WORKSHEET for Evidence-Based Review of Science for Emergency Cardiac Care

Worksheet author(s)

Amanda Hanson, MD, FRCPC	**Date Submitted for review:** February 3, 2010

Clinical question.

ALS-CPR&A-003B "In adult in cardiac arrest (pre-hospital [OHCA], in-hospital [IHCA]) (P), does the use of ultrasound (including trans-thoracic and trans-esophageal echocardiography) during cardiac arrest (I) compared with standard CPR (C), improve any outcomes (eg. ROSC, survival) (O)"

Is this question addressing an intervention/therapy, prognosis or diagnosis? intervention

State if this is a proposed new topic or revision of existing worksheet: new topic

Conflict of interest specific to this question

Do any of the authors listed above have conflict of interest disclosures relevant to this worksheet? NO

Search strategy (including electronic databases searched).

- EMBASE -- "Ultrasound" OR "Echocardiography" AND "Cardiac Resuscitation" OR "ACLS" OR "CPR" OR "Cardiac Arrest"
- Pubmed – "Echocardiography"(Mesh) OR "Echocardiography, Trans-esophageal" (Mesh) OR "Ultrasonography" (Mesh) AND "Cardiopulmonary Resuscitation" (Mesh) OR "Advanced Cardiac Life Support" (Mesh) OR "Death, Sudden, Cardiac" (Mesh). Also searched for "Related Articles" to each article that appeared relevant.
- Cochrane -- "Echocardiography"(Mesh) OR "Echocardiography, Trans-esophageal" (Mesh) OR "Ultrasonography" (Mesh) AND "Cardiopulmonary Resuscitation" (Mesh) OR "Advanced Cardiac Life Support" (Mesh) OR "Death, Sudden, Cardiac" (Mesh).
- Hand search of references of all relevant articles
- Last search: September 2009 yielded 47 papers

• State inclusion and exclusion criteria

Exclusion criteria – not relevant studies, animal studies, reviews, case reports, letters

Inclusion criteria – We searched for all peer-reviewed studies that described the use of ultrasound in cardiac arrest.

• Number of articles/sources meeting criteria for further review:

8

Summary of evidence

Evidence Supporting Clinical Question

Good					
Fair					
Poor					
	1	**2**	**3**	**4**	**5**
Level of evidence					

A = Return of spontaneous circulation
B = Survival of event
C = Survival to hospital discharge
D = Intact neurological survival
E = Other endpoint
Italics = Animal studies

Evidence Neutral to Clinical question

Good					
Fair				**Memtsoudis 2006 (B, C, E)**	**Blaivas 2001 (B)** **Comess 2000 (C, E)** **Salen 2005 (A, B, C, D)** **Salen 2001 (B)** **Tayal 2003 (A,C,E)** **Van Der Wouw 1997 (C, E)**
Poor					**Neindorff 2005 (E)**
	1	**2**	**3**	**4**	**5**
Level of evidence					

A = Return of spontaneous circulation
B = Survival of event
C = Survival to hospital discharge
D = Intact neurological survival
E = Other endpoint
Italics = Animal studies

Evidence Opposing Clinical Question

Good					
Fair					
Poor					
	1	**2**	**3**	**4**	**5**
Level of evidence					

A = Return of spontaneous circulation
B = Survival of event
C = Survival to hospital discharge
D = Intact neurological survival
E = Other endpoint
Italics = Animal studies

REVIEWER'S FINAL COMMENTS AND ASSESSMENT OF BENEFIT / RISK:

Ultrasound has been utilized for diagnostic and procedural guidance at the bedside of the critically ill patient for nearly 3 decades. Unfortunately, few studies have looked at its specific role in guiding the resuscitation of the patient in cardiac arrest. Instead, the research focuses on three primary areas:

1. The use of ultrasound to diagnose treatable causes of cardiac arrest and the prevalence of these conditions (eg. pneumothorax, pericardial effusion, volume depletion, pulmonary embolus). The bulk of studies, however, look at patients who are not in cardiac arrest.
2. The use of ultrasound to guide procedures which maybe performed in the patient in cardiac arrest (eg. central line placement, pericardiocentesis, transvenous pacer placement). Again, the vast majority of studies looking at the use of ultrasound for procedural guidance are done in patients who are not in cardiac arrest.
3. Ultrasound determination of cardiac standstill as an indication to terminate resuscitative efforts. Although these studies are performed in patients in cardiac arrest, the benefits of ultrasound are largely related to decreased resource use and emergency department patient flow, NOT improved patient outcomes.

