Abdominal Aortic Aneurysm Screening During Transthoracic Echocardiography in an Unselected Population

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Objective: **We sought to investigate the echocardiographic prevalence of abdominal aortic aneurysm (AAA) in an unselected group of patients referred for regular transthoracic echocardiography (TTE).**

Methods: **Prospectively, during a 3-month period, a limited ultrasound examination of the infrarenal aorta was performed. AAA was defined as a diameter of 30 mm or more.**

Results: **The abdominal aorta could be visualized in 742 patients. The prevalence of AAA was 4.6%. AAA prevalence increased with age, especially in men. In 34 patients AAA was unknown and aortic diameters exceeded 50 mm in 4 patients. Two underwent elective but urgent operation. Patients with AAA were older and had an increased ascending aorta diameter, larger left ventricular dimensions, higher left ventricular mass index, and lower ejection fraction.**

Conclusion: **AAA is prevalent in patients referred for regular TTE. Routine rapid screening of the abdominal aorta during TTE is beneficial and should, therefore, be part of a standard TTE examination for patients older then 50 years.** (J Am Soc Echocardiogr 2005;18:389-93.)

Abdominal aortic aneurysm (AAA) affects 1% to 2% of the general population but the prevalence increases with aging and other risk factors.[1,2] In men older than 65 years, AAA rupture accounts for 2% of all deaths warranting early detection and operative repair.[3] Half of patients with a ruptured AAA reach the hospital alive with an additional operative mortality of 30% to 60%.[4,5] Sex- and age-standardized mortality of ruptured AAA continues to increase. Elective operation on the other hand, has an associated mortality risk of 2% to 6% and is now recommended in most patients with abdominal aorta diameters exceeding 55 mm.[6,7] Moreover, recent data suggest that the mortality for endovascular AAA repair may be as low as 1%.[8] After successful operation the survival approaches that of the general population.

AAA is mostly asymptomatic and occult on physical examination.[9] Ultrasonographic scanning is a fast, safe, and valid screening method for AAA, with high sensitivity and specificity.[10] Screening for AAA in patients at high risk has been shown to reduce mortality and to be cost-effective in several prospective randomized trials.[11-14] It is, therefore, advocated to start national screening programs in these groups at high risk.[15,16]

However, the efficacy of a population-based screening program depends on compliance and ranges between 51% and 76%.[10,17] Screening of patients for AAA during regular transthoracic echocardiography (TTE) in selected patients has previously been shown to be beneficial, prolonging total examination time only several minutes.[18,19] On the other hand, others have reported that screening during TTE for AAA is not useful because of the low prevalence of the disease.[20]

Currently, there is an increased tendency to start multidisciplinary specialized cardiovascular outpatient clinics in many hospitals with a central role for TTE. The prevalence of AAA in these specialized multidisciplinary cardiovascular outpatient clinics is, therefore, likely to increase.

We conducted this study to investigate the prevalence of AAA in an unselected group of patients referred for regular TTE during a cardiovascular workup in the outpatient clinic of our hospital.

METHODS

Prospectively during a 3-month study period, a limited ultrasound examination of the infrarenal abdominal aorta was performed in an unselected group of 796 consecutive patients referred for regular TTE. Echocardiographic evaluation of the aorta was performed by 6 experienced echocar-

