

A screening program to identify risk factors for abdominal aortic aneurysms

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Background: We aimed to explore the feasibility of a nurse-supervised aneurysm screening program to identify any independent risk factors for abdominal aortic aneurysm (AAA) formation in high-risk patients. **Methods:** We conducted a prospective observational study of 90 male patients in a university-affiliated hospital in southern Ontario. The patients were prospectively evaluated and all underwent abdominal ultrasonography, with the main outcome measure being detection of an AAA. **Results:** AAAs were identified in 18 patients (20%) and had a mean diameter of 3.6 (range 2.8–6.0) cm. A separate analysis was performed to identify risk factors for the presence of an aneurysm. The presence of carotid artery disease proved to be the only statistically significant independent predictor of the presence of AAA (odds ratio 2.23, 95% confidence interval 1.76–2.56). **Conclusions:** This study confirms the feasibility of a nurse-supervised AAA screening program, and on the basis of these results we recommend ultrasonographic screening for AAA in patients with a history of carotid artery disease.

Contexte : Nous voulions étudier la faisabilité d'un programme de dépistage des anévrismes supervisé par une infirmière afin de cerner tout facteur de risque indépendant d'apparition d'un anévrisme de l'aorte abdominale (AAA) chez des patients à risque élevé. **Méthodes :** Nous avons procédé à une étude d'observation prospective portant sur 90 patients de sexe masculin dans un hôpital universitaire du sud de l'Ontario. Nous avons évalué les patients prospectivement et tous ont subi une échographie abdominale dont la principale mesure de résultats a été la détection d'un AAA. **Résultats :** On a trouvé, chez 18 patients (20 %), un AAA d'un diamètre moyen de 3,6 (plage de 2,8 à 6,0) cm. Nous avons procédé à une analyse distincte pour déterminer les facteurs de risque de présence d'un anévrisme. La présence d'une maladie de l'artère carotide s'est révélée être le seul prédicteur indépendant statistiquement significatif de la présence d'un AAA (coefficient de probabilité 2,23; intervalle de confiance à 95 %, 1,76–2,56). **Conclusions :** Cette étude confirme la faisabilité d'un programme de dépistage des AAA supervisé par une infirmière et nous recommandons, à la suite de ces résultats, le dépistage échographique des AAA chez les patients ayant des antécédents de maladie de l'artère carotide.

Repair of an abdominal aortic aneurysm (AAA) is one of the most common surgical procedures performed by vascular surgeons in Canada. An aneurysm is defined as “a focal dilatation of the aorta at least 50% larger than the calibre of the adjacent normal aorta.”¹ Aneurysms have a male predominance (10:1) and are more common in white individuals.² The risk factors associated with AAA development have been well documented and include cigarette smoking, hypertension, advancing age, family history and a history

of cardiovascular disease, carotid artery disease or peripheral vascular disease (PVD).^{2–5} Other factors including abnormal levels or types of collagen and elastin, which cause the arteries to lose their elasticity and expand more easily, are currently being investigated.⁶ Most patients are not aware that they have an AAA, because they do not present with symptoms before rupture.

Rupture of an AAA is a catastrophic event, with a mortality rate ranging between 75% and 90%.⁷ This is a sharp contrast to the low morbidity and

mortality rate of 5% in patients who undergo elective aneurysm repair.⁷ One strategy to lower aneurysm-related mortality is early identification of asymptomatic aneurysms, permitting appropriate elective repair. For this purpose, abdominal ultrasonography is the widely accepted imaging modality of choice, with virtually 100% sensitivity and specificity.⁸

Methods

A prospective observational study was performed at the London Health

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Sciences Centre, London, Ont., from July 1998 to November 1999. Ethics approval was obtained from the Ethics Review Board, University of Western Ontario, and all patients provided signed, informed consent. Ninety consecutive male patients who met the inclusion criteria were recruited from the vascular surgery clinics (Box 1). Patients who had had previous AAA surgery were excluded, as was any patient with a known AAA. Patients were stratified into 3 groups with respect to their major referral diagnosis (PVD, carotid artery disease or family history of AAA). Referral diagnosis was confirmed by objective testings of ankle-brachial index (ABI), carotid duplex, or patient and family history. This is summarized in Box 1.

