Screening for Abdominal Aortic Aneurysms and Associated Risk Factors in a General Population

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Objectives: To evaluate the prevalence of abdominal aortic aneurysms (AAA) in a general population and to compare the results with those of similar studies in other countries.

Design: Ultrasound screening study and collection of clinical and biochemical data.

Setting: An urban Health Service District in Genoa, Italy.


Results: 1601 subjects (741 males and 860 females) out of 2734 invited (58.5%) were evaluated. According to the ultrasound findings, 27 patients (1.7%) had an aortic dilatation of 26-29 mm; an AAA of 30-39 mm was found in 37 (2.3%) and an AAA > 40 mm in 33 (2.1%). The overall prevalence for AAA was 4.4% (8.8% in males and 0.6% in females respectively). The prevalence of smoking, alcohol consumption, coronary heart disease, chronic obstructive pulmonary disease and arterial disease were significantly higher in patients with AAA (p < 0.01).

Conclusions: Ultrasound screening for AAA is a reliable and useful method and should be focused on men, regardless of concurrent disease.

Key Words: Abdominal aortic aneurysm; Ultrasound screening; Risk factors.

Introduction

A screening program in a general population in northern Italy is reported with the aim of evaluating the prevalence of abdominal aortic aneurysms (AAA) and associated cardiovascular risk factors and comparing our data with those of other authors in different countries.

Materials and Methods

A personal letter of invitation was sent to all the subjects of one Health Service District in Genoa aged 65-75 years under the care of participating GPs. Similar leaflets were posted in the GPs' offices and in the out-patient clinics of the same area. Those who accepted were first interviewed by their GP according to a survey that covered medical history, current therapy, smoking and alcohol habits, basic clinical data (blood pressure, heart rate, body weight and height) and then given an appointment for the additional tests.

Arteriopathy was defined as claudication (PAOD), previous transient ischaemic attacks or stroke (TIA); coronary heart disease (CHD) as angina or previous myocardial infarction; dyslipidaemia as total cholesterol > 240 mg/dl or triglycerides > 250 mg/dl; chronic obstructive pulmonary disease (COPD) as asthma, emphysema or chronic bronchitis; hypertension as diastolic pressure > 100 mmHg and/or medical treatment.

Abdominal ultrasound scans were performed at a local outpatient clinic by two radiologists from our University (C.P. and R.P.), using a B-mode linear ultrasonography machine (Toshiba SAL 30). The maximal anteroposterior (AP) and transverse (LL) diameters of the suprarenal (S) and infrarenal (I) aorta were measured in each patient. All measurements were performed by the two radiologists independently and then expressed as a mean.

AAA was defined as any aortic dilatation > 29 mm in either the AP or the LL plane. All cases with an aortic diameter > 25 mm were registered. All patients...
Table 1. Results of the ultrasound screening. Values are mean and (s.d.)

<table>
<thead>
<tr>
<th>Group</th>
<th>No. patients</th>
<th>%</th>
<th>Anteroposterior</th>
<th>Transverse</th>
<th>Anteroposterior</th>
<th>Transverse</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1504</td>
<td>93.94</td>
<td>16.6 (2.7)</td>
<td>18.5 (2.9)</td>
<td>14.7 (2.6)</td>
<td>16.5 (2.8)</td>
</tr>
<tr>
<td>B</td>
<td>27</td>
<td>1.68</td>
<td>20.8 (3.7)</td>
<td>22.4 (3.7)</td>
<td>22.9 (3.8)</td>
<td>26.4 (2.8)</td>
</tr>
<tr>
<td>C</td>
<td>37</td>
<td>2.31</td>
<td>21.8 (4.5)</td>
<td>23.5 (4.5)</td>
<td>28.6 (4.6)</td>
<td>31.1 (3.7)</td>
</tr>
<tr>
<td>D</td>
<td>33</td>
<td>2.06</td>
<td>23.0 (4.1)</td>
<td>24.4 (4.4)</td>
<td>46.5 (8.8)</td>
<td>49.2 (9.9)</td>
</tr>
</tbody>
</table>

with an enlarged aorta (> 25 mm) were subsequently evaluated at the University Dept. of Radiology by the same radiologists under the supervision of a senior (G.C.) using a more advanced ultrasound scanner (Esaote Biomedica AU 450). Those with confirmed aortic dilatation > 25 mm were then seen by the clinical study coordinator (G.S.). Patients with AAA < 40 mm were followed up at 6 month intervals with further scans. Patients with AAA > 40 mm, those with an expansion rate > 5 mm in 6 months and those with symptoms were evaluated for surgical repair.