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0894-7317/$30.00

doi:10.1016/j.echo.2004.09.023

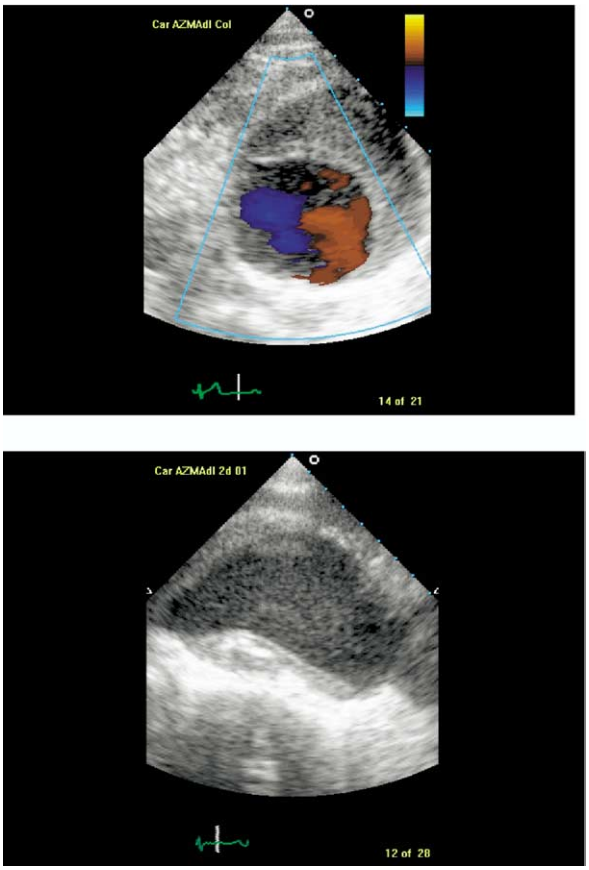

Figure 1 Transverse and longitudinal section through aneurysmal abdominal aorta. A mitral thrombus is seen.

diographers with the use of and ultrasound machine (Sonos 5500, Philips, Best, The Netherlands) with a 3-MHz phased-array transducer. Imaging of the abdominal aorta was performed in a supine position and the aorta was scanned from just proximal to the renal arteries to as distal as possible in both a longitudinal and transverse plane to delineate the area of greatest diameter. A standard echocardiogram was then completed. The maximal abdominal aortic diameter was measured from leading edge to leading edge. AAA was defined when the diameter of the infrarenal abdominal aorta was 30 mm or more in either anteroposterior or lateral dimension (Figure 1, *A* and *B*). Descriptive statistics are reported as means ± SD or percentages. Characteristics of patients with and without AAA were compared. Group comparison was done with Student unpaired *t* test for continuous variables and χ^2 analysis for categorical variables. A *P* value of less than .05 was considered statistically significant.

RESULTS

In total, 796 patients were referred for TTE during the study period. In 54 patients (6.8%), the infrarenal aorta could not be visualized completely, most often

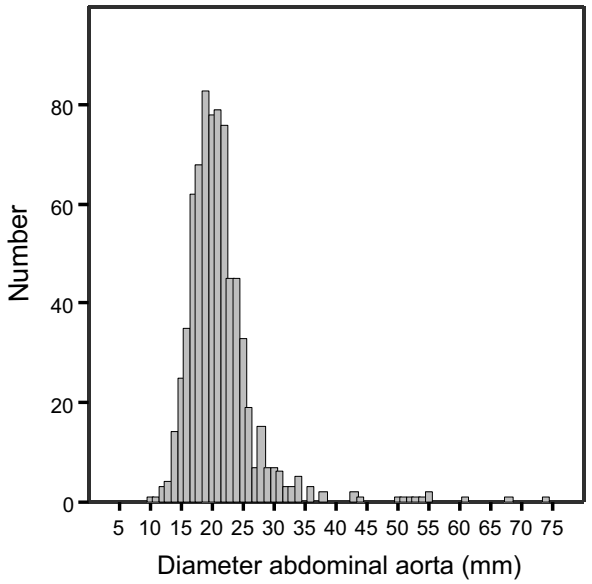

Figure 2 Distribution of abdominal aorta diameters in total group (n = 742).

because of obesity and air. They were excluded from further analysis. There were 386 men (52%) and 356 women (48%), with a mean age of 60.5 years and a mean abdominal aortic diameter of 21.4 mm. The distribution of the abdominal diameter is shown in Figure 2. The reasons for echocardiographic evaluation were: hypertension and postmyocardial infarction (47%), evaluation of valvular function (18%), congestive heart failure (13%), arrhythmia analysis (12%), thrombo-embolic disease (4%), preoperative analysis (3%), and was unknown in the remaining.

In 42 patients (5.7%), an AAA was identified. The prevalence was 8.5% in men and 2.5% in women. The mean diameter of the abdominal aorta was 39.2 mm. AAA was not found before the age of 50 years in both sexes, but the prevalence increased with age for both men and women (Table 1). Two relatively young patients, 57 and 58 years old, had abdominal aortic diameters of 55 mm and 68 mm, respectively, and AAA was previously unknown in one of them. After the age of 70 years AAA increased significantly only in men (Table 1). The majority of abdominal aorta diameters were between 30 and 40 mm (69%) and in 10 patients (23.9%) the diameter exceeded 50 mm (Figure 3). Of 10 patients with an abdominal aortic diameter greater than 50 mm, 5 also underwent an abdominal computed tomography (CT) scan. The diameters measured by echocardiography and CT scanning correlated well ($r = 0.9$; $P = .02$).

