Chapter 4: Screening for abdominal aortic aneurysm: effectiveness and cost-effectiveness

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Screening for abdominal aortic aneurysm: effectiveness and cost-effectiveness

ABSTRACT

Objective:
To review the current literature concerning the effectivity and cost-effectiveness of screening for abdominal aortic aneurysm (AAA).

Design:
Review.

Method:
A review of literature of evaluations of effectivity via meta-analyses and economic evaluations.

Results:
The short-term meta-analyses showed that screening for AAA leads to a significant reduction of AAA-related mortality. The average absolute risk reduction (ARR) was 0.12%. The long-term meta-analysis also showed a significant reduction of overall mortality. The ARR was in this case almost 1%. The five economic evaluations all resulted in cost-effectiveness ratios below euro 20,000 per quality-adjusted life year (QALY), a used threshold level in the Netherlands.

Conclusion:
Based on the available literature, screening for AAA has appeared to be both effective and cost-effective. However, the economic evaluations did not always take into account the peri- and post-operative mortality and morbidity. Economic evaluations are only useful if all possible outcomes are included in the model. Therefore a good model analysis should be made for the Dutch situation, after which a decision may be taken on a possible pilot study and the optimal design thereof.
Introduction
Screening for abdominal aortic aneurysm (AAA) is an interesting but debatable issue. This is the evidence from several articles which appeared in one issue of this journal last year: a summary of the recent Cochrane review "Screening for abdominal aortic aneurysm” (Cosford & Leng, 2007; Hamerlynck et al., 2008) and two editorials by Bol and Van der Graaf, under the heading "Pro and cons on whether to introduce population screening for AAA” (Boll, 2008; Van der Graaf, 2008). Much has been written about the effectiveness of screening for AAA, but little attention has been paid to its cost-effectiveness. In a report by the National Institute for Public Health and the Environment (RIVM) published in 2005, Vijgen et al concluded that there is evidence that screening for AAA is cost effective (Vijgen et al., 2005) Recently, RIVM performed a new review, in which this report was updated to include literature up to mid 2008 (van Gils et al., 2008). Based on this literature, we present in this article the evidence from the literature in terms of cost-effectiveness of screening for AAA.

Methods
We searched the scientific literature on effectiveness evaluations and economic evaluations of AAA screening, published in the period 2005 to mid 2008. For the effectiveness evaluations we selected meta-analyses, and for economic evaluations primary cost-effectiveness studies. For the search strategy and the further methods, we refer to our earlier article in this journal and the original RIVM reports (Vijgen, 2005; van den Berg et al., 2008a; van den Berg et al., 2008b). Since the economic evaluations were performed in different countries and in different years, we have converted the value of all currencies to 2007 Euros. The value the currencies used in the evaluation studies was first converted to the value of the Euro at that time, as indicated by the Organization for Economic Cooperation and Development (OECD, 2009), and then recalculated with the price index for 2007 according to Statistics Netherlands (CBS, 2009). When no currency year was mentioned in the study, we based our indexation on the value of two years prior to the publication date.
**Results**

**Effectiveness**

We identified four meta-analyses addressing the effectiveness of AAA-screening. All four meta-analyses were based on four different randomized controlled trials performed in Viborg (Denmark), Chichester (United Kingdom) Western Australia, and the MASS-study (United Kingdom) (Lindholt et al., 2005; Scott et al., 1995; Vardulaki et al., 2002; Norman et al., 2004; Ashton et al., 2002). All review articles calculated the short-term effectiveness (3.5-5 years) (Cosford & Leng, 2007; Fleming et al., 2005; Mastracci & Cina, 2007; Lindholt & Norman, 2008). In their meta-analysis, Lindholt en Norman (2008), also calculated the long-term effectiveness (7-15 years), on the basis of three long-term follow-up studies of the four trials. In the short-term, the meta-analyses showed a statistically significant reduction in AAA-related mortality with a mean odds ratio (OR) of 0.58 (range: 0.56 to 0.60). This means a relative risk reduction (RRR) of 42% and an average absolute risk reduction (ARR) of 0.12%. The number needed to screen (NNS) was 832 to prevent one death. As for the total short-term non-disease-specific mortality, the meta-analyses showed no statistically significant reduction (Cosford & Leng, 2007; Fleming, 2005; Mastracci & Cina, 2007). The meta-analyses also showed a significant reduction in the long-term AAA-related mortality: OR= 0.47, 95% CI: 0.25 to 0.90. The ARR was 0.28% and the NNS was 353. In the long term, the reduction in total mortality was statistically significant: OR = 0.94, 95% CI: 0.91 to 0.97. The ARR was almost 1% (Lindholt & Norman, 2008). In summary, we conclude that AAA screening leads to a reduction in AAA-related mortality. There was also a tentative indication for an overall mortality reduction. The results for long-term AAA-related mortality were better than those for short-term AAA-related mortality: the NNS decreased and the ARR increased.

