

Bedside ultrasonography at emergency department - "New kids on the block" and "Echoes of future"

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Bedside ultrasonography is increasingly being performed by emergency physician in Hong Kong. Nearly every Accident and Emergency department in Hong Kong is equipped with an ultrasound machine. Ultrasonographic examination is a powerful clinical tool as it is non-invasive, safe, reliable and inexpensive. It has a high diagnostic accuracy in an experienced hand. The practice of performing ultrasonography by local emergency physician is just at the early stage. This article aims to review the characteristic, scope and limitation of bedside ultrasonography at emergency department setting. The issue of training and certification, cost effectiveness and medico-legal implication of this tool is also discussed. The goal of bedside ultrasonography program in Hong Kong is to provide round the clock ultrasound examination and interpretation by well-trained and qualified emergency physician. Establishment of the scope of emergency ultrasound examination and implementation of quality improvement audit on the services is necessary. Training and research in the area of ultrasound imaging should be encouraged. With the maturation of our specialty and the effort of our local emergency physicians, bedside emergency ultrasonography will soon emerge as the "Echoes of the future". (*Hong Kong j.emerg.med.* 2000;7:157-161)

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Introduction

Diagnostic and therapeutic ultrasonography has been used extensively by radiologists and other specialists for example, obstetricians over the past decades to aid clinical management. It is a useful tool since it is noninvasive, fast and reliable in an experienced hand. Bedside ultrasonography has been introduced in the emergency departments in Europe and USA in the past ten years. Their experience shows that ultrasonography is a fast, efficient and safe method to improve the diagnostic ability of emergency physician, hence better patient care.¹⁻⁴ In Hong Kong we are still at the "infancy" stage and more experience and evaluation would benefit our patients further.

The characteristic of emergency ultrasonography

The application of ultrasonography by emergency physician is a little different from the traditional radiologist at their suite. The emergency physicians perform "limited", "highly focused" and "fast" examination on selected patients and it is best thought of as an application of clinical tools like slit-lamp, proctoscopy except that more training is needed for ultrasonography.

The emergency examination is highly focused

This is the most important difference between the traditional ultrasonography performed by the radiologist and emergency physician. In general the emergency physicians are not interested in the fine details of the sonic image and complete examination. We perform ultrasonography in order to answer single specific clinical relevant questions that are usually not answered by other means in the emergency setting⁵ (e.g., does this patient with blunt

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abdominal trauma has haemoperitoneum that require urgent intervention and further evaluation? Is there pericardial effusion?).

The emergency examination is brief

Emergency physicians work in a busy environment and provide round the clock services. Therefore diagnostic evaluation must not be lengthy, particularly in the ill patients. Emergency ultrasound should be completed in a few minutes and available 24 hours a day, 7 days a week. Stable patient who need detailed ultrasound examination would be better performed by the radiologist specialist.⁵

The emergency examination is interactive

Emergency ultrasound should be viewed as an extension of your eyes and hands, scanning the patients will often reveal unexpected areas of tenderness or findings that merit further clinical examination.⁵ This differs significantly from the ultrasound technicians who follow the standard protocol in scanning.

The emergency examination may be repeated as clinical warranted

Ultrasonic image, like clinical findings, may change rapidly, especially in the critically ill patients in the emergency department. Repeat ultrasound examination is often indicated in a particular patient just like serial ECG in a patient with suspected acute coronary syndrome.⁵

The emergency examination emphasis only one finding

Emergency ultrasound scan hinges on the presence or absence of a single finding that will influence clinical decision made by emergency physicians. In fact, we do not perform as many ultrasound scan and as frequently as the radiologists. In order to maintain proficiency with diagnostic ultrasound we should focus on a limited number of critical ultrasound findings.⁵

Why should ultrasound be performed in the emergency departments?

There are a number of reasons for initiating an ultrasound program in emergency departments. The

most important reason is to improve the quality of care to our clients. In fact it should be part of the Continuous Quality Improvement (CQI). Bedside ultrasound scan improve the patient safety by increasing the security of our diagnosis, decreasing the time needed to arrange with the radiologist to perform an urgent scan and lessening the risk of sending unstable patient to the radiology suite.⁶⁻⁹ It also shortens the decision time for patient to be transferred to a trauma centre. The ultrasound machine is portable and ideal for the unstable patient at their bedsides. Extensive evidence has grown in the USA and Europe that emergency physicians are proficient in performing bedside ultrasound.^{1-3,10}

The use of ultrasound machine in the A&E department improves the patient flow. It results in lesser calls to the consultants, less dependence on the on-call radiology services and possibly result in less overcrowding which benefit not only the one being scan but every A&E attendees.⁴ Both the staff' and patients' satisfaction will probably improve. Emergency ultrasound provide a sense of empowerment and less reliant on the other specialist for patient care. It also improves the interaction with other departments and enhance our professional level. It provides opportunities for professional growth and upkeep our knowledge on current practices. After the implementation of ultrasound services in Emergency departments, stress on ancillary departments may decrease. There should be a reduction in the cost of patient care.⁴ It also serves as a teaching and research tool.

