

Emergency Ultrasound Guidelines 2010
Hong Kong College of Emergency Medicine

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SECTION 1: INTRODUCTION

The clinical application of ultrasound (USG) by Emergency Physicians (EPs) has greatly expanded over the past decade. In many countries, liked USA, Australia, United Kingdom and Canada, there are well defined training pathway and credentialing system in emergency ultrasound (EM USG) as well as the scope of practice for this fast expending field.

In Hong Kong, specialties liked Cardiology and Obstetrics & Gynecology, which adopt ultrasound in their daily practice, have been laying down the training requirement of the ultrasound applications for their trainees. Other specialties liked Intensive Care Medicine and Rheumatology have started to organize their own courses and incorporate this noninvasive bedside investigation into their practice.

All Emergency Departments (EDs) in Hong Kong are equipped with USG machines and most Emergency Medicine (EM) practitioners have adopted this non-invasive modality to assist evaluation of acute patients in a timely manner. Much effort has been made by various EDs to facilitate the integration of emergency ultrasound into clinical practice. Facility-wise, all EDs possess at least one USG machine. Some machines are with Doppler capability, endocavity probe, high frequency probe for musculoskeletal examination and even specially designed probe for procedural application. Furthermore, COC (A&E) and some of other centers have organized many USG courses for EM practitioners locally. Some enthusiastic EPs have gone overseas to acquire more advanced techniques. Some centers have developed credentialing and audit mechanism in USG applications for their staff.

Yet, experience of many new residents of emergency departments on medical ultrasound is rather minimal, if not negligible. To disseminate and expand this clinical modality, systematic training should be provided and utilization of emergency ultrasound encouraged. Alongside with this promulgation, the quality of emergency

ultrasound and clinical standards should be upheld. The Hong Kong College of Emergency Medicine (HKCEM) recommends a formal training pathway to every EM practitioner.

This document will cover the following five areas: the scope of practice of emergency ultrasound as currently used in Hong Kong, training pathway, quality and documentation issues, and future of emergency ultrasound.

SECTION 2: SCOPE OF PRACTICE

The emergency ultrasound examination performed by emergency physicians is different from those performed by some other specialties. It is performed at the bedside simultaneously with the clinical examination, or resuscitation. It serves as an extension of the physical examination to provide complementary anatomic and functional information. The bedside examination performed by emergency physicians attempts to answer a single, focused clinical question in a timely manner.

Basic Emergency Ultrasound - Primary applications in emergency ultrasound

I. Trauma ultrasound

The use of ultrasound for traumatic torso injury is currently described as Focused Assessment by Sonography for Trauma (FAST). In Hong Kong, the use of ultrasound to detect traumatic haemoperitoneum was first reported in 1995³. Since then, trauma ultrasound has mostly eliminated the initial use of diagnostic peritoneal lavage at most EDs.

Indications for trauma ultrasound include blunt or penetrating trauma to the torso where there is suspicion of intraperitoneal haemorrhage and pericardial tamponade. The minimum 4-views trauma ultrasound should include:

- RUQ - the Morison's pouch
- LUQ - the perisplenic spaces
- Subcostal - the pericardium
- Pelvis - retrovesical or retrouterine fluid

Limitations of trauma ultrasound include the inability to identify injury to specific viscera, bowel, or retroperitoneal structures. Additionally pathologic air or patient anatomy may make the examination technically difficult, and require alternative imaging modalities.

II. Emergency ultrasound in pregnancy

With the need to diagnose or exclude ectopic pregnancy in the symptomatic first-trimester patient with bleeding or pain, pelvic ultrasound has become a natural application in emergency medicine.

The pelvic ultrasound is typically performed after a pelvic examination by transabdominal ultrasound or endovaginal ultrasound. An additional right upper quadrant view can be used to detect large amounts of intraperitoneal fluid suggestive of ruptured ectopic pregnancy. The real-time examination typically views all segments of the uterus and contents for a gestational sac with an appropriate decidual mantle and a yolk sac or an appropriate size fetal pole to confirm intrauterine pregnancy. The cul-de-sac and adnexae should be visualized for masses or fluid collections. Limitations include non-visualization of the early gestation in the first 4 to 5 weeks of pregnancy, lack of visualization of ectopic pregnancies, and sonographic intrauterine abnormalities such as fibroids or intrauterine devices that may alter the acoustic characteristics of the pelvis.

III. Emergency echocardiography

Signs and symptoms for cardiac tamponade, such as Beck's triad, are often nonspecific in critical patients. There is no alternative bedside test to emergency echocardiography for pericardial effusion.

