

Community-Based, Nonprofit Organization-Sponsored Ultrasonography Screening Program for Abdominal Aortic Aneurysms Is Effective at Identifying Occult Aneurysms

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Early diagnosis of abdominal aortic aneurysm (AAA), prior to rupture, is vital for optimizing patient survival. An abdominal ultrasonography examination of an asymptomatic individual to check for the presence of an AAA, however, is not presently reimbursed by health insurance in the United States. This article reports the results of one nonprofit, community-based screening program, run by Aneurysm Outreach, Inc. (AOI; www.alink.org). AOI offered free screening for AAA to anyone who met the criteria of being (1) over 60 years old; (2) over 50 years old, male, and with positive family history for AAA; or (3) over 55 years old, female, and with positive family history for AAA. AOI organized 21 ultrasonographic screening events between September 2001 and November 2004, and the number of participants per event varied from 24 to 240. Altogether 3,088 individuals met the screening criteria and 22 of them were already known to have AAAs. Thirty-six (1.2%) individuals were excluded from the final analysis due to poor quality of the ultrasonographic images. Among the remaining 3,030 individuals, a dilatation of the aorta was detected and confirmed in 61 (2.0%) individuals, in 4.3% of the screened males and in 0.6% of the screened females. Thirteen individuals had their AAAs repaired surgically. The frequencies of males and current smokers were significantly higher in the AAA group than in the group with normal-size aorta (male AAA 83.6% vs. normal 42.0%, $p < 0.0001$; smoker AAA 54.9% vs. normal 18.1%, $p < 0.0001$). The mean age was significantly higher in the AAA group than in the group with normal-size aorta (AAA 71.0 ± 6.2 vs. normal 68.4 ± 7.0 , $p = 0.005$). In conclusion, the results of this community-based free ultrasonographic screening program are in agreement with randomized controlled screening programs and emphasize the need for systematic screening programs and the importance of finding individuals harboring AAAs before their rupture.

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INTRODUCTION

During the past 20 years, despite advances in diagnostic imaging and in general medical care of patients, there has been essentially no change in the number of patients seen in U.S. hospitals with ruptured abdominal aortic aneurysms (AAAs).¹ Approximately 15,000 individuals die of ruptured AAA each year.² Rupture of AAA is the thirteenth leading cause of death in the United States and accounts for 1-2% of deaths in men over 65 years old.³⁻⁵ The mortality for a ruptured AAA is 80-90%. In contrast, the mortality for elective open surgery, prior to rupture, is only 2-6%.^{1,6} These facts underscore the importance of early diagnosis of AAA, prior to rupture.

Screening for AAA can be performed with a simple, noninvasive ultrasonographic method. It is well documented that a limited ultrasonographic examination is accurate at identifying an AAA,⁷ and the benefits of screening for AAA have been demonstrated in several prospective studies.⁸⁻¹⁷ A nearly 50% reduction in the incidence of ruptured AAA and a 21-68% decrease in AAA-related deaths have been reported.^{8,10-13} An ultrasonographic screening test for AAA, however, is not covered in most cases by health insurance in the United States.

Aneurysm Outreach, Inc. (AOI) is a nonprofit volunteer organization, founded in 1999. In September 2001, AOI started to offer free community-based ultrasonographic screening for AAA, and approximately 3,000 participants were screened by November 2004. We report the results of this screening program and summarize the demographics of those with normal and dilated aortas.

SUBJECTS AND METHODS

The ultrasonographic screening events were advertised in local newspapers, radio, television interviews, public service announcements, and the AOI website (www.alink.org). Individuals were eligible for the free ultrasonographic screening once every 5 years if they were (1) over 60 years old; (2) over 50 years old, male, and with positive family history for AAA; or (3) over 55 years old, female, and with positive family history for AAA. Similar criteria have been used in previously reported screening studies.^{3,4,12,14} Sex, race, age, family history of aneurysms, smoking history, and information about hypertension and hypercholesterolemia were determined; and all data were entered into a questionnaire at the registration of the screening. Participants who did not meet the screening criteria ($n = 157$) and those who were already known to have an AAA ($n = 22$) were excluded from the statistical analysis.

