REVIEW

AHMED ABDEL LATIF, MD
Section of Vascular Medicine, Department of Cardiovascular Medicine, The Cleveland Clinic Foundation

AMJAD ALMAHAMEED, MD, MPH
Section of Vascular Medicine, Department of Cardiovascular Medicine, The Cleveland Clinic Foundation

MICHAEL S. LAUER, MD
Professor of Medicine, Cleveland Clinic Lerner College of Medicine of Case Western Reserve University; Department of Cardiovascular Medicine, The Cleveland Clinic Foundation

Should we screen for abdominal aortic aneurysms?

ABSTRACT

Ultrasonography can screen for abdominal aortic aneurysms (AAAs) safely, cheaply, and accurately. Once detected, an AAA can be monitored and repaired before it is likely to rupture. The US Preventive Services Task Force recently recommended a one-time screening for AAAs by ultrasonography for men age 65 to 75 years who have ever smoked. We should consider expanding the recommendations to include others at risk.

KEY POINTS

AAAs are typically asymptomatic until they rupture, an event that is usually fatal.

Screening for AAAs reduces aneurysm-related mortality and is cost-effective.

Once an AAA is detected, the patient should be aggressively treated for cardiovascular risk factors and regularly monitored with abdominal ultrasonography.

Patients should be referred for open surgical or endovascular repair when the AAA diameter reaches 5.5 cm or is expanding faster than 1.0 cm per year.

THE SHORT ANSWER as to whether we should screen for abdominal aortic aneurysms (AAAs) is yes, but only in appropriate patients.

Screening for asymptomatic vascular disease is a complex issue of great public health importance. Vascular diseases, including AAAs, are often asymptomatic, and the first clinical event is often fatal or life-threatening. The so-called detection gap[1] between pathologically present (but asymptomatic) disease and clinically apparent disease has led to an enormous interest in screening, not only in the medical community but also in the general public and industry.[2]

Although it may seem obvious that detecting disease early should be beneficial, experience with a number of diseases has shown that it isn't necessarily so.[3–7] The apparent benefits of screening may be misleading because of failure to take into account lead time, length time, and overdiagnosis biases.[7] Screening may even be harmful if it leads to patients undergoing dangerous invasive procedures needlessly.[3]

This article examines the issue of screening for AAAs by applying criteria for evaluating screening programs adopted by the World Health Organization (**TABLE 1**).[8] For a more in-depth review of AAAs in general, see our article in a recent issue of this journal.[9]

THE DISEASE: DO AAAs WARRANT SCREENING?

Some cardiovascular screening tests such as calcium scores and stress tests are routinely done in people who have no symptoms, even though randomized trials assessing their bene-

TABLE 1

Criteria for an acceptable screening program

The disease
- Is an important health problem
- Has an asymptomatic but detectable latent stage
- Has a treatment that is better at the latent stage than at a later stage
- Is more prevalent in high-risk populations that can be defined for screening
- Has a cost-effective screening strategy

The screening test
- Is simple, safe, precise, feasible, and validated
- Is ethically acceptable as well as accepted by the target population
- Offers defined cutoff levels and is reasonably cost-effective
- Is suitable and has agreed-upon follow-up intervals for future tests

The treatment
- Is effective and there are accepted preventive measures or treatments for detected patients
- Has clear treatment policy and options

ADAPTED FROM WILSON JM, JUNGNER YG. PRINCIPLES AND PRACTICE OF SCREENING FOR DISEASE. HWO PUBLIC HEALTH PAPER 1968:34.

fit are lacking.[10,11] In contrast, despite evidence that it is beneficial, screening for AAA remains controversial.

Are AAAs an important health problem?

The answer is a qualified yes.

AAAs, defined as an aortic diameter of 3 to 6 cm, are common in older people and are the 10th leading cause of death in American men older than 65 years.[12] In fact, at least 5% of American men older than 65 years are estimated to have AAAs, and the prevalence increases by 6% per decade thereafter.[13]

About 16% of large AAAs (> 5.5 cm) rupture—often a fatal event

Moreover, the overall prevalence of aneurysmal disease seems to be increasing.[14,15] Although life expectancy in the United States is also increasing (eg, from 68.8 years in 1975 to 74.4 years in 2001 for men; 76.6 to 79.8 years in women),[16] the increase in AAAs cannot be attributed solely to the aging of the population nor to better diagnosis.

