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Ruptured Abdominal Aortic Aneurysms: Factors Influencing Postoperative Mortality and Long-term Survival

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Objective: *To update mortality rates and long-term survival of patients admitted to the hospital with ruptured abdominal aortic aneurysm (AAA) and to study prognostic factors associated with mortality.*
Design: *Retrospective follow-up.*
Materials: *309 patients (274 men, 35 women, average age 71) admitted to the hospital between January 1980 and January 1994 who were surgically treated for ruptured AAA were studied.*
Methods: *To identify the preoperative (9), intraoperative (23) and postoperative (49) variables associated with mortality logistic regression analysis (mortality within 48 h) and Cox regression analysis (mortality between 48 h and 30 days) were performed.*
Results: *Hospital mortality improved from 1980 to 1994. Compared with the normal population adjusted for age and sex the long-term mortality rate was increased (standardised mortality ratio 2.1; 95% confidence interval 1.7–2.5). Increased age, peroperative hypotension and need for a bifurcated graft were associated with significantly increased mortality. Co-morbidity was not a predictive variable. Overall hospital mortality was 25%.*
Conclusion: *Surgical repair of ruptured AAA should be considered even in patients with co-morbidity. Elderly patients with severe preoperative hypotension have a very high mortality rate and surgery may not be justified in these cases. Long-term survival is also worse in older patients.*

Key words: Abdominal aortic aneurysm; Rupture; Risk factors; Long-term survival; Mortality.

Introduction

Although the first successful surgical management of a ruptured abdominal aortic aneurysm (AAA) was in 1954, the mortality rate for this procedure is still excessively high; series reporting mortality rates of 50% or more.[1–7] The true mortality for ruptured AAA is even higher if prehospital mortality is included. As overall management of ruptured AAA is still improving, it is important to update mortality rates regularly and to study factors associated with mortality.

The aim of our study was to evaluate hospital mortality in patients with ruptured AAA and to evaluate life expectancy after hospital discharge. Prognostic factors of early mortality (<48 h after admission) and intermediate mortality (48 h–30 days) were studied.

Materials and Methods

A retrospective study was performed of all patients operated on for ruptured AAA at our institution between 1 January 1980 and 31 December 1993. Rupture was defined as either evidence of retroperitoneal haematoma or free blood in the peritoneal cavity at the time of laparotomy. A transperitoneal approach was used in all patients. Nine preoperative, 23 intraoperative and 49 postoperative variables were collected (Table 1).

Mortality was studied for different time periods: within 48 h after admission, and between 48 h after admission and 30 days (including patients already discharged from the hospital). Hospital mortality (all patients who died within the hospital) and mortality after hospital discharge were also determined. For all patients information about mortality was ascertained up to 19 April 1995. After hospital discharge this was obtained from the administration of the municipality in which the patients had lived during admission. If patients had moved to another municipality the new address was requested and the procedure repeated until the present place of residence or date of death was known.

Associations between pre- and peroperative risk factors and mortality within 48 h after admission were analysed by logistic regression in SPSS (Statistical Package for the Social Sciences, Inc, Chicago). For pre-, per- and postoperative risk factors and mortality

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Table 1. The most important preoperative, intraoperative and postoperative variables, are listed in the table.

Preoperative variables		Peroperative variables			Postoperative variables		
Age (years) <70/70–80/>80	Delay of surgery (h) <12/>12	Blood loss <31/>61	Packed cells (units) <5 U/>10 U	Haemoglobin (mmol/l) >5/<5	Cardiac events (arrhythmia, myocardial ischaemia, myocardial infarction, cardiac arrest, cardiac failure) yes/no Pulmonary artery occlusion catheter yes/no		
Known AAA yes/no	Gender female/male	Fresh frozen plasma <3U/>3U	Potassium (mmol/l) <3.5/>5	Thrombocytes 0 U/>1 U	Coma >24 h, electroencephalogram, neurologist in consultation yes/no		
Medical history of respiratory failure yes/no	Medical history of vascular surgery yes/no	Mannitol Yes/no	Diuresis (ml/min) <1/>2	Blood-products <10 U/>20 U	Mechanical ventilation (days) <1/>3 Reintubation yes/no Tracheotomy yes/no FiO2>50% yes/no		
Medical history of renal failure. Serum creat (micromol/ml) <120/>250	Hypotension on admission systolic blood-pressure: <80 mmHg/ >120 mmHg	100 ml NAH-CO3 8.4% (units) <4 U/>4 U	Location AAA Infrarenal/ supra renal Duration procedure (hours) <3/>3	Diameter (cm) <7/>7 Clamp infrarenal/ supra renal	Sepsis yes/no Antibiotic therapy changed yes/no	Positive cultures blood Yes/no Sputum yes/no Intravenous catheter yes/no	Catecholamines Yes/no Blood-products (units) <5/>5
Medical history of cardiac events (angina pectoris, myocardial infarction, cardiac surgery, percutaneous transluminal coronary angioplasty) yes/no		Hypotension (severity) <90 mmHg /<50 mmHg	Hypotension (duration) <30 min/ >60 min ph (minimal value) >73/<7.03	Catecholamines yes/no CO_2 (arterial) <4.7/>6/0 kpa (minimum value)	Relaparotomy yes/no Embolectomy yes/no Intestinal ischaemia yes/no Intestinal bleeding yes/no Colon resection yes/no		