The results reported here are based on 21 free ultrasonographic screening events, each of which had 24-240 participants. Screening was financed by donations, and volunteers helped to schedule participants, record risk factor information, and coordinate screening events. Ultrasonographic scans were performed by a registered vascular technologist (RVT). The ultrasonographic instruments used for the screenings were (1) ATL HDI 3000™ and ATL HDI 5000™ (Philips, Bothell, WA) donated by Vascular Associates Laboratory (VAL; Baton Rouge, LA); (2) Toshiba 140™ (Toshiba, Tokyo, Japan); and Siemens Antares™ (Siemens, Malvern, PA)

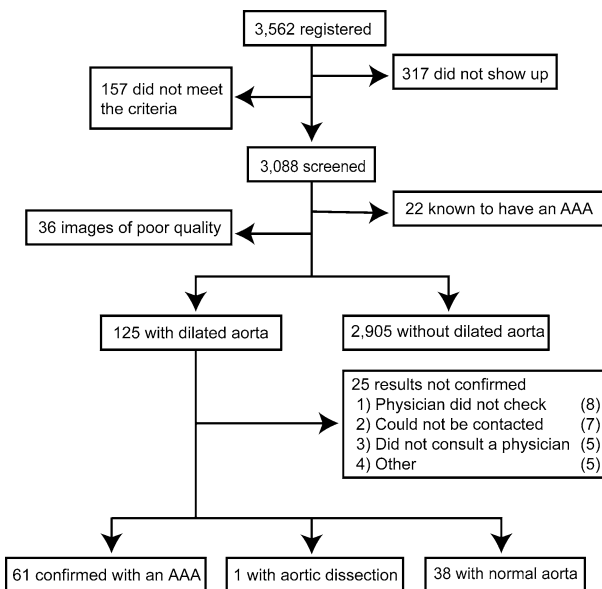


Fig. 1. Outline of the ultrasonographic screening program for AAA organized by AOI.

donated by CVT Surgical Center (CVT, Baton Rouge, LA); and (3) SonoSite TITAN™ and SonoSite 180PLUS™, donated by SonoSite (Bothell, WA).

The participants received a result stating “aorta without dilation” or “aorta with dilation.” The patients were then instructed to seek the attention of their primary-care physician, and a follow-up phone call by AOI was arranged in an attempt to assure compliance. Upon confirmation, an accepted definition of arterial aneurysm¹⁸ (a diameter of infrarenal aorta ≥ 3 cm) was used for the diagnosis of AAA.¹⁹⁻²¹

The analysis and publication of the anonymous data were approved by the institutional review board of Wayne State University.

Statistical analyses were carried out using Fisher’s exact test. Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated by comparing the number of individuals with a specific variable, such as smoking, hypertension, or hypercholesterolemia, between the AAA group and the group with normal-size aorta.

RESULTS

Figure 1 shows the outline of the study. Although 3,562 individuals registered for the ultrasonographic screening, 317 did not show up to the location of screening and 157 did not meet the screening criteria of AOI. Of the 3,088 individuals who met the screening criteria, 22 were excluded

Table I. Demographic and clinical data collected with a questionnaire

	AAA group (<i>n</i> = 61)	Normal aorta group ^a (<i>n</i> = 2,943)	<i>p</i>	OR	95% CI
Gender (% male)	83.6	42.0	< 0.0001	7.0	3.6-13.9
Age (years, ±1 SD)	71.0 ± 6.2	68.4 ± 7.0	0.005		
Race (%)					
Caucasian	94.4	91.1	0.62	1.7	0.5-5.3
African American	3.7	7.7	0.43	0.5	0.1-1.9
Family history (%)					
AAA	21.3	29.7	0.20	0.6	0.3-1.2
Intracranial aneurysm	3.3	9.6	0.12	0.3	0.1-1.3
Smoking (%) ^b	54.9	18.1	< 0.0001	5.5	3.1-9.6
Hypertension (%)	56.4	50.3	0.42	1.3	0.7-2.2
Hypercholesterolemia (%)	54.7	41.4	0.07	1.7	1.0-3.0

^aThis number includes 38 individuals who were diagnosed with AAA by ultrasonographic screening at first and found to have aortas of normal diameter on reexamination.