Despite advances in surgical techniques and in critical care practices over the past several decades, we still see the same number of ruptured AAAs in emergency departments.[17] Such presentations constitute missed opportunities, and when we consider that our elderly population is expected to double by 2030, AAAs may represent a crisis in the making.

Do AAAs have a detectable, treatable latent stage?

Yes, AAAs definitely have an asymptomatic but detectable latent stage during which treatment is more beneficial than later.

Although AAAs are usually asymptomatic during the latent stage, as many as one in three may rupture if left untreated.[18] A ruptured AAA carries a grave prognosis, with an overall mortality rate approaching 75%.[19,20] In contrast, the mortality rate associated with elective surgical repair is only 2% to 6%, and lower figures have been claimed for endovascular repair.[21,22]

About 16% of "large" AAAs (diameter > 5.5 cm) rupture, causing 9,000 AAA-related deaths in the United States per year.[23,24] Several studies[25,26] found that most deaths from ruptured AAAs can be prevented if the AAA is detected and repaired in time. For men older than 60 years, screening can reduce the aneurysm rupture rate by 45% to 49% and reduce AAA-related mortality by 21% to 68%.[27–29]

The Multicenter Aneurysm Screening Study (MASS),[27,28] the largest population-based screening study to date, randomized 67,800 men age 65 to 74 years equally to either a group that received an ultrasound screening for AAA or to a control group. In the screening group, men found to have an abdominal aorta larger than 3 cm in diameter were followed with serial ultrasound scans for

a mean duration of 4.1 years. When an aneurysm reached 5.5 cm, grew more than 1 cm per year, or became symptomatic, it was surgically repaired. The rate of aneurysm-related mortality was 53% lower in the screening group. The study was not powered to detect reduced overall mortality.

Other screening trials in different countries followed participants for 4 to 10 years and had strikingly similar results.[12,30–39]

Although the relative risk reductions in the studies were large, the absolute risk was small. For example, in the MASS trial, there were 65 AAA-related deaths in the intervention group, for an absolute risk of 0.19%; in the control group there were 113 AAA-related deaths, for an absolute risk of 0.33%. The same caveat applies for all the major screening trials.

Can high-risk groups that need screening be defined?

Yes, in most cases. Risk factors for aortic wall dilatation include:

- Male sex
- Older age
- Family history of AAAs or of death from a ruptured aneurysm
- Current or past smoking
- Hypertension
- Known atherosclerotic disease (coronary artery disease, cerebrovascular disease)
- Hypercholesterolemia.

Cardiovascular risk factors, many of which are also risk factors for aneurysms, tend to cluster in certain patients. Men who smoke, have hypertension, and have other cardiovascular risk factors have an incidence of AAA two to five times higher than in the general population. Women older than 60 years with cardiovascular risk factors are two to three times more likely to develop aneurysmal disease.[21,38] Interestingly, evidence from epidemiologic studies suggests that contrary to their strong association with occlusive vascular disease, black race and diabetes mellitus appear to be associated with a lower incidence of AAA.[13,40]

Is screening cost-effective?

Yes, particularly when applied to appropriate candidates and viewed over the long term.

The MASS trial,[27] conducted in the United Kingdom, found that a population-based screening program would cost £28,389 per life-year saved at 4 years. The screening program becomes more cost-effective in the long run with projected cost of only £8,000 per life-year saved.[28] These results were paralleled in the United States by a cost-effectiveness study[21,26] demonstrating a cost-effectiveness ratio of an AAA screening program of $11,285. This figure is comparable to the cost of well-established screening programs such as mammography for breast cancer detection, as well as therapeutic interventions such as coronary artery bypass surgery.[21]

The differences in the literature regarding the exact cost per life-year saved or quality-adjusted life-year units can be explained by the different models, costs and benefits, and assumed probabilities. The vast majority of studies, however, agree on the cost-effectiveness of a single screening ultrasound scan in the high-risk population. The latest United States Preventive Services Task Force (USPSTF) guidelines reflected these recommendations.[41]

IS THERE AN ACCEPTABLE SCREENING TEST?

