Abdominal Aortic Aneurysms

A Reappraisal

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PRIOR to the advent of successful reconstructive aortic surgery, abdominal aortic aneurysm was a condition for which there was no effective therapy. A review of a series of such cases by Estes,1 in 1950, was the first adequate attempt at delineating the natural history of this disease. Since that time, excision of aneurysms with replacement by homografts and, more recently, by synthetic materials has become widespread. Opinion concerning the selection of patients for surgical repair of aneurysms has varied; some authors2,3 have stated that the presence of an abdominal aortic aneurysm is a clear indication for repair; others1 have recommended a more conservative attitude toward this problem.

A study of the records of a large group of untreated patients with abdominal aortic aneurysm seen during a period when vascular surgery was available should provide a guide to the proper selection of patients for aneurysmal excision.4 The records of 141 patients with abdominal aortic aneurysms seen at the Mayo Clinic in the 10 years between January 1, 1950, and January 1, 1960, therefore, were reviewed. Each of these patients either had elected to defer excision of the aneurysm or else were not offered surgery when they were first seen. The records were selected for study only after it was clear that the diagnosis had been established by adequate objective evidence of an aneurysm. Such evidence included the presence of a pulsating, expansile, intra-abdominal mass in the region of the abdominal aorta, roentgenographic calcific shadows compatible with the diagnosis of abdominal aortic aneurysm, aortography, or direct observation at an operation for some other abdominal condition. The diagnosis was made from the roentgenograms of the abdomen or lumbar spine in 99 cases; by physical examination in 73 patients; via aortography in 11; and at operation for other abdominal conditions in 26. The diagnosis was made from more than one of these methods in various cases.

Etiology

All of the 141 aneurysms were considered to be due to arteriosclerosis on the basis of calcification in the wall of the aorta or the absence of a positive serologic test for syphilis. Two patients had positive serologic tests as well as calcification in the wall of the aneurysm; the exact cause in these two cases could not be determined with certainty, but they were considered to be primarily arteriosclerotic in nature. The preponderance of arteriosclerotic aneurysms in the present study is in marked contrast to some previously reported series, for example 57.3 per cent of Kampmeier’s series of 73 cases were considered to be syphilitic in origin.6

Sex and Age at Time of Diagnosis

The age distribution of this series is summarized in table 1. The average age at the time of diagnosis was 67.8 years. The great majority of the patients were more than 55 years old. Of the 141 patients, 116 (82.3 per cent) were men and 25 (17.7 per cent) were women.

Clinical Features

Symptoms and Signs

Nine patients (6.3 per cent) complained of back or abdominal pain which was interpreted as being caused by the aneurysm; one of these patients also complained of a pulsating abdominal mass. The remaining 132 pa-
patients had no symptoms that could be attributed definitely to an aneurysm.

Size of Aneurysm

Estimates of the size of the aneurysm, as determined by physical examination or from the plain roentgenograms of the abdomen, were included in the records of 111 patients. Of these, 83 had small aneurysms and 28 had large ones. We have arbitrarily classified all aneurysms 7.5 cm. in diameter or less as small, and those more than 7.5 cm. in diameter as large.

Associated Cardiovascular Disease

Table 2 indicates the presence of associated cardiovascular disease at the time of diagnosis. Any patient with a history of previous myocardial infarction, cerebral vascular accident or symptoms of angina pectoris was considered to have evidence of coronary or cerebral atherosclerosis.

Decisions as to Operation

Twenty-seven patients refused operation, and the remaining 114 patients were not offered surgical repair of their aneurysms when they were first seen. The reasons for this decision were as follows: 1. The associated cardiovascular disease was thought to increase the surgical risk prohibitively. 2. The poor prognosis inherent in another type of illness militated against operation. 3. The aneurysm was so small that close observation of the patient at intervals for signs or symptoms of enlargement of the aneurysm was thought advisable. This occurred most often when the aneurysm was discovered incidentally in the course of an operation for some other abdominal condition. 4. The patient was so elderly that the operative risk was considered too high and the possible benefits from removal of the aneurysm were less than the hazards of surgery. This last reason usually obtained in patients who were more than 80 years of age.

Prognosis

In this paper prognosis will be considered in terms of survival of the patient after the diagnosis of abdominal aortic aneurysm had been made for the first time at the clinic; the survival rates to be presented were calculated by the direct method. Follow-up information was obtained from 137 (97.1 per cent) of the patients. Only 119, however, were considered in our survival series. The remaining 18 patients were not included because the follow-up period after the diagnosis of aneurysm was inadequate (less than 1 year).

