The value of evaluating the abdominal aorta in patients <50 years of age presenting for abdominal ultrasound

Martin Necas , Matt Adams, Orlaith Brennan, Nicole Curtis , Rachel Heslop and Emma Woodrow-Smith

Department of Ultrasound, Radiology, Waikato Hospital, Pembroke Street, Hamilton, 3204, New Zealand

Abstract

Introduction: Practitioners of US routinely include a survey of the abdominal aorta during abdominal US in accordance with international guidelines. Such practice is of uncertain value in younger patients.

Methodology: This study was a retrospective review of 2000 abdominal US examinations which included visualisation of the aorta in patients <50 years of age. Patient demographics and referral details were recorded, and US images and reports were reviewed for the presence of aortic and periaortic pathology.

Results: The most common indications for US were abdominal pain (1337, 44%), deranged liver function tests (453, 15%), nausea and/or vomiting (229, 8%), elevated inflammatory markers (146, 5%), pancreatitis (134, 4%) and pyrexia (127, 4%). Fewer than half (977, 49%) of the reports contained a comment regarding the aorta. Aortic pathology was reported in 2 (0.1%) cases. Both were reported as aortic ectasia and both represented a false-positive diagnosis. One male patient had a known abdominal aortic aneurysm with endovascular aortic repair. No new aortic aneurysms were found. All cases of atherosclerotic disease were ignored, and none were reported. Periaortic pathology was encountered on 1 patient, but this was known. No case of new periaortic pathology was detected.

Conclusion: Routine and indiscriminate imaging of the abdominal aorta during abdominal US in patients <50 years of age is not evidence based. No new case of abdominal aortic aneurysm or new para-aortic pathology was detected, all cases of atherosclerosis were ignored, and two false-positive diagnoses of aortic ectasia were made.

Keywords: ultrasound, aorta, aneurysm, atherosclerosis.

Impact statement

Effective utilisation of medical imaging modalities such as ultrasound is important, because ultrasound involves physical and cognitive effort on part of the sonographer. Therefore, the utilisation of ultrasound should be on the basis of evidence-based practice and unnecessary imaging steps should be eliminated and avoided. In this paper, we have shown that the current recommended practice of scanning the abdominal aorta during every abdominal ultrasound in younger patients (<50 years) results in no detection of new aortic or periaortic pathology. It therefore represents a wasteful imaging task for the sonographer with no measurable benefit to the patient.

Introduction

Abdominal ultrasound (US) is one of the most common imaging examinations. Survey of the abdominal aorta is advocated in the standards of practice documents by leading international US societies including the American Institute of Ultrasound in Medicine (AIUM), American College of Radiology (ACR), Society for Pediatric Radiology (SPR), Society of Radiologists in Ultrasound (SRU), Australasian Society for Ultrasound (ASUM) and British Medical Ultrasound Society (BMUS).^{1–3} Assessment of the abdominal aorta is recommended regardless of patient's age and clinical indications, despite the fact that the prevalence of aortic pathology is age dependent. The justification for such practice is not provided. While it is true that abdominal US plays an important role in the incidental or clinically suspected detection of abdominal aortic aneurysm (AAA), the prevalence of AAA in patients <50 years is negligible.⁴ The other major aortic pathology is atherosclerosis, which is

Correspondence to email: martin@antegrade.net
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typically subclinical and only requires clinical workup if symptomatic. Aortic atherosclerosis is also age dependent.^{5,6} Other aortic pathologies such as dissections, inflammatory or infective aortitis, unsuspected congenital anomalies, aortic thrombosis, penetrating atheromatous ulcers and mycotic aneurysms are all rare. The unsuspected incidental detection of any of these pathologies on an abdominal US for unrelated clinical indications is not clinically realistic. While there may be reasonable rationale to include aortic survey in select patients such as during a dedicated AAA screening programme⁷ or within a research-based setting,⁸ the indiscriminate imaging of the abdominal aorta in a low-risk population of patients <50 years is of doubtful value. The purpose of this study was to review 2000 abdominal US examinations in patients <50 years presenting for abdominal ultrasonography and to determine the incidence, spectrum and severity of aortic findings.

Methodology

This study was a retrospective sequential review of 2000 abdominal US examinations which included visualisation of the aorta in patients <50 years of age presenting to Waikato District Health board (DHB) US service (Hamilton, New Zealand) between March 2016 and November 2018. Abdominal US examinations were identified using a sequential search of the radiology PACS system (Philips PACS Enterprise). All patients had been examined by (i) qualified sonographers with post-graduate diploma or master's-level qualifications or (ii) trainee sonographers or radiology registrars under the direct supervision of a qualified sonographer. The US machines used were Philips EPIQ 7 or Philips iU22. Patient demographics and referral details were recorded, and US reports reviewed for the presence of aortic and periaortic pathology. Where available, imaging records from computed tomography (CT), magnetic resonance imaging (MRI) or repeat US of our patient cohort for the year following the initial US were reviewed for the presence of aortic and periaortic pathology and compared with the initial US results. Finally, the images of patients aged 45–49 years were reviewed for the presence of atherosclerosis by an expert vascular sonographer and the results were correlated with the radiology reports. Targeted abdominal US examinations that did not include the aorta were excluded. The study was approved by Waikato DHB Clinical Audit Support Unit (Registration Number: 3910DRA181108).

