Ultrasound in Cardiac Arrest
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- Point-of-care ultrasound (POCUS) can play a number of roles in the management of patients in cardiac arrest.

1. **Identifying reversible causes of arrest**:
   - Traditional ACLS asks the clinician to think about “H’s and T’s” but doesn’t provide a way to differentiate which one is affecting the patient.
   - Point-of-care ultrasound can give information about 4 of the “T’s” and 1 of the “H’s.”
     - Tamponade (see [May 2021 EM:RAP](https://www.emrap.org/article/issue202105) for full discussion)
       - A moderate or large effusion during arrest requires pericardiocentesis.
       - If there is a pericardial effusion, consider imaging the aorta looking for dissection.
     - Hypovolemia
       - On ultrasound there would be a small left ventricle (LV) and small inferior vena cava (IVC).
     - Tension pneumothorax
       - Clinicians may not see lung sliding in patients with cardiac arrest.
       - Look for B-lines in the lungs during compressions.
       - If you see B-lines, the visceral and parietal pleura are touching and there is NO PNEUMOTHORAX.
     - Thrombosis
       - Myocardial Infarction (MI)
         - Typically ECG is used to make the diagnosis but can be challenging to obtain.
         - POCUS assessment in MI is useful in patients who are peri-arrest or have some cardiac activity.
         - Look for regional wall motion abnormality (RWMA), which is a focal absence of contraction of a wall of the heart.
       - Pulmonary Embolism (PE)
         - Right ventricular dilation can be seen with pulmonary embolism, but can also be seen in cardiac arrest without pulmonary embolism (see [May 2020 EMRAP](https://www.emrap.org/article/issue202005)).
         - If there is right heart strain in the peri-arrest patient, pulmonary embolism is more likely.
         - If there is a clot visualized in transit, pulmonary embolism is the likely cause of cardiac arrest.
In cases where you are unsure, look for the presence or absence of a deep venous thrombosis (DVT).

Internal Trauma

- Perform a FAST exam looking for free fluid in the abdomen.
- The cause will depend on the clinical scenario, but can also be an indication of ruptured ectopic pregnancy (in a young woman) or ruptured aortic abdominal aneurysm (AAA).

2. **Useful for procedural guidance:**

- Large bore vascular access in the femoral vein (such as an introducer or dialysis catheter)
- Arterial access to help assess for peripheral perfusion during rhythm checks.
- Ultrasound-guided pericardiocentesis

3. **Useful during rhythm checks:**

- Identifies new (eg, occurred as a result of compressions) reversible causes of arrest such as a new effusion or a new pneumothorax.
- Identifies dysrhythmias.
  - While the monitor does a good job, fine ventricular fibrillation can be confused with asystole.
- **Manual pulse check (eg, palpation) is neither sensitive nor specific.**
  - A study by Eberle et al. in a 1996 Resuscitation article ([PMID: 9025126](https://www.ncbi.nlm.nih.gov/pubmed/9025126)) had 207 EMT's evaluate 16 patients on bypass for coronary artery bypass grafting.
    - Approximately 10% of the time, they thought there was a pulse when there was not.
    - Approximately 45% of the time, they thought there was not a pulse when there was one.
    - The average time it took to make those wrong decisions was 24 seconds.
    - Approximately 17% of the time, the correct answer (no pulse or present pulse) was identified within 10 seconds.
  - Another study of 793 arresting patients found that 54% of patients thought to be in PEA actually had cardiac activity on POCUS ([Gaspari 2016, PMID: 27693280](https://www.ncbi.nlm.nih.gov/pubmed/27693280)).
    - Use POCUS to look for organized cardiac activity.
  - An arterial line can be used to confirm peripheral blood flow.
  - Recent literature shows an association of point-of-care ultrasound in cardiac arrest with longer rhythm check pauses.
Huis In’t Veld Resuscitation 2017 [PMID: 28754527] (N = 23 pts) US = 21s, Non-US = 13s


However, these cardiac arrest cases were not optimally run as rhythm checks were all longer than 10 seconds.

- Tactic for improving POCUS use without having prolonged rhythm checks
  - Tactic #1:
    - Prepare 15 seconds before pulse check
      - Charge the defibrillator
      - Put a phased array transducer in the hand closest to the patient and put gel on the probe. Hold a rag in the other hand.
    - During pulse check
      - Obtain subxiphoid view.
      - Have a person count down from 10 to 0.
      - At 2 seconds, take the transducer off and wipe the gel away with a rag.
      - If you cannot get a cardiac window within 8 seconds, assume no cardiac activity and resume compressions.
  - Tactic #2:
    - Separate obtaining images from interpreting images.
      - Record images and review after compressions restarted.
    - CASA protocol ([PMID: 28851499]):
      - 1st pulse check = Look for pericardial effusion
      - 2nd pulse check = Look for right heart strain
      - 3rd pulse check = Look for cardiac motion.

4. Prognostication with point-of-care ultrasound
   - The absence of cardiac contractility on POCUS does not equal futility of cardiac arrest care.
   - A 2012 systematic review found that 2.4% of patients without wall motion detected on echo will go on to achieve return of spontaneous circulation (ROSC) ([Blyth 2012; PMID: 23039118])
   - Additionally, studies demonstrated that agreement on standstill is moderate between users. ([Hu 2018; PMID: 28870394])
   - The 2020 AHA guidelines recommend against using it for prognostication ([Merchant 2020; PMID: 33081530])