Eur J Vasc Endovasc Surg (2015) 49, 113–115

EDITORIAL

International Update on Screening for Abdominal Aortic Aneurysms: Issues and Opportunities

Screening for abdominal aortic aneurysm (AAA) has been shown to be effective at reducing AAA-related mortality and is cost-effective.[1] There are, however, significant variations in AAA screening protocols between healthcare systems[2] and numerous challenges to be overcome. Further evidence of cost- and clinical effectiveness is likely to be required before there is widespread international adoption of AAA screening.

ECONOMICS

One of the key arguments against AAA screening is the declining prevalence of disease, potentially reducing any economic benefit. Cost-effectiveness has, however, been demonstrated (at current prevalence rates) by the English Aneurysm screening programme.[3] The Viborg screening trial[4] has shown that a once-only screening strategy is highly cost-effective (at current AAA prevalence rates) and would remain so at a prevalence of 1.6%, which is half that observed in the original Viborg study. In Sweden, screening is cost-effective at current AAA prevalence rates[5] and will remain so even for an AAA prevalence of 0.5%, unless there is an increase in the rate at which aneurysms are detected prior to screening.

AAA screening is intrinsically linked to ongoing disease surveillance. Long-term modelling suggests that cost-effectiveness could be improved by lengthening surveillance intervals for smaller AAAs, but potential cost savings are relatively limited.[6] Other factors related to the cost-effectiveness of AAA screening include the degree to which lives are lengthened by detecting an AAA and the quality of this improved lifespan. Both the improvement in length of life afforded by AAA screening and the quality of this extended life were assessed in the UK by the MASS trial.[1] While the majority of screened individuals had no significant change in quality of life, there were small subgroups of vulnerable individuals for whom screening had a negative effect on quality of life.[7,8] Contemporary data regarding the outcomes of screening for AAA, including unbiased assessments of the effect of screening on quality, as well as length, of life are required and should be the focus of future research. In particular, it may be necessary to evaluate whether providing additional support (both before and after screening), in a comprehensive or targeted fashion, is worthwhile.

1078-5884/$ – see front matter
http://dx.doi.org/10.1016/j.ejvs.2014.08.015

SUB-ANEURYSMAL AORTIC DILATATION AND MEASUREMENT METHODOLOGY

A specific subgroup that has attracted considerable attention includes patients with an internal aortic diameter of 25–29 mm, when the external diameter may already have reached the 30-mm threshold. These patients are not usually considered to have an AAA, but data suggest they have a significant risk (50%) of developing an AAA within 5 years of the initial scan.[9] More importantly, there is no international consensus on the preferred method for ultrasound measurement of infra-renal aortic diameter and the methods used have often been poorly documented in the various randomized controlled trials. Three methods are in current use: inner-to-inner,[10] outer-to-outer,[11] and leading-edge-to-leading-edge (outer anterior wall to inner posterior wall).[12] A recent publication comparing the three methods showed the lowest variability with the leading-edge-to-leading-edge method, which is routine in cardiac ultrasound measurements.[13] One consequence of changing from outer-to-outer to inner-to-inner methodology, is that this could result in some patients who would previously have been diagnosed as having an AAA now being diagnosed as "normal", that is they would fall into the sub-aneurysmal aortic dilatation category. Whether these patients would require follow-up remains unknown. The impact of measurement methodology on outcomes from screening and the possible benefit of re-screening these types of patient also remain unknown.[9]

TARGET POPULATIONS

The majority of screening programmes recommend a single ultrasound scan for males aged 65 years, irrespective of medical history or risk factors such as smoking. The exception is the US Veterans' Administration (USVA) screening programme, where only men with a history of smoking are invited for screening. Currently, there is no clinical trial evidence regarding the efficacy of screening targeted high-risk male sub-groups over the age of 65 years. The incidence of AAA in the USVA programme, where only previous or current smokers are offered screening, is >7%.[14] This compares with 1.8% for the NHS AAA Screening Programme and 1.7% in the Swedish AAA screening program. The USVA programme screens an older age group, however, which makes direct comparison difficult. It should also be noted that these prevalence rates refer to screen-detected AAA in asymptomatic patients, as patients with known AAA disease are usually excluded from screening. In

addition, disease prevalence rates in populations that would be excluded by such targeted programmes have not been sufficiently investigated and reduced life expectancy among smokers may also reduce any potential gains from screening.

Screening women for AAA remains controversial. Owing to the lower prevalence of AAA in women, screening has always been considered ineffective and there is no clinical trial evidence to support screening in women. However, given that the prevalence of AAA in female smokers is around 2%,[15] and that evidence from health economic models of male AAA screening demonstrated cost effectiveness at much lower prevalence rates, it would seem intuitive that targeting female smokers might be cost-effective. However, it is unclear whether detecting AAA in women would result in an improvement in the length and quality of life. This is because women tend to rupture their AAA earlier in the disease process and have poorer outcomes after AAA repair.[16] To what extent these factors would reduce the benefit of early detection remains unknown. Any studies of the effectiveness of screening women for AAA would need to address this area of uncertainty, either directly, or through statistical modelling.