Screening can reduce AAA deaths by half, but absolute risk is low

Ultrasonography is the cornerstone of AAA screening. It is available in almost every medical center and in many physician offices.

Is the test simple, safe, precise, feasible, and validated?

Yes. Abdominal aortic ultrasonography is fast, inexpensive, safe, and well tolerated by most patients. It is highly accurate, with 95% sensitivity and 100% specificity for AAAs.[42] The most important limitations of ultrasonography are operator dependence and reduced accuracy in people who are obese, have bowel gas, or have periaortic disease. These limitations are less important in the hands of experienced sonographers and in validated, accredited, high-volume vascular laboratories where there is adequate quality assurance.

Clinical abdominal examination should also be considered as part of AAA screening and surveillance. However, although physical examination may detect a large AAA, it is neither sensitive nor specific for small ones.

The role of abdominal self-examination has not been well defined.

Computed tomography and magnetic resonance angiography are accurate for diagnosing AAA but are less often used as first-line creening tests, mainly because of their expense and lack of availability, as well as because of potential contrast-related side effects of computed tomography.

Is the test ethically acceptable, and is it accepted by patients?

Yes. Screening ultrasonography is noninvasive and causes no serious side effects. Several studies and anecdotes from clinical practice suggest that screening for AAAs and diagnosing asymptomatic small aneurysms were not associated with significant long-term emotional or psychological stress to patients[43] or their partners.[44,45] Screening trials have found a high acceptance rate, ranging from 53% to 84%,[27,31,33–36,46] and averaging about 80% in the MASS trial.[27]

A simple screening ultrasound test costs about $500, for which Medicare reimburses about $160. Private insurers and Medicare have been reluctant to reimburse the cost, posing a major obstacle to widespread AAA screening. Sometimes approval is granted on an individual basis. This has not changed with the recent USPSTF decision, although we hope it will.

Screening for AAAs is as cost-effective as other, accepted screening programs

Lack of coverage raises the ethical dilemma of AAA screening being available only to the elite who can afford it. Lawmakers have recently discussed the need for Medicare coverage of screening for appropriately selected patients.[47]

THE TREATMENT: IS THERE A STANDARD OF CARE?

The purpose of screening is to enable patients with a disease to start therapy to change its course and prevent its complications. Other conditions that may affect the disease should also be addressed to improve the overall health of patients and their short-term and long-term outcomes.

The main treatment for AAA is surgical or endovascular repair. No medications have proven to affect aneurysm growth, and none is recommended for routine use.

Is there a clear treatment policy with proven therapeutic options?

Yes. Current guidelines and expert consensus statements recommend repair of AAAs 5.5 cm in diameter or larger, and of smaller AAAs that are rapidly expanding or that cause symptoms.

Rapid advances in endovascular aneurysm repair in the United States have been fostering a trend towards repairing smaller AAAs,[25] even though results of randomized controlled trials suggest it might not be beneficial. Endovascular repair may also be a good option for sicker patients who are not candidates for open surgery. If so, future screening programs could be expanded to people who would not qualify for open repair.

Are there effective measures for small AAAs detected by screening?

Yes. A small, asymptomatic AAA (3–5.5 cm) may serve as a marker for vascular disease elsewhere, and finding one provides a good reason to aggressively start to modify risk factors.

AAA and atherosclerosis share many risk factors that tend to cluster. AAA patients have a high prevalence of systemic atherosclerosis: from 23% to 86% have coronary artery disease, 3% to 20% have cerebrovascular disease, and 12% to 42% have peripheral arterial disease.[48]

Overall cardiovascular health is likely to be improved by lifestyle changes (eg, smoking cessation, improved fitness) and medications for hypertension and dyslipidemia to achieve the targets recommended for secondary prevention. Patients who quit smoking may stave off reaching the AAA repair size during their lifetime.[49]

Are there established follow-up intervals for ultrasound tests for small AAAs?

