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

Worksheet author(s)
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Date Submitted for review:
28 January 2010
Reviewed in WEBINAR September 9th 2009

Clinical question.

"In adult and pediatric patients with presumed cardiac arrest (pre-hospital or in-hospital) (P), are there any factors/characteristics (I) that increase the likelihood of differentiating between a sudden cardiac arrest (i.e. VF) from other etiologies (e.g. drowning, acute airway obstruction) (O)?"

This question addresses diagnosis? yes
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).

Cochrane
Cardiac arrest in All Fields and drowning in All Fields, in all subjects, in all product types: 12 results
sudden death in All Fields and diagnosis in All Fields, in all subjects, in all product types: 25 results
None of these was relevant to the topic of this worksheet.

Medline search (pubmed)
("Death, Sudden, Cardiac"[Majr] AND "Probability"[Mesh]) AND "Signs and Symptoms"[Mesh] 125 results
("Death, Sudden, Cardiac"[Majr] AND "diagnosis "[Subheading:NoExp]) AND "Probability"[Mesh] 317 results
"Death, Sudden, Cardiac"[Majr] AND "Drowning"[Mesh] 4 results
"Death, Sudden, Cardiac"[Mesh] AND "Drowning"[Mesh] 12 results
"Heart Arrest"[Mesh] AND "Epidemiology"[Mesh] 5 results
"Death, Sudden"[Mesh] AND "Diagnosis"[Mesh]) NOT "Death, Sudden, Cardiac"[Mesh] 4640 results

Medline search (pubmed)
((heart arrest OR cardiac arrest OR sudden cardiac death) AND ("non cardiac" [all fields] )[text] OR ("noncardiac")[all fields]) AND ((prevalence)[all fields Mesh] OR (incidence)[all fields, Mesh] OR (epidemiology)[all fields Mesh])
This resulted in 299 references. Limiting this to out-of-hospital [all fields] resulted in 38 references.

(Heart arrest OR cardiac arrest OR sudden cardiac death)[all fields, Mesh]) AND (autopsy [all fields, Mesh] OR coroners and medical examiners [all fields, Mesh]) AND (risk*[Title/Abstract] OR risk*[MeSH:noexp] OR risk *[MeSH:noexp] OR cohort studies[MeSH Terms] OR group*
Searched via clinical queries: clinical study category, etiology broad sensitive search. This resulted in 396 references.
Manual screening of these results did yielded 7 papers that are relevant to the topic of this worksheet

(respiratory failure) AND ((sudden death) OR (heart arrest) OR (cardiac arrest) OR (sudden cardiac death)) AND (resuscitation) AND ((epidemiology) OR (etiology)): 311 results

(pulmonary embolism) AND ((sudden death) OR (heart arrest) OR (cardiac arrest) OR (sudden cardiac death)) AND (resuscitation) AND ((epidemiology) OR (etiology)): 175 results

Embase
sudden death AND epidemiology: 3 results
sudden death AND etiology: 4 results
Asthma AND resuscitation AND (sudden death OR cardiac arrest OR heart arrest) AND (resuscitation) AND (Embase NOT Medline): 20 results

Scopus
(((cardiac arrest) OR (heart arrest) OR (sudden cardiac death)) OR (sudden death)) AND ((epidemiology) OR (etiology))) AND ("out-of-hospital") AND ("non cardiac"): 3 results, all relevant

Google Scholar forward search: 1 extra result

State inclusion and exclusion criteria
Inclusion: sudden death; diagnosis, cause, etiology, epidemiology, drowning, probability
Exclusion: non-human
Limited to English, German, Dutch, French

Number of articles/sources meeting criteria for further review: 39
# Summary of evidence

## Evidence Supporting Clinical Question

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**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

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## Evidence Opposing Clinical Question

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*Italics = Animal studies*
While there are many studies and reports on other etiologies of cardiac arrest besides a primary cardiac cause, there were almost no studies retrieved that could help increase the likelihood of differentiating between a cardiac cause and these other etiologies.

