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Use of Colour Duplex Ultrasound as a First Line Surveillance Tool Following EVAR is Associated with a Reduction in Cost Without Compromising Accuracy CME

C. Gray [a,c], P. Goodman [c], C.C. Herron [a], L.P. Lawler [b], M.K. O'Malley [a], M.K. O'Donohoe [a], C.O. McDonnell [a,*]

[a] Department of Vascular Surgery, Mater Misericordiae University Hospital, Suite 5, 69 Eccles Street, Dublin 7, Ireland
[b] Department of Radiology, Mater Misericordiae University Hospital, Dublin, Ireland
[c] School of Physics, Dublin Institute of Technology, Ireland

WHAT THIS PAPER ADDS

- This study demonstrates that duplex ultrasound can supplant CT as the postoperative surveillance tool of choice following EVAR without any compromise in accuracy of imaging and resulting in significant cost savings.

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ABSTRACT

Introduction: CT scanning remains the postoperative surveillance imaging modality of choice following EVAR. Concerns regarding cost, exposure to ionising radiation and intravenous contrast have led to a search for a less expensive, equally efficacious and safer method of monitoring EVAR patients after endograft deployment. This study evaluated the cost saving obtained if CDUS was employed as a first line surveillance tool following EVAR, as well as comparing the two entities in terms of efficacy.
Patients & methods: Postoperative surveillance CTs and CDUS scans in the 145 patients who have undergone EVAR from 1st June 2003 to 1st July 2010 were compared for the detection of endoleak and determination of residual sac size.
Results: Adopting a protocol where CDUS was employed as the first line surveillance tool following EVAR would result in a reduction in the number of postoperative CTs required in 2010 from 235 to 36. Based on 2010 costings, this would equate to an estimated reduction in expenditure from €117,500 to €34,915 a saving of €82,585. CDUS had a sensitivity of 100% and a specificity of 85% in the detection of endoleaks compared to CT. The positive predictive value was 28% and negative predictive value 100%. The Pearson Coefficient correlation of 0.96 indicates a large degree of correlation between CDUS and CT when measuring residual aneurysm size following EVAR.
Conclusion: CDUS can replace CT as the first line surveillance tool following EVAR. This is associated with a significant reduction in the cost of surveillance without any loss of imaging accuracy.

Introduction

The short term benefits of endovascular (EVAR) over open abdominal aortic aneurysm (AAA) repair of decreased mortality, reduced blood loss, shorter hospital stay and improved quality of life[1,2] are balanced by concerns regarding the durability of the procedure, and the occurrence of the EVAR unique complications of endoleak and graft migration. This mandates lifelong surveillance for patients following EVAR in order to ensure continued exclusion of the aneurysm from the circulation. While contrast enhanced computed tomography (CT) is currently the prevalent imaging modality for EVAR surveillance,[3] concerns exist due to the administration of high doses of ionising radiation together with the potential nephrotoxicity of the intravenous contrast.[4] The increased demand for CT by virtually all hospital disciplines means the availability of scanning time is becoming an issue. Identification of an equally accurate, safer, non-invasive and less harmful method of adequately imaging the aorta with a high sensitivity and specificity following EVAR is desirable.

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* Corresponding author. Tel.: +353 1 830 8241; fax: +353 1 838 0851.
E-mail address: mrcomcdonnell@gmail.com (C.O. McDonnell).

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Colour Duplex Ultrasound (CDUS) is an inexpensive, harmless, non-invasive and widely available imaging modality which is the investigation of choice for the screening and surveillance of AAA prior to intervention.[5,6] Aneurysm sac size and blood flow within the residual aneurysm sac can be determined using CDUS which could therefore be capable of replacing CT as the primary surveillance tool following EVAR. Recent guidelines from the European Society for Vascular Surgery state that CDUS is a safe and sensitive method of endoleak detection, but caution that it should not be a stand alone modality for follow up after EVAR.[7]

While others have compared CDUS with CT as a surveillance tool following EVAR,[8,9] the implications of a potential change to the postoperative follow up algorithm have not been reported. We sought to evaluate the potential cost savings obtained by using CDUS rather than CT as the first line imaging method for post-EVAR surveillance. We also compared the efficacy of the two modalities to ensure that any cost saving would not compromise accuracy of follow up.

Patients & Methods

Patients

Following ethical approval, the CDUS and CT scans of all 145 patients who underwent EVAR at the Mater Hospital from 1st June 2003 to 1st July 2010 were retrospectively reviewed. There were 122 (84.1%) male and 23 (15.8%) female patients with a mean (±SD) age of 77.1 (±7.9) years. There was no statistical difference between the mean male and female ages. Complete patient demographics and risk factors were available in 141 (97.3%) patients. Deficiencies in the clinical notes in 4 (2.8%) patients meant risk factors could not be assessed. No fenestrated EVARs were performed in the hospital during the timespan of the study.

