REVIEW

Screening abdominal aorta aneurysm during echocardiography: Literature review and proposal for a French nationwide study

Dépistage de l’anévrisme de l’aorte abdominale durant l’échocardiographie : revue de la littérature et proposition d’une étude multicentrique française

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Summary Several international guidelines, including those in France, recommend the screening of abdominal aorta aneurysm (AAA) by ultrasound in high-risk populations. However, this preventive screening strategy is poorly implemented. Many patients who undergo transthoracic echocardiography (TTE) are at risk of AAA as defined by the guidelines, and the cardiac ultrasound machines and probes fit perfectly for AAA screening. In this literature review, we collected data from more than 20,000 patients who underwent screening for AAA during TTE,
Introduction

Ruptured abdominal aorta aneurysm (AAA) is a major, life-threatening condition with a grim prognosis: 70% of patients die before reaching the surgery ward and another 10–15% die during the perioperative period. Hence, the rates of survival at hospital discharge do not exceed 15–20% [1,2]. In the USA, it is estimated that 9000 people die each year from a ruptured AAA [3,4], which corresponds to approximately 12,000 cases in Europe. However, this severe condition is preceded by a long period of silent growth of the aneurysm, which may last for more than 10 years before the occurrence of clinical signs. This is therefore a strong rationale for screening AAA for prompt prophylactic intervention, with much lower mortality and morbidity.

In several countries, published guidelines advocate such screening in subjects at high risk of AAA [5,6]. Owing to its availability, harmlessness and relatively low cost, ultrasound is proposed in all these guidelines as the first-line method for detecting an AAA, usually defined by an aortic diameter > 30 mm [7].

Notably, the majority of people with a small AAA (< 50 mm) do not die from this lesion but from other cardiovascular and general conditions. Several risk factors (smoking, hypertension, etc.) are common to AAAs and other cardiovascular diseases [8,9]. Hence, patients managed by cardiologists for any cardiovascular disease should be considered at higher risk for AAA. By using ultrasound routinely to perform transthoracic echocardiography (TTE), cardiologists could take this opportunity to use the same ultrasound probe to screen systematically their patients for an AAA.

In this literature review, we collected all of the available data on the feasibility and results of AAA screening, and the risk factors for prevalent AAA in patients undergoing TTE. Finally, we propose a multicentre, epidemiological study to assess the prevalence of and risk factors for AAA in patients who benefit from TTE.

Literature data collection

In the PubMed database, we used the terms ‘abdominal aneurysm aorta’, ‘echography’ and ‘cardiac’ or ‘echocardiography’, with date restrictions from 1980 to 2009. We retrieved 220 titles, from which 20 abstracts were retained. Ultimately, we found 11 papers dealing with our topic [10–20], one of which [15] was a case report and was excluded. Overall, we found 10 series [10–14,16–20] of patients who had TTE and benefited from concomitant AAA screening.
of the lesions found during TTE. Bekkers et al. reported only two series [10,19] reported data on the verification (surprisingly) disregarded the distal aorta [12,16]. Notably, while others studied the whole abdominal aorta, or even focused their screening on the infra-renal part of the aorta, rates for those who used larger diameters. Some authors proposed alternate definitions, with a diameter threshold set at 25, 35 or 40 mm, with some authors [10,16] reported associations between AAA and several population [8,9]. Interestingly, in the TTE series, some authors [10,16] reported associations between AAA and several echocardiographic variables, mainly in case of left ventricular hypertrophy and/or dilation [10,16].

In several papers, attempts were made to determine patient subgroups at higher risk of AAA. Even in the series with the lowest rates of AAA, some clinical subgroups presented higher prevalence of this lesion (Table 3). Beyond age [10,11,14,16–20] and male sex [10,11,14,17–20], patients who smoke [14,18,20] or those with a family history of AAA [20], hypertension [14,18] or any clinical atherosclerotic disease [17,19] are at higher risk for AAA. These findings are in line with other screening studies in the general population [8,9]. Interestingly, in the TTE series, some authors [10,16] reported associations between AAA and several echocardiographic variables, mainly in case of left ventricular hypertrophy and/or dilation [10,16].

In summary, AAA screening during echocardiography appears largely feasible, requiring only a short additional time and no extra cost. The prevalence of AAA reported in several series is important, but particularities in each of these single centre series limit the clinical relevance of these findings. Besides, the level of training of the cardiologists who performed these specific studies could be higher than average. A large, multicentre survey that includes cardiologists practising echocardiography in different settings is therefore mandatory, to obtain more accurate data on the prevalence of AAA among attendees of an echocardiography laboratory, and better risk stratification for the presence of this lesion. The determination of risk profiles for AAA could then be useful to propose appropriate guidelines. Beyond the detection of large AAAs requiring intervention, the screening of small AAAs could identify a subset of patients at high risk of cardiovascular disease events.

