Registers in cardiovascular epidemiology

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Chapter 3

Increasing incidence of aneurysms of the abdominal aorta in the Netherlands

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Abstract

Objectives - To study the trend in incidence of aneurysms of the abdominal aorta in the Netherlands during the past two decades.
Setting - The Dutch population from 1972 through 1992.
Design - Analysis of all hospital admissions and deaths due to aneurysms of the abdominal aorta.
Outcome measures - Age adjusted and age-specific mortality and discharge rates. In-hospital mortality after surgery upon aneurysms of the abdominal aorta.
Results - From 1972 to 1992 age adjusted mortality from aneurysms of the abdominal aorta rose from 3.1 to 8.1 per 100,000 in men, and from 1.4 to 2.2 in women. Age adjusted discharge rates (alive and dead) for non-ruptured abdominal aortic aneurysms increased from 3.7 to 37.6 per 100,000 in men and from 1.2 to 5.5 in women. For ruptured aneurysms, the age adjusted discharge rates increased from 2.4 to 10.3 per 100,000 in men and from 0.7 to 1.7 in women. Age adjusted in-hospital mortality after surgery upon non-ruptured aneurysms was halved from 13% in 1972 to 7% in 1992, mortality after acute repair upon ruptured aneurysms also decreased from 52% in 1972 to 36% in 1992.
Conclusions - There was an impressive increase in hospital based incidence for aneurysms of the abdominal aorta during the past two decades in the Netherlands. An improved detection rate through ultrasound is probably a major contributor to this increase, but gender differences and the rise in the number of ruptured aneurysms suggest that a real increase in incidence may exist, especially in men. Surgical outcome for both ruptured and non-ruptured aneurysms of the abdominal aorta improved.

INTRODUCTION

Recent reports from England and Wales, the United States and Australia have suggested an increase in mortality from aneurysms of the abdominal aorta during recent decades.[1-4] Simultaneously, a marked increase in the number of hospital admissions and operations for these aneurysms was observed. The annual increase in the incidence of abdominal aortic aneurysms has been estimated at 4.2% in men and 14% in women.[5]

Despite improvements in acute medical care, the prognosis for a patient with a ruptured aneurysm remains poor, with a mortality rate as high as 80 to 90%.[6-9] After the first resection of an aneurysm of the abdominal aorta by Dubost *et al* in 1951, surgical treatment has become the standard treatment for aneurysms of a certain size.[10] Mortality after elective surgery varies between 1.4 and 6.5%.[3,11-19]

We studied the trends in the incidence of aneurysms of the abdominal aorta in the Netherlands by age, sex and calendar year from 1972 through 1992. In addition, changes in in-hospital mortality after surgical treatment of abdominal aortic aneurysms were assessed.

MATERIALS AND METHODS

Population data and the number of deaths due to aortic aneurysms in the Netherlands from 1972-1992 were obtained from Statistics Netherlands, Voorburg, the Netherlands. The number of deaths was grouped by 5 year age categories, sex and underlying cause of death. Causes of death were coded according to the *International Classification of Disease* (ICD). We used ICD-8 rubric aneurysm of the abdominal aorta (441.2) for the period 1972-1978, and we combined ICD-9 rubrics aneurysm of the abdominal aorta, ruptured (441.3) and without mentioning of rupture (441.4) for the period 1979-1992.

Data on hospital admissions for abdominal aortic aneurysms were obtained from the National Medical Register of SIG Health Care Information. The National Medical Register of SIG Health Care Information is a nation-wide database of hospital admissions in the Netherlands. From 1986 onwards, all hospitals (university and general) in the Netherlands participated in this register. In 1972, the starting year of our analysis, 70% of all hospital admissions were recorded, in 1982 the coverage had grown to 97%. On the basis of these figures appropriate multiplying factors were used to estimate the yearly number of hospital admissions in the Netherlands. Records include diagnoses at discharge, age and sex of the patient, length of hospital stay, type of operations performed, and type of discharge (dead or alive). The *Interna-*

tional Classification of Diseases Clinical Modification (ICD-CM) was used to classify diagnoses at discharge. For the period 1972-1979 we used ICD-CM-8 rubrics aneurysm of the abdominal aorta without (441.3) and with rupture (441.4). For the period 1980-1992 we used ICD-CM-9 rubrics aneurysm of the abdominal aorta with (441.3) and without rupture (441.4). Only admissions with a first-listed discharge diagnosis of aneurysm of the abdominal aorta were counted in this study.