In common with other screening programmes, data suggest that males who are invited for AAA screening and who do not attend may be at a higher risk of disease. In the city and suburban areas of Malmö (Sweden), compliance with screening varied between 64% and 89%.[17] In areas with low socioeconomic status, attendance rates were lower, whereas AAA prevalence was higher. In another Swedish study from the greater Stockholm area, several different registries with socio-economic data were cross-matched with the screening database.[18] The most important reasons for non-attendance were: recent immigration (within 5 years), low income, being single or divorced, low level of education, and long travel distances to the screening centre. Targeting non-attenders for more re-invitation may improve the effectiveness of AAA screening, but requires assessment. However there also is evidence that the incidence of AAA varies with ethnicity[19–23] and it may not be appropriate to target all immigrant groups.

CARDIOVASCULAR RISK MANAGEMENT

One criticism of screening is that whilst it reduces aneurysm related mortality, there is only a limited effect on overall mortality. One of the main causes of death in populations screened for AAA is cardiovascular disease and it is known that aortic diameter is a predictor of cardiovascular mortality.[24] People with sub-aneurysmal aortic dilatation or AAA are at higher risk of cardiovascular death than those with normal infrarenal aortic diameter.[25] It should also be noted that the relationship between aortic diameter and cardiovascular mortality is not linear and individuals with both small and large aortic diameters are at higher risk of cardiovascular mortality and morbidity.[26] The increased risk in patients with AAA is partly due to common risk factors for both AAA and other cardiovascular traits. There is some evidence to suggest that having an AAA places an individual at a higher risk of developing cardiovascular disease, irrespective of the presence or absence of traditional risk factors such as smoking and high blood pressure.[27]

The provision of secondary prevention between screening programmes varies. In Sweden, patients with a screen-detected AAA do not routinely receive additional secondary preventative measures (other than smoking cessation advice), unless they have clinical evidence of pre-existing atherosclerosis. In the NHS AAA screening programme, family doctors are advised to prescribe an antiplatelet agent and a statin, together with smoking cessation advice as appropriate. The benefits and risks of either management strategy have not been established.

CONCLUSIONS

The main challenge for proponents of AAA screening is the demonstration of cost-effectiveness. AAA screening also presents an opportunity to improve the general and, in particular, cardiovascular health of individuals being screened. Research and audit are evaluating and improving evidence for the economics of AAA screening and have demonstrated the true health value of AAA screening and surveillance, with access to AAA screening for all high-risk patient groups. Areas of potential quality improvement include: (a) increasing compliance in populations with low socio-economic status and a higher risk of AAA; and (b) adding benefit to AAA screening by determining if secondary cardiovascular prevention in high-risk groups based on infrarenal aortic diameter measurement confers a reduction in cardiovascular mortality.

REFERENCES

1 Thompson SG, Ashton HA, Gao L, Buxton MJ, Scott RA, Multicentre Aneurysm Screening Study G. Final follow-up of the Multicentre Aneurysm Screening Study (MASS) randomized trial of abdominal aortic aneurysm screening. *Br J Surg* 2012;**99**:649–56.

2 Stather PW, Dattani N, Bown MJ, Earnshaw JJ, Lees TA. International variations in AAA screening. *Eur J Vasc Endovasc Surg* 2013;**45**:231–4.

3 Glover MJ, Kim LG, Sweeting MJ, Thompson SG, Buxton MJ. Cost-effectiveness of the National Health Service abdominal aortic aneurysm screening programme in England. *Br J Surg* 2014;**101**:976–82.

4 Lindholt JS, Juul S, Fasting H, Henneberg EW. Preliminary ten year results from a randomised single centre mass screening trial for abdominal aortic aneurysm. *Eur J Vasc Endovasc Surg* 2006;**32**:608–14.

5 Svensjo S, Mani K, Bjorck M, Lundkvist J, Wanhainen A. Screening for abdominal aortic aneurysm in 65-year-old men remains cost-effective with contemporary epidemiology and management. *Eur J Vasc Endovasc Surg* 2014;**47**:357–65.

6 Thompson SG, Brown LC, Sweeting MJ, Bown MJ, Kim LG, Glover M, et al. Systematic review and meta-analysis of the growth and rupture rates of small abdominal aortic aneurysms: implications for surveillance intervals and their cost-effectiveness. *Health Technol Assess* 2013;**17**:1–118.

7 Lindholt JS, Vammen S, Fasting H, Henneberg EW. Psychological consequences of screening for abdominal aortic aneurysm and conservative treatment of small abdominal aortic aneurysms. *Eur J Vasc Endovasc Surg* 2000;**20**:79—83.

8 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—93.

9 Wild JB, Stather PW, Biancari F, Choke EC, Earnshaw JJ, Grant SW, et al. A multicentre observational study of the outcomes of screening detected sub-aneurysmal aortic dilatation. *Eur J Vasc Endovasc Surg* 2013;**45**:128—34.