The basic view performed by EPs for pericardial effusion is the subcostal view supplemented by the apical 4 chambers, parasternal long and short views in case of difficulty. Echocardiographic signs of tamponade physiology in the presence of pericardial effusion include late diastolic right atrial collapse, early diastolic right ventricular collapse, and non-collapsible inferior vena cava. Limitations of the technique falls upon the inability of visualization owing to patient body habitus, pathologic air collections around the chest.

IV. Abdominal aortic aneurysm

Detection of abdominal aortic aneurysm remains as a challenge of high priority for EPs in patients presented with syncope, shock, hypotension, abdominal pain, abdominal mass, flank pain, or back pain. For unstable patients, the presence of an aneurysm on ultrasound will expedite the critical clinical decision. The detection of an aneurysm in haemodynamically stable patients can allow appropriate monitoring, consultation, and, if appropriate, follow-up. Early detection of aneurysm can reduce the potential mortality rate associated with rupture and emergency operation. The abdominal aorta is visualized in 2 planes (transverse and sagittal) continuously from

diaphragm to bifurcation. The inferior vena cava (IVC) and spine should be noted to support correct identification of the aorta, and the size of the aorta should be measured in both planes. Limitations include presence of bowel gas or large body habitus making the ultrasound examination technically difficult. Ultrasound also fails to reliably demonstrate dissection or rupture into the retroperitoneum.

V. Hepatobiliary ultrasound

One of the earliest applications of diagnostic ultrasound in ED is to detect gallstone in patients with RUQ pain. The gallbladder is visualized to detect echogenic material that may produce shadowing, gallbladder wall diameter, and presence of fluid around the gallbladder. Pathology should be confirmed by 2 views. The sonographic Murphy's sign should be elicited. With advanced training, the abnormal size of the common bile duct and the presence of liver masses can be noted. Limitations are associated with contracted gallbladder, non-visualization due to bowel gas, difficult imaging of common bile duct stones, isoechoic liver mass.

VI. Renal ultrasound

The symptoms of renal tract obstruction can be similar to those of musculoskeletal back pain or bowel colic. Ultrasound images the kidneys well and helps in assessing the degree of obstruction. Indications for ultrasound of the renal tract include the detection of hydronephrosis manifested by costovertebral pain, flank pain, or abdominal pain with vomiting. Kidneys should be visualized from upper to lower pole in long and transverse planes for detection of hydronephrosis and echogenicity suggestive of stones with or without shadowing. Both kidneys and the urinary bladder should be imaged. Limitations include inability to detect the cause of the obstruction or degree of renal function. Dehydration or early imaging may result in false-negative examinations while full bladder may result in false-positive examinations.

Advanced applications of Emergency Ultrasound

While the above 6 primary applications can be viewed as the core competency in basic level emergency ultrasound, advanced practice of bedside emergency ultrasound in certain scenarios can benefit the patients which include :

1. Ultrasound guided procedures, such as central vein catheterization and cavity fluid drainage.
2. More sophisticated Echocardiography in critically ill patients, for example, those who are suffering from hypotension, dyspnea or chest pain.
3. Compression ultrasound plus or minus Doppler to rule out acute deep vein

thrombosis in those patients suffering from swollen limbs.

4. Musculoskeletal ultrasound in diagnosing acute soft tissues injury, joint effusion, foreign body management, detection of fracture and ultrasound guided fracture reduction

The above are just examples of the advanced practice of emergency ultrasound and with further research and training, continuous expansion and development in ultrasound application in emergency medicine is expected.

SECTION 3: TRAINING PATHWAY AND LEVEL OF PROFICIENCY

In order to ensure systematic training and quality assurance in emergency ultrasound, the training pathway and levels of proficiency are suggested as follows:

(1) Basic Emergency Ultrasound Trainee

After completion of the Basic Ultrasound Course organized by the ultrasound subcommittee of college or equivalent, a certificate of attendance would be granted. The basic ultrasound course attended should include all the primary applications mentioned in section 2.

It is recommended that, with the certificate of attendance the trainee can practice basic emergency ultrasound with the guidance of Basic EM USG Independent Practitioner (paragraph 2 of the section) of a training center.

It is strongly recommended that before the privilege of independent scanning is granted, certain number of supervised practice (Table 1) has to be attained with results of the scans verified. Each trainee should keep a logbook to document the patient identification, indication, ultrasound findings with attached images/video clips (if electronic logbook is used) and interpretations in order to facilitate the continuous assessment by independent EM USG practitioner or training supervisor. A sample of log sheet (appendix 1) and assessment form (appendix 2) are attached for reference.