A medical history, demographic data, physical examination and risk factor identification were completed for all patients before ultrasonography. This was managed by the clinical trials nurse who incorporated patient education into the screening session and sent follow-up letters to the patients and family doctors after consulting with their vascular surgeon regarding the results of the screening. All patients were asked to fast for 4 hours before the screening ultrasonography.

The same experienced ultrasonographer using a standard protocol per-

formed all ultrasonography. This consisted of ultrasonographic examination of the aorta, using the ATL Ultra Mark 9 HD1 (Soma Technology, Inc.) machine with the TRX C4-2 curved array probe to examine the aorta from the level of the renal arteries to the aortic bifurcation for the presence of an aneurysm. Patients were scanned in sagittal and transverse planes. Anterior-posterior and transverse measurements were recorded from the image. The radiologist verified the ultrasonographic measurements. For our study purposes, an AAA was defined as “a focal dilatation of the aorta at least 50% larger than the calibre of the adjacent normal aorta.”²¹

Two-tailed Student’s *t* test was used for descriptive data, with a *p* value less than 0.05 being significant. All data were described as means (and standard deviation [SD]). Odds ratios were used to identify individual risk factors.

Results

During the study period 90 men were screened for an AAA. As shown in Box 1, the study group consisted of men aged 65 years or more, with a smoking history of more than 10 pack-years. Their mean age was 72.1 (SD 22, range 65–87) years.

Patients were divided into 3 groups according to their primary di-

agnosis, namely, PVD, carotid artery disease and family history, with PVD being the largest of the groups. Sixty-nine of the 90 patients screened presented with PVD as their primary diagnosis. Ten AAAs were detected in this group (14.5%). Seven of the patients had PVD as well as carotid artery disease; no aneurysms were detected in these patients. Five of the patients reported having a first-degree relative with AAA; only 1 of these patients was found to have an aneurysm. There was no correlation between family history and carotid artery disease. Twenty-three patients presented with carotid artery disease as their primary diagnosis; 7 aneurysms were detected in this group (30.4%). Other risk factors identified in the groups included hypertension, diabetes, hypercholesterolemia, chronic obstructive pulmonary disease (COPD) and cardiac disease. Hypertension proved to be the most common risk factor in all groups (55%), followed by hypercholesterolemia (44%), coronary artery disease (42%), COPD (29%) and diabetes (18%) (Fig. 1). There was no statistically significant difference with respect to these risk factors between groups.

Aneurysms were identified in 18 of the 90 (20%) men in the study population and ranged from 2.8 cm to 6.0 cm in anteroposterior diameter, with a mean diameter of 3.6 cm. Only 1 patient whose aneurysm was 6.0 cm

Box 1: Inclusion criteria for study
Male ≥ 65 yr
Smoking > 10 pack-yr
One of the following:
<ul style="list-style-type: none"> • Documented PVD (previous bypass or angioplasty, or symptomatic disease with ABI < 0.80) • Carotid artery disease (previous CEA or carotid stenosis > 70%) • Family history of AAA
AAA = abdominal aortic aneurysm, ABI = ankle-brachial index, CEA = carotid endarterectomy, PVD = peripheral vascular disease.