On study (Courtney, 2005, 57) showed that in out-of-hospital patients with a witnessed cardiac arrest and pulseless electrical activity (PEA) there is over 50% chance that this caused by a pulmonary embolism (PE). Comess (2000, 351) found a PE in 36% of the patients with PEA. Kuisma (1997, 1122) found in a series of 809 patients that 34% had a non-cardiac cause for the cardiac arrest, while Engdahl (2003, 33) reported 25% and Herlitz (2003, 309) reported less than 30%, while Hess (2007, 200) found 22%. Often there is not a problem in establishing a cause, under fairly obvious circumstances, as in drowning or hanging.

Factors that are more often seen in cardiac arrest patients after drowning or airway obstruction are non-shockable rhythm, non-witnessed arrest, younger age, lower central core body temperature and a higher end-tidal CO2 in drowning victims, and more often bystander CPR (Claesson 2008, 381; Grmec 2009, 7).

Other characteristics of drowning or airway obstruction are (hemorrhagic) lung edema, petechial hemorrhage of the conjunctiva and dilation of heart and brain vessels. None of these is sufficiently reliable to differentiate between sudden cardiac arrest and other etiologies.

Non-cardiac causes for cardiac arrest are frequently seen, and these should be considered in the treatment of these patients. Clinical signs may however be insufficiently reliable to differentiate between cardiac and non-cardiac causes for sudden cardiac arrest. Most helpful in differentiating causes for sudden cardiac arrest are cardiac ultrasound and CT scanning of the brain.

Citation List


LOE D4 Poor. Neutral. Case report of two cases and review of literature. This paper discusses (presumed) characteristics of cardiac arrest associated with substance abuse.

LOE D4 Poor. Supporting. Case report. This paper discusses (presumed) characteristics of cardiac arrest associated with emotional stress.


LOE D4 Fair. Supporting. Case series of (near) hanging, some with cardiac arrest. Only 14% of petechial hemorrhage was reported.


LOE D2 Fair. Supporting. Retrospective study of cardiac arrest registry.


LOE D2 Fair. Supporting. Prospective cohort study looking at the incidence (36%) of pulmonary embolism in cardiac arrest patients with PEA.


LOE D1 Fair. Supporting.


LOE D2 Fair. Supporting. Patients with a cardiac arrest of a non-cardiac aetiology differed from the remaining patients by being younger, including more women, less frequently having a witnessed arrest and less frequently being found in ventricular fibrillation/tachycardia


LOE D4 Fair. Supporting. Four cases, showing evidence for the concept that cervical spinal injury can cause cardiac arrest.


LOE D2 Fair. Supporting. The differences between DCA and OHPCA patients were: the DCA patients were younger (46.5 +/- 21.4 vs 62.5 +/- 15.8; p = 0.01), suffered a witnessed cardiac arrest less frequently (9/32 vs 343/528; p = 0.03), were more often found in a nonshockable rhythm (29/32 vs 297/528; p < 0.0001), had a prolonged ambulance response time (11 vs 6 min; p = 0.001), had a relatively better (but not statistically significant) return of spontaneous circulation (ROSC) in the field [22/32 (65%) vs 301/528 (57%); p = 0.33], more of them were admitted to hospital [19/32 (60%) vs 253/528 (48%); p = 0.27]

LOE D3 Fair. Supporting. The proportion of cases with a cardiac aetiology increased with increasing age (P<0.0001)


LOE D4 Fair. Supporting. No clinical factors/characteristics. Incorporating ultrasound to manage cardiac arrest aids in the diagnosis of the most common and easily reversible causes of cardiac arrest not caused by primary ventricular arrhythmia, namely: severe hypovolemia, tension pneumothorax, cardiac tamponade, and massive pulmonary embolus.


LOE D2. Fair. Supporting. Respiratory failure (35.6%), unknown (15.6%), and pulmonary embolism (13.3%) were the most common etiologies. The mean percentage of arrests due to a non-cardiac cause in three sequential time-periods (1995-1999, 2000-2002, 2003-2005) was 9.4%, 20.1% and 37.7%, respectively.