**Statistical analysis**

Data are summarised as mean and standard deviation (s.d.) for continuous, and as frequency tables for qualitative variables.

The analysis of the risk factors took into account only patients with AAA ≥30 mm vs. those with normal aortic size, excluding the grey area ranging from 26–29 mm.

Statistical analysis was performed using the Student's t-test and the chi-square test with significance declared at the 5% level.

**Results**

Between March 1991 and March 1994, 2734 patients from 26 GPs were invited to enter the study; 1601 (58.5%) with mean age 69 (s.d. = 3) years, accepted (741 males and 860 females).

The patients were classified into four groups according to abdominal ultrasound results: (A) normal aortic size, (B) aortic dilatation 26–29 mm, (C) AAA 30–39 mm, (D) AAA > 40 mm. Results are shown in Table 1. The mean age was 69.3 (s.d. = 3.0) in group A, 69.7 (s.d. = 2.7) in B, 69.2 (s.d. = 3.1) in C and 70.1 (s.d. = 2.7) in D. Taking into account groups B + C + D (97 patients) and groups C + D (70 patients), the overall prevalence of AAA was 6.1% and 4.4%, respectively. For AAA > 29 mm the prevalence was 8.8% (65 patients) for the males and 0.6% (five patients) for the females.

In the group with AAA ≥ 40 mm (32 males and one female) 24 underwent elective surgical repair (one death occurred in the postoperative period from acute respiratory distress syndrome), four refused surgery for personal reasons and five were considered unfit for surgery. Among these latter, one died from myocardial infarction (70 mm), one from stroke (42 mm), two ruptured (110 mm, 56 mm) at 1, 8, 22 and 24 months of follow-up, respectively.

In the group with AAA of 30–39 mm (33 males and four females) six patients with AAA increasing to more than 40 mm (18 months) underwent successful elective surgery; two refused follow-up and two died from concurrent neoplasms at 3 and 9 months. The remaining 27 patients are currently undergoing regular ultrasound follow-up. Among the 27 patients (22 males and five females) with an ectatic aorta (26–29 mm), two refused the follow-up and one died from stroke at 28 months; the remaining 24 are undergoing regular follow-up.

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Smoking, alcohol consumption, coronary heart disease, chronic obstructive pulmonary disease and arterial diseases were found to be statistically more prevalent (p < 0.001) in patients with AAA compared to those without AAA. The mean blood pressure was 144/83 mmHg in the patients with normal aortic size and 150/83 mmHg in patients with AAA. An electrocardiogram was performed in 850 patients (414 males and 436 females), classified according to the main groups of the Minnesota code, and confirmed the clinical data on cardiac disease showing a significant difference between 778 normal subjects and 53 patients in group C + D (p < 0.001) (Table 2).

**Discussion**

The prevalence of AAA has shown an increasing trend...
Table 2. Associated risk factors in 1504 subjects with normal aortic size and 70 with AAA > 29 mm