Ethical approval

Ethical approval was granted by Waikato District Health Board's Clinical Audit Support Unit (Registration number: 3910DRA181108).

Results

The results of 2000 consecutive abdominal US examinations on 1881 unique patients including 1263 (67%) females and 618 (33%) males. By study design, all patients were less than

50 years (mean = 29, median 30). Children <16 years of age comprised 16% of our cohort. The youngest patient whose aorta was imaged was 3 days old.

Patients were referred for abdominal US from a range of medical services including inpatient hospital teams (1003, 50%), emergency department (457, 23%), general practitioners (326, 16%) and outpatient specialist clinics (214, 11%). Referring clinicians provided 3030 clinical indications for ultrasound with an average of 1.52 indications per referral. The most common indications for US were abdominal pain (1337, 44%), deranged liver function tests (453, 15%), nausea and/or vomiting (229, 8%), elevated inflammatory markers (146, 5%), pancreatitis (134, 4%) and pyrexia (127, 4%).

Fewer than half (977, 49%) of all abdominal US reports issued by radiologists contained any comment regarding the aorta despite the aorta having been imaged in all cases. Aortic pathology was reported in 2 (0.1%) cases. Both were reported as aortic ectasia, but both represent a false-positive diagnosis. In one case, the aortic diameter was 2.39 cm. In the second case, the aortic diameter was 2.50 cm, but on subsequent examination 1 month later, it was 2.38 cm. The accepted threshold for the diagnosis of an ectatic aorta is a diameter of 2.6–2.9 cm.⁹ Three experts in abdominal aortic aneurysm screening (two specialist vascular sonographers and a vascular surgeon) reviewed the cases and unanimously classified the aortic diameter as normal. One male patient had a known abdominal aortic aneurysm (AAA) with endovascular aortic repair which was cursorily imaged during an abdominal ultrasound as a part of routine screening for hepatocellular carcinoma. The AAA had been detected incidentally on an abdominal radiograph at the age of 47. The patient had a poor cardiovascular health status including smoking, obesity, type 2 diabetes, non-alcoholic fatty liver disease, ischaemic heart disease and community cardiac arrest requiring a coronary artery bypass at the age of 40. Overall, the inclusion of aortic survey during abdominal US in patients <50 resulted in no new diagnoses of abdominal aortic aneurysm, but two false-positive diagnoses of aortic ectasia.

An expert vascular sonographer reviewed the imaging records of all 291 patients over the age of 45 and identified 20 cases of subclinical aortic atherosclerosis (Figure 1). None had been reported. Of these 20 patients, 11 had CT imaging for a variety of clinical reasons. Aortic atherosclerosis was evident on CT in all 11 (100%) patients, but the finding had only been reported in one patient.

Periaortic pathology was encountered on 1 (0.05%) examination, but this was a known seroma based on previous contrast CT in a patient with extensive retroperitoneal dissection for metastatic testicular cancer. No case of new periaortic pathology was detected on ultrasound.

Further abdominal imaging within one calendar year (CT, MRI, US) was performed in 620 cases. Two aortic dissections involving the abdominal aorta were noted on CT, but on review of patient records, the dissections predated the initial

Figure 1: Subclinical aortic atherosclerosis visualised, but not reported in a 49-year-old man. Wall irregularity, hypoechoic plaque (arrow) and large calcifications (arrowheads) are clearly visualised

ultrasound. In both cases, the sonographer had dutifully measured the aortic diameter and ignored the presence of known dissection (despite the imaging records and reports being available) and the radiologists did not comment on the aorta in their reports. Periaortic pathology was identified in 17 (3%) of the 620 cases including 12 cases of lymphadenopathy, two lymphadenitis, one retroperitoneal thickening, one retroperitoneal oedema and one seroma (already mentioned). All periaortic pathology was detected on CT or MRI and none on US.

Discussion

Imaging of the aorta during abdominal US examinations in patients under the age of 50 appears to be motivated by habitual, protocol-based and uncritical compliance with imaging guidelines^{1–3} rather than by genuine clinical need or sound clinical justification. In this study, no single case of new aortic aneurysm was found by imaging the aorta with US in 2000 consecutive abdominal examinations in patients <50 years. All cases of subclinical aortic atherosclerosis were ignored. It appears that sonographers and radiologists make a cursory assessment of the aorta for diameter only, but do not otherwise pay attention to aortic wall characteristics. This is illogical as the incidence of AAA in unselected patients under the age of 50 is extremely low.⁴ Studies on the incidence of AAA and the value of AAA screening generally support screening for AAA from the age of 65 with some variation based on coexisting risk factors such as gender and history of tobacco use.⁷ No professional society or government body currently advocates AAA screening in a population <65.

