Eur J Vasc Endovasc Surg (2016) 52, 29—40

Cost-effectiveness of Elective Endovascular Aneurysm Repair Versus Open Surgical Repair of Abdominal Aortic Aneurysms

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WHAT THIS PAPER ADDS

This is the first study to estimate the lifetime cost-effectiveness of elective endovascular aneurysm repair versus open surgical repair in the Netherlands, based on recently published literature.

Objective/Background: The aim of this study was to estimate the lifetime cost-effectiveness of endovascular aneurysm repair (EVAR) versus open surgical repair (OSR) in the Netherlands, based on recently published literature.

Methods: A model was developed to simulate a cohort of individuals (age 72 years, 87% men) with an abdominal aortic aneurysm (AAA) diameter of at least 5.5 cm and considered fit for both repairs. The model consisted of two sub-models that estimated the lifetime cost-effectiveness of EVAR versus OSR: (1) a decision tree for the first 30 post-operative days; and (2) a Markov model for the period thereafter (31 days—30 years).

Results: In the base case analysis, EVAR was slightly more effective (4.704 vs. 4.669 quality adjusted life years) and less expensive (€24,483 vs. €25,595) than OSR. Improved effectiveness occurs because EVAR can reduce 30 day mortality risk, as well as the risk of events following the procedure, while lower costs are primarily due to a reduction in length of hospital stay. The cost-effectiveness of EVAR is highly dependent on the price of the EVAR device and the reduction in hospital stay, complications, and 30 day mortality.

Conclusion: EVAR and OSR can be considered equally effective, while EVAR can be cost saving compared with OSR. EVAR can therefore be considered as a cost-effective solution for patients with AAAs.

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Article history: Received 10 October 2015, Accepted 2 March 2016, Available online 23 April 2016

Keywords: Aneurysm, Cost-effectiveness, EVAR, Surgery

INTRODUCTION

Patients diagnosed with a large unruptured abdominal aortic aneurysm (AAA) are usually offered elective operative repair given the high risk of rupture. Nowadays, patients with an AAA diameter >5.5 cm are treated electively by open surgical repair (OSR) or endovascular aneurysm repair (EVAR).[1] Several randomized controlled trials (RCT) such as the DREAM, EVAR 1, OVER, or ACE trials have compared the effectiveness of EVAR versus OSR and concluded that EVAR leads to a reduction in short-term mortality.[2—5] A systematic review showed that EVAR may significantly decrease the 30 day mortality and 6 month all cause mortality primarily owing to a lower mortality rate during initial hospitalisation.[6,7] However, EVAR seems to increase the 4 year risk of AAA related re-interventions (9%) compared with OSR (1.7%),[8] and RCTs showed that the gain in all cause mortality disappears after the first 2 years.[9]

The various observed differences in effectiveness between EVAR and OSR underline the need to compare the two procedures in a comprehensive manner. Moreover, costs also need to be considered, as the device used in an EVAR procedure is more expensive than the prosthesis used for OSR. These are two important reasons to examine the cost-effectiveness of EVAR versus OSR.

Several analyses have examined the cost-effectiveness of EVAR versus OSR in different settings.[6,9] A previous study estimated the cost-effectiveness of elective EVAR versus OSR for the Netherlands;[10] however, the time limit of the analysis was 1 year and the data were based on the DREAM trial,[2] which started patient inclusion in 2000. In the economic evaluation,[10] based on the DREAM trial, it was concluded that EVAR was not cost-effective compared with OSR. Other studies have also estimated the cost-effectiveness of EVAR

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http://dx.doi.org/10.1016/j.ejvs.2016.03.001

compared with OSR, albeit for another setting and also often using slightly outdated results, and several clinical events were not included. As endovascular AAA repair is a very dynamic field, its cost-effectiveness should be estimated with recent data, including cost data, technological improvements of the device, and the technical skills of clinicians with EVAR. The aim of this study was to estimate the lifetime cost-effectiveness of elective EVAR versus OSR in patients with AAA in the Netherlands, from a societal perspective.

MATERIALS AND METHODS

A model was developed to simulate a cohort of individuals (72 years old, 87% men)[11] with a newly diagnosed AAA of at least 5.5 cm in diameter and considered fit for elective OSR and EVAR.