Although there is great potential for the use of ultrasound to benefit the patient in cardiac arrest, there are no studies confirming improved outcomes at this time. Future research questions might include: Does ultrasound detection of reversible causes of cardiac arrest allow targeted interventions and lead to subsequent improvement in outcomes? Does ultrasound-guidance of invasive procedures during cardiac arrest lead to an outcome benefit? With increasing emphasis on uninterrupted CPR during cardiac resuscitation, is there evidence of harm when ultrasound interrupts compressions and artificial respirations?

Acknowledgements: Thank-you Mark Link and Laurie Morrison for your support and guidance in the preparation of this worksheet.

Citation List

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.

A prospective study looking at a convenience sample of cardiac arrest patients. LOE 5, fair.

2. Comess KA, DeRook FA, Russell ML, et al. The incidence of pulmonary embolism in unexplained sudden cardiac arrest with pulseless electrical activity. Am J Med. Oct 1 2000;109(5):351-356.

A prospective case series of 36 consecutive cardiac arrest patients in the ED. Of the 25 patients with PEA, 9 (36%) had PE diagnosed on TEE (8) or autopsy (1). 2 of these survived to hospital discharge. LOE 5, fair

3. Memtsoudis SG, Rosenberger P, Loffler M, et al. The usefulness of transesophageal echocardiography during intraoperative cardiac arrest in noncardiac surgery. Anesth Analg. Jun 2006;102(6):1653-1657.

A retrospective chart review examining the use of TEE in the resuscitation of intraoperative cardiac arrest. In 22 patients, 19 had a potential cause of arrest identified on TEE and 12 received therapy directed at this pathological process. 7 patients survived to hospital discharge. LOE 4, fair.

4. Niendorff DF, Rassias AJ, Palac R, et al. Rapid cardiac ultrasound of inpatients suffering PEA arrest performed by nonexpert sonographers. Resuscitation. Oct 2005;67(1):81-87.

Very small prospective study in which very few complete ultrasound examinations were completed. LOE 5, poor.

5. Salen P, Melniker L, Chooljian C, et al. Does the presence or absence of sonographically identified cardiac activity predict resuscitation outcomes of cardiac arrest patients? Am J Emerg Med. Jul 2005;23(4):459-462.

Prospective study of a convenience sample of 70 cardiac arrest patients. None of the 59 patients with absence of cardiac activity on cardiac sonography had return of spontaneous circulation. LOE 5, fair.

6. 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. Jun 2001;8(6):610-615.

Prospective study of 102 non-consecutive cardiac arrest patients examining predictive value of cardiac sonography and capnography. LOE 5, fair.

7. Tayal VS, Kline JA. Emergency echocardiography to detect pericardial effusion in patients in PEA and near-PEA states. Resuscitation. Dec 2003;59(3):315-318.

A prospective observational study of patients with PEA arrest who received bedside cardiac echo by an emergency physician. Of 20 patients, 12 had detectable cardiac activity and 8 of these had pericardial effusions. Of these 8 patients, 7 survived to hospital discharge. LOE 5, fair.

8. van der Wouw PA, Koster RW, Delemarre BJ, et al. Diagnostic accuracy of transesophageal echocardiography during cardiopulmonary resuscitation. J Am Coll Cardiol. Sep 1997;30(3):780-783.

Prospective observational study of TEE in patients with cardiac arrest looking for a reversible cause. Of 48 patients, 41 had a sonographic abnormality. LOE 5, fair.