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Cost-effectiveness of Screening for Abdominal Aortic Aneurysm in Combination with Medical Intervention in Patients with Small Aneurysms

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WHAT THIS PAPER ADDS

Screening for abdominal aortic aneurysm (AAA) in 65 year old men is still cost-effective in the new screening era of lower prevalence of AAA, increasing use of EVAR, and improved medical treatment. The results support current screening programs.

Objectives: Screening for abdominal aortic aneurysm (AAA) among 65 year old men has been proven cost-effective, but nowadays is conducted partly under new conditions. The prevalence of AAA has decreased, and endovascular aneurysm repair (EVAR) has become the predominant surgical method for AAA repair in many centers. At the Malmö Vascular Center pharmacological secondary prevention with statins, antiplatelet therapy, and blood pressure reduction is initiated and given to all patients with AAA. This study evaluates the cost-effectiveness of AAA screening under the above mentioned conditions.
Methods: This was a Markov cohort simulation. A total of 4,300 65 year old men were invited to annual AAA screening; the attendance rate was 78.3% and AAA prevalence was 1.8%. A Markov model with 11 health states was used to evaluate cost-effectiveness of AAA screening. Background data on rupture risks, costs, and effectiveness of surgical interventions were obtained from the participating unit, the national Swedvasc Registry, and from the scientific literature.
Results: The additional costs of the screening strategy compared with no screening were €169 per person and year. The incremental health gain per subject in the screened cohort was 0.011 additional quality adjusted life years (QALYs), corresponding to an incremental cost-effectiveness ratio (ICER) of €15710 per QALY. Assuming a 10% reduction of all cause mortality, the incremental cost of screening was €175 per person and year. The gain per subject in the screened cohort was 0.013 additional QALYs, corresponding to an ICER of €13922 per QALY
Conclusions: AAA screening remains cost-effective according to both the Swedish recommendations and the UK National Institute for Health and Care Excellence recommendations in the new era of lower AAA prevalence, EVAR as the predominant surgical method, and secondary prevention for all AAA patients.

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INTRODUCTION

Patients with abdominal aortic aneurysm (AAA, aortic diameter $\geq$ 30 mm) are at increased risk for rupture and death.[1,2] Ultrasound screening for AAA among 65 year old men reduces AAA related mortality.[3—6] Population based screening programs have therefore been launched in several countries including Sweden. Since 2010, all 65 year old men in the County of Skåne in southwestern Sweden have been invited to AAA screening.[7]

Previous cost-effectiveness studies[8—21] for AAA screening have evaluated surgical benefits only for patients with intermediate/large aneurysms. As risk factors for atherosclerotic vascular disease are common in AAA patients however, they also run an increased risk for other vascular complications such as acute coronary syndrome, cerebrovascular disease, and peripheral artery disease (PAD) as well as the risk of AAA rupture (rAAA).[22] Therefore, current guidelines[22,23] recommend medical treatment for prevention of atherosclerotic manifestations, and surgery to prevent aneurysm rupture. Medical treatment serves as secondary prevention for vascular events in the same manner as recommended to patients with other established vascular diseases.[24]

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The outline of the AAA screening program in Malmö has previously been described.[7] All patients with screen detected AAA receive secondary preventive medication: platelet inhibition (salicylic acid 75 mg daily) and cholesterol lowering (simvastatin 40 mg daily). AAA subjects with hypertension (>140/90 mmHg on repeated examination) were offered a calcium channel blocker (amlodipine 5 mg daily). Patients were referred to their general practitioner for follow up of medication.

Most previous cost-effectiveness studies of AAA screening[8–21] have been based on prevalence figures of 4–5%.[3–6] However, recent studies have confirmed that AAA prevalence among men is decreasing,[25] most likely because of decreased smoking.[26,27]

Previous cost-effectiveness studies have also mainly been based on open repair (OR) of AAA.[8–15] Nowadays however, endovascular aneurysm repair (EVAR) is the leading method in many departments, including Malmö.[28] Comparisons between EVAR and OR for elective repair concerning long-term cost-effectiveness are inconclusive; advantages with OR have been reported in meta-analysis,[29] whereas Mani et al.[30] reported similar costs for EVAR and OR. Furthermore, previous estimates of the cost-effectiveness of AAA screening have only taken the effects of surgical treatment of the aneurysm into account.[8–21]

The first analysis taking into account decreasing prevalence, new endovascular techniques, and potential effects of medical treatment on all cause mortality was therefore conducted.