Following graft implantation all patients underwent regular post operative surveillance, including CDUS and CT scans of the aorta within 7 days of surgery (Fig. 1). After discharge, all patients a CDUS scan at 1 month and then a CDUS scan, and a CT scan, at 6 months, 12 months and annually thereafter provided there was no documented endoleak on either CDUS or CT. Patients who missed scheduled appointments were contacted directly by phone and asked to reattend.

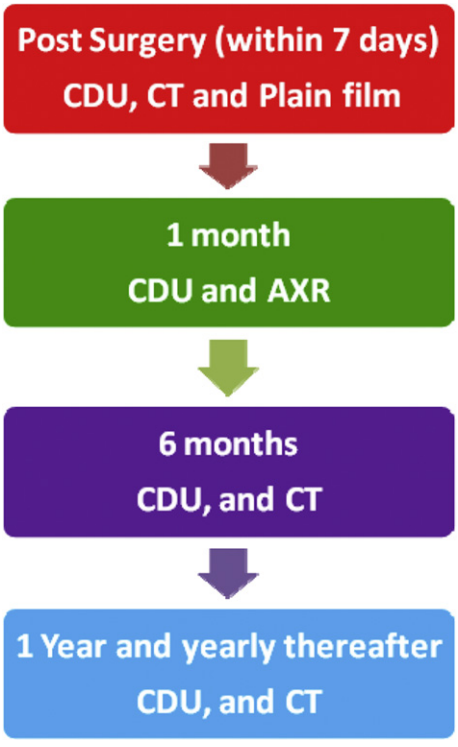

Figure 1. Postoperative surveillance protocol.

A total of 715 scans were performed on the 145 patients, 426 (59.6%) CDUS and 289 (40.4%) CTs. A mean (±SD) of 2.9 (±1.9), CDUS scans and 1.9 ((±1.5) CT scans were performed per patient. Of the total 715 tests performed there were 484 (67.9%) scans available for comparison in 114 (78.6%) of the 145 patients reviewed. The CDUS and CT scans of the remaining 31 (21.4%) patients were not compared due to inconsistent timing of imaging modalities (scans performed greater than 90 days apart were excluded), failure to attend and CT being contra-indicated due to i.v. contrast allergy.

Of the 426 CDUS scans carried out 26 (6.1%) scans were reported as limited, due to the presence of excess bowel gas and body habitus curtailing the determination of residual sac size and endoleak detection. The maximum residual aneurysm size was documented on the remaining 400 (93.9%) CDUS scans. Of the 289 CT's performed 107 (37%) did not have the maximum residual aneurysm sac size documented in the report. The maximum residual aneurysm size was documented on the remaining 182 (63%) of CT scan reports.

Colour duplex ultrasound scanning

All patients were fasted for at least 6 h and scanned in the supine position in a darkened temperature controlled room according to a standard clinical measurement protocol. All scans were performed early in the day to minimise the effect of bowel gas by the same Accredited Vascular Technologist (CG) using a Siemens Sequoia 512 Ultrasound system and later in the study a Siemens S200 Ultrasound system (Siemens AG, Erlangen, Germany). The same 6 mHz curvilinear broadband transducer (range 4 mHz–6 mHz) was used to capture all greyscale and Colour Doppler images. In all cases the technologist was blind to the CT results. Any examination that did not achieve complete visualisation of the entire aneurysm sac was considered limited. Contrast was not used in any patient.

All CDUS began with visualisation of the aorta immediately inferior to the diaphragm. The residual aneurysm was imaged in B-mode in both transverse and longitudinal planes from diaphragm to iliac bifurcation. Multiple measurements were obtained of the residual aneurysm sac in the transverse plane (Fig. 2a). The maximum measurements of the residual aneurysm sac were recorded and compared to the last scan report to ensure that there was no significant increase in sac size. Careful note was made in B-mode of the stent walls to ensure that there was no evidence of obvious defects or kinking of the metal exoskeleton. The iliac arteries were imaged in B-mode throughout their entire length. Multiple transverse and antero-posterior (AP) measurements were obtained (Fig. 2b) and the maximum of the two measurements was recorded for follow up purposes.

The stent and residual aneurysm sac were then assessed using colour flow and spectral Doppler to rule out the presence of an endoleak. This required the use of very sensitive colour flow scale settings to determine the presence of low velocity leaks which may have been present within the residual aneurysm sac (Fig. 2c). The stent was then reassessed in both transverse and longitudinal planes from diaphragm and to iliac bifurcation. Proximal and distal sealing zones were assessed to ensure that there was no evidence of high jet flow indicating a Type 1 endoleak or low velocity flow within the old aneurysm sac demonstrating forward and reversed flow indicating the presence of a Type 2 endoleak. Blood flow