^bSmoking indicates current smoker.

from the final analysis because they were already known to have an AAA and 36 (1.2% of all screened individuals) were excluded due to poor quality of the ultrasonographic images.

Of the remaining 3,030 individuals, 125 were found to have a dilatation of the abdominal aorta based on the ultrasonographic screening. Altogether 100 individuals of the 125 found to have aortic dilatation had follow-up studies performed during subsequent vascular surgery evaluation and an AAA was confirmed in 61 (2.0%, 61/3,030), whereas 38 (38/100, fraction of false-positives 38%) were found to have aortas of normal diameter and one had an aortic dissection. Thirteen (21.3%, 13/61) individuals had an AAA repair operation. There were 25 individuals whose findings were not confirmed because (1) the physician did not do follow-up ultrasonographic screening (*n* = 8), (2) the patient could not be contacted (*n* = 7), (3) the patient did not consult a physician (*n* = 5), or (4) other reasons (*n* = 5).

Table I shows the demographic and risk factor data collected using a questionnaire at the screening registration. Males and current smokers were significantly more frequent in the AAA group than in the group with normal-size aorta (male AAA 83.6% vs. normal 42.0%, *p* < 0.0001, OR = 7.0; smoker AAA 54.9% vs. normal 18.1%, *p* < 0.0001, OR = 5.5). The mean age was significantly higher in the AAA group than in the group with normal-size aorta (AAA 71.0 ± 6.2 vs. normal 68.4 ± 7.0 years, *p* < 0.005). Race, family history of aneurysms, hypertension, and hypercholesterolemia, however, did not differ significantly between the AAA group and the group with normal-size aorta.

Table II. Prevalence of AAA in males and females

	AAA detected	
	Yes	No
Male	51 (4.3%)	1,193 (95.7%)
Female	10 (0.6%)	1,645 (99.4%)

Table II shows the prevalence of AAA in males and females in the screened population. The fraction of males who had an AAA was significantly larger than that of females (males 4.3%, females 0.6%; *p* < 0.0001).

As expected, based on the criteria of this screening program, the mean age of participants with a family history of AAA (*n* = 846) was significantly lower than that of those with no family history (*n* = 2,021) (family history 63.0 ± 8.0 vs. no family history 69.0 ± 6.9 years, *p* < 0.0001).

It is noteworthy that one of the participants, who was excluded from the final statistical analyses due to the fact that he had had a ruptured AAA approximately 8 years ago, was now found to have a dilatation of the iliac artery. A 7 cm iliac artery aneurysm was confirmed in a subsequent examination and the patient referred for immediate endovascular repair operation. The patient in question was motivated to utilize the free screening resource as he had recently lost health insurance coverage. Another participant, who was also excluded from the final statistics, was found to have an aortic dissection. These two cases demonstrate further the value of the AOI screening program.

DISCUSSION

AOI is a nonprofit volunteer organization, whose aim is to (1) raise public awareness about aneurysms; (2) stimulate and fund genetic research through donations; and (3) coordinate a support network for aneurysm patients and their families. One of the initiatives supported by AOI is to have free ultrasonographic screening for AAA. To meet this goal, a free screening program was initiated in September 2001 and by November 2004 approximately 3,000 participants were screened, with 61 (2.0%) participants found to have a dilated aorta and referred to their primary-care physicians or vascular surgeons for further follow-up and treatment, if indicated.

