

Long-Term Benefit and Cost-Effectiveness of Screening for Abdominal Aortic Aneurysm

Kim LG, Scott AP, Ashton HA, Thompson SG. A sustained mortality benefit from screening for abdominal aortic aneurysm. *Ann Intern Med* 2007;146:699–706.

Study Overview

Objective. To determine the effect of an invitation to be screened with ultrasonography for abdominal aortic aneurysm (AAA) versus no invitation to be screened on mortality and cost per life-year gained after 7 years of follow-up.

Design. Randomized controlled trial.

Setting and participants. 70,495 men aged 65 to 74 years who were registered with a family physician at 4 centers in the United Kingdom were identified between 1997 and 1999. Men who had known AAA, previous AAA surgery, terminal illness, or incorrect details in the registry were excluded ($n = 2725$). The remaining 67,770 men were randomized to receive an invitation to be screened for AAA or to not receive an invitation.

Intervention. Those invited for ultrasound screening received surveillance and further intervention according to a set protocol. Participants with aortic diameters < 3.0 cm were considered normal and did not receive surveillance. Participants with aortic diameters ≥ 3.0 cm were considered to have AAAs and managed as follows: those with aortic diameters of 3.0 to 4.4 cm were rescreened every year, those with aortic diameters of 4.5 to 5.4 cm were rescreened every 3 months, and those with aortic diameters ≥ 5.5 cm or greater were offered elective surgery. In addition, participants whose aortas expanded ≥ 1.0 cm each year and participants who experienced symptoms attributable to the AAA were offered surgery.

Main outcome measure. The main outcome of interest was AAA-related mortality, defined as all deaths within 30 days of any AAA surgery (elective or emergent) plus all deaths with ICD-9 codes for ruptured AAA, AAA without mention of rupture, ruptured aortic aneurysm at an unspecified site, or aortic aneurysm at an unspecified site without mention of rupture. Primary analyses of effectiveness used an intention-to-treat approach and Cox regression. Cost-effectiveness was calculated from the perspective of the health care system.

Main results. Of the 67,770 men randomized, 33,883 (50%)

were invited to be screened, and 80% of these (27,204) participated in screening. Follow-up for both groups ranged from 5.9 to 8.2 years (mean, 7.1 years). Of those who participated in screening, 1334 (4.9%) were found to have AAAs. There were more elective AAA surgeries in the invited group than in the control group (450 vs. 156). Conversely, there were more emergency AAA surgeries in the control group than in the invited group (111 vs. 45). There were 301 AAA-related deaths (105 in the invited group and 196 in the control group) and 14,001 deaths overall (21% of all participants). The hazard ratio for AAA-specific mortality was 0.53 (95% confidence interval [CI], 0.42–0.68) in the invited group. The hazard ratio for all-cause mortality was 0.96 (95% CI, 0.93–1.00) in the invited group. For averting AAA-specific mortality, the incremental cost-effectiveness ratio at 7 years of follow-up was \$19,500 (95% CI, \$12,400–\$39,800) per life-year gained using costs derived from the U.K. health system, or \$29,600 (95% CI, \$18,900–\$60,200) using costs derived from the U.S. health system.

Conclusion. Screening for AAA using ultrasonography saves lives among men ages 65 to 74 years. Screening for AAA in this group is also cost-effective from the perspective of the health care system.

Commentary

Kim and colleagues provide excellent evidence for the effectiveness and cost-effectiveness of ultrasound screening for AAA among men ages 65 to 74 years over the longer term. This study updates and expands this group's prior work, which reported outcomes of the Multicentre Aneurysm Screening Study (MASS) at 4 years (42% risk reduction and \$44,000 per life-year saved) [1–3].

MASS has several methodologic strengths. The randomized design with a control group that received no systematic screening is ideal and avoids lead-time bias. Use of mortality as the primary outcome avoids length bias. Population-based sampling maximizes generalizability, and use of a preset protocol for surveillance and intervention allows for easy translation into clinical practice. A limitation of this study is that results cannot be generalized to men younger than

65 years of age, men older than 74 years of age, or women. In addition, cost-effectiveness of testing in the United States may vary from MASS study estimates due to differences in the way health care is delivered in the 2 countries, beyond differences in costs for procedures and services.

It is notable that the type of high-quality data provided by MASS is rare in screening evaluations. MASS provides data directly linking the screening test to health outcomes, which is the type of data emphasized in the analytic framework used by the U.S. Preventive Services Task Force (USPSTF) [4]. Although there have been several randomized trials evaluating breast cancer screening [5], data on the effectiveness of screening for most other diseases have come from lower-quality direct studies, such as cohort and case-control studies, or from indirect data linking various parts of the analytic framework (eg, linking tests to identification of disease, linking identification of disease to treatment, linking treatment to outcomes).

The USPSTF reviewed the topic of screening for AAA in 2005 [6]. Based on a meta-analysis of 4 population-based randomized trials (including earlier results from the MASS study [7]), they recommended 1-time screening for AAA by ultrasonography among men aged 65 to 75 years who have ever smoked [6]. Of note, none of the 4 trials compared the benefit of screening in smokers versus nonsmokers [3], but the USPSTF argued that the higher prevalence of AAA among smokers warrants selective screening. The USPSTF rated this a grade B recommendation, with "good" quality evidence but only a moderate net benefit due to morbidity and mortality associated with AAA-related surgery [6]. The MASS study found a 5% mortality rate overall for elective AAA repair [8], which is comparable with the 4.2% rate that has been found in a large U.S. hospital sample [7]. The same U.S. hospital sample found a complication rate from elective AAA repair of 32.4% [7]; the overall complication rate was not given by the MASS investigators. The MASS study's calculation of cost-effectiveness did not explicitly incorporate the harms associated with surgical complications, but they did adjust their estimate of cost-effectiveness for decrements in quality of life associated with aging and found similar results, with screening costing \$24,600 per quality-adjusted life-year using costs from the U.K. health system (95% CI, \$15,700–\$49,000). This approach may be justified by the group's previous work, which found no differences in self-reported health status between those who received surgery

and those who received surveillance 12 months after detection of an aneurysm [2].

Applications for Clinical Practice

The study by Kim and colleagues adds to the growing literature on the benefits of ultrasound screening for AAA among men aged 65 to 74 years. Although AAA is relatively rare, screening leads to higher rates of elective repair and lower long-term mortality than no screening. Screening for AAA with ultrasonography should be disseminated more widely among men in this age-group, including both smokers and nonsmokers. Some even have argued that the quality of evidence supporting screening is now so strong that it should be considered an indicator of high-quality health care and linked to pay-for-performance incentives [3].

—Review by Lisa M. Kern, MD, MPH

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