**Cost-effectiveness**

Since the publication of the report "Economic evaluation of prevention. Opportunities for Dutch public health policy" (Vijgen, 2005), that discusses the results of seven economic evaluations of AAA screening, five new economic evaluations have been
published. We also found an updated version of a previously published study (Table 1). We will now briefly discuss the six individual studies.

- A Swedish economic evaluation calculated the incremental cost-effectiveness ratio of AAA-screening to be €7760. - (Euro 2007: 8226) per life year gained (LYG) and €9700, - (Euro 2007: 10,282) per QALY (Henriksson & Lundgren, 2005). The Swedish Council for Technology Assessment concluded in 2003 that, because evidence for the cost-effectiveness was lacking, a screening program could not yet be recommended, and additional research was needed. In response, a second study was performed in which it was calculated that further research would be of little help in reaching a decision regarding the implementation of AAA-screening and that screening is cost-effective with €9700, - (Euro 2007: 10,282) per QALY (Henriksson et al., 2006).

- In an economic evaluation of the implementation of ultrasound screening for AAA in the United Kingdom, based on the effect data of the MASS study, it was calculated that the cost per QALY will be 15,723 U.S. dollars (Euro 2007: 15,566) (Silverstein et al., 2005).

- A second economic evaluation was performed on the basis of data of the MASS trial, The estimated cost per LYG was 19,500 U.S. dollars (Euro 2007: 18,720) (Kim et al., 2007a).

- To provide reliable estimates regarding the long-term cost-effectiveness an economic model was developed using the MASS-data. This model was extrapolated over 30 years. The cost per LYG were 2320 British pounds (Euro 2007: 3758) and 2970 British pounds per QALY (Euro 2007: 4811) (Kim et al., 2007b).

- In an economic evaluation performed in Denmark, based on the 5-year results of the Viborg trial, it was concluded that the cost per LYG after 5 years was €9057. - (Euro 2007: 9,238). It was expected that a further reduction to €2708 (Euro 2007: 2762) would occur after 10 years and to €1825 (Euro 2007: 1862) after 15 years(Lindholt et al., 2006).
The sixth economic evaluation was based on the average results of the four AAA-trials. The calculated cost per QALY was 6194 Canadian dollars (Euro 2007: 4707). This study explicitly involved postoperative morbidity in terms of stroke (0.6%), myocardial infarction (5.2%) and dialysis (0.6%) (Montreuil & Brophy, 2008).

The models were based on a single population screening by ultrasound of men aged 65 years and older. All studies except one were based on the standard open surgical procedure. One study also included the endovascular surgical technique in the model (Silverstein, 2005). All studies described the costs and effects of screening, including pre- and postoperative mortality (3% - 6%). The cost-effectiveness of these economic evaluations of AAA-screening was well below the threshold of €20,000 per QALY generally used in the Netherlands.

Table 1: Incremental cost-effectiveness, in 2007 Euros

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<thead>
<tr>
<th>Author</th>
<th>Incremental cost-effectiveness ratio</th>
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<tbody>
<tr>
<td>Henriksson et al.</td>
<td>€8,226 per LYG*; €10,282 per QALY**</td>
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<tr>
<td>Silverstein et al.</td>
<td>€15,566 per QALY</td>
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<tr>
<td>Kim et al. -7 jaar</td>
<td>€18,720 per LYG</td>
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<tr>
<td>Kim et al. -30 jaar</td>
<td>€3,758 per LYG; €4,811 per QALY</td>
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<tr>
<td>Lindholt et al.</td>
<td>€9,238 LYG</td>
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<tr>
<td>Montreuil &amp; Brophy</td>
<td>€4,707 per QALY</td>
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* Life Years Gained
**Quality Adjusted Life Year

Translation to the Dutch situation

Results of foreign economic evaluations can not always be directly translated to the Dutch situation. The key components of the evaluations, such as incidence and prevalence, discount rate and healthcare context need to be scrutinized. Internationally, AAA prevalence is at a similar level (Blankensteijn & Eikelboom,
2003), as is true for the prices of abdominal ultrasound. In the Netherlands the cost of abdominal ultrasound with expert assessment was € 65 in 2003. Given the huge increase in the number of ultrasonography due to introduction of AAA screening, it likely that economies of scale will occur, resulting in reduced costs of ultrasonography.

