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Washington University Emergency Medicine Journal Club
Utility of Bedside ECHO in Predicting Cardiac Arrest Outcomes

Vignette

A shift in TCC yields a now all too familiar dilemma. At peak hours you must manage a patient who has sepsis and requires a central line to follow SCVO2. Your other patient is an asthmatic who, after overstaying the allotted 23 hours in your observation unit by 4 hours, can't speak in full sentences despite a tripod stance and BiPAP. A level 1 hypotensive trauma patient with a pelvic fracture awaits VIR. The nurses hand you an EKG and you shriek because, without even looking down, the machine is reading ACUTE MI and this time, it's right. As you groan thinking it can't get worse than this, it does... EMS brings in a 45 year old healthy appearing patient in full cardiac arrest, down an unknown number of minutes on the scene. It's unclear, but EMS says bystanders were there without an AED but providing compressions for most of time your patient was down. Just to make it worse, EMS is walking in your patient's 5 and 7 year old children to the social work office while their parent goes into TCC-1, Left.

"You don't have time for this," whispers a little voice in your head that on this occasion might be right. As the nurses help move the patient and place monitor leads on the chest, you confirm ETT placement and find out EMS delivered 3 rounds of epinephrine without good effect. You ask to hold compressions but feel no pulse despite narrow complexes going across the monitor at a rate of about 80. Compressions continue, you perform bilateral chest decompression, administer another round of epinephrine, calcium gluconate, and bicarb, and wait 2 minutes while compressions continue. Compressions are held but you feel no pulse (other than your heart pounding as the nurse tells you the AMI looks grey and your septic patient is hypotensive); the monitor again shows PEA. The team, looking desperate, wants you to "call it." You pull out your ultrasound hoping that might show you a cardiac effusion you can drain and story you can tell for the ages but your patient is not so lucky. All you see is standstill. Total resuscitation time gone by: 19 minutes. You ask yourself, "Can I call it? Do I have enough information to tell those kids their parent is gone and there's nothing I can do about it?"

Time stops! Chris Carpenter bounds in, computer in hand, followed by Brian Cohn. They both have on ninja outfits. Chris' is all black with the words "Knowledge" and "Power" embroidered down the sleeves. Brian's is white with a green belt. Carpenter quickly assesses what your PICO should be but hesitates a second to get it going as his mentor's words echo in his head, "He who spreads himself too thin ends up with margarine." Reluctantly (or maybe not so reluctantly), he hands the computer off to Brian Cohn who, trembling in the presence of EBM greatness but newly armed with McDaddy EBM knowledge from McMaster's EBM course, puts his head down and grunts "Let's get it on!"

PICO Question
Population: ED patients who present in cardiac arrest
Intervention: Bedside ultrasound
Comparison: Clinical gestalt, end-tidal CO2
Outcome: Return of spontaneous circulation, survival to hospital admission, survival to hospital discharge, meaningful neurologic recovery

Search Strategy

Out of nowhere Brian inputs (((heart arrest OR cardiopulmonary resuscitation OR cardio-pulmonary resuscitation OR CPR OR advanced cardiac life support OR cardiac arrest OR asystole) AND (echocardiography OR ultrasonography OR echocardi* OR echo OR cardiac echo OR cardiac ultrasound OR cardiac ultrasonography OR TTE OR transthoracic echocardiography OR transthoracic echocardiogram OR trans-thoracic echocardiogram OR trans-thoracic echocardiography OR ultrasound OR sonogram) AND ((incidence[MeSH:noexp] OR mortality[MeSH] OR follow up studies[MeSH:noexp] OR prognos*[TextWord] OR predict*[TextWord] OR course*[TextWord] or death[TextWord]) OR (predict*[tiab] OR predictive value of tests[mh] OR scor*[tiab] OR observ*[tiab] OR observer variation[mh])))) into pubmed. The search yields several articles from which you pick these 4...

Article 1: Blaivas M, Fox JC. Outcome in cardiac arrest patients found to have cardiac standstill on the bedside emergency department echocardiogram. Acad Emerg Med. Jun 2001;8(6):616-621. ANSWER KEY.

Article 2: Salen P, O'Connor R, Sierzenski P, et al. Can Cardiac Sonography and Capnography Be Used Independently and in Combination to Predict Resuscitation Outcomes? Acad Emerg Med. 2001;8(6):610-615. ANSWER KEY.

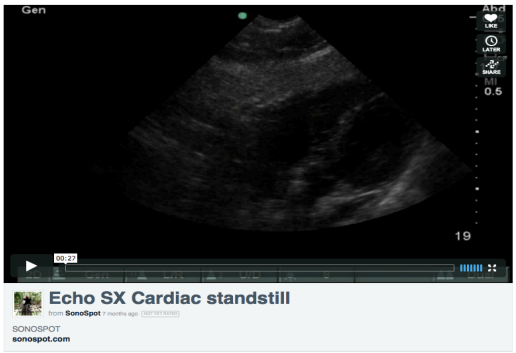
Article 3: Blyth L, Atkinson P, Gadd K, Lang E. Bedside focused echocardiography as predictor of survival in cardiac arrest patients: a systematic review. Acad Emerg Med. Oct 2012;19(10):1119-1126. ANSWER KEY.