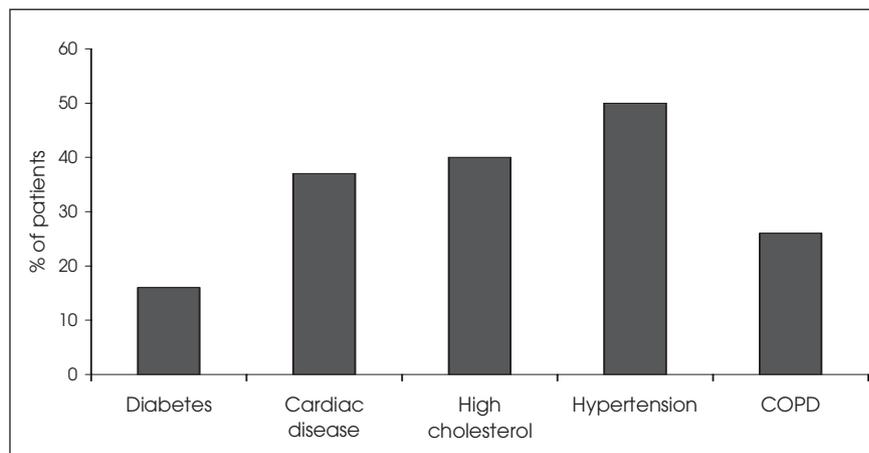


FIG. 1. Risk factors for abdominal aortic aneurysm formation among study patients (n = 90). COPD = chronic obstructive pulmonary disease.

in diameter required surgical repair, and all the others have been followed every 6 months with ultrasonography. In addition, the 3 groups did not differ with respect to blood pressure, heart rate, smoking history or age (Table 1). An analysis of risk factors was performed, and the presence of carotid artery disease was the only statistically significant independent predictor of AAA (odds ratio 2.23, 95% confidence interval 1.76–2.56). PVD and family history were not statistically significant predictors of AAA (odds ratio 0.52 and 1.00, respectively).

Discussion

Certain well-documented risk factors are associated with aneurysm formation. Allardice and colleagues² noted the prevalence of aneurysms to be 14% higher in male patients with PVD. Allen and coworkers⁵ noted that patients with hypertension have a higher incidence of aneurysms, 12% in men and women. The familial tendency for AAA manifests itself as an increased incidence in first-degree relatives, especially brothers. In a screening study in Ireland between 1990 and 1993, 12% of male siblings of individuals with AAA had an aneurysm.³ Cole and colleagues⁴ suggest that the preponderance of this disease in males is a sex-linked type of inheritance pattern. Collin⁹ in the Oxford Screening Program also found male siblings to have a very similar rate. Karanja and colleagues¹⁰ noted a higher incidence (17%) of AAAs in patients with carotid steno-

sis. Lederele and coworkers¹¹ noted that smoking was the risk factor most strongly associated with AAA and that it appeared to be responsible for most clinically important cases of previously undiagnosed AAA. Age (> 55 yr), carotid artery disease, COPD, any atherosclerosis, high cholesterol levels and family history of AAA also had important associations.

The Canadian Propranolol Abdominal Aortic Aneurysm Trial depicted similar risk factors in their study population of 552 patients. These included being male and over the age of 65 years (85%), hypertension (33%), hyperlipidemia (28%) and smoking (75%).¹² Screening programs have been much discussed in the literature. Lee and colleagues¹³ suggested that a “quick screen” program for AAA should be adopted for all men over 60 years of age and reimbursed, because this could reduce hospital costs and mortality rates associated with ruptured AAAs. This type of general screening is not likely to prove cost-effective or practical because of the large number of patients involved and the low incidence in the general population. Ebaugh and colleagues¹⁴ suggested a selected screening of high-risk patients versus mass screening. Kurvers and coworkers¹⁵ suggested screening for patients with peripheral arterial disease, transient ischemic attack, stroke, advanced age and tall stature.

Scott and colleagues¹⁶ in a randomized, prospective study found that ultrasonographic screening decreased the incidence of ruptured

AAAs in men by 55% and reduced the mortality rate by 42%. Cheate¹⁷ indicated that there could be disadvantages from the patients’ perspective, because there is the anxiety associated with the screening and diagnosis. Lucarotti and colleagues¹⁸ and Khaira and colleagues¹⁹ have shown that AAA screening does not produce prolonged anxiety or depression after the initial mild anxiety. Although not objectively tested, our study participants were appreciative of screening. All patients were counselled on the importance of follow-up and were given an AAA information pamphlet by the nurse managing the screening program. In addition, screening programs may offer an additional advantage in that they ensure closer follow-up, which provides the opportunity to monitor other risk factors and intervene when necessary.

