Ultrasound in Shock

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Objectives

- Define “Focused Ultrasound” and rationale for use in practice
- Review FATE / FAST / FEEL exams
- Review a diagnostic algorithm for Ultrasound in shock
- Present real clinical case examples
Focused Ultrasound - Levels

Appropriate level of competence for most clinicians

Level 3:
- Specialist echo examinations, echo for invasive procedures, and majority of post in echo and echo research

Level 2:
- Accept referrals from Level 1, perform comprehensive TTE & TEE, diagnose all cardiovascular abnormalities, optimise onward referral, teaching and research

Level 1:
- Acquire all standard views (TTE, TEE), recognise abnormal vs normal, diagnose common abnormalities, recognise when referral indicated, understand echo vs other techniques

Emergency Echo (FEEL, FATE):
- Acquire standard TTE views in ALS compliant manner, recognise major causes of arrest/shock, recognise when referral for second opinion indicated

Price et al. Cardiovascular Ultrasound 2008
The name game...

- FATE (Jensen MB, Eur J Anaesthesiol 2004)
- FEEL (Breitkreutz R, Crit Care Med 2007)
- BLEEP (Pershad J, Pediatrics 2004)
- Goal-directed limited Echo (Manasia AR, J Cardiothorac Vasc Anesth 2005)
- Goal-oriented hand-held Echo (Vignon P, Intensive Care Med 2007)
- CLUE (Kimura B, Am J Cardiol 2007)
- RACE (McLean A, Crit Care Resusc 2007)
- FOCUS (Beaulieu Y)
- BEAT (Gunst M, J Trauma 2008)
FATE - What is it?

FATE is the original focused echo protocol practiced since 1989. It is a simple and effective roadmap to interpret echocardiographic findings in a clinical context. FATE is easy to learn and quickly performed and can be applied in all possible clinical scenarios pre- and inhospitaly, perioperatively, and in intensive care or emergency settings. The patient can be supine or in the sitting position. All essential information including a quick guidance to interpret the echocardiographic findings is printed on a double-sided laminated pocket card, now also available as an App for i-phone and Android.

http://www.fate-protocol.com/

FATE - Rationale

- Basic cardiac ultrasound can augment other clinical skills
- Invasive monitors (e.g. Swanz-Ganz catheters) have not been shown to improve outcome
- Ultrasound echo machines are more feasible and portable for use by clinicians at the bedside
- Indicated in any patient with hemodynamic instability or shock.
FATE - Windows

Four Standard Windows:

- 1. Subcostal
- 2. Apical
- 3. Para-sternal (Long and Short Axis)
- 4. Pleural (Left and Right)
FATE - Views

BASIC Views

✶ 1. Subcostal 4-ch

✶ 2. Apical 4-ch

✶ 3. Para-sternal
   (Long and Short Axis-mid pap)

✶ 4. Pleural
   (Left and Right)
**FATE - Views**

**EXTENDED Views**

- 1. Subcostal - IVC
- 2. Apical 2 and 3-ch
- 3. Para-sternal
  (Short Axis-mitral and aortic)
FATE - Goals

Focus Assessed Transthoracic Echo (FATE)


1. Look for obvious pathology
2. Assess wall thickness + chamber dimensions
3. Assess bi - ventricular function
4. Image pleura on both sides
5. Relate the information to the clinical context
6. Apply additional ultrasound
FATE protocol provided useful images that contributed positively in 227 out of 233 echo studies (97%)

- ~37% of echo’s revealed NEW information and were DECISIVE in ~24%
Clinical Case #1 - History

- 87 y.o. F with no PMHx presents with chest pain and found to have contained rupture of large thoraco-abdominal aneurysm
- Underwent emergent endograft of aneurysm
- POD #3 – develops hypotension and SOB on the floor necessitating tx to the ICU
- Patient intubated and stabilized on pressors and undergoes chest CT revealing left hemothorax
- Thoracic surgery is consulted and plans for a VAT’s washout via right chest
- Bedside TTE is performed...
Clinical Case #1 - Bedside TTE
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Clinical Case #1 - Diagnosis

A 71-year-old male with a history of hypertension and diabetes presented to the emergency department with shortness of breath and chest pain. Physical examination revealed tachycardia, elevated blood pressure, and bilateral crackles. An electrocardiogram showed atrial fibrillation and ST elevation in leads V1-V3. Laboratory results included a serum creatinine of 1.5 mg/dL and an elevated BNP of 1000 pg/mL. A chest X-ray showed cardiomegaly and bilateral pleural effusions.