The survival rates of traced patients calculated by the direct method are given in table 3 and figure 1. The latter compares the survival figures of the traced patients with the survival rates of a normal population of the same mean age and with those of a series of patients reported by Estes. At the end of 1, 3, and 5 years after diagnosis at the clinic, 87.6, 52.5, and 36.4 per cent of the patients with abdominal aortic aneurysm in our series were living, whereas in a normal population of the same mean age 96.5, 88.9, and 80.6 per cent would be living. Estes
found that 67.0, 49.2, and 18.9 per cent of his patients were living 1, 3, and 5 years after diagnosis. Comparison of the length of survival of those who were refused operation with that of those who deferred it in our series revealed no significant difference.

An attempt was made to correlate the size of the aneurysm with the survival of the patient. Clinical appraisal of size of the aneurysm is indeed difficult; nevertheless analysis of these data may be of some use in determining prognosis. Of 82 patients who were followed for a minimum of 2 years after the initial diagnosis, 42 (73.7 per cent) of the 57 patients with aneurysms designated small and 10 (58.8 per cent) of the 17 patients with large aneurysms were living at the time of follow-up (table 4).

Of the nine patients who had symptoms referable to the aneurysm, five had died at time of follow-up. Two of these deaths were due to ruptured aneurysms; one of these two occurred less than a year, the other more than a year after the diagnosis.

An attempt was made to compare the survival rates of the patients with a history or symptoms of cardiovascular disease at the time of diagnosis of the aneurysm with those of patients without such a history. A distinct and significant difference was found (table 5).

![Abdominal Aortic Aneurysm Survival Rates](image)

**Figure 1**
Survival rates of the present series compared with the survival rates of the normal population and those in Estes series.

Cause of Death

Forty-six of the 137 traced patients (33.5 per cent) are known to have died since diagnosis. The cause of three deaths is unknown. Of the remaining 43, 19 (44.1 per cent) died of a ruptured aneurysm, and 24 (55.9 per cent) died of other causes (table 6).

Of the 43 patients for whom the cause of death is known, 23 had a history or symptoms of cardiovascular disease at the time of diagnosis of aneurysm. Of these 23 patients 26.2 per cent died of ruptured aneurysm, and 65.2 per cent died of other cardiovascular causes. In contrast, of the 20 patients who died who had no history of symptoms of cardiac disease at the time of diagnosis, 65.0 per cent died of ruptured aneurysm and 15.0 per cent died of other cardiovascular causes. None of this latter group died of myocardial infarction (table 6).

Discussion

The presentation of statistical data is meaningless without proper interpretation. The objective of this study was some insight into the selection of patients for surgical excision of the abdominal aortic aneurysms. More surgical technical progress, praiseworthy though it may be, cannot be the sole basis for decisions about surgical intervention. The presence of associated disease, the risk to the patient and the probability of rupture of the aneurysm all require careful consideration in making such a decision.

Previous series have indicated that the presence of an abdominal aortic aneurysm represents a severe hazard to the patient. Survival rates in our series of untreated aneurysms indicate a somewhat better prognosis than previously reported by others. There may be several reasons for this. Because an abdominal aortic aneurysm is no longer a clinical oddity but is a potentially treatable disease, roentgenologists, internists, and surgeons have become much more aware of its existence, and therefore these lesions are very likely being diagnosed more frequently. It is of interest that 93.6 per cent of the patients in the present series were asymptomatic.
whereas in an earlier series from the same clinic Estes\textsuperscript{1} found that only 30.4 per cent of the patients were without symptoms. It would appear that we are seeing abdominal aortic aneurysms earlier in the natural course of the disease. This might explain the somewhat better prognosis that is evident from our figures.

**Selection of Patients for Operation**

In spite of the slightly better survival herein presented, rupture of the aneurysm remains a clear risk for these patients. What then are some of the factors that one should consider in selecting patients for operation? Three factors stand out: (1) the presence of associated symptomatic cardiovascular disease, (2) the size of the aneurysm, and (3) symptoms referable to the aneurysm.

1. Table 5 demonstrates the marked difference in prognosis between the group of patients without associated cardiovascular disease at the time of initial diagnosis, and the group with such disease. Table 6 demonstrates the difference in causes of death between these two groups. It is obvious that patients without associated cardiovascular disease have a distinctly better prognosis than those patients who have associated disease. It is also clear that when a patient without such disease dies, the cause of death is more likely to be rupture of aneurysm than anything else, whereas patients with associated cardiovascular disease will probably succumb to myocardial infarction, stroke, or heart failure rather than to rupture of their aneurysm.