Clearly, the main benefit of a screening program is a reduction in aneurysm-related mortality. Chew and colleagues²⁰ examined the morbidity, mortality and direct costs of ruptured aneurysms versus elective repair by comparing the hospital dollars saved on elective repair and emphasized that this money could be wisely spent on screening strategies for earlier detection and monitoring within high-risk populations.

In this study, we pre-selected a high-risk group of patients who were already at significant risk of an atherosclerosis-related death. All patients were men with a smoking history and 1 major marker of systemic atherosclerosis (either PVD, carotid artery disease or a family history of AAA). Eighteen patients or 20% of this high-risk study population were found to have aneurysms. Most of these were small aneurysms, which were followed with biannual ultrasonography. Only 1 patient had a large aneurysm that prompted repair. No other aneurysms have required repair to date. In order to determine whether this screening program results in a reduction in mortality, longer follow-up is necessary.

Table 1

Demographic characteristics of the study population (n = 90)

Characteristic	Group by primary diagnosis; mean (and range)		
	PVD (n = 69)*	Carotid artery disease (n = 23)*	Family history (n = 5)
Systolic BP, mm Hg	143 (124–170)	143 (120–168)	142 (130–150)
Heart rate, bpm	70 (52–88)	81 (62–84)	79 (66–72)
Smoking history, py	32 (15–150)	34 (15–50)	22 (12–40)
Age, yr	72 (65–84)	72 (68–81)	68 (66–72)

BP = blood pressure; bpm = beats per minute; PVD = peripheral vascular disease; py = pack-year.
*Seven patients had PVD and carotid artery disease.

As with all studies, this study has a number of limitations. A pre-selected high-risk cohort of patients was deliberately chosen. As such, this study's results and recommendations are not applicable when considering wider population-based aneurysm screening. This study's recommendations should not be extrapolated beyond high-risk male patients. In addition, whether this screening program will provide a survival advantage to those patients in whom we have identified AAAs awaits further study and longer-term follow-up.

Nurse-managed clinics have been successfully implemented for colon cancer screening.²¹ These clinics have shown that the environment is friendly and non-threatening, and that nurses have an opportunity to incorporate education into patient care.

It can be argued that the proposed screening may not be a survival advantage in our cohort, because these patients are at significant risk of mortality due to atherosclerosis irrespective of an aneurysm. As most of the aneurysms detected were small, a proportion of our high-risk group may die prior to their aneurysm growing or being repaired, precluding a real survival advantage. This question awaits longer-term follow-up. The cost of a screening program must be assessed as well. As with the survival advantage, the cost-effectiveness of this screening program awaits longer-term follow-up. The additional cost of obtaining a sonogram is about \$200 at our institution. This program will only be cost-effective if a number of the identified aneurysms grow to a sufficient size to require repair, rather than having to solely absorb the cost of additional ultrasonography sessions.

Conclusions

Primary prevention of AAA is not a realistic expectation because of the accumulation of risk factors associ-

ated with aneurysm development. Education for aneurysm detection and investigation is essential for all health care providers. The importance of the physical examination and the identification of risk factors cannot be stressed enough in medical and nursing schools. Based on the results of our prospective study, ultrasonographic screening is recommended in male patients with a history of carotid artery disease who are aged 65 years and above, because this proved to be the only significant predictor of AAA. A nurse-directed screening program for a pre-selected high-risk population has proved feasible. The novel idea of nurses managing screening programs provides a non-threatening environment for the patient, allowing the nurse the opportunity for patient education. Screening programs can be effectively managed by nurses, as we have presented in this paper. Longer-term follow-up and analysis of cost-effectiveness are necessary to determine the importance of this study.

Competing interests: None declared.

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