For all admissions with a first-listed discharge diagnosis of abdominal aortic aneurysms it was determined whether an operation upon the aneurysm was performed. During the study period three different coding systems for operations were used. In the first two coding systems (1972-1989) operations on an abdominal aortic aneurysm were coded among a broader group of operations on abdominal arteries. The combination of a first-listed discharge diagnosis of abdominal aortic aneurysm and an operation from this group could have resulted in a slight overestimation of the actual number of operations upon abdominal aortic aneurysms for that period.

In-hospital mortality (as a percentage) after surgery for non-ruptured or ruptured aneurysms of the abdominal aorta was calculated by dividing the number of patients with discharge status dead after their operation by the total number of admissions with a operation for that type of aneurysm.

Mid-year population figures were calculated by averaging the number of inhabitants in the Netherlands at the start and end of each year. Age adjusted rates were calculated by direct standardisation using the 'new' European standard population as a standard.[20] Age-specific rates were calculated using 10 year age groups (45-54, 55-64, 65-74, 75-84, 85+).

Results

From 1972 to 1992 the population of the Netherlands increased from 13.3 million to 15.2 million. The number of inhabitants of 55 years or over increased from 2.6 million (19%) in 1972 to 3.4 million (22%) in 1992.

Mortality

The absolute number of deaths due to abdominal aortic aneurysms in the Netherlands rose from 231 in 1972 to 756 in 1992. For men, there was a 3.5-fold increase from 171 deaths in 1972 to 590 in 1992. For women the number of deaths increased 2.8-fold from 60 to 166. Of all male deaths in 1992 above the age of 55 years 1.0% was attributed to aneurysms of the abdominal aorta. In women this proportion was 0.3%.

The age adjusted death rates for abdominal aortic aneurysms are shown in figure 1. The death rates for males increased 2.6-fold from 3.1 to 8.1 per 100,000 and for women 1.6-fold from 1.4 to 2.2 per 100,000. Analyses of age-specific death rates for males showed that this rise was most pronounced in the higher age groups, especially in those above 75 years of age. In females, death due to abdominal aortic aneurysms was rare below the age of 75. The moderate rise in the age adjusted death rate for abdominal aortic aneurysms among women mainly resulted from a rise in those above the age of 85 years.

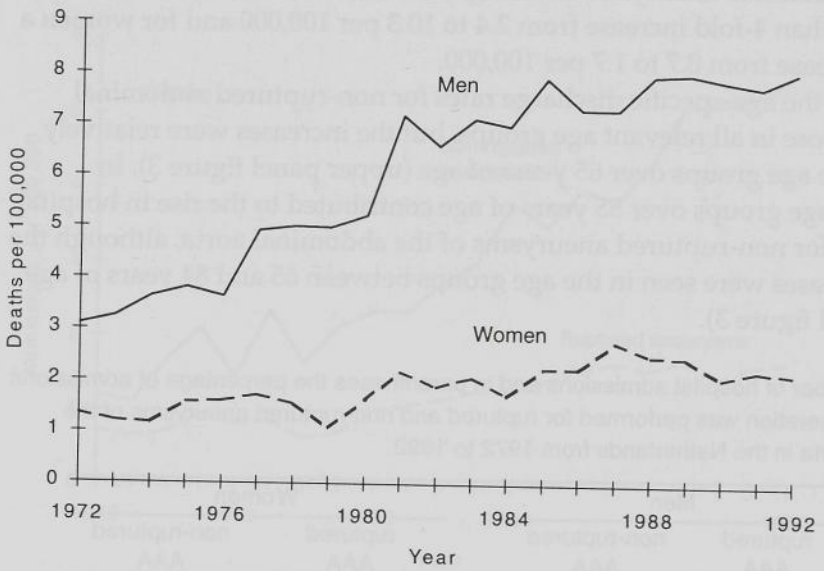

Figure 1. Age adjusted death rates for abdominal aortic aneurysms for men and women in the Netherlands from 1972-1992. Source: Statistics Netherlands. Standardised using the 'new' European Standard Population.