Long-term trials would answer questions, but are expensive and time consuming. A Markov simulation model was therefore used to evaluate potential outcomes of the disease defined as specific health states to estimate cost-effectiveness, and to help in the decision making process.[31]

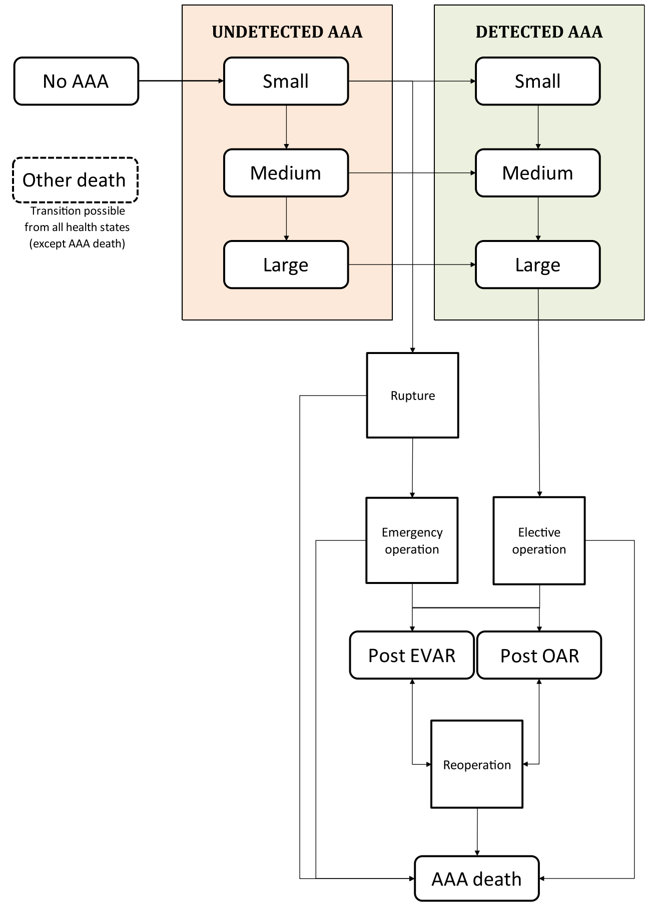

Figure 1. The Markov model used to evaluate screening for abdominal aortic aneurysm (AAA). Rectangles represent health states and square represent events. Possible transitions are represented by the thin arrows. EVAR = endovascular aneurysm repair; OR = open repair.

MATERIALS AND METHODS

Model structure

A deterministic cohort model was developed to evaluate the cost-effectiveness of AAA screening in 65 year old men using decision analysis software (TreeAge Software, Williamstown, MA, USA). The model used 11 (mutually exclusive and collectively exhaustive) Markov health states to simulate the development and progression of AAA (Fig. 1). Cycle length was 1 year, and transition between health states may occur at the end of each model cycle and were governed by transition probabilities. Two identical cohorts of 65 year old men were simulated; the first cohort was invited to screening but the second was not. The cohorts were simulated for 35 years (to age 100 years). The face validity of the model was evaluated during model development by consulting with clinical experts. The model was also carefully tested and debugged in order to reveal any errors in logic or programming.

Health states and transitions

The model contained 11 Markov states, including no AAA, six AAA states, two post-surgery states and two states for death (Fig. 1). AAA health states were divided into two major groups: undetected AAA and detected AAA. Each group contained three different health states representing AAA size: small (30–44 mm), medium (45–54 mm), and large (≥55 mm). Development of AAA was through transition from no AAA to undetected small AAA, whereas growth was represented by transition from small AAA to medium AAA and from medium AAA to large AAA within each group. Detection of AAA was modeled by transition from an undetected AAA state to the corresponding detected AAA state.

Elective surgery could only occur in the detected large AAA state, whereas rupture could occur in all six states, both detected and undetected. Both elective and rupture surgery could be performed by EVAR or OR. Successful surgery was modeled by transition to the post-EVAR or post-OR states (depending on the method of surgery). Death from rupture or surgery was represented by transition to the AAA death state whereas death from all other causes was represented by transition to the other death state.

General input variables (Table 1)

The compliance rate (78.3%) for the invited cohort was based on mean compliance in Malmö.[7] The prevalence of