Yes, but more research is needed.

Periodic ultrasonographic surveillance is recommended for aneurysms smaller than the repair cutoff.[21] However, definite and unified parameters for appropriate surveillance intervals have not yet been determined because clinical trials have enrolled heterogeneous populations and used different standards for diagnosis and management.

Based on the best available data,[21,25,49–54] we propose a surveillance plan for patients diagnosed with small AAAs (2.5–5.0 cm) (TABLE 2). Since men older than 70 years have three times the rate of progression of younger men,[51] they may need more frequent follow-up scans. In addition, aneurysm diameters determined by ultrasound may vary by up to 0.5 cm, which should be considered when recommending optimal times for rescanning and repair.[25]

POLITICAL WILL IS CHANGING

Adopting a national screening program for early detection of AAA has gained momentum recently and was discussed at the congressional level in recent months,[55] signaling the beginning of better societal and political understanding of this issue.

In 1996 the USPSTF neither endorsed nor recommended screening asymptomatic adults for AAA with abdominal palpation or ultrasound. However, in 2005, it updated its recommendations[41,56] and now recommends a one-time screening for AAA by ultrasonography for men age 65 to 75 years who have ever smoked, based on evidence that screening followed by surgical repair of AAAs larger than 5.5 cm decreases AAA-specific mortality.

Some in the vascular community believe that the USPSTF recommendations are still too restrictive. Patients older than 60 years with a history of smoking (regardless of sex), a history of peripheral vascular disease, or a family history of aneurysms are considered at high risk for AAA and should be screened. Furthermore, about 22% of aneurysms occur in nonsmokers,[40] and up to 10% of aneurysms in patients under age 65 ruptured in the Gloucestershire experience; screening men at age 60 instead of 65 would presumably detect most of these before rupture.[57] Therefore, a single ultrasound screen for all men at age 60 or 65 may be justified.[58]

Furthermore, guidelines for selective screening (ie, targeting high-risk populations) were recently proposed in a consensus statement of the major vascular societies in the United States (TABLE 3).[21] This strategy is likely to increase the yield of screening and reduce AAA-related mortality. A single screening ultrasound scan in people at high risk or with equivocal findings on physical examination is both cost-effective and beneficial.[37]

TABLE 2

Proposed surveillance intervals for abdominal aortic aneurysms

BASELINE DIAMETER	SURVEILLANCE INTERVAL
2.5–2.9 cm	None, or after 60 months if risk factors persist
3.0–3.4 cm	24–36 months
3.5–3.9 cm	12–24 months
4.0–4.4 cm	12 months
4.5–5.0 cm	6 months
> 5 cm or expansion rate > 1 cm/year	Refer to vascular specialist

ADAPTED FROM DATA FROM POWELL AND GREENHALGH,[49] LINDHOLT ET AL,[50] LEDERLE ET AL,[25] COUTO ET AL,[51] SANTILLI ET AL,[52] MCCARTHY ET AL,[53] BRADY ET AL,[54] AND KENT ET AL.[21]

TABLE 3

Who should be screened for abdominal aortic aneurysms?

AGE (YEARS)	MEN	WOMEN
US vascular societies[21]		
60–85	Yes	Only if they have risk factors
> 50	Only those with family history of AAA (both men and women)	
US Preventive Services Task Force[56]		
65–75	Yes, if they ever smoked (> 100 cigarettes in a lifetime)	No

