Abdominal Aortic Aneurysm: A Study of One Hundred and Two Cases

By J. Earle Estes, Jr., M.D.

Data were compiled from the records of 101 cases of abdominal aortic aneurysm, almost all of which were due to arteriosclerosis. These records were selected only when there was unequivocal evidence of aneurysm, and cases of true dissecting aneurysm were not included. The data were studied primarily in regard to prognosis of this condition but in addition, all clinical manifestations of abdominal aortic aneurysm were reviewed.

Several excellent analyses of the clinical and pathologic nature of abdominal aortic aneurysm are recorded. In most of these analyses, the aneurysms were preponderantly syphilitic in nature. The cases which formed the basis of this study were almost entirely those of arteriosclerotic aneurysm and therefore they could be used for comparison with cases of syphilitic aneurysm.

Records of 102 patients having an abdominal aortic aneurysm were obtained from the files of the Mayo Clinic through December 31, 1947. These records were accepted for study only after it was clear that the diagnosis had been established on satisfactory objective evidence. Such evidence included the presence of an expansile, pulsatile intra-abdominal mass in the location of the abdominal aorta, or roentgenographic observations compatible with the diagnosis of aneurysm of the abdominal aorta, or the finding of an abdominal aortic aneurysm at surgical exploration.

Etiology

The criteria for the etiologic diagnosis of abdominal aortic aneurysm were as follows:

1. An aneurysm was considered to be arteriosclerotic in nature if roentgenograms revealed evidence of calcification in the aneurysm, in the abdominal aorta, or in other arteries, or if a clinical diagnosis of arteriosclerosis obliterans had been made.

2. An aneurysm was considered to be syphilitic in origin if there was a positive serologic reaction for syphilis, or clinical evidence sufficient for a diagnosis of syphilis, or both; provided there was no objective evidence of arteriosclerosis of the abdominal aorta.

3. An aneurysm was considered to be due to both syphilis and arteriosclerosis if the criteria designated for each were present.

4. An aneurysm was considered to be traumatic if the role of trauma in development of the aneurysm was likely.

Of the 102 aneurysms considered in this study, 97 were considered to be due to arteriosclerosis. In 35 cases there was no record of objective evidence of syphilis, arteriosclerosis, trauma, or any other etiologic factor. In all except 2 of the 35 cases, however, the patients were of such an age (nearly always more than 50 years and generally more than 60 years) that arteriosclerosis was almost certainly the basis for aneurysm. The 2 youngest of the 35 patients were 42 and 43 years old, respectively. Furthermore, in the total series of 102 patients there were 2 others younger than 42 years who had positive evidence of arteriosclerosis. It seemed reasonable, therefore, to include the aneurysms in all of these 35 cases in the group of 97 considered to be arteriosclerotic in nature. In the case of 2 of the 97 arteriosclerotic aneurysms there was a history of trauma to the abdomen. This trauma was of such dubious nature, however, that the aneurysms were not included in the traumatic classification. In addition to the 97 aneurysms due to arteriosclerosis, there was 1 due to syphilis, 3 to arteriosclerosis and syphilis, and 1 to trauma.

In Kampmeier's series of 73 cases of ab.
dominal aortic aneurysm, 57.3 per cent of the patients had syphilis. No specific figures were given for the incidence of arteriosclerotic aneurysms but the latter were "very few." Scott reviewed the records of 96 cases of abdominal aneurysm involving the aorta and its branches. He reported the incidence of syphilis as 58.3 per cent, arteriosclerosis 20 per cent, mycotic lesion 18.8 per cent, periarteritis nodosa 1 per cent and tuberculosis 1 per cent. Of the abdominal aortic aneurysms alone, Scott reported that 74 per cent were due to syphilis, 21 per cent to arteriosclerosis and 5 per cent to mycotic lesions. Hubeny and Pollack reviewed the records of 48 cases of "saccular abdominal aortic aneurysm" from the files of Cook County Hospital. They considered that the aneurysms of 75 per cent of their cases were due to syphilis. Eight of the 48 aneurysms were arteriosclerotic. The data in these three reports were based on both clinical and necropsy material. Pratt-Thomas, in a review of data on 17 aneurysms of the abdominal aorta, encountered at necropsy, considered 15 to be due to syphilis, 1 to arteriosclerosis and 1 of indeterminate nature.