Apart from the increased risk of operation for patients who have cardiovascular disease in addition to an abdominal aortic aneurysm, they also have a poorer prognosis as to life, and are more likely to die from this illness rather than their aneurysm. This observation suggests that all the pertinent factors should be considered with care before aortic resection is recommended for these patients.

2. Although clinical estimates of the greatest diameter of any aneurysm are only gross measurements, arbitrary division of aneurysms into small and large may be of some help in the decision for surgical repair, as shown in table 4. Because the majority of patients with large aneurysms were operated on, we were able to follow only 19 untreated patients for more than 2 years. Nevertheless, the survival rates between the two groups are distinctly different: 73.7 per cent of the patients with small aneurysms survived 2 years or more; 58.8 per cent of the patients with large aneurysms survived 2 years.

More significant perhaps are some other figures. Abdominal aortic aneurysms that are less than 4.5 cm. in diameter are usually not palpable.\textsuperscript{8} Of the 26 patients in our series whose aneurysms were discovered in the course of operations for other abdominal conditions, seven had aneurysms that were by direct measurement less than 4 cm. in diameter. Of these seven patients only one has died, and the cause of death was renal failure secondary to carcinoma of the bladder. Of 13 patients whose aneurysms were discovered

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**Table 3**

*Survival Rates of Patients with Untreated Abdominal Aortic Aneurysm*

<table>
<thead>
<tr>
<th>Period, years</th>
<th>Patients Total</th>
<th>Patients Traced</th>
<th>Lived beyond indicated period Number</th>
<th>Per cent*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>119</td>
<td>113</td>
<td>99</td>
<td>87.6</td>
</tr>
<tr>
<td>2</td>
<td>87</td>
<td>82</td>
<td>58</td>
<td>70.7</td>
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<tr>
<td>3</td>
<td>65</td>
<td>59</td>
<td>31</td>
<td>52.5</td>
</tr>
<tr>
<td>4</td>
<td>46</td>
<td>43</td>
<td>19</td>
<td>44.2</td>
</tr>
<tr>
<td>5</td>
<td>34</td>
<td>33</td>
<td>12</td>
<td>36.4</td>
</tr>
<tr>
<td>6</td>
<td>20</td>
<td>19</td>
<td>5</td>
<td>26.3</td>
</tr>
</tbody>
</table>

*Based on traced patients. Inquiry as of July 1, 1960.

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**Table 4**

*Two-Year Survival Rates of Patients with Untreated Abdominal Aortic Aneurysm by Size of Aneurysm*

<table>
<thead>
<tr>
<th>Diameter of aneurysm, cm.</th>
<th>Patients Total</th>
<th>Patients Traced</th>
<th>Lived 2 or more years after diagnosis Number</th>
<th>Per cent*</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;7.5 (small)</td>
<td>59</td>
<td>57</td>
<td>42</td>
<td>73.7</td>
</tr>
<tr>
<td>&gt;7.5 (large)</td>
<td>19</td>
<td>17</td>
<td>10</td>
<td>58.8</td>
</tr>
<tr>
<td>Unstated</td>
<td>9</td>
<td>8</td>
<td>6</td>
<td>75.0</td>
</tr>
<tr>
<td>Total</td>
<td>87</td>
<td>82</td>
<td>58</td>
<td>70.7</td>
</tr>
</tbody>
</table>

*Based on traced patients. Inquiry as of July 1, 1960. Only patients in whom diagnosis was made before July 1, 1958, are included in the calculations.

*\textsuperscript{1}Estes, J. H., Jr. Aneurysms of abdominal aorta, Arch. Surg., 80: 587 (1960).*
Table 5

Survival Rates for Patients with Untreated Abdominal Aortic Aneurysm with and without Associated Heart Disease

<table>
<thead>
<tr>
<th>Period, years</th>
<th>Without heart disease</th>
<th>With heart disease</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Patients</td>
<td>Lived beyond indicated period</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>Traced</td>
</tr>
<tr>
<td>1</td>
<td>72</td>
<td>69</td>
</tr>
<tr>
<td>3</td>
<td>41</td>
<td>38</td>
</tr>
<tr>
<td>5</td>
<td>18</td>
<td>18</td>
</tr>
</tbody>
</table>

*Based on traced patients. Inquiry as of July 1, 1960.

