Increasing Trends in Mortality Rate of Aortic Aneurysms in Japan, 1955–90

YAO-HUA HU, HIROYUKI SHIMIZU, NORITO KAWAKAMI, NAOYOSHI TAKATSUKA, MASAYO IDO and HAJIME HIROSE *

Department of Public Health and *Department of Surgery, Gifu University School of Medicine, Gifu 500

HU, Y.H., SHIMIZU, H., KAWAKAMI, N., TAKATSUKA, N., IDO, M. and HIROSE, H. Increasing Trends in Mortality Rate of Aortic Aneurysms in Japan, 1955–90. Tohoku J. Exp. Med., 1993, 171 (3), 221–228 — To know the characteristics of mortality from aortic aneurysms in Japan, the age-adjusted and age-specific mortality rates of the diseases were calculated based on the Vital Statistics of Japan published from the Statistics and Information Department, Minister's Secretariat, Ministry of Health and Welfare. The overall age-adjusted mortality rate increased 24.8-fold from 0.43 to 10.98 per 100,000 for males, and 18.6-fold from 0.23 to 4.54 per 100,000 for females from 1955–90. The most common type was abdominal aortic aneurysms followed by dissecting and thoracic aortic aneurysms. The mortality rates of dissecting and thoracic aortic aneurysms increased greater than that of abdominal aortic aneurysms. The mortality rate of dissecting aneurysms was higher than that of abdominal and thoracic aortic aneurysms in age groups of 64 years or under. The mortality rate of abdominal aortic aneurysms was the most common in age groups of 65 years or over. ——— mortality; aortic aneurysms

It is reported that mortality rate of abdominal aortic aneurysms has increased, whereas the rates of dissecting and thoracic aortic aneurysms have decreased in recent decades in England and Wales, the USA and Western Australia (Castleden et al. 1985; Lilienfeld et al. 1987; Fowkes et al. 1989). Hirayama reported that the number of deaths due to aortic aneurysms has sharply increased in Japan from 1955–90 (Hirayama 1992). He also reported that the increasing trends in deaths from dissecting and thoracic aortic aneurysms were greater than that from abdominal aortic aneurysms, although he did not show the mortality rates. We calculated the age-adjusted mortality rates of the disease according to type of aneurysms in Japan comparing those in England and Wales, and the USA.

MATERIALS AND METHODS

We obtained number of deaths from aortic aneurysms and population, 1955–90, by sex and age from the Vital Statistics in Japan. We defined the following diseases as aortic aneurysms based on the International Classification of Diseases (ICD) diagnostic codes: ICD

Received August 11, 1993; revision accepted for publication September 30, 1993.

221
451 (unsyphilitic and dissecting aortic aneurysms) (during 1955–69); 441.0 (dissecting aortic aneurysm), 441.1 (thoracic aortic aneurysm), 441.2 (abdominal aortic aneurysm), 441.9 ('other' types: aortic aneurysms, aortic dilatation, aortic hyaline necrosis and aortic rupture) (during 1970–78); and 441 (aortic aneurysms) (during 1979–90). Aortic aneurysms due to syphilis were excluded from the analyses. Numbers of deaths from aortic aneurysms by type (dissecting, thoracic and abdominal) were available only from 1970–78.

Number of deaths from aortic aneurysms and population in England and Wales were obtained by 5-year age group from OPCS (Office of Population Census Survey) Mortality Statistics in England and Wales in 1970, 1978 and 1989.

Number of deaths from aortic aneurysms in the USA were obtained by type, sex, age and race from the Vital Statistics in the United States in 1965, 1970, 1975, 1980 and 1985, but only the whole population of the USA was obtained from the Survey of International Statistics edited by the Statistic Bureau of Prime Minister's Office in the same years described above. Since number of deaths from aortic aneurysms by age in each type and the population by age in each race were not obtained, the age-adjusted mortality rates of aortic aneurysms by type and race in the USA could not be calculated. However, we could calculate the ratios of the number of deaths from aortic aneurysms to that from thoracic ones by sex and race. The mortality rates of aortic aneurysms in three areas and periods were adjusted to the world population.

**RESULTS**

Fig. 1 shows that the age-adjusted mortality rates of aortic aneurysms rose steadily throughout the study period in Japan. The rate increased 24.8-fold from 0.43 to 10.98 per 100,000 for males, and 18.6-fold from 0.23 to 4.54 per 100,000 for females. The increasing percentage was relatively higher in the early period than that in recent two decades. The rates increased 24.7% for males and 19.2% for females from 1955–69, and 6.3% and 6.7% from 1970–90, respectively.

The most common type was abdominal aortic aneurysms followed by dissecting and thoracic aortic aneurysms in both sexes during 1970–78 (Table 1).