Rather than focusing solely on aortic diameter, a more valid reason to assess the aorta in the future may be to assess and report on the degree of subclinical aortic atherosclerosis as a marker for cardiovascular disease. The link between aortic plaque and cardiovascular disease is well established; however,

there is no current consensus on reporting or management of patients with subclinical atherosclerosis.^{8,10} The lack of clinical guidelines and clinician requests for assessment of subclinical aortic atherosclerosis may explain why sonographers and radiologists ignore it.

The likelihood that US scanning of the aortic region fortuitously uncovers incidental and clinically unsuspected periaortic pathology is extremely low. In this cohort, zero cases of new periaortic pathology were identified on US in 2000 cases, but 17 cases of new periaortic pathology were identified in 620 patients who received further CT or MRI. Ultrasound is simply not an effective screening tool for the incidental identification of periaortic pathology.

Unlike CT or MRI, US imaging of the aorta requires an investment of physical labour by the sonographer as well as cognitive burden for both the sonographer and the radiologist. Removing the requirement to image the aorta would have the potential to improve the efficiency of the abdominal examination, while decreasing the work burden for sonographers. The authors propose that the common practice to indiscriminately and uncritically image the aorta in patients <50 years of age be reconsidered by international professional bodies. Instead, sonographers should image the aorta when requested and exercise sound critical judgement and extend the examination to include the aorta where appropriate. Sonographers already carry the mandate to extend the US examination where clinically appropriate, so this would not represent a change to current clinical practice.^{11–13}

Anecdotally, some US practitioners believe that following a standard checklist can ensure that all required structures on a US imaging protocol are always assessed. There is some validity in the argument to ensure consistency of practice; however, standard checklists should not include unnecessary or wasteful tasks that increase the work burden for the sonographer and radiologist without any measurable clinical benefit.¹⁴ Instead, abdominal protocols should be adjusted to incorporate only evidence-based imaging tasks. This may include imaging of the aorta in patients over a defined age threshold and not below. Most current ultrasound systems allow the user to define multiple imaging protocol checklists that incorporate predictive features and guide the user through the required imaging steps ensuring that no step has been missed.

This study has several limitations. First, the study was performed on unselected patients presenting to a single centre and was not a cross-sectional population-based study. This may introduce unexpected patient selection biases. It is likely that these biases will trend towards increased level of pathology when compared to background pathology rates. Second, despite the review of 2000 patients, the number of patients with new aortic and periaortic findings is zero. It is possible that expanding the patient sample to many thousands of patients may result in some positive findings for analysis. Third, the study was performed in a single centre. It is possible that other centres may approach aortic assessment and reporting differently.

On the other hand, the US imaging in this study was performed in accordance with broadly accepted national and international standards and the study was performed in a tertiary teaching hospital whose operational characteristics are similar to many centres in New Zealand and Australia and overseas.

Conclusion

Routine and indiscriminate imaging of the abdominal aorta during abdominal US in patients <50 years of age in accordance with industry guidelines is not evidence based. In this cohort of 2000 consecutive US examinations, fewer than half of all abdominal ultrasound reports contained a comment about the aorta, no new case of abdominal aortic aneurysm or new periaortic pathology was detected, all cases of atherosclerosis were ignored, and two false-positive diagnoses of aortic ectasia were made.

Authorship declaration

The authorship listing conforms with the journal's authorship policy, and all authors are in agreement with the content of the submitted manuscript.

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Conflict of Interest

None.

Author contributions

Martin Necas: Conceptualization (lead); Data curation (lead); Formal analysis (lead); Methodology (lead); Project administration (equal); Resources (lead); Supervision (equal); Writing-original draft (lead); Writing-review & editing (lead). **Matthew Adams:** Conceptualization (supporting); Data curation (lead); Formal analysis (equal); Investigation (equal); Methodology (equal); Project administration (equal); Resources (equal); Writing-original draft (supporting); Writing-review & editing (supporting). **Orlaith Brennan:** Conceptualization (supporting); Data curation (supporting); Formal analysis (supporting); Investigation (supporting); Methodology (supporting); Writing-original draft (supporting); Writing-review & editing (supporting). **Nicole Curtis:** Conceptualization (equal); Data curation (equal); Formal analysis (equal); Investigation (equal); Methodology (equal); Project administration (equal); Supervision (supporting); Validation (lead); Writing-original draft (supporting); Writing-review & editing (supporting). **Rachel Heslop:** Conceptualization (supporting); Data curation (equal); Formal analysis (supporting); Funding acquisition (supporting); Investigation (supporting); Methodology (supporting); Writing-original draft (supporting); Writing-review & editing (supporting). **Emma Woodrow-Smith:** Conceptualization (supporting); Data curation (equal); Formal analysis (supporting); Investigation (equal); Methodology (supporting); Writing-original draft (supporting); Writing-review & editing (supporting).

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