The patient was diagnosed with acute heart failure and was treated with intravenous diuretics and inotropic support. An echocardiogram confirmed left ventricular dysfunction with an ejection fraction of 30% and severe mitral regurgitation. The patient was transferred to the intensive care unit for further management.

Key findings from the echocardiogram include:
- LV: Left Ventricle
- AoR: Aortic Root
- DF: Doppler Flow
- MV: Mitral Valve
- Ta: Tricuspid Annulus
FAST - Exam
FAST - What is it?

- Focused
- Assessment with ultrasonography in trauma

The FAST protocol is a rapid method used to identify blood in the pericardial space, intraperitoneal cavity, and pleural space based on the premise that blood will pool to dependent areas.
FAST - Rationale

- Bleeding and hemorrhage is the most common cause of hypotension in trauma
- Diagnostic Peritoneal Lavage (DPL) is invasive with associated risk
- Computed Tomography (CT) is time consuming
- Fluid is easily identified by ultrasound as anechoic (jet black) adjacent to hyper-echoic structures (e.g. liver and diaphragm)
- In the proper setting, literature suggest FAST has 70-90% sensitive and nearly 100% specific for detecting clinically significant bleeding
FAST - Advantages

- Ultrasound is portable, repeatable and non-invasive
- Can be performed rapidly at the bedside
- Can be done simultaneously with resuscitation efforts
- Does not require use of contrast or radiation exposure (safe in pregnancy and pediatrics)
FAST Goals

- Rapid detection of:
  - Hemoperitoneum
  - Hemopericardium
  - Hemothorax
  - Pneumothorax (eFAST)
FAST Indications / Contraindications

**INDICATIONS:**
- Blunt or penetrating thoraco-abdominal trauma
- Trauma / Abdominal Pain in pregnancy
- Unexplained Hypotension in ANY patient

**CONTRAINDICATIONS:**
- Any immediate indication for OR (e.g. evisceration or ruptured diaphragm on outside hospital imaging, etc.)
FAST - Views

Four FAST Views:

- Cardiac
- Peri-Hepatic (Right Upper Quadrant)
- Peri-Splenic (Left Upper Quadrant)
- Pelvic
FAST - Where to Begin?

Horizontal Subxiphoid (HS) line

RUQ
MID-AXILLARY LINE

LUQ
POST-AXILLARY LINE
Clinical Case #2

* 71 y.o. female POD #9 from L3-L5 lami awaiting d/c to rehab
* Pt found unresponsive, agonal breathing --> Code Blue called
* Pt appeared pale with a distended abdomen. Hypotensive (SBP 80’s)
* Volume initiated and tx to ICU. Poor trans-thoracic windows prompting TEE
* PMHx: Fibrolipoma of spinal cord; DJD Lumbar spine; Chronic Pain syndrome; GERD; Anxiety; Depression
Clinical Case #2
FEEL - Exam
FEEL - What is it?

- Focused
- Echocardiographic
- Evaluation in Life Support
Focused echocardiographic evaluation in resuscitation management: Concept of an advanced life support–conformed algorithm

Raoul Breitkreutz, MD; Felix Walcher, MD, PhD; Florian H. Seeger, MD

Emergency ultrasound is suggested to be an important tool in critical care medicine. Time-dependent scenarios occur during preresuscitation care, during cardiopulmonary resuscitation, and in postresuscitation care. Suspected myocardial insufficiency due to acute global, left, or right heart failure, pericardial tamponade, and hypovolemia should be identified. These diagnoses cannot be made with standard physical examination or the electrocardiogram. Furthermore, the differential diagnosis of pulseless electrical activity is best elucidated with echocardiography. Therefore, we developed an algorithm of focused echocardiographic evaluation in resuscitation management, a structured process of an advanced life support–conformed transthoracic echocardiography protocol to be applied to point-of-care diagnosis. The new 2005 American Heart Association/European Resuscitation Council/International Liaison Committee on Resuscitation guidelines recommended high-quality cardiopulmonary resuscitation with minimal interruptions to reduce the no-flow intervals. However, they also recommended identification and treatment of reversible causes or complicating factors. Therefore, clinicians must be trained to use echocardiography within the brief interruptions of advanced life support, taking into account practical and theoretical considerations. Focused echocardiographic evaluation in resuscitation management was evaluated by emergency physicians with respect to incorporation into the cardiopulmonary resuscitation process, performance, and physicians’ ability to recognize characteristic pathology. The aim of the focused echocardiographic evaluation in resuscitation management examination is to improve the outcomes of cardiopulmonary resuscitation. (Crit Care Med 2007; 35[Suppl.]:S150–S161)

