

The Delineation of a Global Vascular Profile

The coexistence of AAA, PAD, and CVD in patients with CAD.

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To assess the prevalence of common manifestations of peripheral vascular disease, such as abdominal aortic aneurysms (AAAs), peripheral arterial disease (PAD), and cerebrovascular disease (CVD) in patients with coronary artery disease (CAD), we undertook two studies. The first study, the Epics I Study (Evaluation of Possible Abdominal Aortic Aneurysms in patients who have undergone previous coronary artery bypass grafting [CABG]), sought to evaluate the prevalence of AAAs in men and women, 60 years of age and older, who had undergone CABG. The second study, the recently initiated Epics II, seeks to evaluate the prevalence of AAAs, PAD, and CVD in individuals 60 years of age and older who have angiographically documented $\geq 50\%$ stenosis in at least one coronary artery. Epics I revealed a 9% prevalence of AAAs in men and a 5% prevalence of AAAs in women, both well above the prevalence found in population-based studies. Epics II is in its early phase (256 patients screened out of 1,000), yet preliminary results reveal that there is at least a 25% prevalence of PAD and a 28% prevalence of CVD in both male and female subjects and a 5% prevalence of AAAs in men and a 2% prevalence of AAAs in women. The increased prevalence of AAAs noted in those patients with a history of CABG as presented in the Epics I data, along with the high prevalence of PAD and CVD in patients with CAD, speaks to the global nature

of vascular disease and to the need to delineate a patient's global vascular profile—the presence or absence of AAAs, PAD, and CVD—in any patient with CAD. To adequately delineate the global vascular profile of a patient with CAD, routine screening for AAAs, PAD, and CVD is recommended.

EPICS I

Large, population-based studies report a 4% prevalence of AAAs in men and a 1% prevalence of AAAs in women.¹⁻⁷ Recently, however, Monney et al reported finding 40 unsuspected AAAs (a 10% prevalence) in 395 consecutive men who underwent CABG.⁸ This not only represents a considerable increase in the prevalence of AAAs, but it also identifies a group of subjects who are at an increased risk for the lethal consequences of undiagnosed AAAs. Because little is known about the prevalence of AAAs in patients who have undergone CABG, Epics I evaluated the prevalence of AAAs in this population by screening the abdominal aorta with ultrasound.⁹⁻¹⁴

Purpose

Epics I sought to gather data on the prevalence of AAAs in both men and women, 60 years of age or older, who had undergone CABG. Additionally, because no data exist on the prevalence of AAAs in women who had undergone

TABLE 1. UNSUSPECTED AAAs: NUMBER OF SUBJECTS EVALUATED AND RESULTS

	No. Enrolled	No. Unable to Screen	No. Screened	Total AAAs	Percent	No. of Known AAAs	No. of Unknown AAAs
Men	525	8	517	47	9%	16	31
Women	247	12	235	12	5.1%	6	6
Total	772	20	752	59		22	37

TABLE 2. UNSUSPECTED AAAs BY SIZE

	3 cm–3.9 cm	4 cm–4.9 cm	≥5 cm	Total
Men	30	11	6	47
Women	6	4	2	12
Total	36	15	8	59

CABG, we felt it was important to evaluate them to see if this subgroup had a greater prevalence of AAAs than the 1% to 1.3% reported in several of the large, population-based studies.

Methods

Permission for Epics I and Epics II was obtained from the McLaren Regional Medical Center (Flint, MI) institutional review board. In Epics I, men and women, aged 60 years or older, with a history of CABG, were self-enrolled after learning about the study from advertisements or their cardiac surgeon. Patients were invited to enroll even if they had an AAA being followed by a physician or if their AAA had been surgically treated. AAAs identified by screening were classified as *previously unknown*, whereas AAAs being followed or previously treated were classified as *known*. This classification allowed us to determine the importance of screening in the detection of AAAs.

After informed consent was received, screening for AAAs was performed by registered vascular technologists in our Intersocietal Commission for the Accreditation of Vascular Laboratories (ICAVL)-approved vascular lab by using an HP (Hewlett Packard, Palo Alto, CA), GE (GE Medical Systems, Waukesha, WI), Philips (Philips Ultrasound, Bothell, WA), or Siemens (Malvern, PA) duplex machine. The criteria used to diagnose an AAA was the same criteria used in many of the reported screenings and by the American Vascular Association: an infrarenal aortic diameter >30 mm, with the probe perpendicular to the axis of the aorta.¹⁵ Data were also collected on the subjects' smoking history and the presence or absence of diabetes and hypertension. The study was initiated in September 2004 and was completed in July 2005.