between 48 h and 30 days this analysis was performed by Cox regression in SPSS. The Kaplan Meier method was used to calculate the cumulative per cent survival rate versus time of follow-up for the subgroup patients older then 80 years, aged between 70–80 years and patients younger than 70 years. The life expectancy after hospital dismission compared with that of the general population adjusted for age and calendar time was calculated using the standardised mortality ratio (SMR). When a SMR equals unity the mortality in the patient group at hand equals that of the general population of the same age structure. When the ratio is above unity the mortality in the patient group is higher than expected.

Results

Three hundred and nine patients were included in this study. The age of the patients ranged from 49 to 91 years. The mean age was 71 years. Eighty-nine per cent (274) of the patients were men. One hundred and four patients were younger than 70 years, 135 patients aged between 70–80 years and 40 patients were older than 80 years.

Table 2. Early mortality (mortality within 48 h after admission) and hospital mortality in the periods 1980–1982, 1983–1985, 1986–1988, 1989–1991 and 1991–1993 respectively.

Periods	Early mortality	Hospital mortality
1980–1982	17% (7 of 42)	40%
1983–1985	9% (6 of 67)	30%
1986–1988	9% (5 of 91)	22%
1989–1991	12% (8 of 69)	28%
1991–1993	0% (0 of 40)	5%

Early mortality

During the period 1980–1982 the early mortality was 17% (seven of 42 patients), the period 1983–1985 9% (six of 67 patients), the period 1986–1988 5% (five of 91 patients), the period 1989–1991 12% (eight of 69 patients) and the period 1991–1993 0% (none of 40 patients) (Table 2). The hospital mortality in these

Table 3. Causes of inhospital mortality after repair of ruptured AAA ($n=309$).

Causes	Within 48 h	After 48 h
Cerebral	1 (4%)	
Circulatory	24 (92%)	20 (38%)
Respiratory	1 (4%)	4 (8%)
Renal		6 (12%)
Sepsis		3 (6%)
Other infections		3 (6%)
MOF		15 (29%)
Unknown		1 (2%)

Table 5. Postoperative complications between 48 h and 30 days. ($n=233$).

Postoperative complications between 48 h and 30 days	
Complication	No. of patients
Arrhythmias	183 (66%)
Myocardal infarction/CHF	17 (6%)
Cardiac Arrest	16 (6%)
>3 days mechanical ventilation	89 (32%)
Serum creatinine >250 µmol/l	85 (30%)
Intestinal ischaemia	45 (16%)
Intestinal bleeding	40 (14%)
Sepsis	14 (5%)
Relaparotomy	44 (16%)

periods was 40%, 30%, 22%, 28% and 5%, respectively. The hospital mortality over the whole period was 25%. The causes of early and inhospital mortality are listed in Table 3. As expected, most patients died of circulatory failure and multiple organ failure.

Table 4 shows the pre- and peroperative variables that were significantly associated with early mortality (48 h) after repair of ruptured AAA. Early mortality was significantly ($p<0.05$) associated with <12 h time interval between onset symptoms and arrival in the hospital, age, supra- versus infrarenal extension of the aneurysm, bifurcated graft versus single tubular graft, severe hypotension and total bloodloss.

Intermediate

Table 5 shows the most important postoperative complications in 283 patients between 48 h and 30 days after surgery. Table 6 shows the pre-, per- and postoperative variables associated with mortality after 48 h and within 30 days after repair of ruptured AAA. The factors that were significantly associated with late mortality were the need for a bifurcated graft peroperative hypotension, oliguria and postoperative organ system failure.

Long-term mortality

Compared to the normal population adjusted for age and sex, the long-term mortality of the patients that were discharged from the hospital for the whole period (1980–1995) increased by a factor of 2:1 (=SMR 95% CI 1.7–2.5). From 1980–1984 the SMR was 2.8 (95% CI 1.2–5.0) from 1985–1989 the SMR was 1.9 (95% CI 1.3–2.6) and from 1990–1994 the SMR was 2.2 (95% CI 1.7–2.7). The one-year survival was 65%. The Kaplan Meier curve in Fig. 1 shows the survival curves for the different age groups after hospital admission over a maximum follow-up period of 15 years. The patients younger than 70 years showed a better survival rate.

Table 4. Pre- and peroperative variables associated by logistic regression analysis with early mortality after repair of ruptured AAA.

