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Regional Differences in Case Mix and Peri-operative Outcome After Elective Abdominal Aortic Aneurysm Repair in the Vascunet Database

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WHAT THIS PAPER ADDS

Although the peri-operative mortality of elective abdominal aortic aneurysm (AAA) repair has been reduced significantly over time, the risks associated with this operation are not negligible. Important differences in the risk of peri-operative mortality exist based on patient comorbidity and anatomy. In addition, the outcome of AAA repair varies between regions. In order to assess the regional variation in peri-operative outcome, the current report analyses the role of case selection in terms of AAA size and patients' comorbidities on peri-operative mortality, using the Vascunet database. The report indicates that variations in outcome can be partly attributed to differences in case mix and patient selection.

Objective/background: National differences exist in the outcome of elective abdominal aortic aneurysm (AAA) repair. The role of case mix variation was assessed based on an international vascular registry collaboration.
Methods: All elective AAA repairs with aneurysm size data in the Vascunet database in the period 2005—09 were included. AAA size and peri-operative outcome (crude and age adjusted mortality) were analysed overall and in risk cohorts, as well as per country. Glasgow Aneurysm Score (GAS) was calculated as risk score, and patients were stratified in three equal sized risk cohorts based on GAS. Predictors of peri-operative mortality were analysed with multiple regression. Missing data were handled with multiple imputation.
Results: Patients from Australia, Finland, Hungary, Norway, Sweden and the UK ($n = 5,895$) were analysed; mean age was 72.7 years and 54% had endovascular repair (EVAR). There were significant variations in GAS (lowest = Finland [75.7], highest = UK [79.4], p for comparison of all regions $< .001$), proportion of AAA < 5.5 cm (lowest = UK [6.4%], highest = Hungary [29.0%]; $p < .001$), proportion undergoing EVAR (lowest = Finland [10.1%], highest = Australia [58.9%]; $p < .001$), crude mortality (lowest = Norway [2.0%], highest = Finland [5.0%]; $p = .006$), and age adjusted mortality (lowest = Norway [2.5%], highest = Finland [6.0%]; $p = .048$). Both aneurysm size and peri-operative mortality were highest among patients with a GAS >82. Of those with a GAS >82, 8.4% of men and 20.8% of women had an AAA <5.5 cm.
Conclusion: Important regional differences exist in case selection for elective AAA repair, including variations in AAA size and patient risk profile. These differences partly explain the variations in peri-operative mortality. Further audit is warranted to assess the underlying reasons for the regional variation in case-mix.

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INTRODUCTION

Elective repair of abdominal aortic aneurysm (AAA) is performed to save life by preventing rupture. Although the peri-operative mortality of elective AAA repair has been reduced significantly over time, mainly the result of the broad introduction of endovascular repair (EVAR), the risks associated with this operation are not negligible.[1—3] Important differences in risk of peri-operative mortality between subgroups exist based on patient related factors such as comorbidity and aneurysm anatomy, as well as factors related to the operative technique and surgeon/centre volume.[2—6] In retrospective analyses, the peri-operative mortality rate varies from <1% in healthy, young patients treated with EVAR to >8% in octogenarians treated with open repair.[3,4,7]

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Table 1. Patient characteristics.

	Overall	OR	EVAR	p
n	5,895	3,176	2,007	
Age (y; mean ± SD)	72.7 ± 7.9	71.9 ± 8.0	74.0 ± 7.7	<.0001
Female (%)	15.6	16.9	13.6	.001
Aneurysm diameter (cm; mean ± SD)	6.6 ± 1.5	6.7 ± 1.6	6.6 ± 1.4	.175
Cardiac disease (%)	47.9	46.8	49.5	.243
Renal disease (%)	6.7	5.6	8.5	<.001
Cerebrovascular disease (%)	11.3	11.6	12.3	.368
Peri-operative mortality (%)	2.9	3.8	1.5	<.001
GAS (mean ± SD)	78.2 ± 10.4	77.2 ± 10.4	79.7 ± 10.4	<.001

Note. OR = odds ratio; EVAR = endovascular aneurysm repair; GAS = Glasgow Aneurysm Score.