Hospital discharges

The total number of admissions with a first-listed discharge diagnosis of an abdominal aortic aneurysm increased from 433 (39% ruptured) in 1972 to 4,002 (22% ruptured) in 1992. In both men and women there was a marked increase in ruptured and non-ruptured cases, but the increase in non-ruptured aneurysms was more pronounced (table 1). The contribution of ruptured cases of abdominal aortic aneurysms to the total number of admissions for ruptured aneurysms and for surgery upon non-ruptured aneurysms decreased from 63% in 1972 to 35% in 1992. The percentage of admissions for non-ruptured abdominal aortic aneurysms in which an operation was performed, increased from 37% in 1972 to 53% in 1992 and for ruptured aneurysms from 40 to 66%.

The age adjusted discharge rates for ruptured and non-ruptured aneurysms are shown in figure 2. In men, the age adjusted discharge rates for non-ruptured abdominal aortic aneurysms increased 10-fold from 3.7 to 37.6 per 100,000. In women the increase was 4.6-fold from 1.2 to 5.5 per 100,000. For ruptured abdominal aneurysms these figures were less dramatic. In men there was a more than 4-fold increase from 2.4 to 10.3 per 100,000 and for women a 2.4-fold increase from 0.7 to 1.7 per 100,000.

For men, the age-specific discharge rates for non-ruptured abdominal aneurysms rose in all relevant age groups, but the increases were relatively higher in the age groups over 65 years of age (upper panel figure 3). In women, all age groups over 55 years of age contributed to the rise in hospital admissions for non-ruptured aneurysms of the abdominal aorta, although the largest increases were seen in the age groups between 65 and 84 years of age (lower panel figure 3).

Table 1. Number of hospital admissions and in parentheses the percentage of admissions in which an operation was performed for ruptured and non-ruptured aneurysms of the abdominal aorta in the Netherlands from 1972 to 1992.

Year	Men		Women	
	ruptured AAA	non-ruptured AAA	ruptured AAA	non-ruptured AAA
1972	136 (44%)	204 (41%)	31 (23%)	62 (23%)
1977	329 (59%)	517 (58%)	43 (31%)	124 (34%)
1982	419 (63%)	1,034 (59%)	69 (36%)	171 (53%)
1987	655 (74%)	1,817 (65%)	114 (51%)	262 (52%)
1992	755 (67%)	2,724 (53%)	125 (59%)	398 (51%)

AAA = Abdominal Aortic Aneurysm.