Factors associated with early mortality (<48 h)		
Preoperative variables	Grouping	Relative Risk* (95% CI)
Age	<70/>70 yrs	7.2 (2.1–25.1)
Delay of surgery	<12 h/>12 h	0.1 (0.01–0.95)
Known AAA	Yes/no	3.2 (1.1–9.4)
Peroperative variables		
Location AAA	Infra/suprarenal	4.6 (1.0–20.6)
Procedure	Bifurcated/single tubular	3.0 (1.1–8.3)
Hypotension (severity)	<90/<50 mmHg	14.5 (2.0–103)
Hypotension (duration)	<30/>60 min	4.8 (1.7–14.0)
Blood loss	<3 l/>6 l	8.5 (1.6–46.4)
Blood products	<10 units/>20 units	5.9 (1.6–20.9)
Diuresis	>2/<1 ml/min	16.0 (1.9–132)
Mannitol	No/yes	0.4 (0.2–1.0)

*Adjusted for age and sex

Table 6. Pre-, per- and postoperative variables associated by Cox regression analysis with intermediate mortality after repair of ruptured AAA.

Factors associated with intermediate mortality (>48 h, <30 days)		
Preoperative variables	Grouping	Relative Risk* (95% CI)
Age	<70/>80 yrs	5.1 (2.1–11.6)
Preoperative variables		
Procedure	Bifurcated/single tubular	1.8 (1.0–3.4)
Hypotension (duration)	<30/>60 min	2.2 (1.0–5.0)
Postoperative variables		
Cardiac event (infarction/ arrhythmia)	No/yes	10.4 (2.5–43.2)
Coma >24 hrs	No/yes	5.6 (2.7–11.6)
Mechanical ventilation	<1/>3 days	8.2 (3.6–18.7)
Serum creatinine	<120/>250 μmol	13.4 (2.9–61.4)
Dialysis	No/yes	8.9 (4.2–18.9)
Intestinal ischaemia	No/yes	4.2 (2.0–8.9)
Blood product transfusion	<5/>5 units	2.8 (1.5–5.1)
Sepsis	No/yes	3.4 (1.4–8.2)
Relaparotomy	No/yes	2.2 (1.1–4.2)

*Adjusted for age and sex.

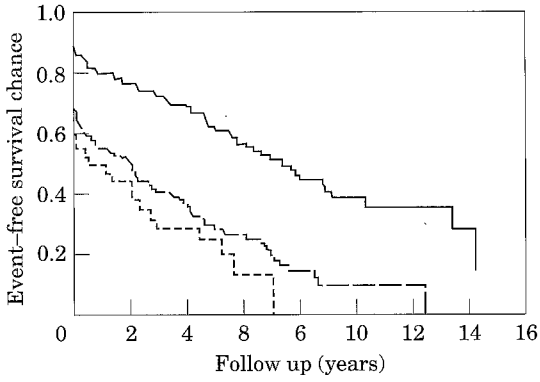

Fig. 1. Survival curves for the different age groups after hospital admission over a maximum follow-up period of 15 years since repair of ruptured aneurysm. Age group (– – –) >80; (— –) 70–80, (—) ⩽70.

Discussion

Advances in operative techniques, anaesthesia, blood transfusion, respiratory management, intensive care and graft materials have reduced the mortality rate for elective repair to about 5%.[7] However, the reported mortality rate for ruptured AAA is still excessively high, ranging from 30–75%.[1–6] Differences in mortality rates between hospitals have been attributed to differences in patient population, delay in treatment and surgical experience.[5] This present series reports a hospital mortality of 25% and a one-year survival rate of 65%. The St. Antonius Hospital is a referral hospital for elective and acute repair of AAAs. In our hospital every patient still having cardiac rhythm with a ruptured AAA undergoes fluid resuscitation and surgical treatment without delay.

As in other series[5,8–12] we divided the clinical variables analysed to predict mortality of ruptured AAA repair into three categories: preoperative, intraoperative and postoperative. Predictors for early and intermediate mortality were not the same. It was difficult to compare our results with other studies because the studies differed in the time periods (hospital mortality no time period mentioned, hospital mortality within 30 days, hospital mortality after 30 days) over which the mortality was measured. Like Abu Rahma[4] we detected that infra- versus suprarenal clamping and bloodloss factors were significantly associated with mortality. Postoperative variables in our study associated with intermediate mortality have already been mentioned in the literature.[3,8,11,12] We found that death is not the result of factors prior to hospital admission as comorbidity was not a predictive variable. This suggests that surgical repair in patients with significant co-morbidity should not be withheld.

Our procedural protocol is to not waste time with preoperative assessment, to keep the operative time as short as possible, to use a tube-graft wherever possible and not to operate on other intra-abdominal pathology. Using the protocol, the survival of patients has improved over the last decade. However, surgery may not be justified in elderly patients with severe preoperative hypotension as the hospital and long-term mortality are very high.

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