Key Words: emergency echocardiography; focused echocardiographic evaluation in resuscitation; resuscitation; cardiopulmonary resuscitation; algorithm; critical care ultrasound
Proposed Integration of a brief Echocardiography (FEEL) into the ALS to identify Reversible Causes

When to apply

Unresponsive?
Open Airway, look for signs of life
CPR: 30:2
Defibrillator/Monitor
Assess Rhythm

Shockable (VF/pulseless S VT)
1 Shock
Immediately resume CPR 30:2 for 2 min

Non-shockable PEA/Asystole?
Immediately resume CPR 30:2 for 2 min

after 5 CPR cycles
FEEL --> Pseudo-PEA?
end-exp. CO₂, pulse check

FEEL - Rationale for use

Identify (or rule out) 4 mechanical causes of PEA:

1. Tamponade
2. Hypovolemia
3. Pulmonary Embolism
4. Severe LV Dysfunction (MI)
FEEL - Rationale for avoiding

AHA Consensus Statement

CPR Quality: Improving Cardiac Resuscitation Outcomes Both Inside and Outside the Hospital
A Consensus Statement From the American Heart Association
Endorsed by the American College of Emergency Physicians

Abstract—The "2010 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care" increased the focus on methods to ensure that high-quality cardiopulmonary resuscitation (CPR) is performed in all resuscitation attempts. There are 5 critical components of high-quality CPR: minimize interruptions in chest compressions, provide compressions of adequate rate and depth, avoid leaning between compressions, and avoid excessive ventilation. Although it is clear that high-quality CPR is the primary component in influencing survival from cardiac arrest, there is considerable variation in monitoring, implementation, and quality improvement. As such, CPR quality varies widely between systems and locations. Victims often do not receive high-quality CPR because of provider ambiguity in prioritization of resuscitative efforts during an arrest. This ambiguity also impedes the development of optimal systems of care to increase survival from cardiac arrest. This consensus statement addresses the following key areas of CPR quality for the trained rescuer: metrics of CPR performance; monitoring, feedback, and integration of the patient’s response to CPR; team-level logistics to ensure performance of high-quality CPR; and continuous quality improvement on provider, team, and systems levels. Clear definitions of metrics and methods to consistently deliver and improve the quality of CPR will narrow the gap between resuscitation science and the victims, both in and out of the hospital, and lay the foundation for further improvements in the future. (Circulation. 2013;128:00-00.)
2015 Recommendations—Updated

Ultrasound (cardiac or noncardiac) may be considered during the management of cardiac arrest, although its usefulness has not been well established (Class IIb, LOE C-EO).

If a qualified sonographer is present and use of ultrasound does not interfere with the standard cardiac arrest treatment protocol, then ultrasound may be considered as an adjunct to standard patient evaluation (Class IIb, LOE C-EO).
Clinical Case #3

- 67 y.o. male POD #3 from toe amputation
- Pt found unresponsive without palpable pulse - CPR initiated
- Ultrasound performed during CPR

- PMHx: Peripheral Vascular Disease; HTN; GERD
Clinical Case #3
Ultrasound Shock Algorithm

TTE
- Pleural Ultrasound
- Abdominal Ultrasound
  (FATE / FAST / FEEL)

Pericardial effusion
  - Tamponade
Severely hypokinetic LV
  - Pump failure
Severely enlarged akinetic RV
  - Pulmonary embolism
Small hyperdynamic LV, collapsed IVC
  - Hypovolemia
Hypercontractile LV
  - Sepsis
No sliding sign Stratosphere sign
  - Pneumothorax

Courtesy of Sajid Shahul, MD
THANK YOU!