REFERENCES

1. **Pasternak RC, Abrams J, Greenland P, Smaha LA, Wilson PW, Houston-Miller N.** 34th Bethesda Conference: Task force #1—Identification of coronary heart disease risk: is there a detection gap? J Am Coll Cardiol 2003; 41:1863–1874.
2. **Lee TH, Brennan TA.** Direct-to-consumer marketing of high-technology screening tests. N Engl J Med 2002; 346:529–531.
3. **Yamamoto K, Ohta S, Ito E, et al.** Marginal decrease in mortality and marked increase in incidence as a result of neuroblastoma screening

at 6 months of age: cohort study in seven prefectures in Japan. J Clin Oncol 2002; 20:1209–1214.
4. **Woods WG, Gao RN, Shuster JJ, et al.** Screening of infants and mortality due to neuroblastoma. N Engl J Med 2002; 346:1041–1046.
5. **Schilling FH, Spix C, Berthold F, et al.** Neuroblastoma screening at one year of age. N Engl J Med 2002; 346:1047–1053.
6. **Cunningham G.** The science and politics of screening newborns. N Engl J Med 2002; 346:1084–1085.
7. **Patz EF Jr, Goodman PC, Bepler G.** Screening for lung cancer. N Engl J Med 2000; 343:1627–1633.
8. **Wilson JM, Jungner YG.** Principles and practice of screening for disease. HWO Public Health Paper 1968:34.
9. **AlMahameed A, Latif A, Graham LM.** Managing abdominal aortic aneurysms: treat the aneurysm *and* the risk factors. Cleve Clin J Med 2005; 72:877–888.
10. **Fowler-Brown A, Pignone M, Pletcher M, Tice JA, Sutton SF, Lohr KN; U.S. Preventive Services Task Force.** Exercise tolerance testing to screen for coronary heart disease: a systematic review for the technical support for the U.S. Preventive Services Task Force. Ann Intern Med 2004; 140:W9–24.
11. **Greenland P, LaBree L, Azen SP, Doherty TM, Detrano RC.** Coronary artery calcium score combined with Framingham score for risk prediction in asymptomatic individuals (erratum in JAMA 2004; 291:563). JAMA 2004; 291:210–215.
12. **Scott RA, Ashton HA, Kay DN.** Abdominal aortic aneurysm in 4237 screened patients: prevalence, development and management over 6 years. Br J Surg 1991; 78:1122–1125.
13. **Lederle FA, Johnson GR, Wilson SE, et al.** Prevalence and associations of abdominal aortic aneurysm detected through screening. Aneurysm Detection and Management (ADAM) Veterans Affairs Cooperative Study Group. Ann Intern Med 1997; 126:441–449.
14. **Melton LJ 3rd, Bickerstaff LK, Hollier LH, et al.** Changing incidence of abdominal aortic aneurysms: a population-based study. Am J Epidemiol 1984; 120:379–386.
15. **Bickerstaff LK, Hollier LH, Van Peenen HJ, Melton LJ 3rd, Pairolero PC, Cherry KJ.** Abdominal aortic aneurysms: the changing natural history. J Vasc Surg 1984; 1:6–12.
16. **Arias E, Anderson RN, Kung HC, Murphy SL, Kochanek KD.** Deaths: final data for 2001. Natl Vital Stat Rep 2003; 52:1–115.
17. **Heller JA, Weinberg A, Arons R, et al.** Two decades of abdominal aortic aneurysm repair: have we made any progress? J Vasc Surg 2000; 32:1091–1100.
18. **Darling RC, Brewster DC, Ottinger LW.** Autopsy study of unoperated abdominal aortic aneurysms. The case for early detection. Circulation 1977; 56(suppl)II161–II164.
19. **Ernst CB.** Abdominal aortic aneurysm. N Engl J Med 1993; 328:1167–1172.
20. **Brown LC, Powell JT.** Risk factors for rupture in patients kept under ultrasound surveillance. UK Small Aneurysm Trial Participants. Ann Surg 1999; 230:289–297.
21. **Kent KC, Zwolak RM, Jaff MR, et al; Society for Vascular Surgery; American Association of Vascular Surgery; Society for Vascular Medicine and Biology.** Screening for abdominal aortic aneurysm: a consensus statement. J Vasc Surg 2004; 39:267–269.
22. **The UK Small Aneurysm Trial Participants.** Mortality results for randomised controlled trial of early elective surgery or ultrasonographic surveillance for small abdominal aortic aneurysms. Lancet 1998; 352:1649–1655.
23. **Gillum RF.** Epidemiology of aortic aneurysm in the United States. J Clin Epidemiol 1995; 48:1289–1298.
24. **Centers for Disease Control and Prevention.** Deaths from each cause by 5-year age groups, race, and sex: United States, 2001. www.cdc.gov/nchs/dta/statab/mortfinal/2001_work1.pdf. Accessed 12/1/05.
25. **Lederle FA.** Ultrasonographic screening for abdominal aortic aneurysms. Ann Intern Med 2003; 139:516–522.
