Internal or external wall diameter for abdominal aortic aneurysm screening?

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ABSTRACT

INTRODUCTION The national abdominal aortic aneurysm (AAA) screening programme measures internal wall diameter; however, current UK intervention criteria use external wall diameter. Our aim was to determine the clinical significance of the difference between these two measurements.

PATIENTS AND METHODS Fifty patients on an aneurysm surveillance programme were ultrasound scanned by two experienced vascular scientists, blinded to the other's results. Maximum anteroposterior internal wall and maximum anteroposterior external wall diameters were measured.

RESULTS The median difference between internal and external diameter was 6 mm (IQR 6–7) for scientist 1 and 7 mm (IQR 5–8) for scientist 2. This was statistically significant ($P < 0.0002$). External wall diameter displayed less interobserver variability (3 mm vs 6 mm).

CONCLUSIONS Screening measurements underestimate aneurysm size by 6 mm and display greater variability in comparison to external wall measurements. These findings should be understood to prevent a delay in the detection and treatment of AAAs.

KEYWORDS

Abdominal aortic aneurysm – Ultrasound – Diameter

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Ultrasound screening for abdominal aortic aneurysms (AAAs) is being introduced in the UK following level 1 evidence showing a reduction in aneurysm-related mortality in men aged 65–79 years.¹ The screening programme uses a longitudinal and a transverse measure of the maximum anteroposterior internal wall diameter (IWD).² However, national intervention criteria³ are based on maximum anteroposterior external wall aortic diameter (EWD). The anteroposterior plane is used because it has a lower variability.⁴

These differences may lead to confusion when interpreting screening measurements. The primary aim of this study was to determine the difference between internal and external wall diameters. The secondary aim was to determine the interobserver variability of these measurements.

Patients and Methods

We performed an observational study on 50 consecutive small AAA patients on an existing surveillance programme. Each gave informed consent for ultrasound assessment, which was performed as part of routine annual quality

assurance. Each patient underwent independent ultrasound assessment by two vascular scientists with a minimum of 3 years' experience. Patients were double scanned during one appointment and remained supine between examinations. Scientists were blinded to each other's measurement and to previous imaging results. Measurements taken were maximum anteroposterior EWD and maximum anteroposterior IWD. Images were obtained at 90° to the longitudinal axis of the aorta to minimise parallax error. A HDI 5000 machine (Philips, Bothel, USA) with a 3–5 MHz probe was used. Statistical analysis were performed using GraphPad Prism v5 (GraphPad Software, USA). Two-tailed tests were used and statistical significance was taken at $P < 0.05$.

Results

Aneurysm size ranged from 32–78 mm (EWD). None of the aneurysms was inflammatory or leaking. Of the aneurysms, $14 \pm 2\%$ were ≤ 35 mm (EWD).

Scientist 1 found the external–internal wall difference to be 6 mm (IQR 6–7). Scientist 2 found the difference to be 7

Figure 1 Bland–Altman plots showing interobserver agreement for (A) external wall diameter (EWD) and (B) internal wall diameter (IWD). Dashed line represents 95% limits of agreement.

mm (IQR 5–8). This was statistically significant for both observers ($P < 0.0002$, Mann–Whitney test).

Bland–Altman plots (Figs 1 and 2) revealed the 95% limits of agreement for EWD were 3 mm and for IWD 6 mm. The largest single discrepancy between sonographers (10 mm) came in an IWD measurement.

Discussion

Our results suggest that screening measurements underestimate external wall measurements by 6 mm. In addition, screening measurements display greater variability. Hence aortic measurements found on screening to be 24 mm could actually be considered aneurysmal. When considering sur-

gical referral, screening measurements of 49 mm may in reality equate to the intervention threshold of 55 mm.

The 6 mm discrepancy is supported by magnetic resonance imaging studies of the healthy aorta in men aged 65 years demonstrating aortic thickness to be 2 mm (*i.e.* 4 mm for both walls).⁵ However, with inflammatory aneurysms, wall thickness can measure up to 15 mm.⁶ Hence IWD measurements will further underestimate this type of aneurysm.

Interobserver variability for EWD in this study was within the bounds of two other studies, which estimated EWD variability to be ± 2 mm⁷ and ± 4 mm,⁸ respectively. We believe the greater IWD variability arose from luminal thrombus which caused difficulty identifying the true internal wall (Fig. 2). Hence, we recommend that these problems are addressed in the training of screening sonographers.

The limitations of this study are that of numbers, normal aortas and an independent gold standard measurement such as computed tomography.

Conclusions

Screening measurements underestimate previous measurements by 6 mm and display greater variability. This should be recognised to avoid a delay in the diagnosis and treatment of abdominal aortic aneurysms. Internal and external wall variabilities need to be audited in the early stages of the screening programme.

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Figure 2 Luminal irregularities, such as dissected thrombus (shown above), can cause difficulty when deciding where the inner wall lies. However, the external wall is more obvious and hence more reproducible. Picture courtesy of Mary Ellis.

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