Of the 42 patients, AAA was previously known in only 8 (19%) and in this group preoperative evaluation was the primary indication for TTE. When these patients were excluded the overall prevalence was

Table 1 Age-specific prevalences of abdominal aortic aneurysm

Age (y)	Sex	No. screened	AAA (≥ 30 mm)
<39	Men	30	0
	Women	55	0
	Total	85	0
40-49	Men	50	0
	Women	40	0
	Total	90	0
50-59	Men	87	4 (4.6%)
	Women	68	2 (2.9%)
	Total	155	6 (3.9%)
60-69	Men	104	7 (6.7%)
	Women	75	3 (4%)
	Total	179	10 (5.6%)
>70	Men	115	22 (19.1%)*
	Women	118	4 (3.4%)*
	Total	233	26 (11.2%)
Total		742	42 (5.7%)

AAA, Abdominal aortic aneurysm.
*$P < .0001$ between men and women > 70 years.

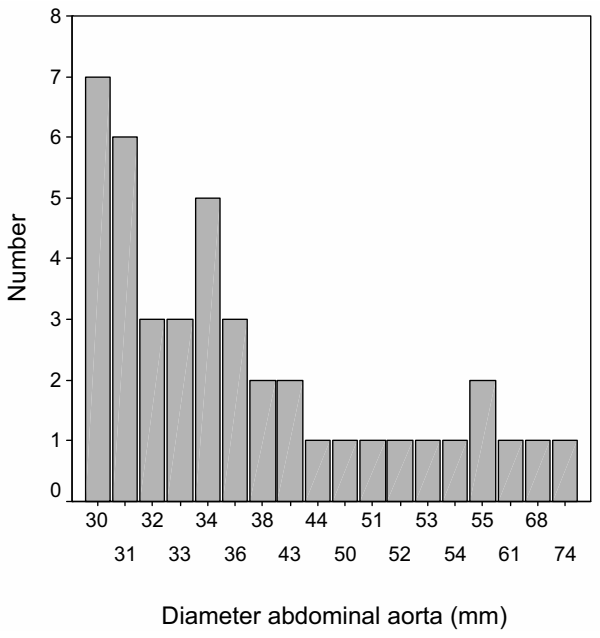

Figure 3 Distribution of abdominal aorta diameters in aneurysm group (n = 42).

4.6%. The mean (± SD) aortic diameter of these patients was 52.6 ± 10.4 mm, compared with 36.1 ± 9.2 mm in the patients in whom AAA was unknown ($P < .002$). In 4 out of 34 patients (12%) with a previously unknown AAA the aortic diameters exceeded 50 mm. Two underwent urgent operation: one patient was symptomatic with an abdominal aorta diameter of 54 mm and the other was asymptomatic with a diameter of 74 mm. Comparison of patient characteristics showed that patients with AAA were significantly older; were predominantly men; and had a more dilated ascending aorta, a lower left ventricular (LV) ejection fraction, and higher LV dimensions (both end-diastolic and end-systolic) and LV mass index (Table 2).

Table 2 Patient characteristics of both patients with and without abdominal aortic aneurysm

	Abdominal aortic aneurysm		
	No (n = 700)	Yes (n = 42)	*P* value
Age (y)	59.8 ± 15.6	71.9 ± 9	<.0001
Male (%)	353 (50.4)	33 (78.6)	<.0001
LA (mm)	42.5 ± 6.8	45.1 ± 5.3	.004
Ascending aorta (mm)	34.3 ± 4.3	37.7 ± 7.4	.006
LVEDD (mm)	49.8 ± 6.4	52 ± 5.7	.02
LVESD (mm)	34.2 ± 7.5	37.2 ± 7.5	.01
IVSEDWT (mm)	9.2 ± 3.3	10.1 ± 1.2	.001
PWEDWT (mm)	9 ± 1	9.7 ± 1.2	<.0001
LV mass index	200 ± 57.1	239.1 ± 63.6	.02
LVEF (%)	58 ± 12	53.5 ± 13.3	.04

IVSEDWT, Interventricular septal end-diastolic wall thickness; *LA*, left atrial size; *LV*, left ventricular; *LVEDD*, left ventricular end-diastolic dimension; *LVEF*, left ventricular ejection fraction; *LVESD*, left ventricular end-systolic dimension; *PWEDWT*, posterior wall end-diastolic wall thickness.