Apart from supervised scanning in EDs, session training in other relevant diagnostic ultrasound lab, such as radiology department, antenatal clinic or echocardiography lab is obviously pertinent to emergency ultrasound. Of course these should not replace the supervision by qualified EM USG practitioner, who should be the mentor of EM USG trainee.

It is recommended that the period of supervised scanning training should be completed within 1 year after attending the approved ultrasound course. Approval from the training supervisor should be sought if the training period is beyond 1 year.

Table1. The recommended numbers of applications in basic emergency ultrasound:

<i>Primary application</i>	<i>Minimum (Total)</i>	<i>Minimum (positive scans)</i>
Trauma	25	5 <i>(Scans of ascites or ruptured ectopic pregnancy can substitute)</i>
USG in pregnancy*	25	5
Echocardiography	15	2 (pericardial effusion +/- tamponade)
AAA	20	5
Hepatobiliary	20	5
Renal	20	5

**Remark: It can be optional as early pregnancy pelvic scan may not be encouraged in some training centers*

Methods of confirming negative scans outcome include:

- Direct supervision of the emergency ultrasound examination
- Over-read of static or video images
- Confirmatory imaging investigations (ultrasound by other specialists, computed tomography, magnetic resonance imaging etc.)
- Surgical procedure
- Postmortem examination
- Confirmation of patient clinical outcome

Methods of confirming positive scans outcome include:

- Confirmatory imaging investigations (ultrasound by other specialists, computed tomography, magnetic resonance imaging etc.)
- Surgical procedure
- Postmortem examination

(2) Basic Emergency Ultrasound Independent Practitioner

An EM physician would become a Basic Emergency Ultrasound Independent Practitioner within his/her servicing ED if:

1. He/she is an existing instructor of basic or advanced ultrasound course organized by the ultrasound subcommittee of college,
OR
2. He/she is the training supervisor or consultant EP of the training center,
OR
3. An EM practitioner who has attended the basic and advanced EM USG courses organized by COC (A&E) or college or equivalent, and has been independently practicing EM USG for at least 3 years before 2009, and endorsed by the training supervisor of the training center,
OR
4. The EM USG Trainee has fulfilled all the training requirements in the paragraph (1) of the section, and endorsed by the training supervisor of the training center

(3) Certificate in Basic Emergency Ultrasound (*course under development*)

The EM USG Independent Practitioner can apply for the certificate in Basic Emergency Ultrasound if:

1. He/she has been practicing Basic EM USG for at least 6 months after being an independent practitioner in a training center, and
2. Being nominated by the training supervisor, and
3. Successfully gone through a assessment by the ultrasound subcommittee of college

Training pathway and levels of proficiency in advanced emergency ultrasound would be discussed later when the training and credentialing in basic ultrasound become more robust in future.

The training pathway and level of proficiency in Basic Emergency Ultrasound is summarized in the chart of appendix 3 for reference.

SECTION 4: DOCUMENTATION AND QUALITY IMPROVEMENT

The emergency ultrasound plays different roles in different clinical settings, thereby complicating record keeping. It may be a diagnostic test, and a record of the patient's

progress or an adjunct for intervention. To communicate with other physicians and services, all emergency ultrasound examinations for the purpose of facilitating patient-care decisions should have the results documented on the medical records. Examination documentation should only include information specific to the intended objectives of the examination. It would be advisable to attach a hard copy of ultrasound images to the records concerned if possible.

Although emergency ultrasound is generally a limited and focused examination, it is agreed that incidental findings will occur (e.g. gallstones seen on a FAST examination). Such findings should be noted in the medical record if relevant and the patient being informed if necessary.

Quality review, continuous professional education and continuous quality improvement in EM USG

Quality review of emergency ultrasound examinations serves two purposes. First, it acts as a tool for education and a channel of feedback for residents in training period. Quality review is needed for most if not all of such examinations. Secondly, it is a tool to monitor ongoing performance in physicians who have completed their training in emergency ultrasound. For such situation, review of a certain percentage of scans may suffice.

Basic EM USG Independent Practitioner should be actively involved in the quality assurance and research programs of his/her training center for continuous quality improvement. Also relevant USG courses or session training in other pertinent specialties can be taken to refresh the knowledge and skill, as well as exploring further development in the field.

Equipment quality assurance and management

Ultrasound machines require periodic maintenance and cleaning after each patient encounter. Standards for mechanical and electrical output, calibration of measurement, and infection control should be followed. All transducers, especially intracavitary transducers, must be cleansed per appropriate infection control methods to pathogens carried by blood and bodily secretions.