In an international comparison of outcome of AAA repair in nine national and regional vascular registries based on the Vascunet database collaboration, there was evidence of variation in peri-operative mortality after elective AAA repair between countries.[1] Variations in case selection were identified and displayed by regional differences in the rate of female patients and rate of ruptured AAA repairs. Although most elective AAA repairs were performed in patients with a maximum AAA diameter of >5 cm, there were also important variations in AAA size.

The current report analyses the differences in case selection in terms of AAA size, patient age, and comorbidities in the Vascunet database, and the potential effect of these variations on peri-operative mortality.

MATERIALS AND METHODS

The current compilation of data in the Vascunet database includes 31,427 intact AAA repairs performed in nine countries in the period 2005—09, and has been described in a previous publication.[1] Data on maximum AAA diameter at time of repair was available for 5,895 of these cases from Australia, Finland, Hungary, Norway, Sweden, and the UK. The current analysis was focused on these cases in order to be able to assess the rate of small aneurysms (<5.5 cm) operated on in different regions and the role of AAA size on peri-operative outcome. Patients were excluded from the Danish (n = 2,500) and Swiss (n = 1,814) registries, which did not report AAA size, and from the Italian registry (n = 9,107), which only reported diameter ranges. Aneurysm size was reported in selected patients in the Australian (15.5%), Finnish (47.4%), Hungarian (78.1%), Norwegian (98.7%), and UK (24.4%) registries. In the Swedish registry, AAA size was only registered for patients operated on after May 2008. Patients with no AAA size data in these registries were also excluded from analysis. A sensitivity analysis of patient characteristics and outcome of those included versus those excluded in the current paper was performed.

In order to assess outcome based on case mix, age adjusted peri-operative mortality was calculated per country. For assessment of the combined effect of age and comorbidities, 10 possible AAA related risk scores were considered.[8] As the Vascunet database is based on several registries with variations in peri-operative variables, the risk scores possible for use were limited, as several of the scores require an extensive number of variables not available in the current registries. The Glasgow Aneurysm Score (GAS) was the preferred risk score for this analysis, owing to the clear definition of the four variables required (GAS = age + 7 for cardiac comorbidity; +10 for cerebrovascular comorbidity; +14 for renal comorbidity) and the extensive validation available. The patient cohort was stratified in three subgroups based on GAS. Cut off points were selected after assessment of the total cohort's GAS distribution histogram in order to create three subgroups of equal size. This was achieved with the cut off levels of GAS <74 (n = 1,912), 74—82 (n = 2,042), and >82 (n = 1,941).

The peri-operative outcome was assessed overall, as well as based on operative technique for all patients and for subgroups. When assessing peri-operative mortality in subgroups, owing to the small denominator, data were omitted in subgroups with a total number of cases <50. Crude and age adjusted mortality were analysed for each country. To assess the effect of pre-operative AAA size and comorbidities on peri-operative mortality, risk factors were assessed in uni- and multivariable analysis.

Statistics

All continuous data are presented with the mean and compared using the Student t test or one-way analysis of variance. Proportions are presented as percentages and compared using the chi-square test. Binary logistic regression was used to estimate the odds ratios (ORs) for age (per year), female sex, AAA diameter (per cm), and comorbidities (cardiac, cerebrovascular, and renal) in relation to peri-operative mortality. Uni- and multivariable analysis (with forced entry of all the abovementioned parameters) were performed. ORs are presented with 95% confidence intervals (CIs). Owing to variations in the registration of comorbidities between registries, values were missing for some of the comorbidity parameters. These values were replaced with multiple (10×) fully conditional imputations based on the available data.[9] Missing values were age (0.6% of cases), cardiac comorbidity (5.2% of cases), renal comorbidity (5.7% of cases), and cerebrovascular comorbidity (45.0% of cases). The high number of missing values regarding cerebrovascular comorbidity was owing to lack of reporting of this parameter in Australia, Hungary, and the UK. To assess GAS model discrimination, receiver operating characteristic (ROC) curve analysis was performed for the