Table 1 also shows that the age-adjusted mortality rates of dissecting and thoracic aortic aneurysms sharply increased from 1970–78 in Japan, and the increased percentage was 77.3% and 61.0%, respectively. The age-adjusted

![Fig. 1. Age-adjusted mortality rates of aortic aneurysms in Japan from 1955–90.](image)

---

**Fig. 1. Age-adjusted mortality rates of aortic aneurysms in Japan from 1955–90.**

---

males; females.
mortality rate of abdominal aortic aneurysms also increased, but the increased percentage was not so remarkable compared with the other two types. On the contrary, the rate of 'other' types of aortic aneurysms decreased from 1970–78.

The age-specific mortality rates of the three types of aortic aneurysms showed somewhat different patterns (Table 2). The mortality rate of dissecting aneurysms was higher than that of abdominal and thoracic aortic aneurysms in age groups of 64 years or under. The mortality rate of abdominal aortic aneurysms

<table>
<thead>
<tr>
<th>Type</th>
<th>Rate (per 100,000)</th>
<th>Increased %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1970</td>
<td>1978</td>
</tr>
<tr>
<td>Dissecting</td>
<td>0.66(117)</td>
<td>1.17(278)</td>
</tr>
<tr>
<td>Thoracic</td>
<td>0.41( 68)</td>
<td>0.66(140)</td>
</tr>
<tr>
<td>Abdominal</td>
<td>1.58(195)</td>
<td>2.21(357)</td>
</tr>
<tr>
<td>Other</td>
<td>0.74(118)</td>
<td>0.62(118)</td>
</tr>
<tr>
<td>Total</td>
<td>3.39(498)</td>
<td>4.66(893)</td>
</tr>
</tbody>
</table>

*Standardized to the world population.
Figures in parentheses show the number of deaths.

Table 2. Crude mortality rates of aortic aneurysms by type in Japan, 1978 (per 100,000)

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Dissecting</th>
<th>Thoracic</th>
<th>Abdominal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
<td>Male</td>
</tr>
<tr>
<td>30-34</td>
<td>0.08</td>
<td>0.04</td>
<td>0.02</td>
</tr>
<tr>
<td>35-39</td>
<td>0.09</td>
<td>0.07</td>
<td>0.04</td>
</tr>
<tr>
<td>40-44</td>
<td>0.29</td>
<td>0.07</td>
<td>0.05</td>
</tr>
<tr>
<td>45-49</td>
<td>0.41</td>
<td>0.20</td>
<td>0.15</td>
</tr>
<tr>
<td>50-54</td>
<td>1.04</td>
<td>0.20</td>
<td>0.12</td>
</tr>
<tr>
<td>55-59</td>
<td>1.32</td>
<td>0.45</td>
<td>0.50</td>
</tr>
<tr>
<td>60-64</td>
<td>1.76</td>
<td>0.62</td>
<td>0.98</td>
</tr>
<tr>
<td>65-69</td>
<td>3.31</td>
<td>0.85</td>
<td>2.01</td>
</tr>
<tr>
<td>70-74</td>
<td>3.87</td>
<td>1.76</td>
<td>2.47</td>
</tr>
<tr>
<td>75-79</td>
<td>2.89</td>
<td>1.99</td>
<td>2.64</td>
</tr>
<tr>
<td>80-84</td>
<td>3.48</td>
<td>1.33</td>
<td>2.14</td>
</tr>
<tr>
<td>85+</td>
<td>2.70</td>
<td>1.60</td>
<td>1.35</td>
</tr>
<tr>
<td>Total*</td>
<td>0.49</td>
<td>0.23</td>
<td>0.25</td>
</tr>
</tbody>
</table>

*Including age groups 29 years of age or less.
was the most common in age groups of 65 years or over. The pattern of the age-specific mortality rate in 1978 was consistent with that in 1970. The mortality rate of dissecting aortic aneurysm markedly increased in 45-74 years old, and the mortality rates of thoracic and abdominal aortic aneurysms due to increase in 65 years old or over from 1970-78.
The age-adjusted mortality rates of aortic aneurysms increased at least these two decades also in England and Wales (Table 3). In 1989 the rate of all aortic aneurysms in England and Wales was about 4-fold higher than that in Japan (10.54 per 100,000 in males, 4.21 per 100,000 in females) for both sexes. The most common type of aortic aneurysms in England and Wales was abdominal aortic aneurysms in both males and females.

There are some similarities in the age distribution of the mortality rates of aortic aneurysms between England and Wales and Japan. In England and Wales the mortality rate of dissecting aortic aneurysms was higher than those of abdominal and thoracic aortic aneurysms in 65 years old or less for males, and in 75 years old or less for females. The mortality rate of dissecting aortic aneurysms sharply decreased in age groups of 55-74 years old in both sexes from 1978-89. The increase in the mortality rates of thoracic and abdominal aortic aneurysms were due to the increase in 65 years old or over in both sexes.

In the USA the overall age-adjusted mortality rate of aortic aneurysms was high in 1970 compared with that in 1965 for males, although the rate decreased from 1970-85 (Table 4). The rate was almost stable for females from 1965-85. The overall age-adjusted rates in the USA were less than those in Japan (8.2 per 100,000 in males, 3.4 per 100,000 in females) for both sexes in 1985.