Results

In Epics I, 772 subjects who had undergone CABG self-enrolled (525 men, 247 women; aged 60 years or older) (Table 1). Eight of the 525 men could not be screened because of obesity, leaving a study group of 517 men. Forty-seven AAAs were found in this group, for a prevalence of 9%. Sixteen of the 47 AAAs were either being followed by a physician or had been surgically treated (five open repairs, two endovascular repairs) and were classified as *known*, whereas 31 AAAs were discovered by the screening process and were thus classified as *previously unknown*.

Of the 247 women, 12 could not be screened, leaving a study group of 235 subjects. In this group, 12 AAAs were found (5.1% prevalence). Six of the 12 AAAs were either being followed by a physician or had been surgically treated (two open repairs) and were classified as *known*, whereas six AAAs were discovered by the screening process and were classified as *previously unknown*.

Table 2 categorizes the AAAs found in the men and women by their greatest diameter, dividing them into three size categories: 3 cm to 3.9 cm, 4 cm to 4.9 cm, and ≥5 cm. In the breakdown of the men and women by ethnicity, the overwhelming majority of subjects were Caucasian (Table 3).

Table 4 divides the male and female groups into 5-year age brackets, indicating the number of subjects screened for each 5-year age interval, and both the number of AAAs found and the prevalence per age category. In men, prevalence of AAAs increased with age. The number of women screened in any given age bracket was too small to indicate a trend.

Table 5 represents the smoking history of the subjects, dividing them into three categories (those who never smoked, former smokers, and current smokers) and lists the number and prevalence of AAAs in each category. Only three AAAs were found in 126 men who never smoked for a prevalence of 2.3%. Three-hundred forty-eight men were former smokers, and 36 AAAs were found in this group, a prevalence of 10.3%. Forty-three men were current smokers, and eight AAAs were found in this group (18.6% prevalence). Of the women, 118 never smoked, and only two AAAs were found, for a prevalence of 1.6%. Of the 101 for-

TABLE 3. AAAs AND ETHNICITY

Men	Ethnicity	AAAs
Caucasian	481	46
Black	28	1
Hispanic	5	0
Asian	1	0
Other	2	0
Total	517	47
Women	Ethnicity	AAAs
Caucasian	217	11
Black	16	1
Hispanic	2	0
Asian	0	0
Other	0	0
Total	235	12

TABLE 4. AAAs BY SUBJECT AGE

Gender	60 y–64 y	65 y–69 y	70 y–74 y	75 y–79 y	≥80 y
Men	Screened = 100 AAAs found = 7	Screened = 111 AAAs found = 6	Screened = 131 AAAs found = 13	Screened = 95 AAAs found = 10	Screened = 80 AAAs found = 11
	7%	5.4%	9.9%	10.5%	13.7%
Women	Screened = 57 AAAs found = 2	Screened = 53 AAAs found = 3	Screened = 48 AAAs found = 2	Screened = 48 AAAs found = 3	Screened = 40 AAAs found = 2
	3.5%	5.6%	4.1%	6.2%	5%

mer smokers, seven AAAs were found (6.9% prevalence). Of the 16 women who were current smokers, three AAAs were found (18.7% prevalence).

Table 6 examines the relationship between diabetes and the prevalence of AAAs. No relationship between diabetes, type I or II, and the prevalence of AAAs could be established. Table 7 looks at the impact of hypertension in men and women, and again, no relationship could be established between hypertension and the presence of an AAA.

Discussion

Several large population-based studies of AAA screening report a 4% prevalence of AAAs in men and a 1% prevalence of AAAs in women. However, little is known about the prevalence of AAAs in people who have undergone CABG. Overall, we found 47 AAAs in 517 men who had undergone CABG, for a prevalence of 9%, similar to the 10% reported by Monney et al.¹⁶ Twelve AAAs were found among the female subjects, for a prevalence of 5.1%. The prevalence of AAAs among men and women was considerably higher than that reported in the population-based studies.

These findings suggest that men and women who have undergone CABG represent a high-risk group for harboring an AAA and need to be screened before surgery. To underscore the importance of screening in detecting AAAs in CABG patients, it should be noted that although 16 of the 47 AAAs were known in the men, 31 of the 47 AAAs (two-thirds [66%]) were unknown and discovered by the screening process. Similarly, in the women, six of the 12 AAAs were known; however, the other six AAAs (50%) were unknown and were detected by the screening process.