The preponderance of syphilitic aneurysms in these studies is clearly manifest. In recent years, however, a growing appreciation of the incidence of arteriosclerotic aneurysms of the abdominal aorta has developed. Blakemore in 1947 reported that of 32 patients with aneurysms in this location admitted in recent years to Presbyterian Hospital, New York, arteriosclerosis was the cause in 26. It seems certain that the aneurysms in the present study were almost always arteriosclerotic in origin.

**Age of Patients at Time of Diagnosis**

The age distribution of the patients in this study is summarized in table 1. It is apparent that only 27.5 per cent of the patients were under the age of 60 years at the time of diagnosis and only 6.9 per cent were under the age of 50 years. A significant difference may be noted in Kampmeier's patients of whom 67.6 per cent were under the age of 45 years. Also, Scott reported 75 per cent of his patients to be under the age of 50 years.

**Incidence of Hypertension**

Ninety-four of the 102 records studied contained sufficient information for analysis as to the presence or absence of hypertension. For the purposes of this analysis hypertension was considered to be present if the blood pressure was at least 160 systolic or 100 diastolic, expressed in millimeters of mercury. These levels were used so that the incidence of hypertension would not be appreciably affected by relatively minimal degrees of hypertension. The incidence of hypertension was the only factor in this study wherein a significant difference existed between males and females. Twenty-five of 68 males (36.8 per cent) and 16 of 26 females

<p>| Table 1.—Abdominal Aortic Aneurysm: Distribution of Patients According to Age at Time of Diagnosis. |</p>
<table>
<thead>
<tr>
<th>Age, years</th>
<th>Patients</th>
<th>Per cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>40–49</td>
<td>7</td>
<td>6.9</td>
</tr>
<tr>
<td>50–59</td>
<td>21</td>
<td>20.6</td>
</tr>
<tr>
<td>60–69</td>
<td>47</td>
<td>46.1</td>
</tr>
<tr>
<td>70–79</td>
<td>21</td>
<td>20.6</td>
</tr>
<tr>
<td>80–89</td>
<td>6</td>
<td>5.8</td>
</tr>
<tr>
<td>Total</td>
<td>102</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Table Continued

(61.5 per cent) were hypertensive. The difference in the incidence of hypertension lay in the age group of 60 to 69 years. In this group, 8 of 10 women (80 per cent) had hypertension, while in the same age group only 13 of 33 men (39.4 per cent) were similarly afflicted. It should be recognized, however, that the total number of 10 females in this group is quite small from the statistical standpoint. Other age groups contained relatively similar percentages of males and females with hypertension.

**Symptoms**

Abdominal pain and the presence of an abdominal mass that was noted by the patient were the two most frequently encountered symptoms. They were present, respectively, in 37.3 per cent and 25.5 per cent of the 102 patients. It is significant that 31 (30.4 per cent)
of the 102 patients had no symptoms referable to aneurysm (table 2). The aneurysms of these 31 patients were discovered either on physical examination, by a roentgenologic examination of the appropriate region, or by surgical exploration.

PHYSICAL SIGNS

Eighty-eight and three-tenths per cent of the 102 patients had an expansile, pulsatile abdominal mass. A thrill or bruit over the mass was present in 28.4 per cent of the 102 patients. Only 7 patients (6.9 per cent) had no physical findings referable to aneurysm (table 3). Diagnosis in these 7 instances was established by appropriate roentgenologic examination or by surgical exploration.