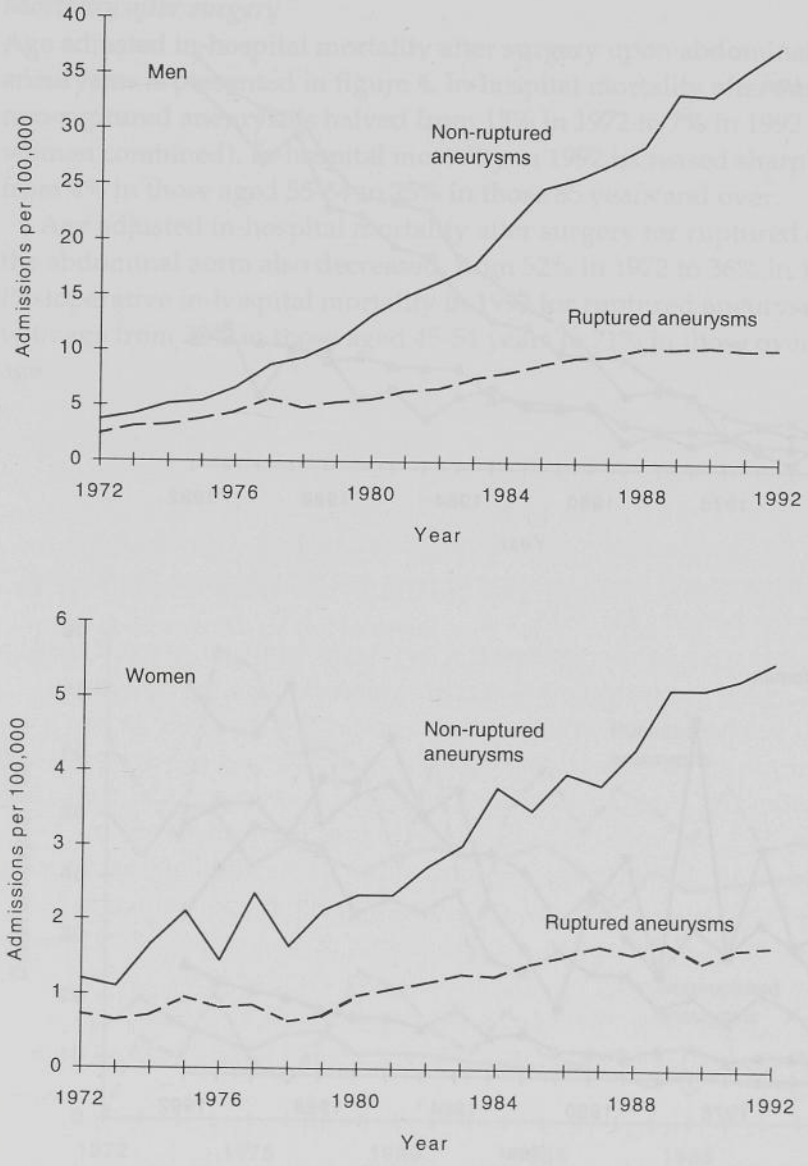

Figure 2. Age adjusted discharge rates for abdominal aortic aneurysms without rupture and with rupture in men (upper panel) and women (lower panel) in the Netherlands from 1972-1992. Source: SIG Health Care Information. Standardised using the 'new' European Standard Population.

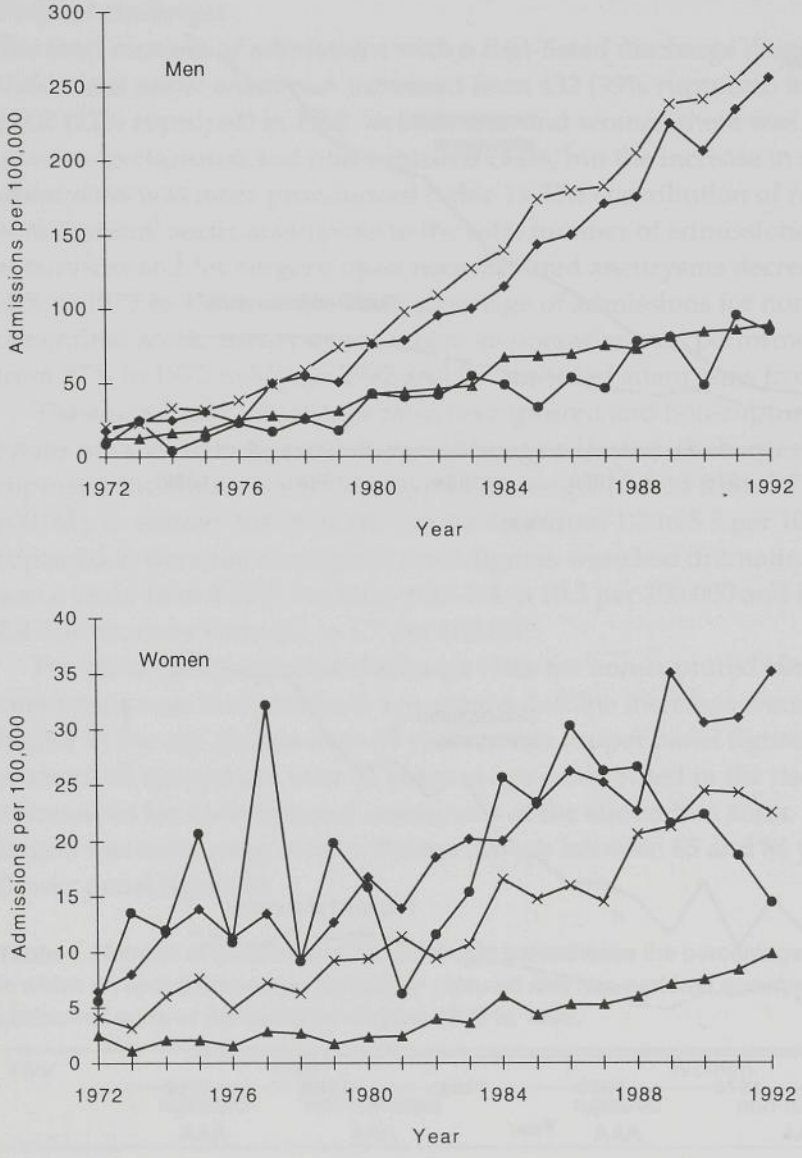

Figure 3. Age-specific discharge rates for non-ruptured abdominal aortic aneurysms in men (upper panel) and women (lower panel) in the Netherlands from 1972-1992. Age groups in years: ▲=55-64, x=65-74, ♦=75-84, ●=85 and over. Source: SIG Health Care Information.

