Morphology of Small Abdominal Aortic Aneurysms Should be Considered before Continued Ultrasound Surveillance

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Background: To evaluate abdominal aortic aneurysm (AAA) morphology in a cohort of patients presenting with ruptured AAA (rAAA) and to explore if aneurysms with diameters below the recommended threshold for elective repair (<55 mm) have some distinctive morphological characteristics.

Methods: All patients diagnosed with rAAA using computed tomography (CT) scans between January 2006 and June 2013 were eligible for this study. Where CT scans of acceptable quality were available, images were reconstructed in a dedicated three-dimensional vascular workstation for evaluation of aneurysm diameters and morphology. All morphological characteristics were defined according to the reporting standards for endovascular aortic aneurysm repair. Additionally, fusiform AAAs were defined as aneurysms involving the whole circumference of the aortic wall and saccular AAAs as spherical aneurysms involving only a portion of the aortic circumference.

Results: A total of 248 patients were identified. Of those, 83% ($n = 206$) had high-quality CT scans available and were included in the study. Patients were on average 75 years old and 85% were men. Mean aneurysm diameter was 76 ± 14 mm and 95% ($n = 197$) had fusiform morphology. Six percent (n = 12) were <55 mm and those included all saccular aneurysms in women (n = 3) and 22% of saccular aneurysms in men (n = 2). The remaining saccular aneurysms ($n = 4$) were small with a maximal diameter of 56 mm. Aneurysms <55 mm had less angulated proximal necks than their larger counterparts ($P < 0.01$). No other morphological differences were found between the groups.

Conclusions: Ruptured aneurysms are often large and the ≥55 mm threshold for elective repair is probably appropriate. However, approximately 6% of rAAAs are <55 mm, with a significant portion being saccular, especially in women. Morphological assessment of AAAs with CT scans should be considered in small aneurysms (40−55 mm), particularly in women, to exclude saccular morphology before continued ultrasound surveillance.

INTRODUCTION

The decision to operate on patients with an intact abdominal aortic aneurysm (AAA) is based on the balance between the risk of rupture and the risk involved with the procedure. Numerous studies and different methods have been used to assess the rupture risk and predict operative outcomes accounting for the patient's age, cardiopulmonary physiology, and other comorbidities.[1] At present, the size is still considered the best predictor of rupture but which size is the most appropriate threshold for repair?

The current recommendations from the European and North American vascular societies as well as the latest Cochrane review is to perform elective repair in a reasonable fit person if the aneurysm size exceeds 55 mm.[2−4] This is mainly based on the UK Small Aneurysm Trial (UKSAT)[5] and the

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American Aneurysm Detection and Management study (ADAM).[6] In both studies, patients with 40–55 mm AAAs were randomized to either open surgical repair or surveillance. No benefit was found in early aneurysm repair due to high perioperative mortality and the low annual rupture risk in the surveillance groups. However, the rationale for using the upper limit of 55 mm is not clearly stated. This prompted us to review CT scans and patient data for all ruptured AAAs (rAAA) that were admitted to our clinic during the past few years. More specifically, we evaluated the proportion of patients whose aneurysm size was beyond the present guidelines for elective treatment and explored if rAAAs with diameters <55 mm had some distinctive morphological characteristics.

METHODS

All patients diagnosed with rAAA at our hospital from January 2006 to June 2013 were identified from the patient registry. The hospital is a tertiary referral center with a catchment area of approximately 1.5 million inhabitants, performing approximately 200 endovascular and open surgical procedures on abdominal and thoracic aortic aneurysms annually. Patient data was retrospectively reviewed and entered in a computerized database. Patients with confirmed rupture (presence of a hematoma adjacent to the aneurysm sac or a contrast leakage outside the aortic lumen) and a high quality, thin slice (0.5–3 mm) computed tomography (CT) scans were included in the study. CT scans were performed on a multidetector spiral CT scanner (Siemens, Erlanger, Germany) and reconstructed with 0.75–3 mm axial slices. AAA morphology was evaluated in a dedicated vascular three-dimensional workstation (Aquarius TeraRecon, San Francisco, CA) by one of the authors (T.K.) for the purpose of this study. We have previously shown good intra- and interobserver agreement in AAA diameter measurements with this investigator.[7]

All morphological definitions were based on the reporting standards for endovascular aortic aneurysm repair (EVAR).[8] Additionally, the proportion of rAAAs at diameters below 55 mm was registered for both fusiform and saccular aneurysms where fusiform AAA was defined as aneurysm involving the whole circumference of the aortic wall and saccular AAA as a spherical aneurysm involving only a portion of the aortic circumference. Aneurysm diameter was measured on axial reconstructions perpendicular to the maximal ellipse at the widest point for both fusiform and saccular aneurysms. All diameter measurements were taken from outer wall to outer wall.

Statistics

t-test was used for analysis of length, diameter, and angulation measurements. Chi-squared and Fisher's exact tests were used for gender and morphology comparisons. All statistical analyses were done in SPSS version 22.0 (SPSS, Inc., Chicago, IL, www.spss.com). Measurements are presented as mean ± standard deviation. $P < 0.05$ was considered significant.

RESULTS

A total of 248 patients were diagnosed with rAAA at our clinic during the study period. Of those, 83% ($n = 206$) met the inclusion criteria and were included in the study. Seventy percent ($n = 144$) were treated with endovascular repair, 19% ($n = 39$) with open repair, and 11% ($n = 23$) received neither surgical or endovascular treatment. Patients were on average 75 years old (range 54–94) and 85% were men. Baseline patient characteristics are given in Table I. Mean aneurysm diameter was 76 ± 14 mm and significantly smaller in women (77 ± 14 vs. 70 ± 14 mm, $P < 0.01$). Ninety-five percent ($n = 197$) had fusiform morphology, and those aneurysms were significantly larger than their saccular ($n = 9$) counterparts (77 ± 13 vs. 52 ± 11 mm, $P < 0.01$). In total, 5.8% ($n = 12$) of ruptures occurred at diameters <55 mm (men 5.1% [$n = 9$], women 9.7% [$n = 3$]) of which 42% had saccular morphology. Saccular morphology accounted for 100% of rAAAs <55 mm in women ($n = 3$) and 22% in men ($n = 2$). At diameters ≥55 mm, only 2% ($n = 4$) were saccular, measuring 55 mm ($n = 3$) and 56 mm ($n = 1$) in diameter, respectively (Fig. 1). Moreover, when saccular aneurysms were excluded from the analysis, only 4% ($n = 7$) of the ruptures occurred <55 mm in men and none in women. Except for neck angulation, recorded as the higher value on either anteroposterior or lateral view reconstructions, there were no significant morphological differences between the groups (Table II).

DISCUSSION

In the present investigation, 94% of all rAAAs were ≥55 mm in diameter, which is the current size threshold for elective aneurysm repair. In concordance with previous studies, the majority was quite