 of the 40 patients or 83 per cent were dead at the end of 1 year. At the time of this review four patients were still living, 1 1/2, 3 1/2, 5 1/3, and 8 years after the dissection.

The results of our study and those of Hirst's collected series of cases are compared in figure 1. Although our series is smaller, the results are similar to those found by Hirst and associates. Both groups indicate that both the early and the late prognosis for this disease is poor. In their study of 26 cases, Kuipers and Schatz found a somewhat better survival in that 50 per cent of their patients survived 6 weeks and only seven of 11 patients with chronic dissection died within 5 years.

Cause of Death

Thirty-six of our 40 patients are dead. The cause of death was determined by necropsy in 24. Twenty-two had external rupture of the dissecting aneurysm of the aorta: hemothorax resulted in 16, hemothorax in five, and both hemothorax and hemoperitoneum in one. In the other two cases in which necropsy was performed, death was caused by pulmonary edema in one and by pneumonia in the other. In eight cases sudden death occurred, but its cause was not determined.

A site of re-entry of the dissection was found at necropsy in 11 of 22 cases; in all of these patients external rupture of the dissecting aneurysm had occurred also. This observation casts doubt on the axiom that re-entry of the dissection into the true lumen constitutes healing.

Discussion

In view of the poor prognosis demonstrated for patients suffering from dissection of the aorta an effective method of surgical treatment is most desirable. Surgical treatment has been tried for several years, but its safety and effectiveness are not certain as yet. The first technic consisted of establishing re-entry
into the true lumen of the aorta distal to the original site of dissection, which should have restored circulation to points distal to the dissection but could not significantly decrease the threat of rupture of the thin outer layer of aorta into a body cavity, which, in fact, is the principal cause of death. It is preferable to reunite the dissected layers of the aorta at the site of the original intimal tear, and thus to repair the tear and to direct blood flow through the normal channel. This procedure usually requires resection of a segment of aorta and insertion of a prosthetic graft. Such an approach always requires the identification of the site of entry, and as yet this cannot be done by aortography as accurately as would be desirable. It is fortunate, therefore, that the sites of intimal tear are commonly located in only two areas and that the symptoms and signs, plus venous aortography, usually permit fairly accurate differentiation between them. Surgical intervention is indicated for acute dissection of the aorta on an emergency basis whenever possible. Heart-lung bypass is employed when the primary site is in the ascending aorta, and left heart bypass when it is in the descending thoracic aorta. Although such procedures carry a high risk at this time, advances are being made, and they probably offer greater security to the patient than conservative management would.

Factors That May Influence Prognosis

The factors in our 40 cases that might influence the prognosis of aortic dissection are listed in table 4. The number of cases in our series is small, but in general, lesions of the ascending or arch portion of the aorta appear to have a worse prognosis for survival than the lesions distal to the left subclavian artery. Similar results have been noted by others.

Hypertension appears to worsen the prognosis in cases of aortic dissection. Hypertensive patients in our series had persistent blood pressure higher than 160/90 mm. of mercury on daily determinations made in the hospital and usually also had funduscopic changes of hypertensive disease or they had blood pressure exceeding 160/90 on two or more occasions on different clinic visits, and, again, usually had funduscopic changes of hypertension. Patients who had a history of hypertension in the past, which was not documented on our examinations, or who had only a few abnormal determinations of blood pressure or insufficient data were considered to have indeterminate blood pressure findings. Only one of 22 patients with documented

### Table 4

Factors and Their Influence on Prognosis in Aortic Dissection

<table>
<thead>
<tr>
<th>Factor</th>
<th>Total patients</th>
<th>&gt; 1 wk.</th>
<th>&gt; 2 wk.</th>
<th>&gt; 3 mo.</th>
<th>&gt; 1 yr.</th>
<th>&gt; 3 yr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location of tear</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ascending aorta or arch</td>
<td>30</td>
<td>14</td>
<td>10</td>
<td>8</td>
<td>5</td>
<td>3*</td>
</tr>
<tr>
<td>Descending aorta</td>
<td>10</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Blood pressure†</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hypertension</td>
<td>22</td>
<td>15</td>
<td>12</td>
<td>10</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Normal</td>
<td>7</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2*</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>35</td>
<td>18</td>
<td>14</td>
<td>12</td>
<td>7</td>
<td>4*</td>
</tr>
<tr>
<td>Female</td>
<td>5</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Age, yr.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>57 yr. or less</td>
<td>14</td>
<td>8</td>
<td>7</td>
<td>6</td>
<td>2</td>
<td>1*</td>
</tr>
<tr>
<td>&gt; 57</td>
<td>26</td>
<td>11</td>
<td>8</td>
<td>6</td>
<td>5</td>
<td>3</td>
</tr>
</tbody>
</table>

*One patient alive 1 1/2 years after his dissection.
†Adequate blood pressure data not available on 11 patients.
hypertensive disease survived more than 3 years.

Patients younger than the average age of the patients in this study seem to have a slightly more favorable prognosis, at least in the early stages after aortic dissection. The number of female patients in this series (five cases) permits no attempt at prognostication with regard to the sex of the patient.

As noted earlier, the type of surgical approach will depend on the site of the primary tear as well as the extent of the aortic dissection. Thus it is important when considering surgical treatment of aortic dissection not only to make the diagnosis but to localize both the origin and extent of the dissection if possible. The location of the pain and the constellation of manifestations of the dissection often are of help in this respect, but, when possible, confirmation by venous angiography seems indicated in cases of aortic dissection.

In recent years interest has developed in the occurrence of aortic dissection in experimental lathyism in rats. Correlation of the observation that aortic dissection and skeletal abnormalities occur in growing rats fed sweet pea meal or certain amino-nitriles led Bean and Ponseti to investigate a series of cases of aortic dissection. They found that 35 per cent of 20 patients with aortic dissection had kyphoscoliosis or skeletal abnormalities of the chest. These findings, coupled with the well-known occurrence of aortic dissection and skeletal abnormalities in the Marfan syndrome, are intriguing. In our series of cases of aortic dissection, however, only one patient had a skeletal anomaly and that was a funnel chest; in fact, no patients with the Marfan syndrome were found in our series.

**Summary**

Between 1945 and 1961 50 patients with aortic dissection were seen at the Mayo Clin-ic. Survival information for prognostic purposes was available in 40 patients and revealed that more than half of the patients were dead within a week. Of 15 patients who survived the acute phase (2 weeks) more than half were dead within a year. The cause of death was determined by necropsy in 24 patients and 22 died of external rupture of the dissecting aneurysm. In 11 patients a site of re-entry in the dissection was found and in all of these patients external aortic rupture had occurred also. The surgical approach to the treatment of aortic dissection is discussed in the light of these findings. The relationship of the location of the primary tear, blood pressure, and the age of the patient to prognosis is reviewed.

**References**

The Prognosis in Aortic Dissection (Dissecting Aortic Hematoma or Aneurysm)
RANDOLPH M. MCCLOY, JOHN A. SPITTELL, JR. and DWIGHT C. McGOON

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