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Training Requirements for Point of Care Ultrasound in Acute Medicine

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Key Points
- Point of care ultrasound (POCUS) by an acute medicine trainee may be a useful tool in the investigation of certain groups of patients on an acute medical unit
- POCUS should not replace formal departmental ultrasound examination or cross-sectional imaging in cases where significant pathology is suspected
- A formal curriculum for training in 'Acute Medical' POCUS is required, with establishment of minimum requirements for acquisition of competence

Abstract

The aim of the study was to explore the ultrasound training requirements in acute medicine by comparing the ultrasound skill of an acute medicine trainee (AMT) with that of the radiology department following short ultrasound training.

Results

43 participants (34 males and 9 females). The mean age was 58 (range 20-93 years). Liver: AMT reported 15/17 as normal (Specificity 88%) and diagnosed ascites in 100% (NPV 93%). Gallbladder: There was 100% sensitivity and NPV for excluding gallstone. CBD: Sensitivity and specificity of 83 and 95% for dilated CBD (NPV 95%). Kidneys: AMT identified 100% of normal kidneys. Spleen: Splenomegaly diagnosed with 95% specifity and NPV.

Conclusion

The AMT achieved a high level of accuracy in diagnosing and excluding gallstone, dilated CBD, ascites and splenomegaly.

CBD = Common Bile Duct, NPV=Negative Predictive Value.

Keywords

Acute medicine, Ultrasound training, point of care.

Introduction

Ultrasound is a non-invasive, safe, relatively inexpensive and quick diagnostic tool that has many applications in a variety of areas of medicine.[1]

Within the National Health Service (NHS) ultrasound has traditionally been performed by a trained ultrasonographer or radiologist.[2] This is changing with ultrasound now being utilised by a number of non-radiology specialities, including emergency medicine,[3] intensive care medicine,[4] urology[5] and gynaecology and obstetrics,[6] as a bedside diagnostic or procedural tool. Due to the increased demand by these specialities for formal ultrasound training, the Royal College of Radiologists (RCR) in 2005 issued guidance on training of non-radiology specialties in ultrasound. Acute medicine was not included in this guidance since it was not a recognised speciality at that time.[2]

The primary aim of this study was to compare the accuracy of abdominal ultrasound performed at the bedside by an acute medicine trainee (AMT) with that of the radiology department (RAD). The secondary aims were to evaluate the role of ultrasound in the Acute Medicine Unit (AMU) and the length of training required to gain competency in Point of Care ultrasound (POCUS).

Methods

A prospective study was carried out on an AMU in a large university teaching hospital. Approval was obtained from the local ethics committee.

Patients were selected if the medical team, as part of the patients' initial management, had requested an abdominal ultrasound examination. Each participant then underwent an ultrasound by the AMT on AMU prior to their ultrasound by RAD. Nine consultant radiologists, two supervised trainee radiologists and five sonographers performed and reported the RAD ultrasound scans. Their range of experience was varied from 2 to 30 years of ultrasound practice.

The ultrasound reports by AMT and RAD were compared for individual findings. In addition, the ultrasound images for each examination were reviewed by two consultant radiologists, who were blinded to the reports, and classified these as being either of 'diagnostic value' or 'not of diagnostic value'.

The RAD used Toshiba ultrasound systems with 3-5 MHz transducers (Toshiba, Japan).

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	Liver	Gallbladder	CBD	Pancreas	Kidney	Spleen
Total Reported	37	29	30	22	65	29
Normal Reports by RAD	17	17	24	20	64	24
Normal reports by AMT	15	14	23	19	64	23
Specificity by AMT	88%	82%	96%	95%	100%	96%

Table 1: Percentage agreement of normal reports for all organs. CBD=Common Bile Duct.

The AMT used a portable Sonosite MicroMaxx (USA) ultrasound with 3-5 MHz transducer. Prior training in ultrasound had been under the supervision of a senior sonographer with attendance at a weekly three hour session in the ultrasound department. The AMT had enrolled as a part time student in a local Postgraduate Certificate in Medical Ultrasound (PGCMUS) university course. At the start of the study the AMT had observed 62 and performed 57 supervised ultrasound examinations.

In total the AMT had attended 60 hours of practical ultrasound sessions and 92 hours of university lectures prior to commencing the study.

Results

43 patients were recruited to the study. The mean age was 58 with a range of 20-93 years (34 males and 9 females). Three patients were excluded as they did not undergo a subsequent ultrasound by the RAD. All the images (100%) for each ultrasound examination by the AMT and RAD were classified as being of diagnostic value.

Direct comparison between the different solid organs was as follows: liver 37, gallbladder (GB) 29, common bile duct 30 (CBD), pancreas 22, kidneys 65 (right kidney 33, left kidney 32) and spleen 29.