Article 4: Aichinger G, Zechner PM, Prause G, Sacherer F, Wildner G, Anderson CL,Pocivalnik M, Wiesspeiner U, Fox JC. Cardiac movement identified on prehospital echocardiography predicts outcome in cardiac arrest patients. Prehosp Emerg Care. 2012 Apr-Jun;16(2):251-5. ANSWER KEY.

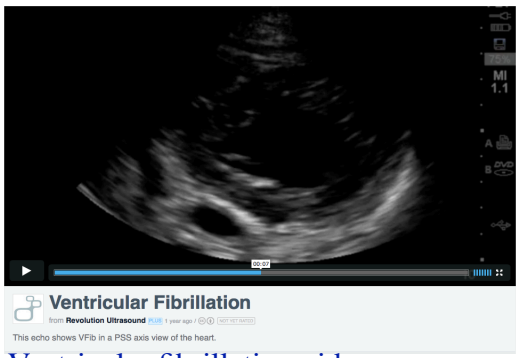
Bottom Line

Out-of-hospital cardiac arrest remains a leading mechanism of death in the United States, with an estimated incidence of 300,000 events per year (McNally 2011). Overall survival has remained stable at approximately 8% since the 1950s (Sasson 2010) despite initiatives to improve survival rates (improved bystander CPR, public use of automated external defibrillators). Given the very low likelihood of survival in patients presenting to the ED without a pulse (0.9% in one large database), efforts have been made to determine those in whom ongoing resuscitation is futile.

While some recommend bedside cardiac ultrasound as a diagnostic tool in cardiac arrest to aid in detection of reversible conditions such as severe hypovolemia, pericardial tamponade, and massive pulmonary embolism (Hernandez 2008), there has also been widespread use to evaluate for the absence of cardiac activity, with the results frequently affecting the duration of resuscitation efforts. In one survey of graduates from the LA County/USC Medical Center residency program, 68% reported using ultrasound during cardiac arrest, and 91% of these reported using the results in deciding when to terminate resuscitation efforts (Schoenberger 2007). It is important, however, to review the evidence surrounding this practice.



Cardiac standstill video



Ventricular fibrillation video

We identified three primary studies (Blavais 2001, Salen 2001, Aichinger 2012) and one meta-analysis (Blyth 2012) dealing with this subject. In patients in cardiac arrest with no cardiac activity on ultrasound, all of the papers revealed low rates of survival to hospital admission, ranging from 0% to 3.1%. While no clearly identified survival threshold exists above which resuscitation should be continued, given the severity of the outcomes a low threshold should be used. The pooled survival to hospital admission rate in the meta-analysis of 2.4% (95% CI 1.3-4.5%) would indicate that cardiac ultrasound should not be used alone to to determine when further attempts at resuscitation are futile. Unfortunately, the meta-analysis and two of the studies did not assess survival beyond admission or neurologically intact survival. The one study to assess survival to hospital discharge (Aichinger 2012) found that none of the 31 patients with cardiac standstill survived to discharge, however the width of the 95% confidence interval (0%-11%) prevents us from safely applying these results to clinical practice.

There was consensus among those present that these studies do not support stopping resuscitation efforts in cardiac arrest patients based on the absence of cardiac activity on ultrasound. This decision was based on both the size of the studies (and resulting width of the confidence intervals), and the lack of assessment of long-term outcomes (beyond hospital admission/discharge). Many felt that future studies should exclude patients in ventricular fibrillation or ventricular tachycardia, as standard care would dictate ongoing resuscitation in these patients. Future studies will also need to beware the potential adverse consequences of pausing CPR for ultrasound performance, making sure to time this with pulse checks.

One of the issues in these studies was the use of relatively short-term outcomes. The meta-analysis and two of the primary studies evaluated survival to hospital admission as the primary outcome. More clinically important outcomes may include survival to hospital discharge, 30-day or one-year survival, and neurologically intact survival assessed by modified Rankin Scale or CPC score. A conference of the Research Working Group of the American Heart Association Emergency Cardiovascular Care Committee to discuss appropriate outcomes in resuscitation research demonstrated the difficulties in such studies. There was no consensus on a single appropriate outcome, and conference participants were unable to agree on the ideal outcome measure when confronted with 4 hypothetical cases. There was consensus that large trials designed to have a major impact should use longer-term endpoints at least 90 days out coupled with some neurological and quality-of-life assessment.

There are currently no registered trials addressing long-term outcomes of cardiac arrest patients with cardiac standstill on ultrasound. The Reason 1 trial is currently recruiting patients to assess survival to hospital discharge, and the investigators plan to enroll 1000 patients. This would make it the largest study to date on this subject. Based on the expected results of this trial, the investigators plan on gaining funding to conduct a similar trial that will look at long-term outcomes in these patients.