LOCATION OF ANEURYSM AS INDICATED BY PHYSICAL EXAMINATION

In 84 of the 102 cases, the location of the aneurysm, as indicated by physical examination, was accurately described. Sixty-five (77.4 per cent) of the 84 aneurysms were found in the epigastria (10 cases), umbilical (13 cases), left hypochondriac (23 cases) or left lumbar region (19 cases). Only small numbers of aneurysms occurred in the lower part of the abdomen or in the right side of the abdomen. In addition to the aforementioned 84 cases, there were 8 cases in which the location of the aneurysm was less accurately designated. In 1 of these 8 cases the aneurysm filled the entire right side and in another the entire left side of the abdomen, and in 6 it involved “the entire aorta.”

**Table 2.—Abdominal Aortic Aneurysm: Symptoms**

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Patients</th>
<th>Per cent of 102 patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abdominal pain</td>
<td>38</td>
<td>37.3</td>
</tr>
<tr>
<td>Abdominal mass</td>
<td>26</td>
<td>25.5</td>
</tr>
<tr>
<td>Abdominal throbbing</td>
<td>17</td>
<td>16.7</td>
</tr>
<tr>
<td>Backache</td>
<td>14</td>
<td>13.7</td>
</tr>
<tr>
<td>Gastro-intestinal symptoms</td>
<td>10</td>
<td>9.8</td>
</tr>
<tr>
<td>Shock</td>
<td>8</td>
<td>7.8</td>
</tr>
<tr>
<td>Leg pain</td>
<td>3</td>
<td>2.9</td>
</tr>
<tr>
<td>None</td>
<td>31</td>
<td>30.4</td>
</tr>
</tbody>
</table>

**Table 3.—Abdominal Aortic Aneurysm: Physical Signs**

<table>
<thead>
<tr>
<th>Sign</th>
<th>Patients</th>
<th>Per cent of 102 patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expansile, pulsatile abdominal mass</td>
<td>90</td>
<td>88.3</td>
</tr>
<tr>
<td>Thrill or bruit</td>
<td>29</td>
<td>28.4</td>
</tr>
<tr>
<td>Nonpulsatile abdominal mass</td>
<td>3</td>
<td>2.9</td>
</tr>
<tr>
<td>Other aneurysm</td>
<td>2*</td>
<td>2.0</td>
</tr>
<tr>
<td>Anemia</td>
<td>2</td>
<td>2.0</td>
</tr>
<tr>
<td>Abdominal rigidity</td>
<td>1</td>
<td>1.0</td>
</tr>
<tr>
<td>None</td>
<td>7</td>
<td>6.9</td>
</tr>
</tbody>
</table>

*1 patient with a popliteal aneurysm and 1 patient with bilateral fusiform dilatation of the femoral arteries.

**Figure 1.** Anteroposterior view of the abdomen showing a soft-tissue mass (abdominal aortic aneurysm) to the left of the vertebral column with scattered plaques of calcification in the wall of the aneurysm.

ROENTGENOGRAPHIC EVIDENCE

Appropriate roentgenograms were obtained in 78 of the 102 cases. In 67 of the 78 cases (85.9 per cent) the roentgenograms disclosed evidence pathognomonic of or compatible with the diagnosis of abdominal aortic aneurysm. In 11 of the 78 cases (14.1 per cent) roentgenograms did not disclose any abnormality. The most prevalent roentgenologic observation was that of scattered plaques of calcification in the wall of the aneurysm or in the aorta. This occurred in 52 of the 67 cases (77.6 per cent). The presence of a soft-tissue mass, aneurysm, or enlarged aorta was the roentgenographic evidence in 36 cases (53.7 per cent). Curvilinear, linear, or laminated calcification was shown in 8 cases (11.9 per cent) and erosion
of bone (vertebra) in 5 cases (7.5 per cent). Displacement of the esophagus, stomach, duo-
denum, and left ureter occurred in 4 patients, respectively. The types of roentgenographic
evidence noted in this study are illustrated in figures 1, 2, 3 and 4. Fluoroscopic examination
in suspected cases of abdominal aortic aneu-
rysm was of no significant value except in
occasional cases showing displacement of cer-
tain viscera after the ingestion of barium.