Mortality after surgery

Age adjusted in-hospital mortality after surgery upon abdominal aortic aneurysms is presented in figure 4. In-hospital mortality after surgery upon non-ruptured aneurysms halved from 13% in 1972 to 7% in 1992 (men and women combined). In-hospital mortality in 1992 increased sharply with age from 4% in those aged 55-64 to 25% in those 85 years and over.

Age adjusted in-hospital mortality after surgery for ruptured aneurysms of the abdominal aorta also decreased, from 52% in 1972 to 36% in 1992. Postoperative in-hospital mortality in 1992 for ruptured aneurysms increased with age from 28% in those aged 45-54 years to 71% in those over 85 years of age.

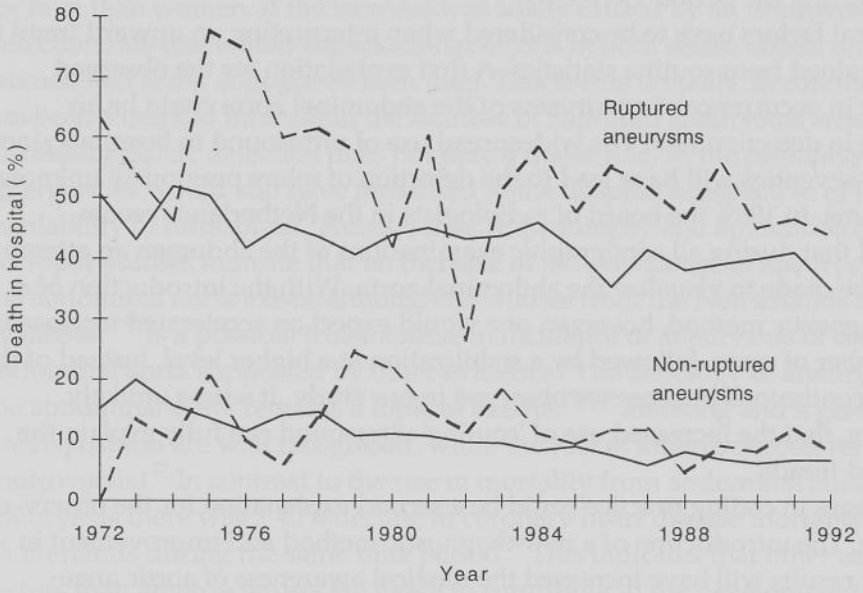

Figure 4. Age adjusted in-hospital mortality after surgery for non-ruptured and ruptured aneurysms of the abdominal aorta in men (solid line) and women (broken line). Source: SIG Health Care Information. Standardised using the 'new' European Standard Population.

Discussion

This study shows a pronounced increase in both mortality from and hospital discharge rates for aneurysms of the abdominal aorta in the Netherlands during the past two decades. This increase remained after adjustment for age and was more prominent in men than in women. During the same period, surgical outcome after surgery for ruptured abdominal aneurysms reduced gradually but remained high, while in-hospital mortality after elective surgery of abdominal aortic aneurysms halved to 7%.

Although the age adjusted death rates observed in the Netherlands are lower than those reported by Fowkes *et al* in England & Wales,[2] their relative increase in men from 1960 and 1984 was comparable with our estimate (2.6-fold in the Netherlands *vs.* 2.5-fold in England and Wales). The higher death rate from aneurysms of the abdominal aorta in Fowkes' study could originate from their restriction to those aged 40 years and over, and from differences in the composition of the standard population. Lilienfeld *et al* observed death rates and trends similar to ours among whites in the United States, during the period 1951-1981.[1]

Several factors have to be considered when interpreting an upward trend in data obtained from routine statistics. A first explanation for the observed increase in occurrence of aneurysms of the abdominal aorta could be an increase in detection rate. The widespread use of ultrasound in hospitals since the mid-seventies will have lead to the detection of many previously unknown aneurysms. In 1989, the board of radiologists in the Netherlands recommended that during all sonographic examinations of the abdomen an attempt should be made to visualise the abdominal aorta. With the introduction of a new diagnostic method, however, one would expect an accelerated increase in the number of cases, followed by a stabilization at a higher level, instead of the steady, continuous increase we observed in our study. It seems unlikely, therefore, that the increased use of 'routine' ultrasound can fully explain the observed trends.

