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Transthoracic Ultrasound Evaluation of Arch and Descending Thoracic Aortic Pathology

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WHAT THIS PAPER ADDS

This study increases awareness about the potential use of ultrasound in patients with thoracic aortic pathologies. The study promotes the use of ultrasound as an additional tool in this cohort of patients and should therefore be considered as a valid tool in the management of these patients.

Background: Duplex ultrasonography (DUS) currently has limited applicability in the diagnosis and surveillance of thoracic aortic pathologies because of associated limitations. This study investigates the feasibility of using an optimised DUS protocol to detect descending thoracic aortic pathology.

Methods: Forty patients were scanned (20 cases and 20 controls). All patients but one had a technically adequate assessment of the thoracic aorta (at least one view of the descending thoracic aorta). Using a size threshold of 40 mm, 16 out of 19 cases and two out of 20 control patients would have been recommended for definitive imaging. Using a cutoff of 35 mm, this became 18 out of 19 cases and six of 20 controls. Sensitivity and specificity were 100% and 70% for a threshold of 35 mm, and 84% and 90% for a threshold of 40 mm.

Results: This was a prospective, case control cohort study. Patients with computed tomography (CT) confirmed thoracic aortic pathology underwent DUS of the thoracic aorta. A control group known to have no thoracic pathology also underwent DUS. The sonographer performing DUS was blinded to the CT findings, and recorded the presence of pathology or any dilated aortic segment where visualised. Diameter cutoff points of 35 mm and 40 mm were compared.

Conclusions: DUS has the potential to be used as a diagnostic modality for thoracic aortic pathology, and may have a role in surveillance for some patients for whom CT scanning is contraindicated. Further validation and refinements to this technique are required. However, this study provides proof of concept.

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INTRODUCTION

Thoracic aortic aneurysms (TAAs) and thoracic aortic dissection (TAD) are potentially life threatening conditions. Early diagnosis is desirable. However, 95% of patients are asymptomatic.[1,2] As the maximum diameter of the thoracic aorta increases, observed aortic growth and adverse event rates increase exponentially.[3,4] Diagnosis is currently reliant on imaging studies of the aorta such as computed tomography (CT), magnetic resonance (MR) angiography, and catheter angiography. Such technologies are expensive and can be associated with significant risks including radiation exposure and nephrotoxicity from contrast agents. In the case of MR imaging, access to this service remains limited in some healthcare settings. Consequently, these modalities are not ideal for screening or ongoing pre-operative or post-operative surveillance programmes.[5]

Unlike abdominal aortic aneurysms (AAAs) that are readily assessed by duplex ultrasound scan (DUS), the thoracic aorta has traditionally been excluded from assessment by DUS. This is because TAAs are more complex to evaluate using ultrasound modalities because of the anatomical location of the descending thoracic aorta within the thorax. The distance from the chest wall, surrounding bone, and the presence of intrapulmonary gas limit image acquisition via transthoracic ultrasound.[5–7] Trans-oesophageal echocardiography (TEE) can overcome many of these issues and has been shown to visualise much of the

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descending aorta with similar measurements to CT or MR angiography. However, routine use in diagnosis or surveillance is again limited due to the invasive nature of the procedure.[8,9]

Over the last few years, specific DUS techniques have been reported to allow visualisation of various parts of the thoracic aorta. TTE has been shown to effectively visualise the ascending aorta with similar accuracy to TEE using non-standard acoustic windows.[6] Further studies have also reported that cardiac ultrasound can accurately visualise more distal regions of the thoracic aorta, particularly in the parasternal long axis view.[10] Recently, few case reports have described cardiac ultrasound diagnosis of TAAs, including the descending aorta in emergency settings.[11,12] This study aimed to prospectively assess the feasibility and accuracy of DUS for the diagnosis of aneurysms of the descending thoracic aorta and to propose a functional protocol for such an assessment.

PATIENTS AND METHODS

Study design

In this prospective pilot study, 20 consecutive patients with known thoracic aortic pathology were referred to a vascular laboratory for ultrasound assessment of either the carotid arteries or the abdominal aorta between November 2014 and January 2016. All patients were previously diagnosed with a TAA by a dedicated CT angiogram, so no new findings were expected. A single vascular sonographer with experience in cardiac ultrasound performed all ultrasound measurements. Twenty patients with known AAA (but no TAAs) also underwent assessment of the descending thoracic aorta, and constituted the control group. The sonographer was blinded to the CT diagnosis, location, and extent of the aortic pathology in all patients. The metric of interest was the maximum diameter of the different areas of the descending aorta from the isthmus to the level of the diaphragm. A conservative cutoff point of 35 mm and a liberal cutoff of 40 mm were both tested.