LOE D3 Fair. Supporting. Subarachnoid haemorrhage (SAH) was found in 16.2% of 142 (selected) OHCA survivors. SAH-induced OHCA survivors were significantly more likely to be female, to have experienced a sudden headache, and trended to have achieved return of spontaneous circulation (ROSC) prior to arrival in the emergency department less frequently. Ventricular fibrillation (VF) was significantly less likely to be seen in SAH-induced than SAH-negative OHCA (OR, 0.06; 95% CI, 0.01-0.46).


LOE D2. Fair. Neutral. Prospective study. Trauma, non-traumatic bleeding, intoxication, near drowning and pulmonary embolism were the most common etiologies, of non-cardiac etiology of cardiac arrest, comprising 61.2% of cases. The non-cardiac etiology was suspected pre-hospital in 176 (63.8%) cases; in the remaining cases, the etiology was revealed only after in-hospital investigations or autopsy.


LOE D4. Fair. Neutral. This paper shows that almost 50% of causes of cardiac arrest is of non-cardiac origin. The most common non-cardiac causes of arrest were trauma, intoxication, near-drowning, and hanging.


LOE D4 Fair. Supporting. Retrospective study. Presumed cardiac cause was sensitive (96%) but less specific (77%). Noncardiac causes such as pulmonary embolism, cerebral disorders, or exsanguination were those most frequently overlooked. Asystole occurred significantly more often in patients in whom presumed cause remained undetermined or differed from the definitive cause.


LOE D4 Fair. Supporting. Retrospective study. PE was found as the cause in 60 (4.8%) of 1246 cardiac arrest victims. The initial rhythm diagnosis was pulseless electrical activity in 38 (63%), asystole in 19 (32%), and ventricular fibrillation in 3 (5%) of the patients. Echocardiography is supportive in determining PE as the cause of cardiac arrest.

LOE D4 Fair. Supporting. Common features such as previously known aortic aneurysm, old age, male gender and pulseless electrical activity as initial cardiac rhythm should increase suspicion of aortic dissection.


LOE D4 Fair. Supporting. Study that excluded patients with known cardiac origin for cardiac arrest. CT showed abnormalities in 79%, often influencing treatment or decision to withdraw treatment.


LOE D2 Good. Neutral. Good study, showing insufficient reliability for accurate clinical diagnosis of pediatric cardiac arrest patients.


LOE D2 Good. Supporting. Prospective study, comparing clinical diagnose with post-mortem diagnose.


LOE D3 Fair. Supporting. Patients with an aortic cause of death often had prodromal symptoms (53% 95% CI; 28%-77%) and hemopericardium (47% 95% CI; 23%-72%), were older, and were more likely to have a pulse in the ED, an arrest rhythm of pulseless electrical activity, and an arrest witnessed arrest by a medical provider.


LOE D4 Fair. Neutral. Prospective study, looking at unselected cardiac arrest.


LOE D4 Fair. Neutral. Cardiac causes accounted for cardiac arrest in 56.4%, noncardiac causes 39.3%, and undetermined cause 4.3%.


LOE D4 Fair. Neutral. Four cases of patients with asthma with sudden, unexplained death and no status asthmaticus at time of death.


LOE D4 Fair. Supporting. Post-mortem study. In a highly selected group of sudden deaths, in which there was often a question about cause of death, the rate of initial death certificate accuracy is only one half. Furthermore, coronary artery disease as the cause of death is less than 50%, far less than initial death certificate diagnoses would indicate.

LOE D4 Fair. Neutral. Non-cardiac disease included pulmonary emboli, aortic aneurysms, and intracerebral haemorrhage and caused 89 out of 322 cases (27.6%) deaths.


LOE D4 Fair. Neutral.


LOE D2 Fair. Supporting. Patients with non-cardiac cause for cardiac arrest were younger.


LOE D2 Fair. Neutral. Same cohort of cardiac arrest patients as other study.


LOE D4 Fair. Supporting.


LOE D4 Fair. Neutral. Cohort with only drowning patients.


LOE D4 Fair. Neutral