Scope of ultrasound services in A&E department

The application of emergency bedside ultrasound should fulfil the following criteria:^{11,12}

1. A condition in which ultrasonography is accepted as a primary diagnostic modality.
2. A condition in which an ultrasound examination would decrease significantly costs and time associated with patient evaluation.
3. Life threatening or serious medical condition.
4. A situation in which ultrasonography serves as an adjunct for a commonly performed

procedure.

5. For those who perform and/or interpret diagnostic ultrasound examination, patients essential background material must be obtained.

Heller and Jehle divided the indication for ultrasound in the Emergency Department into the following categories:¹³

A. Immediate/Life threatening indication

1. Evaluation of possible internal haemorrhage in patient with major trauma

Time is golden in trauma management. Early detection of internal haemorrhage and rapid surgical intervention is the key for haemorrhage control. Failure to detect intraabdominal injury may result in significant morbidity and mortality. Physical examination has been unreliable in the setting of concomitant head injury, spinal trauma, drug use or other distracting injuries. Extensive research had been done on the role of bedside ultrasound scan in blunt abdominal trauma and proven to be a sound screening diagnostic aid in initial trauma management.^{6,8,9,14} Ultrasound have replaced DPL in some European centres, trauma centres in both Canada and United States.⁹ Bedside ultrasound skill will probably be incorporated into the next edition of ATLS course.

The main goal of ultrasound examination in blunt abdominal trauma is the detection of haemoperitoneum. A FAST examination had been proposed and can be completed within 5 minutes.^{6,9,12} It is noninvasive and could be performed in unstable trauma patients in Emergency department. Six areas are evaluated with ultrasonography for fluid collection during the FAST examination.

- a. Right upper quadrant/Morrison's pouch
- b. Left upper quadrant/splenorenal recess
- c. Subxiphoid area (pericardial fluid)
- d. Right paracolic gutter
- e. Left paracolic gutter
- f. Pelvis (pouch of Douglas/retrovesical pouch)

The reported sensitivity varies from 80% to 100%

while specificity ranges from 88% to 100% in adult patients with blunt abdominal trauma.⁹ Similar statistic has been obtained in the paediatric patients⁹ and it is also recommended for pregnant trauma patient. The trauma surgeon should base his decision on individual patient's clinical condition and be aware of the limitation of ultrasound scan, and the availability of other diagnostic modality, for example CT scan, DPL. There is still insufficient data to support the use of bedside ultrasound in penetrating abdominal and chest trauma in the Emergency department setting.⁷

2. *Documentation of foetal life in a pregnant trauma patient or maternal instability*
3. *Establishment of the presence or absence of an intrauterine pregnancy in a symptomatic patient.*
4. *The presence of pericardial effusion and tamponade*
5. *Possible and symptomatic aortic aneurysm*
6. *Diagnosis of electromechanical dissociation*

B. Urgent indication

Urgent ultrasound examination could be performed by an appropriately trained emergency physician or by an imaging specialist, depending on the availability of the services and the local protocol.^{4,5} If emergency physician is providing the services, follow up and review of ultrasound finding must be provided. Example of this category is listed but not limited to the following: *1. establishment of the presence or absence of an intrauterine pregnancy in a haemodynamically stable patient; 2. evaluation of gallbladder disease; 3. evaluation of obstructive uropathy, renal colic; 4. deep vein thrombosis; 5. arterial vascular disease; 6. testicular torsion; 7. echocardiogram in patient with acute cardiac ischaemia, acute pulmonary oedema, pulmonary embolism and hypotension of unknown cause; 8. pancreatitis; 9. jaundice; 10. appendicitis and etc.*^{4,5,14}

C. Procedural indication¹⁵

1. *Vascular access*
2. *Suprapubic urinary bladder aspiration, estimation of residual urine in bladder*
3. *Foreign bodies localisation and removal*
4. *Pericardiocentesis*
5. *Thoracentesis*
6. *Paracentesis*

Limitations of bedside ultrasound in emergency department

Although bedside ultrasound has the advantage of speed, repeatability and safety. Emergency physician should be aware of the limitations of this modality.