Several prospective randomized screening studies have been carried out.⁸⁻¹⁷ In these studies, individuals who met the criteria, most of whom were males over 60 or 65 years old, were invited to participate in screening and then followed up and compared to a nonscreened population. The largest number of participants in previous screening studies was 70,495 men and the longest time of follow-up was 13 years in studies carried out in the United Kingdom.^{8,16} These studies demonstrated the cost-effectiveness of population-based screening programs and a decrease in the number of aneurysm-related deaths.^{8-12,14-16}

Well-documented risk factors for AAA include male sex, increased age, family history, smoking, and hypertension.^{3,4} In particular, being a male and over 65 years old are strong risk factors for AAA.²⁻⁴ Family history of AAA is another important factor to be included into screening criteria since AAA is frequently familial and prevalence of AAA in siblings of AAA patients is high (13-30%).²²⁻²⁵ In a recent consensus statement, Kent et al.²⁶ recommended ultrasonographic screening for AAA in all individuals over 60 years of age and in those over 50 years of age with family history of AAA. The recommendation by the U.S. Preventive Service Task Force for ultrasonographic screening for AAA was to screen all men aged 65-75 years who have ever smoked.²⁷

In the current screening study, 2.0% of individuals who met the criteria, 4.3% of males and 0.6% of females, were found to have an AAA (Table II). These frequencies are in agreement with previous epidemiological studies and prospective randomized ultrasonographic screening studies.^{8,9,11,12,28} As also shown previously by other studies,^{3,4} the frequencies of male gender, smoking, and mean age were significantly higher in the AAA group. Family history, however, did not show a

significant difference between the AAA group and the normal group. The prevalence of family history of AAA in the group with normal-size aorta (29.7%) was surprisingly high, suggesting that those individuals who have a family history for AAA were very motivated to participate in this type of screening.

The benefits of ultrasonographic screening for AAA have been widely recognized, and we are aware of at least one additional free screening program for AAA, Legs for Life®, which was started by the Society of Interventional Radiology (www.legsforlife.org). Legs for Life is a once-a-year event that offers free screening for AAA at over 300 hospitals throughout the United States, and approximately 17,000 individuals participated in 2003. A fundamental role for volunteer organizations is raising awareness of disease conditions in the public. When ultrasonographic screening for AAA becomes a national program covered by health insurance, the emphasis of these organizations will shift from both education and providing screening to education and possibly coordinating screening events.

There were 48 individuals who were confirmed to have an AAA but were not operated on because the AAA was relatively small in size. An important question is how to manage these small AAAs clinically when no proven medical treatment has yet been discovered and extending endovascular surgery to these patients might not be appropriate. Research on new pharmacological therapies to prevent or slow down the growth of an AAA is, therefore, needed urgently.

The effectiveness of ultrasonographic screening at detecting AAAs before rupture was demonstrated in this study as well as in previous studies. Since this screening program was run by volunteers and financed by donations, the size of the population screened was limited. Considering the prevalence of AAA in the United States and the impact of AAA on the well-being of the aging population,¹⁷ we strongly support the proposal²⁶ of a national screening program for AAA covered by health insurance. Such a systematic screening program would be expected to save lives^{8-12,14-16} and should result in a decreased burden to the overall cost of health care related to AAA in the United States.

CONCLUSIONS

Altogether 61 (2.0%) of the 3,066 eligible individuals who participated in the free ultrasonographic screening events organized by AOI were found to have aortic dilatations, which were confirmed to be

AAAs in subsequent examinations. These individuals were referred to their primary-care physicians or vascular surgeons for further follow-up and treatment, if indicated. Thirteen individuals had their AAAs surgically repaired. The frequencies of male gender, current smoker, and mean age were significantly higher in the AAA group than in the group with normal-size aorta. The results of this community-based free ultrasonographic screening program are in agreement with randomized controlled screening trials and emphasize both the humanitarian and economical importance of finding individuals harboring AAAs prior to rupture.

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