Table 5 shows that the ratio of the number of deaths from abdominal aortic aneurysms to that from thoracic aortic aneurysms is approximately 8 : 1 in England and Wales, and the USA white males, while 2 to 3 : 1 in Japanese and the USA nonwhite males.

**Discussion**

The age-adjusted mortality rates of aortic aneurysms in Japan have increased in recent decades. The most predominant type was abdominal aortic aneurysms followed by dissecting and thoracic aortic aneurysms, although the latter two types showed larger percentage increase than the abdominal ones. It is possible that the improvement in diagnosis and better surgical techniques after the mid-1960s (Melton et al. 1984) is responsible for the observed increase in aortic aneurysms in Japan. However, the age-adjusted mortality rates of aortic aneurysms for males showed a greater increase than that for females. The sex difference suggests that the increasing mortality rates of aortic aneurysms in Japan be not all due to the diagnostic techniques. We also observed a decline in the rate of the 'other' types of aortic aneurysms. The 'other' types may include aneurysms at unknown or undescribed sites. The decrease in the 'other' types may be due to the progress of medical diagnostic techniques: physicians may have been able to describe the site or type of aortic aneurysms more precisely in recent years.

Our results from the age distribution confirmed that dissecting aortic aneurysms occur in younger ages compared with abdominal and thoracic aortic aneurysms (Sabiston 1986). Atherosclerosis is a major cause of the coronary heart
disease (CHD), stroke, and aortic aneurysms (Ross and Glomset 1976). However, the mortality rates of aortic aneurysms, CHD, stroke did not show the same trends: the mortality rate of abdominal and thoracic aortic aneurysms increased in Japan and England and Wales, and the mortality rates of these two types of aortic aneurysms were stable in the USA (Lilienfeld et al. 1987), although the mortality rates of CHD and stroke decreased in these three countries (Melton et al. 1984; Horibe et al. 1990). Although blood pressure and serum cholesterol were the strongest and the most consistent predictors of atherosclerosis in both the coronary arteries and aortas (Reed et al. 1987), there may be some other risk factors associated only with death from aortic aneurysms. The process of development from atherosclerosis to rupture of aortic aneurysms may be longer and more complicated than that from atherosclerosis to infarction of coronary arteries.

Epidemiologic studies have also demonstrated a 2 to 8-fold increased risk of aortic aneurysms in heavy smokers compared to nonsmokers (Hirayama 1992; Reed et al. 1992). However, in Japan the sharply increasing mortality rates of aortic aneurysms were inconsistent with a declining trend for the proportion of smokers during the same period (Ministry of Health and Welfare 1993). It is well known that the mortality rate of lung cancer has increased regardless of decrease in the proportion of smokers in Japan, but the rates have already declined in England and Wales and the USA along with earlier and quicker decreasing trends in the proportion of smokers (Royal College of Physicians of London 1977; Ernster 1988). The effect of decreased proportion of smokers on the development and rupture of aortic aneurysms may be appeared a few decades after beginning of the change. We may have to wait for the decreasing trend in Japan until early period of the next century.

Hypertension is also confirmed as main and potential risk factor for the rupture of aortic aneurysms (Lilienfeld et al. 1987). However, it is unlikely to explain our findings, since the prevalence rate of hypertension in Japan has decreased in recent decades (Fujishima et al. 1992).

On the other hand, the proportion of the mortality rates of aortic aneurysms by type in Japanese males was different from those in England and Wales, and the USA white males. Abdominal aortic aneurysms were the predominant cause of aortic aneurysm mortality in white males. There is a possibility that an innate susceptibility difference among races as well as its interaction with environmental factors contribute to the difference in development and rupture of abdominal aortic aneurysms. Furthermore, we cannot explain the reason why the mortality rates of aortic aneurysms in England and Wales were much higher than those in the USA white in both sexes, while the ratio of abdominal aortic aneurysms to thoracic aortic aneurysms is the same. It is also reported that incidence rate of abdominal aortic aneurysms increased in the two countries (Melton et al. 1984; Fowkes et al. 1989). There may be some specific factors which contribute to the rupture of aortic aneurysms in England and Wales. Where the mortality rates of
Aortic Aneurysms in Japan

ischemic heart diseases and cerebrovascular diseases are also high compared with those in the USA (Health and Welfare Statistics Association 1992). One of the possibility is a traditional type of diet in England and Wales, e.g., per capita consumption of fruits and vegetables in England and Wales were much lower than that in the USA in 1970s (The Organization for Economic Cooperation and Development 1978).

We calculated the age-adjusted prevalence rate of asymptomatic aortic aneurysms in Japan based on the Annual of the Pathological Autopsy Cases in Japan. This analysis did not show an increase in the prevalence rate from 1955-89 (unpublished data). The observed increase in the mortality rate in Japan might be due to increase in risk of growing and/or rupture of aortic aneurysms.

Acknowledgments

We thank Dr. Y. Arai and Dr. C. Nagata for their assistance in getting the data from England and Wales and the USA.

References