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Normal (%)</th>
<th>AAA (%)</th>
<th>x2</th>
<th>d.f.</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smokers</td>
<td>No</td>
<td>59.7</td>
<td>11.3</td>
<td>66.57</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Ex</td>
<td>25.8</td>
<td>49.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>14.5</td>
<td>39.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alcohol</td>
<td>No</td>
<td>58.6</td>
<td>35.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>41.4</td>
<td>64.9</td>
<td>14.31</td>
<td>1</td>
</tr>
<tr>
<td>Arteriopathy</td>
<td>TIA</td>
<td>3.1</td>
<td>2.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>PAOD</td>
<td>9.8</td>
<td>23.7</td>
<td>15.42</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>87.1</td>
<td>74.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHD</td>
<td>No</td>
<td>83.2</td>
<td>62.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>16.8</td>
<td>37.1</td>
<td>18.94</td>
<td>1</td>
</tr>
<tr>
<td>ECG</td>
<td>Normal</td>
<td>58.2</td>
<td>28.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Abnormal</td>
<td>41.8</td>
<td>71.7</td>
<td>18.06</td>
<td>1</td>
</tr>
<tr>
<td>Dyslipidoæmia</td>
<td>No</td>
<td>66.9</td>
<td>64.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>33.1</td>
<td>35.1</td>
<td>0.20</td>
<td>1</td>
</tr>
<tr>
<td>Diabetes</td>
<td>No</td>
<td>85.9</td>
<td>85.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>14.1</td>
<td>14.1</td>
<td>0.002</td>
<td>1</td>
</tr>
<tr>
<td>COPD</td>
<td>No</td>
<td>91.6</td>
<td>68.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>8.4</td>
<td>32.0</td>
<td>41.72</td>
<td>1</td>
</tr>
<tr>
<td>Hypertension</td>
<td>No</td>
<td>55.8</td>
<td>45.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>44.2</td>
<td>54.3</td>
<td>2.74</td>
<td>1</td>
</tr>
</tbody>
</table>

AAA = abdominal aortic aneurysm; TIA = transient ischaemic attacks; PAOD = arteriopathy; CHD = coronary heart disease; COPD = chronic obstructive pulmonary disease.

over the last few decades (4.7/100 000 subjects in 1951, 31.9/100 000 in 1980) and this situation does not seem related to more reliable diagnostic methods alone.2

The natural history of AAA shows a trend towards expansion and rupture according to the initial size.3-6 Unfortunately, the treatment of associated risk factors does not significantly modify this trend, even if the use of β-blockers may be helpful in controlling the growth of aortic aneurysms7 and stopping smoking may reduce the risk of death.8

The efficacy of screening programme for asymptomatic AAA has already been emphasised by many authors from different countries.9-12 Our results confirm the findings. An attendance of 58.5% is in the range of the other studies13-21 on healthy populations (46%-79%), but was probably affected by the unexpectedly low acceptance rate of local GPs. This may reflect the behaviour of some practitioners who do not tolerate 'interference' with their practices or who simply consider screening programmes as academic studies rather than reliable means for prevention.

Although the criteria both for patient selection and the definition of AAA13-21 differ, our prevalence data are in keeping with those of the literature. Our overall prevalence for AAA > 29 mm (4.4%) is remarkably similar to that of Scott et al.20 who screened over 8000 subjects of both sexes aged 65-80. Moreover, the prevalence for males (8.8%) in our series fits with similar screening programmes (range 5.4%-10.7%) and underlines the very low prevalence in females (0.6%).

Risk factors have not been reported in all the series on healthy population. There is general agreement on smoking8,14-16,18,21 but few studies have shown a statistical significance for CHD,14,16,21 COPD,14,21 arterial disease,14,21 and alcohol consumption.14 Only Krohn et al.16 have reported hypertension as a main risk factor, but the contrary has been asserted by others14,20,21 and none have indicated dyslipidaemia.14,16 These two last findings are consistent with the emerging thought that atherosclerotic and aneurysmal diseases must be distinguished as two different entities,22 and that hypertension plays a major role in the expansion of the AAA rather than in its pathogenesis.23,24 Our results confirm a statistical significance for the risk factors above.

The final issues concern which subjects to screen and when to operate. Regarding the former, we have based our selection on reports in the literature which indicate that the population aged 65-75 is that most likely to benefit to the greatest extent, from screening in terms of life expectancy. The second question is more open to debate. Given that results of ongoing U.K. and Canadian trials on the management of small AAA are not yet available, we opted to operate on AAA ≥ 40 mm.25,26

In conclusion, the results of our screening study show a prevalence of asymptomatic AAA in a general population in our area, which is comparable to that of similar series carried out in other European countries.

Acknowledgements

The authors express their gratitude to Mrs N. Defraia for her secretarial support and to Mrs V. Novelli and Mrs R. Porta for their technical contribution.

The authors thank Pierrel-Milan, EMAC-Genoa, Vascutek-Rome and Polaroid-Genoa for their financial and technical support.

References


Accepted 1 December 1994