Descending thoracic aorta ultrasound protocol

All scans were performed using a GE LOGIQ E9 using a 2 MHz phased array by a dedicated vascular sonographer with great experience of assessment of patients with aneurysmal disease. Ultrasound assessment was considered satisfactory when at least two of the three regions of the descending thoracic aorta were visualised, partially satisfactory when a single view was obtained and inconclusive when none of the three windows could be obtained (Supplementary fig. 1). A combination of different acoustic windows was used to assess the descending thoracic aorta (Fig. 1). All the aortic measurements were performed using

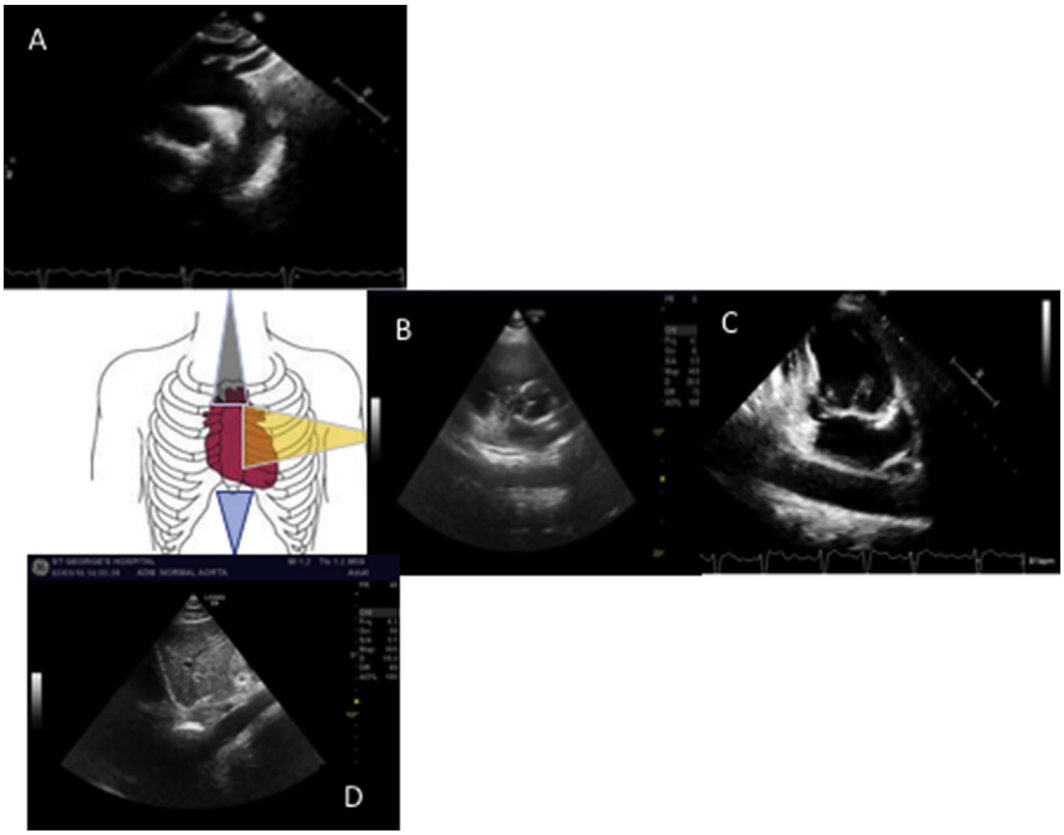

Figure 1. Main acoustic windows used in this study to assess the aortic arch and descending thoracic aorta. (A) Suprasternal window. The aortic arch and the three major supra-aortic vessels can be visualised with this window. (B) Longitudinal view of the aorta in parasternal long axis window. To obtain a longitudinal view of the mid descending thoracic aorta, modification of the standard parasternal long axis view was used; the transducer was rotated by 90°. (C) Apical two chamber views of the descending aorta (longitudinal views of the aorta). (D) Subcostal view. The distal end of the thoracic aorta and proximal segment of the abdominal aorta are visualised in this window.

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