Changes in coding practice could be a second explanation for the observed increase. The introduction of a new diagnostic method and improvement in surgical results will have increased the medical awareness of aortic aneurysms. This might result in improved case detection and more deaths attributed to aneurysms and can explain part of the observed increase mortality from abdominal aortic aneurysms. However, results from autopsy studies still suggest that many aneurysms remain undetected during life.[21-24]

The number of hospital admissions can be influenced by changes in referral practice. The national hospital registry is based on admissions, not on individuals. Therefore, hospital statistics overestimate the incidence of new cases, as admissions for diagnostic work-up and referrals to other hospitals for operation can not be recognised. With the introduction of ultrasound and computerised tomographic diagnosis, which are often performed on an outpatient basis, the number of re-admissions might have decreased over time. This view is supported by the increase in the percentage of discharges for non-ruptured abdominal aortic aneurysms in which an operation was performed (37% in 1972 *vs.* 53% in 1992).

Apart from the improvement in diagnostic capabilities and perhaps a change in coding practice, the rise in mortality and morbidity from aneurysms of the abdominal aorta could reflect a true increase in incidence.[25,26] Although this type of research does not allow for a valid estimate of the incidence of aneurysms of the abdominal aorta there is evidence in favour for such a true increase. First of all, the increase was not the same in men and women. There was a larger increase in both mortality and the number of hospital admissions for men than women. If the increase was solely caused by an improved detection rate one would expect similar effects in both sexes, unless of course, women had fewer sonograms than men. This seems unlikely. Secondly, there has been a marked increase in the number of ruptured aneurysms where ultrasonographic detection does not play a major role. In the past days these emergencies would still have presented to the hospital irrespective of the availability of ultrasound. Thirdly, data from autopsy and epidemiologic necropsy studies indicate that an increase in the prevalence of aneurysms of the abdominal aorta exists, although no studies from the Netherlands are available.[21-24] Is a possible true increase in incidence of aneurysms of the abdominal aorta supported by other evidence? The aetiology of aneurysms of the abdominal aorta remains a topic of debate.[17,27-29] Smoking and a genetic predisposition are well recognised, while the role of atherosclerosis remains controversial.[27] In contrast to the rise in mortality from abdominal aortic aneurysms there was a 40% decline in coronary heart disease mortality in the Netherlands during the same time period.[30] This indicates that other aetiologic factors than atherosclerosis are likely to contribute to the development of abdominal aortic aneurysms. On the other hand, the decline in mortality for coronary heart disease, as a competing cause of death, could have contributed to the increase in incidence and mortality from aneurysms of the abdominal aorta.

In-hospital mortality after surgery upon non-ruptured abdominal aortic aneurysms dropped considerably from 13% in 1972 to 7% in 1992. This decline in mortality, despite a trend to operate upon older patients and upon patients with more co-morbidity, probably reflects improvements in surgical and anaesthetic techniques. On the other hand, the availability of ultrasound may have led to a disproportionate increase in the detection of smaller aneurysms, thereby improving postoperative mortality. The Dutch national average of 7% in-hospital mortality after surgery upon non-ruptured aneurysms of the abdominal aorta was higher than reported in most other studies. In a recent overview, mortality after elective surgery varied between 1.4 and 6.5%.[17] Several factors could be responsible for the observed differences in postoperative mortality. Firstly, favourable results from specialised centres may not reflect operative mortality from an entire country. Secondly, different definitions both in elective surgery and in postoperative mortality were used in the studies. Thirdly, differences in patient profiles, e.g. age and co-morbidity, are not taken into account by these crude comparisons. During the study-period, in-hospital mortality after surgery upon ruptured aneurysms also improved but was still 36% in 1992, despite advances in critical care.

In conclusion, a clear increase in age adjusted discharge rates for and mortality from abdominal aortic aneurysm occurred in the Netherlands between 1972 and 1992, most notably in men. Undoubtedly, the introduction of ultrasound contributed to this trend, but a true increase in incidence of aneurysms of the abdominal aorta is also likely.

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