SECTION 5: FUTURE DIRECTIONS

The future of emergency ultrasound will be shaped by research and clinical adoption of new applications by EPs. In the coming years, we would expect more EPs performing ultrasound examinations and its growing application in more disease entities. Emergency ultrasound may be considered a standard for some situations in ED practice.

Extended scope of application

One of the most exciting aspects of emergency ultrasonography is associated with its continuous development and adaptation of new applications. New applications will need to meet several conditions before gaining acceptance by emergency ultrasonographers including: its applicability to the emergency setting as well as utility in local situation, the emergency physicians' ability to gain proficiency in the potential application and to have the application performed in a timely manner, support by local demographics, and most important of all, its impacts on patient care and outcome. Table 2 lists current examples of more advanced emergency ultrasound applications that give considerable promise for the future practice of ultrasound by EPs with relevant training and experience.

Table 2. Future potential application of emergency ultrasound.

Application	Rationale
Airway	Intubation detection in the apnoeic patient
Head and neck	Peritonsillar abscess detection and drainage
Testicular ultrasound	Rule out testicular torsion
Regional anesthesia	Ultrasound guided nerve and plexus block
Orbital ultrasound	Retrobulbar haematoma and retinal detachment, diagnosis of increase intra-cerebral pressure
Transoesophageal echocardiography	Cardiac function and aortic disease
Obstetric second- and third-trimester bleeding	Placenta previa. Placental abruption

New ultrasound technologies in emergency ultrasound

Currently, ultrasound machines are getting smaller, more portable, and more sophisticated at lower price. Integral to the advancement of ultrasound technology is the migration of much technology to machines aimed at the emergency ultrasound role. The following relatively new ultrasound technology may become a standard for ED machines in the future:

- Linear transducer with frequency > 10 MHz
- Color Doppler
- Power Doppler
- Tissue harmonic imaging

3/4-dimensional ultrasound, and contrast agents, currently used in other settings, may extend into the emergency ultrasound setting in the future.

Acquisition of ultrasound skills as standard ED management

In the coming years, more EPs would take up basic applications of emergency ultrasound. All new emergency medicine specialists are expected to be proficient in emergency ultrasound. Ultrasound examination may be considered as a standard for some ED situations or disease entities e.g. FAST in blunt abdominal or multiple trauma, pelvic ultrasound examination for first trimester per vaginal bleeding.

REFERENCE

1. Emergency Ultrasound Guidelines; The policy statement of American College of Emergency Physicians 2008
2. Emergency Medicine Ultrasound Training Recommendations; College of Emergency Medicine, United Kingdom, 2009
3. Clinician Performed Emergency Ultrasound Guidelines; Australasian College of Emergency Medicine, Australia, 2006
4. Recommended standards in emergency ultrasound; Canadian Emergency Ultrasound Society, Canada, 2009

Appendix 1:

SAMPLE

Focused Emergency Ultrasound Record Sheet

A&E Department xxxxxxxx Hospital

Indications (please tick, each patient can have > 1):

- Trauma:
- Suspected abdominal aortic aneurysm:
- Suspected pericardial effusion+/-tamponade:
- Suspected biliary colic/acute cholecystitis/obstructive jaundice:
- Suspected obstructive uropathy:
- Bleeding/pain complicating early pregnancy:
- Others: _____

Patient Label

Please attach the LABELLED still images here

Result of scanning

Findings: _____

Suspected diagnosis: Confirmed Ruled out Undetermined

Name of performing specialist/trainee: _____

Verification of the scan

(can be filled up at later stage)

Results verified by: comprehensive US by radiologist/cardiac/OG

other imaging modality

operative findings

others: _____

Accuracy of the focused scan: Yes No Undetermined

Appendix 2:

Sample

Assessment form for Basic Emergency Ultrasound

For each scan the trainee should demonstrate the ability in (put a ✓ in):

Before the scanning:

- Explaining to patient the indication & purpose of the scan (if feasible)
- Proper infection control measures
- Proper preparation before scanning (eg. Glove, gel and towel)

During the scanning:

- Proper probe/frequency selection
- Proper patient posture
- Proper B mode image acquisition technique
- Doppler utilization technique (if necessary)
- Optimal B mode images acquired
- Appropriate image interpretation
- Adequate images recorded
- Proper scanning speed

After the scanning:

- Explanation of the scanning result and subsequent planning to patient (if feasible)
- Proper documentation of scanning results and fill in the relevant forms (if necessary)
- Proper communication with other specialty if necessary
- Proper machine maintenance after scanning
- Scanning result verified with other imaging modality/surgical procedure/clinical outcome/other relevant measures

Overall assessment:

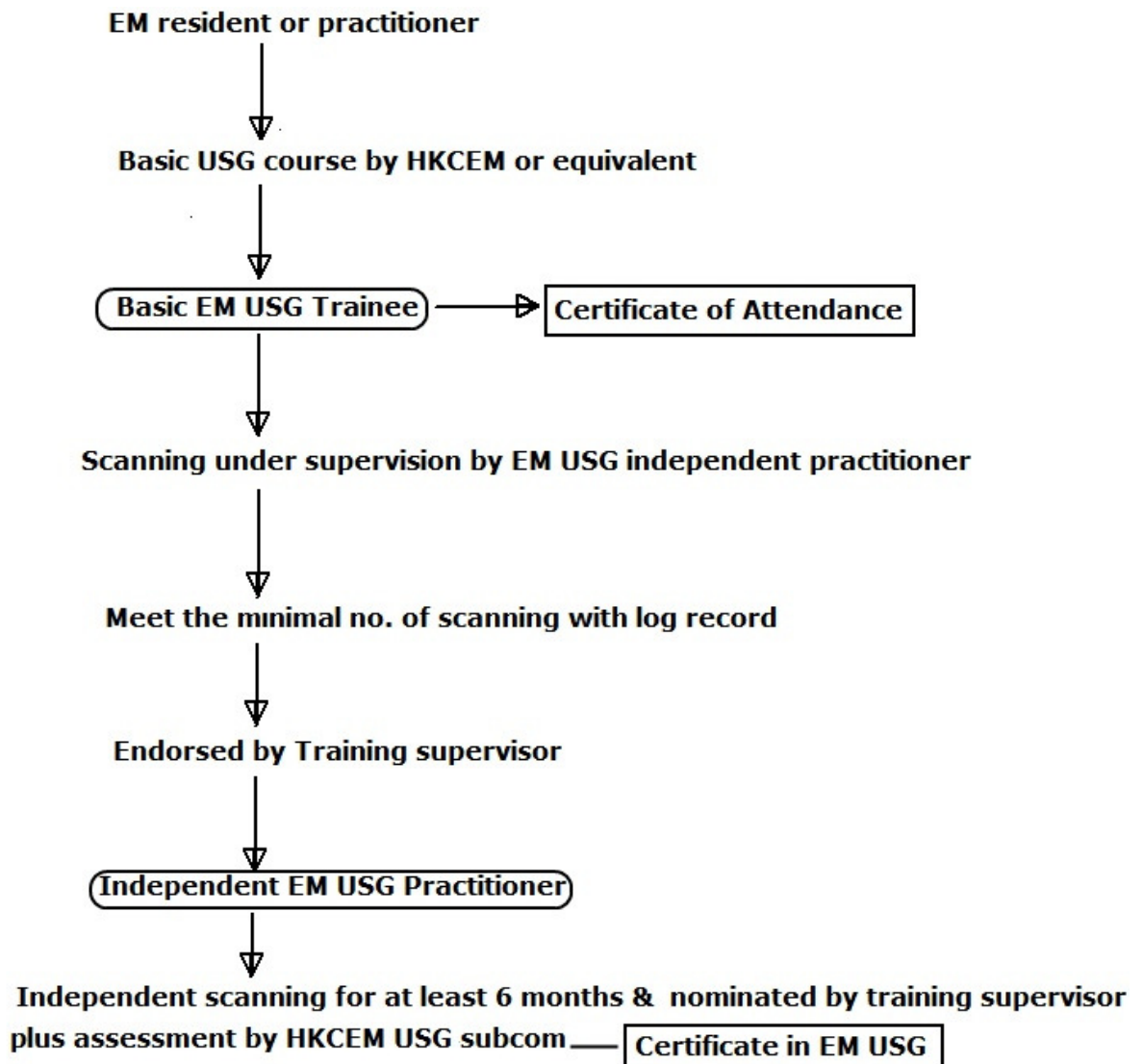
- Satisfactory (fulfill all criteria)
- Acceptable (fulfill all criteria with hints)
- Need further improvement Comment: _____

Scanned patient reference number: _____

Name & signature of ultrasound trainee: _____

Name & signature of assessor: _____

Appendix 3: Training pathway & level of proficiency



Note:

The following criteria would be the requirement of being an Independent EM USG Practitioner during the interim period:

1. He/she is an existing instructor of basic or advanced ultrasound course organized by the ultrasound subcommittee of college,
OR
2. He/she is the training supervisor or consultant EP of the training center,
OR
3. An EM practitioner who has attended the basic and advanced EM USG courses organized by COC (A&E) or college or equivalent, and has been independently practicing EM USG for at least 3 years before 2009, and endorsed by the training supervisor of the training center,