26. **Lee TY, Korn P, Heller JA, et al.** The cost-effectiveness of a "quick screen" program for abdominal aortic aneurysms. Surgery 2002; 132:399–407.
27. **Ashton HA, Buxton MJ, Day NE, et al; Multicentre Aneurysm Screening Study Group.** The Multicenter Aneurysm Screening Study Group (MASS) into the effect of abdominal aortic aneurysm screening on mortality in men: a randomised controlled trial. Lancet 2002; 360:1531–1539.
28. **Multicentre Aneurysm Screening Study Group.** Multicentre aneurysm screening study (MASS): cost effectiveness analysis of screening for abdominal aortic aneurysms based on four year results from randomised controlled trial. BMJ 2002; 325:1135.
29. **Wilmink AB, Quick CR.** Epidemiology and potential for prevention of abdominal aortic aneurysm. Br J Surg 1998; 85:155–162.
30. **Norman PE, Jamrozik K, Lawrence-Brown M, Dickinson J.** Western Australian randomized controlled trial of screening for abdominal aortic aneurysm [abstract]. Br J Surg 2003; 90:492.
31. **Heather BP, Poskitt KR, Earnshaw JJ, Whyman M, Shaw E.** Population screening reduces mortality rate from aortic aneurysm in men. Br J Surg 2000; 87:750–753.
32. **Wilmink AB, Quick CR, Hubbard CS, Day NE.** Effectiveness and cost of screening for abdominal aortic aneurysm: results of a population screening program. J Vasc Surg 2003; 38:72–77.
33. **Scott RA, Wilson NM, Ashton HA, Kay DN.** Influence of screening on the incidence of ruptured abdominal aortic aneurysm: 5-year results of a randomized controlled trial. Br J Surg 1995; 82:1066–1070.
34. **Wilmink TB, Quick CR, Hubbard CS, Day NE.** The influence of screening on the incidence of ruptured abdominal aortic aneurysms. J Vasc Surg 1999; 30:203–208.
35. **Lindholt JS, Juul S, Fasting H, Henneberg EW.** Hospital costs and benefits of screening for abdominal aortic aneurysms. Results from a randomised population screening trial. Eur J Vasc Endovasc Surg 2002; 23:55–60.
36. **Scott RA, Bridgewater SG, Ashton HA.** Randomized clinical trial of screening for abdominal aortic aneurysm in women. Br J Surg 2002; 89:283–285.
37. **Scott RA, Vardulaki KA, Walker NM, Day NE, Duffy SW, Ashton HA.** The long-term benefits of a single scan for abdominal aortic aneurysm (AAA) at age 65. Eur J Vasc Endovasc Surg 2001; 21:535–540.
38. **Lederle FA, Johnson GR, Wilson SE; Aneurysm Detection and Management Veterans Affairs Cooperative Study.** Abdominal aortic aneurysm in women. J Vasc Surg 2001; 34:122–126.
39. **Greenhalgh RM, Powell JT.** Screening men for aortic aneurysm. BMJ 2002; 325:1123–1124.
40. **Lederle FA, Wilson SE, Johnson GR, et al.** Immediate repair compared with surveillance of small abdominal aortic aneurysms. N Engl J Med 2002; 346:1437–1444.
41. **Fleming C, Whitlock EP, Beil TL, Lederle FA.** Screening for abdominal aortic aneurysm: a best-evidence systematic review for the U.S. Preventive Services Task Force. Ann Intern Med 2005; 142:203–211.
42. **LaRoy LL, Cormier PJ, Matalon TA, Patel SK, Turner DA, Silver B.** Imaging of abdominal aortic aneurysms. AJR Am J Roentgenol 1989; 152:785–792.
43. **Vammen S, Lindholt JS, Ostergaard L, Fasting H, Henneberg EW.** Randomized double-blind controlled trial of roxithromycin for prevention of abdominal aortic aneurysm expansion (erratum in Br J Surg 2002; 89:120–121). Br J Surg 2001; 88:1066–1072.
44. **Wanhainen A, Rosen C, Rutegard J, Bergqvist D, Bjorck M.** Low quality of life prior to screening for abdominal aortic aneurysm: a possible risk factor for negative mental effects. Ann Vasc Surg 2004; 18:287–293.
45. **Spencer CA, Norman PE, Jamrozik K, Tuohy R, Lawrence-Brown M.** Is screening for abdominal aortic aneurysm bad for your health and well-being? ANZ J Surg 2004; 74:1069–1075.
46. **Irvine CD, Shaw E, Poskitt KR, Whyman MR, Earnshaw JJ, Heather BP.** A comparison of the mortality rate after elective repair of aortic aneurysms detected either by screening or incidentally. Eur J Vasc Endovasc Surg 2000; 20:374–378.
47. **Wood S.** Proposed Medicare reimbursement for aortic aneurysm screening gains momentum and Congress support. www.theheart.org [HeartWire > News]. Mar 29, 2004. www.the-

