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Natural History of Thoraco-abdominal Aneurysm in High-Risk Patients☆

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Abstract *Introduction:* There is considerable interest in the role of novel endovascular techniques for the treatment of patients with complex aneurysms who are unsuitable for standard interventions. Knowledge of the natural history of these lesions, as well as other co-morbidities, is required in order that these techniques may be applied correctly in this high-risk group.
Method: This study reviews the outcome of patients deemed to be unfit for surgery following assessment under the Scottish National Thoraco-abdominal aneurysm service (TAAA) service (2002–2008).
Results: Of 216 patients assessed, 89 (41%) patients were considered to be unfit for intervention. The median (interquartile range, IQR) age of patients was 75 (70–80) years and there were 39 men (44%). Median (IQR) aneurysm size was 6 (5.6–7.0) cm. The median (IQR) follow-up time was 12 (7–26) months. There were 49 (55%) deaths during the follow-up period of which 23 (47%) cases were due to ruptured TAAA and 26 (53%) were not aneurysm-related. Comparing patients with aneurysms $<$6 cm (33 patients) with those aneurysms $\geq$6 cm (56 patients) there was no difference in aneurysm-related death ($p = 0.32$) or all-cause mortality ($p = 0.147$).
Conclusion: Aneurysm-related mortality amongst patients unsuitable for open TAAA surgery is considerable and evolving endovascular techniques may permit intervention in selected patients. However any intervention can only be justified if the patient's life expectancy is sufficient to allow benefit to accrue.

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Introduction

The mortality associated with rupture of a thoraco-abdominal aortic aneurysm (TAAA) remains very high. In contrast, the outcomes for elective TAAA repair have improved in recent decades.[1,2] This improvement can be attributed to advances in operative technique as well as developments in pre-operative assessment and peri-operative care.[3,4] In particular, the ongoing development of endovascular techniques, including branched and fenestrated grafts, continues to challenge the indications and thresholds for operative intervention in patients with asymptomatic TAAA.[5–10]

All interventions, whether open, endovascular or hybrid, are associated with significant risk. Therefore decision-making must weigh carefully the risk of rupture against the individual's estimated operative risk. The assessment of risk of aneurysm rupture is based largely on natural history data, which are limited currently.[11–16]

In 1999 a National Service was established for the assessment and management of all patients with a TAAA in Scotland. Patients considered suitable for assessment for intervention are referred from both regional vascular units and district general hospitals. This study reports the outcome of patients who, after thorough assessment, were considered to be unfit for surgical repair, and were managed non-operatively.

Patients and Methods

Since the establishment of the Scottish National Thoraco-Abdominal Aortic Aneurysm Service, data have been collected prospectively in a clinical database. All patients assessed for suitability for intervention over a seven-year period (January 2002–December 2008) were identified from the database. Information from the database together with hospital records was used to gather demographic and clinical details.

All patients were assessed using a comprehensive investigation protocol that included routine blood tests (full blood count, electrolytes, liver function tests, coagulation profile), a chest radiograph, an electrocardiogram (ECG), pulmonary function tests and non-invasive cardiac stress testing (exercise ECG and/or stress echocardiogram). Percutaneous coronary angiography was used selectively. Computed Tomography (CT) angiography was used to determine the extent and morphology of the aneurysm, and the suitability of the aneurysm for open or endovascular surgical repair. In addition, the patient was reviewed by a multidisciplinary team comprising a consultant vascular surgeon, a vascular anaesthetist, an interventional radiologist and a cardiologist.

For those patients considered unfit for surgery following assessment, the reason for refusal was recorded. The patient's General Practitioner was telephoned at six-monthly intervals to obtain follow-up information and, where the patient was found to be deceased, the cause of death was established from death certificate data. Patients with an aneurysm <6 cm in maximum diameter were compared to those with an aneurysm ≥ 6 cm.

Statistical analysis was performed using SPSS for Windows Release 15.0.0. Univariate analyses between groups were determined by χ^2 or Fisher's exact test for categorical variables. Kaplan–Meier survival curves were constructed and compared using a log rank test. $P \leq 0.05$ was considered significant.

Results

Two hundred and sixteen patients were assessed by the TAAA service over the seven-year study period. Of these, 89 (41%) patients were found to be unsuitable for intervention following assessment. There were 39 men (44%) and the median (interquartile range, IQR) age was 75 (70–80) years. Table 1 summarises the baseline demographic data. The median (IQR) aneurysm diameter at referral was 6.0 (5.6–7.0) cm. Thirty-three (37%) patients had a TAAA <6 cm in maximum diameter and 56 (63%) had a TAAA ≥ 6 cm. Table 2 details the extent of the aneurysm for all of those assessed, for those operated upon and for those considered to be unsuitable for intervention.

The reasons for patients being turned down for intervention are listed in Table 3. Many patients, 37/89 (42%), were considered to be unfit for surgery as a result of the presence of multiple (two or more) co-morbidities or global frailty.

Follow-up was complete for all 89 (100%) patients. Median (IQ range) follow up was 12 (7–26) months. None of the 89 patients underwent a surgical or endovascular procedure during the follow-up period. During the follow-up period 49/89 (55%) patients died. Considering those patients who had died during the follow-up period 23/49 (47%) had a ruptured aneurysm whilst the remaining 26 patients (53%) died of a cause unrelated to their aneurysm. Further details of the cause of death are listed in Table 4.

The overall survival for non-operated patients was 64% (SE 0.054) at 12 months and 52% (SE 0.061) at 24 months (Fig. 1). A comparison was made between the outcome of patients with an aneurysm <6 cm (33 patients) at the time of assessment and that of those with an aneurysm ≥ 6 cm (56 patients) (Fig. 2). At 12 months the survival of patients with aneurysms <6 cm was 71% (SE 0.083) and for patients with aneurysms ≥ 6 cm was 60% (SE 0.071). Over the entire study period there was no difference in survival between

Table 1 Patient demographics.

Demographic	All patients ($n = 89$)	Aneurysm <6 cm ($n = 33$)	Aneurysm ≥ 6 cm ($n = 56$)
Age, median years (IQR)	75 (70–80)	74 (68–78)	76 (71–80)
Male gender, *n* (%)	39 (44%)	13 (38%)	26 (47%)
Max. aneurysm diameter, median cm (range)	6.0 (5.0–10.0)	5.5 (5.0–5.9)	7.0 (6.0–10.0)