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## ORIGINAL ARTICLE

## Emergency ultrasound of the abdominal aorta by UK emergency physicians: a prospective cohort study

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**Objective:** To establish whether UK emergency physicians could reliably perform focused ultrasound of the abdominal aorta in patients with suspected abdominal aortic aneurysm (AAA).

**Methods:** A prospective cohort study was conducted in the emergency department of a tertiary level UK teaching hospital. All patients who underwent an abdominal aortic ultrasound by an emergency physician during a 12 month period from January to December 2005 were included. The principle outcomes were presence of an AAA (external wall diameter >3 cm) or death from ruptured AAA. Outcome data were obtained from paper and electronic patient records and primary care telephone follow up.

**Results:** 120 focused ultrasound scans looking for AAA were performed by 19 different UK emergency physicians of various grades. Of the 120 scans, 26 (22%) were positive for an AAA, of which 17 cases represented a new diagnosis. Ruptured aneurysms represented 46% (12/26) of all positive scans, of which four patients underwent emergency repair. In the remaining 14 patients the AAA was an incidental finding that was not the reason for their presentation to the emergency department. Emergency ultrasound had a sensitivity of 96.3% (95% confidence interval (CI) 81.0% to 99.9%); a specificity of 100% (95% CI 91.8% to 100%); a negative predictive value of 98.6% (95% CI 88.0% to 99.9%); and positive predictive value of 100% (95% CI 86.8% to 100%) for the detection of AAA.

**Conclusion:** Emergency ultrasound scanning by UK emergency physicians has high sensitivity and specificity for identifying AAA, consistent with international experience.

The use of ultrasound by emergency physicians is becoming increasingly popular in the UK. The immediacy and availability of bedside ultrasound in the emergency department means that critical management decisions can be made earlier. One of the key roles identified internationally for emergency physician performed ultrasound is early identification of abdominal aortic aneurysms (AAA). Clinical assessment of the abdominal aorta for AAA has shown to be unreliable.<sup>1</sup> Internationally, studies have demonstrated that emergency physicians can accurately perform aortic ultrasound scans with relatively little training.<sup>2–5</sup>

The current evidence for the diagnostic ability of emergency physician ultrasound for detection of AAA is based on a number of international small cohort studies.<sup>2–5</sup> These series report high sensitivities (94–100%) and specificities (98–100%), but the prevalence of aortic aneurysm in these series varies widely. These studies are compromised because they are conducted on selected patients, and were all conducted abroad where ultrasound training differs. We aimed to establish whether UK emergency physicians could reliably perform focused ultrasound of the abdominal aorta in patients with suspected AAA.

## METHODS

A prospective cohort study was conducted in the emergency department of a tertiary level UK teaching hospital. Emergency ultrasound for the detection of AAA, undertaken by emergency physicians, was introduced within a tight clinical governance framework.

Emergency physicians received standardised training, before performing ultrasound scanning for possible AAA. The training consisted of a 1 day course covering both theory and practical skills, combined with a structured training programme. Individuals were only able to undertake unsupervised scans once they had completed a competency based assessment. Many of the scans undertaken were by an emergency physician

training in emergency ultrasound and were supervised by a more experienced practitioner. The use of, and training for, emergency ultrasound was in accordance with the 2005 Royal College of Radiologists published training framework for the training and use of ultrasound by non-radiologists.<sup>6</sup>

All patients who underwent an abdominal aortic ultrasound by an emergency physician during a 12 month period from January to December 2005 were included. Patients eligible for emergency aortic ultrasound scan were adults presenting with back pain, abdominal pain or any other suspicion for the presence of an AAA. All scans were undertaken using a Toshiba Nemio machine. Standard transverse (fig 1) and longitudinal views and measurements were obtained of the abdominal aorta. A diameter >3 cm was considered aneurysmal. Hard copies (transverse and longitudinal views) were obtained and a single line report written in the patient record as to the presence of an AAA or not. All scans were approved by a level 2 accredited practitioner.<sup>6</sup> All ultrasound scans were recorded in the departmental log. The principle outcomes were presence of an aortic aneurysm (external wall diameter >3 cm) or death



Figure 1 Transverse ultrasound image of abdominal aortic aneurysm.

**Table 1** Summary of patients with abdominal aortic aneurysms (AAAs) identified

Number of AAAs detected	26 (22%)
Number of newly identified AAAs	17
Number of ruptured AAAs	12
Number of patients undergoing emergency repair	4
Number of patients treated conservatively	8
Number of patients with incidental AAA	14

from ruptured AAA. Outcome data were obtained from paper and electronic patient records. The results of the scan undertaken by the emergency physician were compared with results of computed tomography, formal ultrasound, laparotomy, or post-mortem. If none of these were performed patients were followed up with case notes and, where required, by contacting their general practitioner.