**Study proposal: A French nationwide study of abdominal aorta aneurysm screening during TTE**

In collaboration with the Council of Echocardiography, the Working Group for Vascular Diseases/Thrombosis of the French Society of Cardiology is going to undertake a nationwide epidemiological survey to assess the prevalence and risk factors for AAA screened systematically during TTE. During a predetermined week, 500 cardiologists who perform

**Literature review**

Regarding the feasibility of abdominal aorta visualization, although no abdominal preparation was considered before TTE, diagnostic quality image yields of 82% [12] to 96% [20] were reported (Table 1). Eight of 10 studies reported the duration of the aorta imaging, mostly below 5 minutes. Only one study [20] reported an average aorta imaging duration of 7.7 minutes (ranging from 1.1 to 20 minutes). Importantly, in that study, the full length of the abdominal aorta was analysed [20], while the AAA is located mostly at the infra-renal segment.

The details of each series, along with the prevalence rates of AAA, are summarized in Table 2. The prevalence of AAA varied substantially from one series to another, ranging from 0.8% in a very large series of more than 14,000 patients [19] to 6.0% in an unselected series of 250 patients [18], and even 6.5% in a series of patients with hypertension [20]. Several reasons may explain these differences: first, while AAA was usually defined by a diameter >30 mm, some authors proposed alternate definitions, with a diameter threshold set at 25, 35 or 40 mm, with *a priori* lower rates for those who used larger diameters. Some authors focused their screening on the infra-renal part of the aorta, while others studied the whole abdominal aorta, or even (surprisingly) disregarded the distal aorta [12,16]. Notably, only two series [10,19] reported data on the verification of the lesions found during TTE. Bekkers et al. reported a good correlation between diameters measured in a couple of large AAAs (>50 mm) by computed tomography scan and ultrasound [10]. In the study by Seelig et al., a high specificity of 9% was reported for the detection of AAA >30 mm [19]. All series are consistent with higher rates in the elderly and in men, whereas the participants mean age and sex ratio varied from one study to another. When study participants were preselected (e.g. according to the presence of hypertension [20]), higher rates of AAA were noted. Similarly, in some series, those with known AAA were excluded logically [17,19], but this was not the case in all series, and often this information was not clearly stated. Finally, unknown cases of AAA may be less frequent in tertiary care units [19]; this issue was raised by the authors of the largest series from the Mayo Clinic [19], who reported the lowest rates of AAA: actually patients referred to them were mostly managed already by other centres, with a higher probability to have their AAA discovered prior to the referral. This is a source of selection bias, which may be relevant to other echocardiography laboratories, depending on its healthcare network.

<table>
<thead>
<tr>
<th>First author, year [study reference]</th>
<th>Aorta imaging success rate (%)</th>
<th>Reported imaging duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eisenberg et al., 1995 [12]</td>
<td>82</td>
<td>≤ 5 minutes</td>
</tr>
<tr>
<td>Schwartz et al., 1996 [18]</td>
<td>86</td>
<td>NA</td>
</tr>
<tr>
<td>Spittell et al., 1997 [20]</td>
<td>96</td>
<td>Average 7.7 minutes (1–20)</td>
</tr>
<tr>
<td>Jaussi et al., 1999 [14]</td>
<td>&gt; 95</td>
<td>≤ 5 minutes</td>
</tr>
<tr>
<td>Giaconi et al., 2003 [13]</td>
<td>91</td>
<td>&lt; 2 minutes</td>
</tr>
<tr>
<td>Bekkers et al., 2005 [10]</td>
<td>93</td>
<td>NA</td>
</tr>
<tr>
<td>Ruggiero et al., 2006 [17]</td>
<td>95</td>
<td>33.8 ± 18.6 seconds</td>
</tr>
<tr>
<td>Roshanali et al., 2007 [16]</td>
<td>91</td>
<td>Average 2.2 minutes (1.1–4.4)</td>
</tr>
</tbody>
</table>

NA: not available.
Table 2  Prevalence of abdominal aorta aneurysm in different series of transthoracic echocardiography.

