Outcomes After Open Repair for Ruptured Abdominal Aortic Aneurysms in Patients with Friendly Versus Hostile Aortoiliac Anatomy

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WHAT THIS PAPER ADDS

Patients with a ruptured abdominal aortic aneurysm (RAAA) and unsuitable anatomy ("hostile anatomy") for endovascular aneurysm repair are generally allocated to open repair. In our prospective cohort study, the death rate was comparable in patients with hostile and friendly anatomy after open repair for an RAAA. Despite aortic reconstruction being more challenging in patients with a hostile anatomy, we consider logistic aspects of care to be the most important factors contributing to the outcomes after open repair for an RAAA.

Objectives: In patients with a ruptured abdominal aortic aneurysm (RAAA), anatomic suitability for endovascular aneurysm repair (EVAR) depends on aortic neck and iliac artery characteristics. If the aortoiliac anatomy is unsuitable for EVAR ("hostile anatomy"), open repair (OR) is the next option. We hypothesized that the death rate for OR is higher in patients with hostile anatomy than in patients with friendly anatomy.
Methods: We conducted an observational cohort study in 279 consecutive patients with an RAAA treated with OR between 2004 and 2011. The primary endpoint was 30-day or in-hospital death. Aortoiliac anatomy (friendly vs. hostile) was determined prospectively by the vascular surgeon and the interventional radiologist treating the patient. A multivariable logistic regression analysis was done to assess the risk of dying in patients with hostile anatomy after adjustment for age, sex, comorbidity, and hemodynamic stability.
Results: Aortoiliac anatomy was friendly in 71 patients and hostile in 208 patients. Death rate was 38% (95% confidence interval (CI): 28 to 50%) in patients with friendly anatomy and 30% (95% CI: 24 to 37%) in patients with hostile anatomy ($p = .23$). After multivariable adjustment, the risk of dying was not higher in patients with hostile anatomy (adjusted odds ratio 0.744, 95% CI 0.394 to 1.404).
Conclusion: The death rate after open repair for an RAAA is comparable in patients with friendly and hostile aortoiliac anatomy.

Article history: Received 4 September 2013, Accepted 2 January 2014, Available online 31 January 2014
Keywords: Aneurysm, Ruptured, Aortic aneurysm, Abdominal, Aortoiliac anatomy, Open repair, Vascular surgical procedures

INTRODUCTION

Anatomical suitability for endovascular aneurysm repair (EVAR) depends on aortic neck and iliac artery characteristics. The aortoiliac anatomy of patients with a ruptured abdominal aortic aneurysm (RAAA) has been shown to be suitable ("friendly anatomy") for EVAR, in approximately 40% of cases.[1,2] If the anatomy is unsuitable for EVAR ("hostile anatomy"), open repair (OR) is the next option. Hostile anatomy comprises shorter, wider, or more angulated aortic necks and calcified or tortuous iliac arteries. As the number of patients treated with EVAR is increasing,[1] fewer patients with friendly anatomy are being treated with OR. This leaves the more challenging patients for OR. Previous studies have shown that outcomes are worse after OR in patients with hostile anatomy than in patients with friendly anatomy.[3–5] For this reason, aortoiliac anatomy might be an important confounder in observational and randomized studies comparing OR and EVAR.

In the present study, we hypothesized that after OR for an RAAA, outcomes are worse in patients with hostile anatomy for EVAR than in patients with friendly anatomy

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1078-5884/$ — see front matter
http://dx.doi.org/10.1016/j.ejvs.2014.01.003

for EVAR. The objective was to test this hypothesis with regard to the outcomes of in-hospital death rate, in-hospital complication rate, and long-term survival.