Equipment capabilities

The ultrasound machine used in the A&E department may not be as sophisticated as the one used by other specialists, for example lack of Doppler, colour flow capabilities and transoesophageal probe. Other factors, such as limited transducer frequency, lower power output, greater artifact formation will limit the accuracy of the tool.⁵ Hopefully in the near future, the capability, price and quality of the machine will improve.

Bedside ultrasound is not comprehensive

Emergency physician aims at focused ultrasound examination. Some diagnosis will certainly be missed without a formal comprehensive examination.⁵ On the other hand, truly incidental but potentially important finding, for example a metastatic tumour may go undetected. However, this is not our main concern as we aim at specific examination to answer critical questions that affect our immediately clinical decision. Comprehensive examination should be left to the other specialists.

Ultrasound examination is operator dependent

Emergency physicians use ultrasound scan as an adjunct to our clinical practice. We do not receive any formal ultrasound training and our expertise in terms of breath and depth of exposure and experience will be less than an ultrasound specialist. However we have the advantage of being able to integrate the clinical information into the scan just like the interpretation of the plain X-ray film. As we gain more experience in performing ultrasound, proficiency will definitely improve.

Certification and training issue for emergency ultrasonography

A lot of debate on whether emergency physicians are qualified to provide ultrasound services to our clients.^{1,2,12,15} What are the criteria of training and

crediting the emergency ultrasonography. The Society for Academic Emergency Medicine Ultrasound Task Force recommends 40 hours of instruction in ultrasonography and total 150 ultrasound examinations, and that more than 50% of these examinations should be performed for patients for whom it is clinically indicated.^{10,15} Whether we should adopt this criteria in Hong Kong will be the decision of the academic bodies. We need to set up committee to investigate what is the best training requirement for our trainee and liaise with other specialty for the future development of emergency ultrasound in Hong Kong.

Cost effectiveness issue

This is a complex issue and best thought of in terms of opportunity costs - that is, what else could be done with this resources, for example whether the money spent on the ultrasound machine in Emergency department could better spend on other services. The potential saving of radiology charges of emergency physician performed ultrasound had been examined in the United States and demonstrated a reduction in the case management cost.^{4,14} However the situation in Hong Kong is quite different with the radiology departments operating on a bulk service contract rather than individual basis. Further survey and study is needed to investigate whether bedside ultrasound by emergency physician is cost efficient. It is indeed an art to spend the least money and provide the best patient care services.

Medicolegal issue

There is still no comprehensive study on the number of compensation claim suits against emergency physician who performed ultrasound at the emergency department.¹⁴ Emergency physicians need to be well prepared to avoid being sued by patients and other parties. Good documentation of the indications and findings of ultrasound examination is essential. Auditing and continuous quality improvement programs need to be implemented in order to review the common faults and misdiagnosis so that better guidelines could be developed.

The goal of A&E department ultrasound program

The goal of the services should include the followings:^{4,11,12}

1. Providing indicated ultrasound examination, interpretation and clinical correlation on the immediate basis, and is available at all times, for emergency patients with life threatening conditions or selected urgent conditions and for certain procedural uses where morbidity and mortality could be reduced.
2. Emergency physicians providing emergency ultrasound services should possess appropriate training and hands-on experience to perform and interpret limited bedside ultrasound imaging.
3. Establishing the scope of emergency ultrasound studies and provide proper documentation of the indications and results of these studies.
4. Encourage research in the area of ultrasound imaging and other known or evolving bedside imaging techniques and modalities.
5. Establish monitoring and a quality improvement program for Emergency ultrasound studies.
6. Training in performing and interpreting ultrasound imaging studies should be included in the emergency medicine training curriculum.

Conclusion

Emergency ultrasonography is portable, fast, noninvasive, safe and inexpensive. It provides a wealth of anatomic and functional information in a variety of conditions. Widespread use of limited bedside ultrasonography by emergency physicians will improve diagnostic accuracy and efficiency, increase the quality of care and probably a cost-effective technique for the practice of emergency medicine.

In Hong Kong, the bedside ultrasound imaging technique in the Accident and Emergency departments is just the "New kids on the block". Survey and discussion concerning the scope, training, certification and cost effectiveness of this

challenging modality need to be carried out. Hopefully with the maturation of our specialty and continual effort of our local emergency physicians, bedside emergency ultrasound will be emerge as the "Echoes of the future".

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