For liver the RAD reported 17 as normal and 20 as abnormal. The AMT identified 15 of the normal reports (Specificity 88%) (Table 1). There was a substantial agreement[7] for ascites (kappa 0.841, 95% CI 0.63-1) with specificity of 100%, NPV (Negative Predictive Value) of 93% and sensitivity of 77%. The agreement was at moderate level for fatty liver and cirrhosis with NPV of 88% and 93% respectively but with low sensitivity and specificity for both pathologies. The AMT was able to identify the only case of liver metastasis although failed to recognise two cases of simple liver cysts and one case of benign haemangioma (Table 2).

RAD reported 17 normal and 12 abnormal gallbladders. The AMT recognised 82% (n=14) of those which were normal. There was high sensitivity (100%) and specificity (94%) for detection of gallstones with NPV of 100%. The NPV was 93% and 96% for sludge and thick wall. For dilated CBD the AMT showed a specificity of 95% and sensitivity of 83% with Kappa value of 0.79 and NPV of 95% (Table 3).

For hydronephrosis, kidney mass and kidney stone there was 100% specificity and NPV but sensitivity was

	Liver (n=37)					
	Fatty Liver	Ascites	Cirrhosis	Cyst	Mets	Haemangioma
True positive	6	7	3	0	1	0
False positive	5	0	2	1	0	0
True negative	23	28	30	34	36	36
False negative	3	2	2	2	0	1
Kappa(95% CI)	0.454(0.135-0.773)	0.841(0.63-1)	0.537(0.138-0.937)	-0.037(-0.09-0.015)	1(1-1)	1(1-1)
Sensitivity	66%	77%	60%	0%	100%	0%
Specificity	82%	100%	93%	97%	100%	100%
PPV	54%	100%	60%	N/A	100%	N/A
NPV	88%	93%	93%	94%	100%	97%

Table 2: Shows AMT report for liver pathologies, Mets=Metastasis, CI=Confidence Interval, PPV=Positive Predictive Value, NPV=Negative Predictive Value.

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	Gallbladder(n=29)			CBD(n=30)
	Gallstone	Sludge	Thick wall	Dilated CBD
True positive	10	0	0	5
False positive	1	0	3	1
True Negative	18	27	25	23
False negative	0	2	1	1
Kappa(95% CI)	0.925(0.782-1)	0	-0.055(-0.138-0.029)	0.792(0.515-1)
Sensitivity	100%	0%	0%	83%
Specificity	94%	100%	89%	95%
PPV	90%	N/A	N/A	83%
NPV	100%	93%	96%	95%

Table 3: Shows AMT report for gallbladder and CBD, CI=Confidence interval, PPV=Positive Predictive Value, NPV=Negative Predictive Value.

not calculated as none of these pathologies were present in these patients (Table 4).

Pancreas was reported least frequently (n=22). The only case of pancreatic mass was correctly identified by the AMT, although one case of chronic pancreatitis was not identified by the AMT (Table 4).

Of the 29 reported spleens, the kappa value was 0.758 (95% CI: 0.44-1) for splenomegaly with NPV and specificity of 95 % and sensitivity of 80% (Table 4).

Discussion

Ultrasound is being utilised by non-radiology specialities to answer specific clinical questions at the point of care, rather than to replace the need for formal departmental imaging. This study has explored the accuracy of bedside ultrasound on AMU and the extent of training required for an acute medicine trainee compared with the formal ultrasound training. POCUS was of particular use in the diagnosis of gallstones, dilated CBD, ascites and

	Kidneys(n=65)		**Pancreas(n=22)**			**Spleen(n=29)**	
	Hydronephrosis	**Kidney stone**	**Thin cortex**	**Kidney Mass**	**Pancreatic Mass**	**Chronic pancreatitis**	**Splenomegaly (>12 cms)**
True positive	0	0	1	0	1	1	4
False positive	0	0	0	0	0	1	1
True negative	65	65	64	65	21	19	23
False negative	0	0	0	0	0	1	1
Kappa(95% CI)	N/A	N/A	1	N/A	1	0.45(-0.191-1)	0.758(0.44-1)
Sensitivity	N/A	N/A	100%	N/A	100%	50%	80%
Specificity	100%	100%	100%	100%	100%	95%	95%
PPV	N/A	N/A	100%	N/A	100%	50%	80%
NPV	100%	100%	100%	100%	100%	95%	95%

Table 4: Shows AMT report for each kidneys, pancreas and spleen pathologies, CI=Confidence interval, PPV=Positive Predictive Value, NPV=Negative Predictive Value.

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splenomegaly. However, the study also showed that certain clinical scenarios are beyond the scope of POCUS such as pancreatic and complex liver pathologies. The role for pancreatic ultrasonography on AMU is not clear as trans-abdominal ultrasound is less sensitive than other imaging modalities (CT or MRI) for pancreatic pathologies such as acute pancreatitis.[8]

The high sensitivity, specificity and NPV for the diagnosis of gallstone is comparable to previous studies.[9 10] The sensitivity and specificity were higher for dilated CBD (83% and 95%) compared with 60% and 92% in a previous study of 129 patients.[9] This is of particular value for the diagnosis and management of jaundiced patients admitted to AMU since the finding of gallstones on ultrasound will help to guide subsequent clinical management.[11] The fact that two out of seven cases of ascites and one of six cases of dilated common bile duct were missed indicates that 'normal' POCUS cannot replace the need for formal departmental ultrasound or cross-sectional imaging in the management of jaundiced patients on AMU. However, an abnormal POCUS may help to guide management in the acute setting and out-of-hours. The finding of ascites may help to guide paracentesis in cases of clinical doubt, while the presence of dilated bile ducts in a septic patient with jaundice might help inform the choice of antibiotic therapy.