Blakemore emphasized the low incidence of
erosion of vertebral bodies in his series of 32
abdominal aortic aneurysms. There was 1 such
instance in his 26 cases of arteriosclerotic aneu-
rysm while there were 4 instances of such ero-
sion in his 12 cases of syphilitic aneurysm.
Erosion of bone was present in only 5 of 67
cases referred to in a preceding paragraph.

Surgical Exploration

Surgical exploration was carried out in 15
cases; in only 2 of these cases was a therapeutic
procedure performed. One of these procedures
consisted of wrapping the aneurysm with cello-
phone. In this case the patient committed suicide after three years because of severe pain.
The second patient had partial ligation of the
aneurysm with fascia lata. This individual died
four years later of myocardial infarction.

The usual finding on surgical exploration
was a diffuse aneurysmal dilatation of the aorta

![Fig. 2a. Anteroposterior and, b, lateral views of the lumbar part of the spinal column and the abdomen disclosing a soft-tissue mass with curvilinear calcification.](image1)

![Fig. 3. The esophagus and stomach, containing barium, are displaced to the left by an aneurysm which lies mainly to the right of the vertebral column.](image2)
presence of an aneurysm; therefore, surgical
treatment of the aneurysms of these patients
was not contemplated preoperatively.

Fig. 4a. Anteroposterior and, b, lateral views of the thorax and upper part of the abdomen; c, anteroposterior view of the abdomen. These disclose aneurysms of the thoracic and abdominal aorta, erosion of the anterior surface of the twelfth dorsal vertebra, and an abdominal aneurysm that contains curvilinear and scattered calcification.

### Table 4.—Abdominal Aortic Aneurysm: Survival after the Time of Diagnosis

<table>
<thead>
<tr>
<th>Period, years</th>
<th>Patients*</th>
<th>Survived beyond indicated period</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>Patients traced</td>
</tr>
<tr>
<td>1</td>
<td>102</td>
<td>91</td>
</tr>
<tr>
<td>2</td>
<td>84</td>
<td>74</td>
</tr>
<tr>
<td>3</td>
<td>74</td>
<td>63</td>
</tr>
<tr>
<td>4</td>
<td>62</td>
<td>52</td>
</tr>
<tr>
<td>5</td>
<td>46</td>
<td>37</td>
</tr>
<tr>
<td>8</td>
<td>25</td>
<td>20</td>
</tr>
<tr>
<td>10</td>
<td>11</td>
<td>8</td>
</tr>
</tbody>
</table>

* Inquiry as of January 1, 1949. [The one-year group comprises those patients whose aneurysm was diagnosed one or more years prior to the time of inquiry, that is, in 1947 or earlier; the five-year group comprises those patients whose aneurysm was diagnosed in 1943 or earlier, and so forth.]

### Prognosis

In this study the prognosis is stated in terms of survival of the patient after establishment of the diagnosis of an abdominal aortic aneurysm at the clinic. It is recognized that the patients may have had an aneurysm for months or years before the diagnosis was made. However, it is very difficult to state prognosis in terms of survival from the onset of symptoms because, first, some patients (30.4 per cent in the present series) are asymptomatic at the time a diagnosis of abdominal aortic aneurysm is made and, second, it is not always possible to be reasonably certain that an individual’s symptoms are due to aneurysm.

Sixty-seven per cent of the traced patients survived one year or longer, following the diagnosis of an abdominal aortic aneurysm at the clinic, 49.2 per cent survived three years or longer and only 18.9 per cent five years or longer (table 4). No patient in this series survived for ten years after diagnosis, but data on only 8 traced patients were available for the study of ten-year survival. The survival rate for the patients who were asymptomatic at the time of diagnosis was no better than the survival rate of patients who had symptoms. The survival rate was much lower than that of the normal population of age 65 years (fig. 5). The latter age was used inasmuch as the mean age of the 102 patients was also 65 years.