DISCUSSION

Our data show that unrecognized AAA was found in 4.6% by quick screening of the abdominal aorta in a group of patients referred for regular TTE. Limited screening of the abdominal aorta during regular TTE was feasible in 93.2% of patients. Although we did not measure prolongation of the total examination time, abdominal aortic evaluation can be done within minutes. In one study a prolongation of total examination time of 6 to 8 minutes was reported.[19] Similar prevalence was found in other studies.[19,21] In a study by Schwartz et al,[18] 250 patients referred for TTE (men age > 55 years and women age > 65 years) underwent screening for AAA. The overall prevalence was 4.6% when patients with a known AAA were excluded. The prevalence found in these studies and in our study is higher than in the general population and relates to the fact that patients referred for echocardiography are more likely to have multiple risk factors for AAA. We found AAA to be increasingly prevalent with age, with a significant difference between men and women after 70 years. Other variables that were significantly associated with AAA included increased left atrial size, LV dimensions, LV mass index, LV end-diastolic and end-systolic dimension, interventricular septal and posterior wall end-diastolic wall thickness, and diameter of the ascending aorta. Patients with AAA also had a lower ejection fraction. Although we did

not measure blood pressure and did not specifically look for concomitant risk factors, all most likely relate to hypertensive heart disease. AAAs usually develop in the atherosclerosis prone infrarenal aorta that suggests potential differences in aortic structure, biologic features, and stress along the length of the aorta.[22] Remarkable in our findings is the significantly increased ascending aorta diameter in patients with AAA. Although still within the limits of normal, it suggests a common risk factor, pathophysiologic mechanism, or both.

Because AAA most often is asymptomatic and undiagnosed, public screening programs have been developed for early detection to reduce the associated high mortality of ruptured AAA, which is in contrast with the low mortality of elective operation for AAA.[4-6] It has been a topic of considerable debate, however, because the optimal design of an AAA screening program with respect to age, sex, and frequency of screening remains undetermined. In addition, the efficacy of public screening programs depends on compliance, with decreased compliance expected in older age groups where AAA prevalence is highest. Abdominal palpation has been reported to have a low overall sensitivity in detecting AAA.[23,24] Ultrasound, however, is very accurate in detecting AAA and diameters measured with ultrasound correlate well with those measured with CT, although CT scanning tends to overestimate the diameter.[10,25] For screening to be beneficial a disease should be of reasonably high prevalence, have a high mortality if left undetected, be treatable with low mortality, and the screening technique used must be safe, accurate, and of low cost. Ultrasonographic screening for AAA fulfills these criteria. Consequently, the higher the expected prevalence of AAA in certain patient groups, the more beneficial and accurate ultrasound screening will be. There is conflicting evidence about the usefulness of screening for AAA during regular TTE, partly because of the relatively low prevalence of the disease reported.[20] The rate of growth of abdominal aneurysms is relatively unpredictable with wide interindividual variability but seems to be increased in larger aneurysms. β-Blocking agents and risk factor modification have been shown to slow progression.[26,27] The mean expansion rate of AAA has been estimated to vary between 0.28 and 0.38 cm/year.[27,28] When rescreened the incidence of AAA in patients age 64 to 81 years who had a normal aorta at initial screening turned out to be 4% in 10 years. All diameters were under 4 cm with low risk of rupture.[21] A one-time screening of men aged 60 to 65 years has also been shown to be cost-effective.[29,30] A second screening in patients with aortic diameters less than 30 mm has been shown to be of little practical value and is, therefore, not recommended. However, the following recommendations for subsequent surveillance have been made: patients with AAA between 3 and 4 cm should have an ultrasound after 1 year, between 4 and 4.5 cm after 6 months, and greater then 4.5 cm should be referred to a vascular surgeon.

Postmortem studies have suggested that 95% of deaths from ruptured AAA occur at or above the age of 65 years. It has, therefore, been recommended to focus screening at age 65 years to maximize the potential number of life years gained. In our study group AAA started to occur at age 55 years with two patients already having significantly dilated abdominal aortas before the age of 60 years, with diameters of 55 and 68 mm, respectively. Previous studies and our study demonstrate that AAA is more common in men, so screening can probably be restricted to men only. During our study period of 3 months, 4 patients with a previously unknown AAA were detected with aortic diameters exceeding 50 mm; two patients underwent urgent operation.

In conclusion, AAA is prevalent in an unselected group of patients referred for TTE, especially in men after the age of 55 years. In our opinion, consistently screening the abdominal aorta during regular TTE is beneficial and adds in the number of detected asymptomatic patients with unknown AAA and should be part of every standard TTE examination in patients older than 50 years.

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