Sensitivities, specificities, predictive values, and their 95% confidence intervals (CI) were calculated using STATA statistical software version 9. Ethical approval was not sought because the data were collected as part of an audit project.

## RESULTS

Over the 12 month period a total of 120 focused ultrasound scans looking for AAA were performed by 19 different UK emergency physicians of various grades. This represented 119 patients, with one patient attending the department on two separate occasions. The age range of the patients was 32–100 years (mean age 73 years). The mean number of scans performed per emergency physician was 6 (range 1–25).

The follow up period ranged from 5–17 months. Of the 120 scans 26 (22%) were positive for an AAA. Of the negative scans at follow up 44 patients had undergone other imaging of their aortas. A total of 50 patients had no further imaging. A total of 70 patients either had a positive scan or an alternative assessment of their aortic calibre. These 70 patients were utilised for the further statistical analysis.

Of the 26 patients where an AAA was identified, in 17 cases this represented a new diagnosis. Ruptured aneurysms represented 46% (12/26) of all positive scans, of which four patients underwent emergency repair. In the remaining 14 patients the AAA was an incidental finding that was not the reason for their presentation to the emergency department. Results for patients where AAAs were identified are summarised in table 1.

For the 44 patients where the emergency physician did not identify an AAA and whom underwent further imaging, one patient was identified as having an AAA. In this case, a 4.3 cm AAA was detected at 14 months follow up. No other AAAs were detected. The results for the patients who underwent further imaging are summarised in table 2.

Table 3 summarises the sensitivity, specificity, negative and positive predictive values for the detection of AAA with ultrasound by UK emergency physicians in all patients who underwent follow up.

In the 50 patients who did not undergo further imaging of their aorta none had died from a ruptured AAA at follow up.

**Table 2** Summary of ultrasound scans compared to alternative assessment of the aorta

	AAA	No AAA	Totals
Positive ultrasound by emergency physician	26	0	26
Negative ultrasound by emergency physician	1	43	44
Totals	27	43	70

AAA, abdominal aortic aneurysm.

**Table 3** Sensitivity, specificity, negative and positive predictive values of emergency ultrasound for the detection of abdominal aortic aneurysm by UK emergency physicians

Sensitivity	96.3% (95% CI 81.0% to 99.9%)
Specificity	100% (95% CI 91.8% to 100%)
Negative predictive value	98.6% (95% CI 88.0% to 99.9%)
Positive predictive value	100% (95% CI 86.8% to 100%)

## DISCUSSION

We have shown that emergency ultrasound scanning by UK emergency physicians has high sensitivity and specificity for identifying AAA, consistent with international experience. The training required to achieve this is relatively simple and short.

The benefits of timely identification of an AAA where it is leaking are obvious.<sup>7</sup> Only four of the 14 patients where a ruptured AAA was identified underwent surgical repair. The remaining 10 patients represent a group where it was felt that surgical or endovascular repair of the aorta was futile. A number of patients in this group were either moribund or peri-arrest on arrival in the emergency department. Identifying an AAA in this patient group has the benefit of sparing the patient futile attempts at resuscitation.

A number of patients were identified with an AAA which was not leaking (14 patients). Although the potential benefits of screening for AAAs in the UK has been outlined,<sup>8</sup> at present there is no established national screening programme. There is a potential benefit of early identification of AAAs to allow consideration of elective repair or surveillance.

This was a prospective observational study with several limitations. There is a possible selection bias, in that we cannot be sure that a number of scans were not recorded in the log. It is surprising that no indeterminate scans were entered into the log. At the time of the study, scans where body habitus or other factors made the scan indeterminate were disregarded, did not affect patient management and were not entered into the log. This was a convenience sample with no predetermined inclusion criteria; this may also have led to higher sensitivities and specificities than a study conducted on consecutive patients. Fifty patients that underwent emergency ultrasound did not have subsequent imaging to assess the size of the abdominal aorta. Clearly, it is possible that within this group some AAAs were missed by the emergency physicians. However, at follow up, no patient within this group had died from ruptured AAA. In the patients that were still alive at follow up, and who did not have an AAA identified by an emergency physician, it is extremely unlikely that a symptomatic AAA would have been the cause of their attendance.

## CONCLUSIONS

UK emergency physicians can accurately and usefully undertake emergency ultrasound scans to detect AAA with a sensitivity comparable to that obtained internationally. The benefits include timely identification of patients with a leaking AAA, allowing optimal appropriate management to be instituted, and also the identification of asymptomatic AAA to enable a planned approach to their future management.

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Competing interests: PA and RK have established an ultrasound course sponsored by Toshiba, profits from the course are used in an educational fund.

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