The cause of death was ascertained in 49 of the 64 patients known to be deceased. Thirty-one of the 49 patients (63.3 per cent) died from rupture of the aneurysm and 18 (36.7 per cent) died from other causes.

By way of comparison, Kampmeier reported that the duration of symptoms before death was six months or less in 61.3 per cent of 57 patients; twelve months or less in 87.7 per cent, and twelve months to three years in 10.5
per cent. Death was due to aneurysmal rupture in 31 of 38 patients (81.6 per cent). Scott stated that 70 per cent of his 96 patients were dead in thirty-six months and that 17 per cent survived five years. Pratt-Thomas found that the average length of life after onset of symptoms was six months in 14 of his 17 cases.

In 6 of the 102 cases considered in the present study the records were considered to contain unquestionable evidence that the patient’s symptoms were due to leakage of the aneurysm. These records were studied from the standpoint of survival after such an incident.

**Summary**

An analysis of 102 cases of abdominal aortic aneurysm is presented. Arteriosclerosis was the etiologic basis for aneurysm in 97 cases in this series. Only 27.5 per cent of the patients were less than 60 years of age at the time of diagnosis and only 6.9 per cent were less than 50 years of age. The mean age was 65 years. A difference existed between males and females in respect to the incidence of hypertension. This difference lay in the age group of 60 to 69 years, in which 80 per cent of the women and

---

*Fig. 5. Survival rates for traced patients who had abdominal aortic aneurysm as compared to the survival rates of the normal population of age 65 years.*

A great variation was found but in general the prognosis was poorer than that for the entire series. One patient died on the day of onset of symptoms. One patient survived only five days, 2 survived four weeks, 1 survived six months and 1 survived for four years. The last-mentioned patient underwent surgical exploration because of her symptoms, and a large retroperitoneal hemorrhage was discovered. Surgical repair of the aneurysm was not attempted. She then lived for four years before she died of aneurysmal rupture.*

---

* I am indebted to Dr. Joseph Berkson and Mr. Robert P. Gage, Section on Biometry and Statistics, 39.4 per cent of the men had hypertension. The most common symptoms were abdominal pain and abdominal mass, but nearly a third of the patients had no symptoms. The most common physical signs were the presence of an expansile, pulsatile abdominal mass and a thrill or bruit. Roentgenograms disclosed scattered calcification in the aneurysm or in the aorta in slightly more than three-fourths of the cases, and a soft-tissue mass, aneurysm, or enlarged aorta in a little more than half the cases. The
ABDOMINAL AORTIC ANEURYSM

survival rate for traced patients was much lower than that for the general population.

REFERENCES
Abdominal Aortic Aneurysm: A Study of One Hundred and Two Cases
J. EARLE ESTES, JR.

Circulation. 1950;2:258-264
doi: 10.1161/01.CIR.2.2.258

Circulation is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
Copyright © 1950 American Heart Association, Inc. All rights reserved.
Print ISSN: 0009-7322. Online ISSN: 1524-4539

The online version of this article, along with updated information and services, is located on the World Wide Web at:
http://circ.ahajournals.org/content/2/2/258

Permissions: Requests for permissions to reproduce figures, tables, or portions of articles originally published in Circulation can be obtained via RightsLink, a service of the Copyright Clearance Center, not the Editorial Office. Once the online version of the published article for which permission is being requested is located, click Request Permissions in the middle column of the Web page under Services. Further information about this process is available in the Permissions and Rights Question and Answer document.

Reprints: Information about reprints can be found online at:
http://www.lww.com/reprints

Subscriptions: Information about subscribing to Circulation is online at:
http://circ.ahajournals.org//subscriptions/