Our findings are consistent with other studies that report that increasing age and smoking are independent risk factors for the development of an AAA.^{1,17–21} With increasing age, the prevalence of AAAs is greater in both men and women. Smoking has been reported to be the single most preventable risk factor for AAAs. Smokers are 7.6 times more likely to have an AAA than nonsmokers, and ex-smokers are three times more likely to have an AAA than

nonsmokers.^{18–21} Indeed, 44 of the 47 AAAs found in the 517 male subjects were found in either current or former smokers, whereas only three AAAs were found in the 126 men who had never smoked, a prevalence of only 2.3%. Of the 43 men who were current smokers, eight AAAs were found (18.6% prevalence). Comparable results were found in the female subjects: 118 nonsmokers were found to have only two AAAs (1.6% prevalence), whereas seven AAAs were found in 101 former smokers (6.9% prevalence), and three AAAs were found in 16 women who were current smokers (18.7% prevalence).

Our findings did not suggest a relationship between the presence of diabetes and the number of AAAs. In men, only eight AAAs were found in 171 subjects with type II diabetes (4.6% prevalence). No AAAs were found in 11 subjects with type I diabetes. Most of the AAAs (n=39) found in men were in the 335 nondiabetic subjects (11.6% prevalence).

Hypertension did not significantly have an impact on the prevalence of AAAs in men. Thirty-six AAAs were found in 371 hypertensive men (9.7% prevalence), and 11 AAAs were found in 146 nonhypertensive men (7.5% prevalence). In women, the prevalence of AAAs was higher: 11 AAAs were found in the hypertensive group of 198 women, and only one AAA was found in the group of 37 nonhypertensive subjects, suggesting that it may play a role in this group.

Our findings suggest that those undergoing CABG are at

TABLE 5. AAAs AND SMOKING HISTORY

		No. of Subjects	No. of AAAs	Prevalence
Men (517)	Never	126	3	2.3%
	Former	348	36	10.3%
	Current	43	8	18.6%
Women (235)	Never	118	2	1.6%
	Former	101	7	6.9%
	Current	16	3	18.7%

TABLE 6. AAAs AND DIABETES

		No. of Subjects	No. of AAAs	Prevalence
Men (517)	Nondiabetic	335	39	11.6%
	Diabetes type II	171	8	4.6%
	Diabetes type I	11	0	0
Women (235)	Nondiabetic	141	8	5.7%
	Diabetes type II	88	4	4.5%
	Diabetes type I	6	0	0

a higher risk for harboring an AAA and that this subset of the population merits routine screening of the abdominal aorta for AAAs before undergoing CABG surgery. In addition, our findings suggest that the SAAAVE (Screen Abdominal Aortic Aneurysms Very Effectively) Act screening benefit provided by Medicare for newly enrolled male smokers and females with a family history of AAA should be amended to provide screening of the abdominal aorta for all men and women in the Medicare program who have undergone or are about to undergo CABG.²²

Epics I Conclusions

Men and women who have undergone CABG have a higher prevalence of AAAs than the population at large. In men with a history of CABG, this prevalence is 9% versus 4% for the general population, whereas in women with a history of CABG, this prevalence is 5.1% versus 1% for the general population. Male gender, age, and smoking are independent risk factors for AAAs, but diabetes and hypertension do not significantly have an impact on the prevalence of AAAs.

Screening of the abdominal aorta was very important in the detection of AAAs in both men and women. The screening process identified 31 of the 47 AAAs in the male group (66%) and six of the 12 AAAs in the female group (50%).

With the documented accuracy of screening of the abdominal aorta for the detection of AAAs, and the documented increased prevalence of AAAs in patients with a history of CABG, patients about to undergo CABG should be routinely screened for AAAs. Furthermore, the SAAAVE legislation should be expanded to include all Medicare recipients who have undergone or are about to undergo CABG.²²

INITIAL DATA ON EPICS II

A brief overview will be given because only 256 subjects with documented $\geq 50\%$ stenosis of at least one coronary artery (out of a planned 1,000) have been screened to date.