heart.org/viewArticle.do?primaryKey=540200. Accessed Apr 2, 2004.

48. **Sanfelippo P.** Abdominal aortic aneurysm—2003: what we know, what we don't know—a review. Int Angiol 2003; 12:145–152.
49. **Powell JT, Greenhalgh RM.** Small abdominal aortic aneurysms. N Engl J Med 2003; 348:1895–1901.
50. **Lindholt JS, Vammen S, Juul S, Fasting H, Henneberg EW.** Optimal interval screening and surveillance of abdominal aortic aneurysms. Eur J Vasc Endovasc Surg 2000; 20:369–373.
51. **Couto E, Duffy SW, Ashton HA, et al.** Probabilities of progression of aortic aneurysms: estimates and implications for screening policy. J Med Screen 2002; 9:40–42.
52. **Santilli SM, Littooy FN, Cambria RA, et al.** Expansion rates and outcomes for the 3.0-cm to the 3.9-cm infrarenal abdominal aortic aneurysm. J Vasc Surg 2002; 35:666–671.
53. **McCarthy RJ, Shaw E, Whyman MR, Earnshaw JJ, Poskitt KR, Heather BP.** Recommendations for screening intervals for small aortic aneurysms. Br J Surg 2003; 90:821–826.
54. **Brady AR, Thompson SG, Fowkes FG, Greenhalgh RM, Powell JT; UK Small Aneurysm Trial Participants.** Abdominal aortic aneurysm expansion: risk factors and time intervals for surveillance. Circulation 2004; 110:16–21.
55. **Burton TM.** Support gathers to force coverage of aneurysm test. Wall Street Journal March 23, 2004, D.3.
56. **U.S. Preventive Services Task Force.** Screening for abdominal aortic aneurysm: recommendation statement. Ann Intern Med 2005; 142:198–202.
57. **Earnshaw JJ, Shaw E, Whyman MR, Poskitt KR, Heather BP.** Screening for abdominal aortic aneurysms in men. BMJ 2004; 328:1122–1124.
58. **Frame PS.** Screening for abdominal aortic aneurysm. BMJ 2004; 329:E311–E312.

ADDRESS: *Amjad AlMahameed, MD, Section of Vascular Medicine, S60, Department of Cardiovascular Medicine, The Cleveland Clinic Foundation, 9500 Euclid Avenue, Cleveland, OH 44195; e-mail almahaa@ccf.org.*

CME 1.5 CREDIT HOURS

CME ANSWERS

Answers to the credit test on page 103 of this issue

1 **E** 2 **E** 3 **B** 4 **B** 5 **A** 6 **B** 7 **C** 8 **D** 9 **A**
10 **B** 11 **C** 12 **E** 13 **D** 14 **B** 15 **D**