None of the patients in this study group were found to have hydronephrosis, so it is not possible to determine from these results whether the AMT would have been able to identify this condition. Acute renal failure is a common indication for urgent ultrasound, so this would be an important area for further study. The absence of false positive examinations of the kidneys in this group is worthy of note.

Splenomegaly (>12 cms)[12] would have been missed in one patient if departmental ultrasound had not been undertaken, although the other 4 cases were correctly diagnosed. Splenomagaly may be suspected clinically[13] and ultrasound may be useful for confirmation of this suspicion. Although this may be helpful in the diagnosis of certain infections, haematological malignancies and portal hypertension[14] it is unlikely that this would change management in the out of hours setting.

The study has given some indication as to the required duration of ultrasound training for an acute medicine trainee to achieve competency. The AMT reached this level of competency by observing 62 and performing 57 ultrasound examinations under supervision. The RCR recommends a minimum of 50 ultrasound examinations for focused emergency ultrasound and 250 examinations for gastrointestinal and urology ultrasound to reach level one of training.[2] The American College of Emergency Physician(AECP) recommends a minimum of 150 ultrasound examinations to achieve general emergency ultrasound competency.[15] The level of ultrasound training required for acute medicine is probably closer to the requirements for emergency medicine. However there are some aspects of ultrasound training which are specific to acute medicine which therefore warrant special attention and consideration of a different curriculum. It is recognised that the rate of acquisition of ultrasound skills varies considerably between operators so that assessment of competency is more relevant than number of examinations performed.

References

1. The British Medical Ultrasound Society (BMUS). Statement on the safe use, and potential hazards of diagnostic ultrasound [Online].[2000] [cited 2009: Sep 10th]; available from: ULR: http://www.bmus.org/policies-guides/pg-safety04.asp.
2. Royal College of Radiologists. Ultrasound Training Recommendations for Medical and Surgical Specialties. [Online].[2004] [cited 2009: Sep 12th]; available from: ULR: http://www.rcr.ac.uk/docs/radiology/pdf/ultrasound.pdf
3. Dogra V. Emergency ultrasound. *Radiologic Clinics of North America* 2004; **42(2)**: xi–xi.
4. Kendall.MD.FACEP; JL, Stephen R. Hoffenberg M, FACEP; R. Stephen Smith M, RDMS,FACS. History of emergency and critical care ultrasound: The evolution of a new imaging paradigm. *Critical Care Medicine* 2007; **35(5)**: 126–30.
5. Tim J. Dudderidge OJK. Urology Led Ultrasound services; Time to Focus. *BJU International* 2007; **100(5)**: 981–83.
6. Royal College of Obstetricians and Gynaecologists. Diploma in Advanced Obstetric Ultrasound [Online][2009] [cited 2009: Sep 12th]; available from ULR: http://www.rcog.org.uk/education-and-exams/ examinations/ results.
7. Landis, J.R. and Koch, G.G. The measurment of observer agreement for categorical data. *Biometrics* 1977; **33**: 159–74.
8. Horowitz M, Grendell J. The diagnosis of acute pancreatitis at a large, urban university hospital. *Gastroenterology* 1995; **108(4, Supplement 1)**: A361–A61.
9. Miller AH, Pepe PE, Brockman CR, Delaney KA. ED ultrasound in hepatobiliary disease. *Journal of Emergency Medicine* 2006; **30(1)**: 69–74.
10. Larson JL, Fox JC, Scruggs W, Barajas G. An Analysis of Emergency Department Bedside Ultrasound in the Diagnosis of Cholelithiasis. *Annals of Emergency Medicine* 2008; **51(4)**: 545–45.
11. Gilmore I, Garvey CJ. Investigation of jaundice. *Medicine* 2007; **35(1)**: 13–16.
12. R G Hosey, C G Malttacola, V Kriss, *et al*. Ultrasound assessment of spleen size in collegiate athletes. *Br J Sports Med* 2006; **40**: 251–54.
13. John F. Munro,Ian W. Campbell editors:.M J Ford,AD Cumming, Macleod's clinical Examination, ed. 10,2000,Churchill Livingstone,p 165.
14. Pozo AL, Godfrey EM, Bowles KM. Splenomegaly: Investigation, diagnosis and management. *Blood Reviews* 2009; **23(3)**: 105–11.
15. 2008 American College of Emergency Physician Policy Statement. *Annals of Emergency Medicine* 2009; **53(4)**: 550–70.

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