Table 6

Abdominal Aortic Aneurysm: Known Causes of Death in Total Series*

<table>
<thead>
<tr>
<th>Cause of death</th>
<th>Total patients</th>
<th>Associated cardiovascular disease at first diagnosis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Per cent</td>
</tr>
<tr>
<td>Rupture of aneurysm</td>
<td>19</td>
<td>44.1</td>
</tr>
<tr>
<td>Other cardiovascular causes</td>
<td>18</td>
<td>41.9</td>
</tr>
<tr>
<td>Myocardial infarction</td>
<td>9</td>
<td>41.9</td>
</tr>
<tr>
<td>Stroke</td>
<td>6</td>
<td>33.3</td>
</tr>
<tr>
<td>Congestive heart failure</td>
<td>3</td>
<td>14.3</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>6</td>
<td>14.3</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>2</td>
<td>4.7</td>
</tr>
<tr>
<td>Uremia</td>
<td>1</td>
<td>2.3</td>
</tr>
<tr>
<td>Bleeding duodenal ulcer</td>
<td>2</td>
<td>4.7</td>
</tr>
<tr>
<td>Accident</td>
<td>1</td>
<td>2.3</td>
</tr>
<tr>
<td>Total</td>
<td>43</td>
<td></td>
</tr>
</tbody>
</table>

*Three additional deaths occurred, but cause is not known.

at operation and were between 4 and 7.5 cm. in diameter, two died of ruptured aneurysms; one of these deaths occurred less than 1 year, the other more than 2 years after diagnosis. Of six patients who had aneurysms more than 7.5 cm. in diameter, three died of ruptured aneurysms; one of these deaths occurred less than 1 year, one 1 year, and one 4 years after the diagnosis. Valid statistical conclusions cannot be made from such a small series; however, it appears that the smaller the aneurysm the less likely it is to rupture.

3. Since only nine of our patients had symptoms that could be directly related to the presence of an abdominal aortic aneurysm, it is impossible to make any statistical analysis, but it has been a widely held clinical impression that when an aneurysm becomes symptomatic rupture is imminent. Our data do not negate this thesis, and it seems reasonable to assume that symptomatic aneurysms are indeed a hazard to the patient. Certainly symptoms that can be directly attributed to an aneurysm should be a clear-cut indication for excision of that aneurysm, if possible.

Decision for or against surgical intervention in any situation must, in the final analysis, be on an individual basis. Arbitrary rules may or may not be helpful in specific situations. Many indefinable factors influence the physician in making any decision. Our purpose is to provide some guide to prognosis so that physicians may better evaluate their patients. In general, when we see patients with symptomatic abdominal aortic aneurysms of any size or patients who have asymptomatic aneurysms without associated cardiovascular disease, we recommend operation. Patients who have small asymptomatic aneurysms plus evidence of other cardiovascular disease often
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will be observed carefully for new evidence of expansion of the aneurysm or symptoms from it.

For the patient with a large aneurysm associated with other cardiovascular disease, the decision is difficult. If the associated disease is severe, we usually advise continued observation. If the associated disease is mild, we recommend surgical excision of the aneurysm.

Summary

Of 141 patients with abdominal aortic aneurysms diagnosed at the Mayo Clinic from 1950 through 1959 who were not operated on, follow-up information was obtained from 137 patients (97.1 per cent). Of those followed 1 year or more, 87.6 per cent survived 1 year or more; 52.5 per cent survived 3 years, and 36.4 per cent survived 5 years after diagnosis. These results indicate that the prognosis of abdominal aortic aneurysm in this selected group of patients was somewhat better than that previously reported.

The prognosis and survival of patients who had a history of associated cardiovascular disease at the time of diagnosis of aneurysm is distinctly less good than those of patients who had no such history. Of those with such a history, 75.0 per cent survived 1 year, 33.3 per cent survived 3 years, and 20.0 per cent survived 5 years. Of those without such a history 95.7 per cent survived 1 year, 63.2 per cent survived 3 years, and 50.0 per cent survived 5 years.

Patients with abdominal aortic aneurysms and associated cardiovascular diseases are more likely to die of cardiovascular complications other than ruptured aneurysms. Patients with abdominal aortic aneurysms who have no evidence of associated cardiovascular disease are more likely to die from a ruptured aneurysm than from anything else.

It would appear that small asymptomatic abdominal aortic aneurysms in patients with associated cardiovascular disease may be carefully observed until signs of expansion of the aneurysm or symptoms from the aneurysm appear.

References

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