The cost of a ‘quick-scan’ ultrasonography, which scans the aorta and no other organs, will be € 20. In the model studies, an annual discount rate from 3%-5% was used for both costs and effects. The only study that did not discount, was that of Lindholt et al, because of the short period of 5 years it covered (Lindholt, 2006). In the Netherlands, a discount rate of 4% for costs and 1.5% for effects is currently used (Oostenbrink et al., 2004). This has a positive effect on the presented incremental cost-effectiveness ratios of the model studies in the previous section. In summary, we assume that the results of the foreign evaluation can be translated to the Dutch situation, because the main parameters that determine the cost-effectiveness are comparable with the Dutch parameters.

**Discussion and conclusion**

Based on the studies, screening for abdominal aortic aneurysm in The Netherlands seems both effective and cost effective. Currently, there is a discussion in the Netherlands whether or not screening for AAA should be introduced. On the one hand, some argue for the introduction based on effectiveness and cost-effectiveness (Boll et al., 2003; Bonneux, 2008). On the other hand, others pose that caution is indicated because of, among other things, the large number of people that needs to be screened to prevent one death (van der Graaf, 2007). In 2006, The Health Council came to the conclusion that screening for AAA was not yet advisable (Bonneux, 2008; Gezondheidsraad, 2006). According to the Council more research should be performed into the effectiveness and cost-effectiveness of screening and long-term treatment. A draft guideline of the Dutch Society for Surgery, in collaboration with the Dutch Society for Vascular Surgery and the Dutch Society of Interventional Radiology, the Dutch Society of Intensive Care and Dutch Anesthetists Association,
recommends to start a screening program, but only in a research context. Such a pilot implementation study should address several questions, such as the effect of drug treatment on the growth of the AAA, the impact of the introduction of endovascular surgery through the groin, shifting the diameter of the aneurysm for an indication for surgery, depending on condition and age of the patient, and the severity and extent of the postoperative morbidity.

Several publications indicate that the published effectiveness and cost-effectiveness studies took inappropriate account of perioperative mortality and morbidity (Legemate & Bossuyt, 2006; Ehlers et al., 2008). Perioperative mortality is included in economic evaluations, but it is not always clear whether and to what extent postoperative morbidity is also included. Only one economic evaluation clearly describes the percentages of postoperative morbidity included in the model (Montreuil & Brophy, 2008). Economic evaluations are useful only if all the costs and benefits of all possible outcomes are included in the model.

In recent years several publications on the effectiveness and cost-effectiveness of screening men aged 65 years and older for AAA were published. The present article shows that the cost-effectiveness of AAA screening in all publications was favorable. For the effect of screening on AAA-related mortality more evidence is present than for the effect on total mortality. In the Netherlands implementation of population-wide screening for colorectal cancer is scheduled for 2010-2011. There is much evidence that this will lead to a reduction of colon cancer-related deaths, but there is no evidence for the reduction of total mortality (Moayyedi & Achkar, 2006; Moayyedi, 2007). Yet, this is not an obstacle to proceed with the large-scale implementation of the screening program. There is currently much research going on in the Netherlands as to the most suitable method for this screening program (Bakkenist & van den Berg, 2008). A recent economic evaluation shows that combined screening for both colorectal cancer and AAA with CT tomography may be cost effective, compared with only colorectal cancer screening by colonoscopy (Hassan et al., 2008). This article does not give final answers to all questions regarding the benefits and risks of introduction of AAA screening in the Netherlands. However, it shows that such
screening is likely to be effective and cost effective. The questions that remain must be answered through research in the Dutch context.

References


Blankensteijn JD, Eikelboom BC. Zijn er internationale verschillen? Volksgezondheid Toekomst Verkenning, Nationaal Kompas Volksgezondheid 2003 [cited 04-03-2008]; Available from: http://www.nationaalkompas.nl> Gezondheid en ziekte\ Ziekten en aandoeningen\ Hartvaatstelsel\ Aneurysma van de buikaorta