MATERIALS AND METHODS

We conducted an observational cohort study in all consecutive patients with an RAAA treated with OR in the Amsterdam ambulance region between May 2004 and February 2011. Patients who had previously undergone aortic reconstruction, or had an RAAA with an aortoenteric fistula or whose anatomy was not classified, were excluded. Details of the cohort of patients in the Amsterdam ambulance region have been published previously.[6] All patients with an RAAA in the region, comprising 10 hospitals and 1.38 million inhabitants, were registered prospectively. All patients were to be evaluated with computed-tomographic angiography (CTA) on arrival at the hospitals. Patients regarded as too hemodynamically unstable to undergo CTA, immediately underwent OR after confirmation of the diagnosis with duplex ultrasound. After CTA, aortoiliac anatomy (friendly vs. hostile) was classified by the vascular surgeon and the interventional radiologist treating the patient in the acute setting. Patients with friendly anatomy who were clinically suitable for both EVAR and OR, were randomized to the Amsterdam Acute Aneurysm Trial.[6] Patients with a hostile anatomy were not randomized and were treated with OR. By this treatment algorithm, a cohort of patients treated with OR with either friendly or hostile anatomy was created for the present study. The criteria of friendly and hostile anatomy were based on the instructions for use (IFU) of an aorto-uni-iliac endograft and are shown in Table 1. OR comprised midline laparotomy and exclusion of the aneurysm by either polyester tube or polyester bifurcated graft.

The study was conducted in accordance with the principles of the Declaration of Helsinki. Because of its observational design, written informed consent from patients was not necessary for the present study.

Outcomes

The primary endpoint was the combined 30-day or in-hospital death rate. The primary endpoint of included patients was checked for errors in the communal registry of all death certificates in the Netherlands.

The secondary endpoints were severe complications, a composite endpoint of death or complication, long-term survival, length of hospital stay, length of intensive care unit (ICU) stay, and peroperative blood loss. Details of severe complications were collected retrospectively from the medical patient charts by the primary author. Severe complications were defined as cardiac (myocardial infarction including enzymatic changes or severe hemodynamic dysfunction necessitating resuscitation or with a fatal outcome), renal (requiring temporary or permanent dialysis), gastrointestinal (ischemia necessitating bowel resection, stoma or fatal bowel ischemia), neurological (stroke or spinal cord ischemia), graft related (graft occlusion or infection), major amputation, or the need for acute reoperation in accordance with the reporting standards.[7] Long-term survival was also derived from the communal registry of death certificates (last search October 10, 2013).

Table 1. Criteria for friendly and hostile aortoiliac anatomy based on the instructions for use of an aorto-uni-iliac endograft.

Suitable infrarenal anchoring segment
A minimum length of the infrarenal segment of at least 10—15 mm
An infrarenal diameter of 20—32 mm
No obstructing calcifications, tortuosity, or thrombus
Suitable iliac anchoring segment
An ipsilateral iliac diameter of 8—18 mm
A contralateral iliac diameter of 10—20 mm
At least one iliac artery should be able to accommodate an endograft
No obstructing calcifications, tortuosity, or thrombus

EVAR = endovascular aneurysm repair.

Data collection

Data collection and statistical analysis were done with IBM SPSS Statistics 19.0 (SPSS Inc., Armonk, NY, USA). Patient variables collected from the patient charts were age, sex, comorbidity categorized as cardiac disease (previous history of arrhythmia, cardiac surgery or myocardial infarction), pulmonary disease (chronic obstructive pulmonary disorder (COPD)), renal disease (previous history of chronic kidney failure or dialysis), cerebrovascular disease (previous history of transient ischemic attack or stroke), serum hemoglobin (in mmol/L, 1 mmol/L corresponds with 1.61 g/dL), serum creatinine (in μmol/L, 1 μmol/L corresponds with 88.4 mg/dL), and incidence of suprarenal aortic cross clamping. The preoperative lowest in-hospital systolic blood pressure (SBP) and incidence of cardiopulmonary resuscitation (CPR) were used as markers for hemodynamic stability. The preoperative Glasgow aneurysm score (GAS),[8] a validated score used for case-mix comparison, was calculated. Double data entry was done for the patient variables and data were checked for inconsistencies. Inconsistencies were resolved by consulting the original patient charts. To validate the decision of friendly or hostile anatomy, aneurysm characteristics were measured by the primary author in the sagittal, coronal, and axial planes of the preoperative CTA. The measurements were done blinded for type of anatomy and outcome.

To include all patients in the regression analyses, an imputation procedure was done using logistic and linear regression models whereby ten datasets were created.[9] The most critically ill patients needed the most urgent decisions and the fewest notes were made. To correct for bias of most missing data in the most critically ill patients, we included “death” as a predictor in the imputation model. Other predictors were the baseline characteristics, level of consciousness, and Glasgow coma scale. The statistical analysis was done in the ten separate imputed datasets and the outcomes were pooled.