Although the prevalence of the manifestations of peripheral vascular disease, such as

AAAs, PAD, and CVD, are documented in the general population, less understood is the coexistence of these common manifestations of peripheral vascular disease in those with documented CAD.^{9,23-27}

Purpose

Epics II seeks to evaluate the coexistence and prevalence of AAAs, PAD, and CVD in individuals with angiographically documented coronary artery stenosis $>50\%$ by screening to identify those conditions. By establishing the coexistence of these conditions, Epics II seeks to reinforce the concept that

CAD and the manifestations of peripheral vascular disease are but individual component of one's global vascular profile.²¹⁻²⁸ For optimum vascular health in patients with CAD, screening to identify the manifestations of peripheral vascular disease is mandatory in order to delineate an individual's global vascular profile—identifying the coexistence of CAD, AAAs, PAD, and CVD.²⁷

Methods

Permission for Epics II was obtained from the McLaren Regional Medical Center IRB. Patients were given a recruitment flyer at the time of their cardiac catheterization, and those who wanted to self-enroll and who met the inclusion criteria were invited to participate after signing an informed consent. AAA screening was the same as that used for Epics I.²⁹ Eligible patients were men and women, aged 60 years or older, who had recently been diagnosed as having a stenosis $\geq 50\%$ in at least one coronary artery. The presence of CVD was determined by using peak systolic velocities of 100 cm/s as the criteria to suggest a stenosis $\geq 30\%$, considered a positive marker for occlusive disease. Similarly, a resting ankle-brachial index of ≤ 0.79 was considered a positive marker for PAD. Risk factors considered are smoking history, hypertension, diabetes, and hyperlipidemia.

Preliminary Results

Data from Epics II are rather limited because only 186 men and 105 women have self-enrolled. Of these, 155 men

TABLE 7. AAAs AND HYPERTENSION

		No. of Subjects	No. of AAAs	Prevalence
Men (517)	Hypertensive	371	36	9.7%
	Normotensive	146	11	7.5%
	Total	517	47	
Women (235)	Hypertensive	198	11	5.5%
	Normotensive	37	1	2.7%
	Total	235	12	

TABLE 8. VASCULAR PROFILE OF SUBJECTS WITH $\geq 50\%$ CORONARY ARTERY STENOSIS

		Men	Women
AAAs	Screened	155	90
	AAAs found	8	2
	Prevalence	5.1%	2.2%
PAD	Screened	158	86
	AAAs found	40	22
	Prevalence	25%	25%
CVD	Screened	166	90
	AAAs found	47	29
	Prevalence	28%	32%

and 90 women have been screened, with the remaining subjects awaiting their scheduled screening dates. Because of the relatively small numbers to date, only a brief overview of the findings is presented in Table 8.

Discussion

While patients are thoroughly evaluated for the presence of CAD, the coexisting manifestations of peripheral vascular disease (AAAs, PAD, and CVD) may be overlooked. Epics II was undertaken to establish the prevalence of the manifestations of peripheral vascular disease in patients with angiographically proven CAD of $\geq 50\%$ in at least one coronary artery and the need for screening to adequately identify the prevalence of an AAA, PAD, and CVD in these subjects. The concept of the need to delineate an individual's global vascular profile—to screen for the coexisting presence of AAA, PAD, and CVD in those with CAD—is critical to providing better vascular care for these individuals. Only by identifying these coexisting vascular conditions can their lethal consequences be prevented.

With the growing body of evidence reporting the increased prevalence of AAAs in subjects undergoing CABG, ranging from 9% to 18%,^{16,28,30} and with data from Epics II revealing a 25% prevalence of PAD in both men and women, and a 28% prevalence of CVD in men and a 32% prevalence of CVD in women with CAD, the concept of the global nature of vascular disease is reinforced, and the need to evaluate an individual's global vascular profile—the coexistence of CAD, AAAs, PAD, and CVD—is being documented. We look forward to completing Epics II and providing further data to support the concept of the need to evaluate and delineate a patient's global vascular profile. ■

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and David B. Wilson, MD, have disclosed that they are partners of Michigan Vascular. Brenda S. Buckle, ANP, BC; Joanne E. Drago, LPN, RVT, FSVU; and Ann M. Inskeep, RVT, have disclosed that they are partners in Michigan Vascular Research Center. The Michigan Vascular Research Center received a grant from Medtronic Vascular to conduct the trial. The Michigan Vascular Research Center received a grant to cover the cost of conducting the study, but did not gain additional income. Dr. Dall'Olmo may be reached at (810) 732-1620.

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