The model estimated the lifetime cost-effectiveness of elective EVAR versus OSR. The measure of health benefit was expressed in expected quality adjusted life years (QALYs) and costs were measured in 2013 Euros (€). A societal perspective, as proposed by the Dutch guidelines,[12] was adopted; however, indirect costs and non-medical costs were assumed to be equal between the treatment strategies and were left out of the analyses. Costs and health benefits were discounted at 4% and 1.5%, respectively, according to the current Dutch guidelines.[12] The model was closely based on a previously published model but was adjusted in several aspects:[13] (1) costs of procedures were adapted to the Dutch setting; (2) additional events were included (e.g., deep venous thrombosis [DVT], pulmonary embolism [PE], major amputation of lower extremities), (3) transition probabilities (e.g., mortality and events) were derived from more recent publications; and (4) quality of life (QoL) values were based on the DREAM trial.[10]

Structure

The model consisted of two sub-models, namely a short-term decision tree model (which captured events that took place in the first 30 post-operative days), and a long-term Markov model to model disease progression thereafter (up to 30 years). Patients who experienced pre-operative complications while waiting to undergo the operation were not included in this analysis; it was assumed there were no differences in costs and effects between the interventions during waiting time (expert opinion).

Short-term model. The short-term model included 30 day mortality, conversion from EVAR to OSR, and events (AAA and laparotomy related re-intervention, major amputation of lower extremities, myocardial infarction [MI], DVT, PE, pneumonia, permanent and temporary renal failure, disabling and non-disabling stroke) (Fig. 1).

Long-term model. The costs and health effects (life years, QALYs) of patients who survive the first 30 days post-procedure were estimated in the long-term model for a lifetime horizon (30 years) (Fig. 2). The cycle length used in the first 2 years was 1 month, and after 2 years a yearly cycle was used. This model consisted of four disease states ("Alive, no event", "Post-non-fatal event—first year", "Post-non-fatal event—subsequent years", and "Death"). Two "Post-non-fatal event" states were incorporated as the costs and QoL of patients with an event were different for the first year compared with subsequent years.[13]

Depending on the occurrence of an event in the first 30 days, patients could enter the long-term model in the "Alive, no event" or in the "Post-non-fatal event—first year" if they had experienced a non-fatal event in the first 30 days. Patients in the "Alive, no event" state had an ongoing chance of an event (MI or stroke) and an ongoing chance of dying for any reason. Patients who experienced an event were moved to the "Post-non-fatal event—first year" state. The costs and health outcomes of patients that survived the first year after the event were modeled in the "Post-non-fatal event—subsequent years" state. Patients in the "Post-non-fatal event" states were only at risk of death and not at risk of an additional event. The "Post-non-fatal event" states included patients who had had various types of events, which means that the average costs and QoL represented weighted averages. The costs and health outcomes of patients who experienced an event (e.g., stroke, MI, renal failure) were modeled separately in this heterogeneous state. Mortality was not modeled separately, as specific risks after each event were not available.

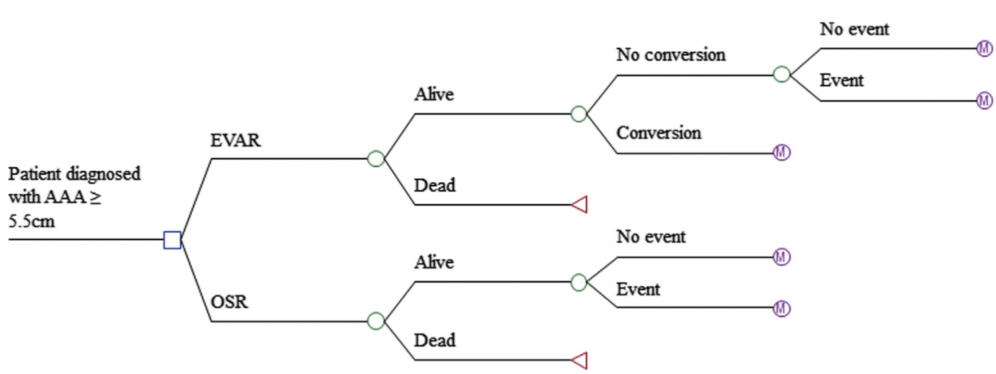

Figure 1. Short-term model (first 30 days). This short-term model estimates the effects (i.e., survival and clinical events) and costs peri-operatively and 30 days post-operatively for both endovascular aneurysm repair (EVAR) and open surgical repair (OSR). *Note.* AAA = aortic abdominal aneurysm.

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