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ORIGINAL ARTICLE

The New Dimension in Aortic Measurements - Use of the Inner Edge Measurement for the Thoracic Aorta in Australian Patients

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Background Historically, aortic measurements were established using M-mode echocardiography, measuring from the leading edge to leading edge. Improvements in echocardiographic imaging now permit accurate assessment using the blood-tissue interface. Normal values have not been established using this technique.

Methods A prospective analysis of consecutive patients without pathology was conducted. Measurements of aortic dimensions were made using the blood-tissue interface and the leading edge methods at end-diastole, and at end-systole using the blood-tissue interface. Data collected included BSA, and aortic measurements (LVOT, root, ST junction, mid ascending aorta, aortic arch).

Results The echocardiograms of 512 patients were evaluated. The mean age was 56 years, with 304 males (59%) and 208 females (41%). The average measurements (blood tissue interface) were: aortic root 31.2 mm, sinotubular junction 25.9 mm, mid ascending aorta 30.6 and aortic arch 23.4. On average, the leading edge method measurements were 1.5 mm larger ($p < 0.0001$), consistent with the added thickness of the anterior aortic wall. Ratios to BSA were also estimated. Tables have been created suggesting normal and abnormal values.

Conclusions Improvements in echocardiographic imaging permit the blood-tissue interface to be readily visualised. Reference ranges for the estimation of aortic sizes using this method are provided. More accurate and anatomical estimation of the aortic dimensions can now be achieved.

Keywords Echocardiography • Aorta • Dimensions • Measurements

Introduction

Echocardiographic measurements of the thoracic aorta were originally established using M-mode [1–5]. The technique involved measuring the leading edge of the aortic wall (outer wall) to the next leading edge (the inner wall of the aorta), at end diastole [1–3,5]. With the advent of two-dimensional (2D) echocardiography, these measurements were confirmed using the leading edge to leading edge concept [6–9]. Reference ranges for these measurements have previously been established, and confirmed [5–8].

With the improvement in echocardiographic technology, it is now possible to accurately visualise the blood-tissue interface [5,10–12]. Many of the guidelines for chamber measurement have been adjusted to reflect this more anatomical measurement, but until recently, not for the aortic dimensions [8–10]. Previous research has stratified aortic size by age, [7] and by comparing the dimensions to the patient's

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body surface area (BSA) [10,11,13]. This study was designed to estimate reference ranges for the thoracic aorta, using the direct measurements, comparing them to the BSA, and with breakdowns by sex and age. The inner edge to inner edge measurements (utilising the blood tissue interface) were compared to the leading edge data.

Methods

Prospective patients having a transthoracic echocardiogram (TTE) at the Heart Care Partners testing facility in Brisbane, Australia, were included. The echocardiograms were done on a General Electric Vivid 7 or S6 machine, using harmonic imaging. All studies were performed by the same sonographer and read by a single cardiologist with sub-specialty training in echocardiography, to eliminate variations in measurement technique (minimise measurement bias). The study ran from July 2012 to August 2012. All adult patients were included. Patients with aortic stenosis, bicuspid aortic valves, Marfan's syndrome, previous aortic surgery and atrial fibrillation were excluded. Mean patient sizes suggested that this was not an obese population, and the mean blood pressure was in the normal range.

Measurements of aortic dimension were made according to the blood-tissue interface and the leading edge to leading edge methods at end-diastole. Recordings were made from the parasternal long-axis acoustic window to visualise the aortic root and proximal ascending aorta, and the suprasternal view to visualise the aortic arch, according to the American Society of Echocardiography guidelines for quantification of the aorta [5,10]. Measurement of the aortic root and ascending aorta were made at the point of maximum diameter. The ascending aorta was visualised separately. The point of maximum diameter was identified either in the view associated with the aortic root, or by measuring the aorta separately in the rib space above. Ideally this was done 3 cm beyond the sinotubular (ST) junction. Measurements were made in the anterior-posterior plane, perpendicular to the long axis of the aorta, in a zoomed-up view. At the arch, the measurement was made in the superior-inferior dimension. Data collected included the date of test, date of birth,

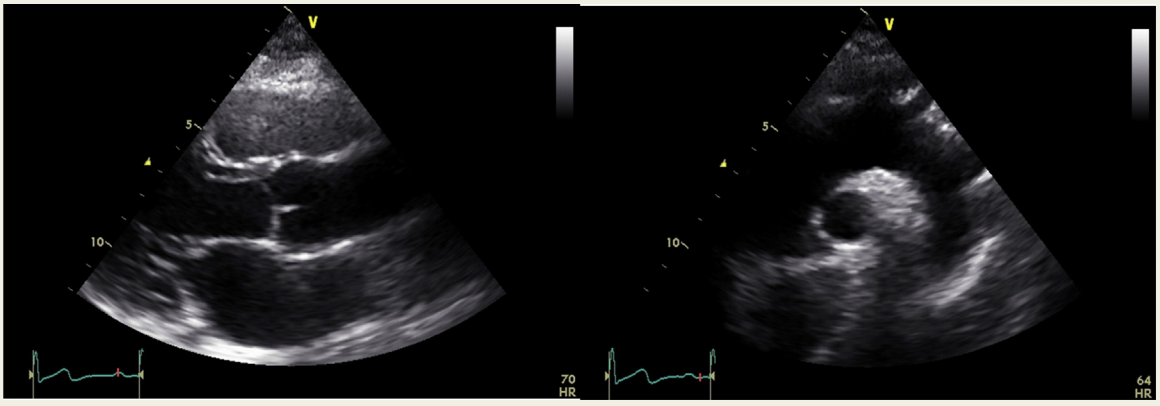

Figure 1 & 2 Diagram of the aortic root and ascending aorta. Diagram of the aortic arch.

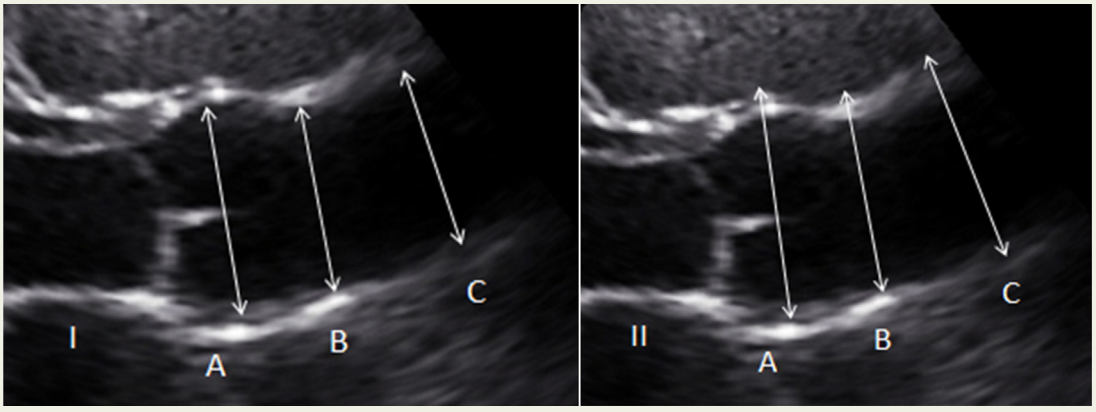

Figure 3 Aortic Root and ascending aorta. A - Aortic root, B – ST junction, C – Ascending aorta
I – Inner edge to inner edge technique II – Leading edge to leading edge.