10 Hartshorne TC, McCollum CN, Earnshaw JJ, Morris J, Nasim A. Ultrasound measurement of aortic diameter in a national screening programme. *Eur J Vasc Endovasc Surg* 2011;**42**:195—9.

11 The U.K. Small Aneurysm Trial: design, methods and progress. The UK Small Aneurysm Trial participants. *Eur J Vasc Endovasc Surg* 1995;**9**:42—8.

12 Singh K, Bonaa KH, Solberg S, Sorlie DG, Bjork L. Intra- and interobserver variability in ultrasound measurements of abdominal aortic diameter. The Tromso Study. *Eur J Vasc Endovasc Surg* 1998;**15**:497—504.

13 Gurtelschmid M, Bjorck M, Wanhainen A. Comparison of three ultrasound methods of measuring the diameter of the abdominal aorta. *Br J Surg* 2014;**101**:633—6.

14 Chun KC, Teng KY, Chavez LA, Van Spyk EN, Samadzadeh KM, Carson JG, et al. Risk factors associated with the diagnosis of abdominal aortic aneurysm in patients screened at a regional Veterans Affairs health care system. *Ann Vasc Surg* 2014;**28**:87—92.

15 Svensjo S, Bjorck M, Wanhainen A. Current prevalence of abdominal aortic aneurysm in 70-year-old women. *Br J Surg* 2013;**100**:367—72.

16 Powell JT, Bown MJ. Evidence does not support reducing the threshold diameter to 5 cm for elective interventions in females with abdominal aortic aneurysm. *Eur J Vasc Endovasc Surg* 2014;**48**(6):614—8. http://dx.doi.org/10.1016/j.ejvs.2014.08.016.

17 Zarrouk M, Holst J, Malina M, Lindblad B, Wann-Hansson C, Rosvall M, et al. The importance of socioeconomic factors for compliance and outcome at screening for abdominal aortic aneurysm in 65-year-old men. *J Vasc Surg* 2013;**58**:50—5.

18 Linne A, Leander K, Lindstrom D, Tornberg S, Hultgren R. Reasons for non-participation in population-based abdominal aortic aneurysm screening. *Br J Surg* 2014;**101**:481—7.

19 Costa M, Robbs JV. Abdominal aneurysms in a black population: clinicopathological study. *Br J Surg* 1986;**73**:554—8.

20 Hobbs SD, Wilmink AB, Bradbury AW. Ethnicity and peripheral arterial disease. *Eur J Vasc Endovasc Surg* 2003;**25**:505—12.

21 Lederle FA, Johnson GR, Wilson SE, Gordon IL, Chute EP, Littooy FN, et al. Relationship of age, gender, race, and body size to infrarenal aortic diameter. The Aneurysm Detection and Management (ADAM) Veterans Affairs Cooperative Study Investigators. *J Vasc Surg* 1997;**26**:595—601.

22 Salem MK, Rayt HS, Hussey G, Rafelt S, Nelson CP, Sayers RD, et al. Should Asian men be included in abdominal aortic aneurysm screening programmes? *Eur J Vasc Endovasc Surg* 2009;**38**:748—9.

23 Spark JI, Baker JL, Vowden P, Wilkinson D. Epidemiology of abdominal aortic aneurysms in the Asian community. *Br J Surg* 2001;**88**:382—4.

24 Freiberg MS, Arnold AM, Newman AB, Edwards MS, Kraemer KL, Kuller LH. Abdominal aortic aneurysms, increasing infrarenal aortic diameter, and risk of total mortality and incident cardiovascular disease events: 10-year follow-up data from the Cardiovascular Health Study. *Circulation* 2008;**117**:1010—7.

25 Duncan JL, Harrild KA, Iversen L, Lee AJ, Godden DJ. Long term outcomes in men screened for abdominal aortic aneurysm: prospective cohort study. *BMJ* 2012;**344**:e2958.

26 Norman PE, Muller J, Golledge J. The cardiovascular and prognostic significance of the infrarenal aortic diameter. *J Vasc Surg* 2011;**54**:1817—20.

27 Forsdahl SH, Solberg S, Singh K, Jacobsen BK. Abdominal aortic aneurysms, or a relatively large diameter of non-aneurysmal aortas, increase total and cardiovascular mortality: the Tromso study. *Int J Epidemiol* 2010;**39**:225—32.

The International AAA Screening Group

M. Björck
Uppsala, Sweden

M.J. Bown*, E. Choke
Leicester, UK

J. Earnshaw
Gloucester, UK

T. Flørenes
Oslo, Norway

M. Glover
London, UK

M. Kay
Birmingham, UK

S. Laukontaus
Helsinki, Finland

T. Lees
Newcastle, UK

J. Lindholt
Odense, Denmark

J.T. Powell
London, UK

A. van Rij
Otago, New Zealand

S. Svensjö
Falun, Sweden

A. Wanhainen
Uppsala, Sweden

*Corresponding author. M.J. Bown, Department of Cardiovascular Sciences and NIHR Leicester Biomedical Research Unit, University of Leicester, Leicester, UK.
Email-address: m.bown@le.ac.uk (M.J. Bown)