<table>
<thead>
<tr>
<th>First author, year [study reference]</th>
<th>N</th>
<th>Selection</th>
<th>Age (years)</th>
<th>AAA definition</th>
<th>Aorta segment</th>
<th>Prevalence (men/women)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eisenberg et al., 1995 [12]</td>
<td>323</td>
<td>Unselected</td>
<td>57</td>
<td>&gt; 25 mm</td>
<td>Distal aorta not always visualized</td>
<td>2.0% (8.5/2.5)</td>
<td></td>
</tr>
<tr>
<td>Schwartz et al., 1996 [18]</td>
<td>250</td>
<td>Unselected</td>
<td>—</td>
<td>&gt; 30 mm</td>
<td>?</td>
<td>6.0%</td>
<td></td>
</tr>
<tr>
<td>Spittell et al., 1997 [20]</td>
<td>209</td>
<td>Age &gt; 50 years with HTN</td>
<td>71.3</td>
<td>&gt; 30 mm</td>
<td>Abdominal aorta</td>
<td>6.5% (8.4/4.3)</td>
<td></td>
</tr>
<tr>
<td>Jaussi et al., 1999 [14]</td>
<td>297</td>
<td>Unselected</td>
<td>58.6</td>
<td>&gt; 30 mm</td>
<td>Infra-renal</td>
<td>5.7% (8.2/1.7)</td>
<td>Seven false positive cases (93.5% specificity)</td>
</tr>
<tr>
<td>Seelig et al., 2000 [19]</td>
<td>14,876</td>
<td>Unselected, age &gt; 50 years</td>
<td>68.5</td>
<td>&gt; 30 mm</td>
<td>Not stated</td>
<td>0.8% (1.3/0.2)</td>
<td></td>
</tr>
<tr>
<td>Bernard et al., 2002 [11]</td>
<td>1106</td>
<td>Unselected</td>
<td>61</td>
<td>&gt; 35 mm</td>
<td>Infra-renal</td>
<td>1.0%</td>
<td>81% unknown cases. Prevalence up to 19% in men aged &gt; 70 years. Ten patients with AAA &gt; 5 cm; five underwent abdominal CT scan: diameters correlated well ($r^2 = 0.9$).</td>
</tr>
<tr>
<td>Giaconi et al., 2003 [13]</td>
<td>181</td>
<td>Unselected (?) men</td>
<td>61</td>
<td>≥ 30 mm</td>
<td>?</td>
<td>3.8% (3.8/--)</td>
<td></td>
</tr>
<tr>
<td>Bekkers et al., 2005 [10]</td>
<td>742</td>
<td>Unselected</td>
<td>60.5</td>
<td>&gt; 30 mm</td>
<td>Infra-renal</td>
<td>5.7%</td>
<td></td>
</tr>
<tr>
<td>Ruggiero et al., 2006 [17]</td>
<td>1107</td>
<td>Selected and unselected</td>
<td>—</td>
<td>—</td>
<td>?</td>
<td>5.6%</td>
<td>Only those with history of surgery for AAA excluded</td>
</tr>
<tr>
<td>Roshanali et al., 2007 [16]</td>
<td>1285</td>
<td>Unselected</td>
<td>40.7</td>
<td>&gt; 40 mm</td>
<td>Supra-renal only</td>
<td>3.8% (4.5/3.6)</td>
<td>&gt; 3 cm, 4.9%; &gt; 5 cm, 0.5%</td>
</tr>
</tbody>
</table>

AAA: abdominal aorta aneurysm; CT: computed tomography; HTN: hypertension.
echocardiography routinely will be asked to screen for AAA in at least 10 consecutive patients who match with the inclusion and exclusion criteria. This will lead to the screening of at least 5000 patients undergoing TTE. The cardiologists will be selected on the basis of their willingness to participate into the study; they will be practitioners in public or private institutions or have a private practice. Patients’ inclusion criteria will be all men over the age of 60 years and women over the age of 65 years who undergo TTE for any medical reason.

Figure 1. Abdominal aorta aneurysm screening during transthoracic echocardiography: imaging incidences and measurement protocols.
The protocol, along with the imaging technique (Fig. 1) and standards for the measurement of the abdominal aorta, will be sent to all participant cardiologists. A video clip will also be available on the study website to show the imaging incidences and the measurement standards. Training will be required for those with poor experience of abdominal aorta imaging. The prevalence rate of AAA will be calculated overall, and within gender and age subgroups. It is estimated that the aorta will be measurable in 90% of cases and that the prevalence of AAA > 30 mm will be around 4.5%, which should lead to the screening of 200 unknown cases of AAA. The AAA rates will also be analysed according to the echocardiography laboratory setting, and the indications for cardiac imaging. A multivariate analysis will be performed to detect the risk factors for AAA in this setting.

Conclusions

Screening for AAA by ultrasound is proposed in the general population at risk of this lesion. This review highlights the potential benefit of systematic screening for AAA in patients undergoing TTE. The feasibility exceeds 90%, and the cost is low, given the short amount of time required, with no additional probe or software needs. The prevalence of AAA varies dramatically from one study to another, due not only to lesion definition, population selection and characteristics, but also to the mode of referral to the echocardiography laboratory within the health network, with lower rates in tertiary care centres, due to selection bias. However, the benefit of this screening strategy may be improved by a better profiling of those at risk of AAA. To date, we have not found a report of a multicentre study that combines different healthcare settings. Such a study would be mandatory to propose practical guidelines for the screening of AAA at the end of cardiac imaging during TTE. We present here the design of a large, multi-centre study, which will be undertaken during 2010 in France. We plan the screening of 5000 consecutive patients who undergo TTE for any indication in one of the different participating centres. All cardiologists who perform echocardiography are invited to take part in this pragmatic study.

Conflict of interest statement

None.

References


