WORKSHEET for Evidence-Based Review of Science for Veterinary CPCR

1. Basic Demographics

Worksheet author(s)

Debra Liu, DVM Elise Boller, DVM, DACVECC	**Date Submitted for review:** April 26th 2011
[redacted]	[redacted]

2. Clinical question:

MON05: In dogs and cats with suspected cardiac arrest (P), is the evaluation of an ECG (I) vs. assessment for other signs of life (e.g. pupil size, agonal breathing, femoral pulse) (C) a reliable tool for diagnosis of cardiac arrest?(O)

3. Conflict of interest specific to this question:

Do any of the authors listed above have conflict of interest disclosures relevant to this worksheet? None

4. Search strategy (including electronic databases searched):

4a. Databases

1) MEDLINE via PUBMED (performed on April 17th 2011)

- Clinical Queries: Category→Diagnosis; SCOPE→Broad
- Keywords: cardiopulmonary arrest ECG
- Activated limits: Animals, Humans, English, Field (Title/Abstract)
- Yield: 44 items → ***3 relevant items***

2) CAB abstract (1910-2011 Week 14) (performed on April 17th 2011)

- Basic search
- Keywords: cardiopulmonary arrest and resuscitation and ECG electrocardiogram diagnosis
- No inclusion of related terms
- Activated limits: Abstract, English
- Additional limits: Journal, Journal article, Journal issue
- Yield: 54 items → ***3 relevant items***

4b. Other sources

1) GOOGLE SCHOLAR (performed on April 17th 2011)

- Keywords: asystole monitor ECG electrocardiogram cardiopulmonary arrest diagnosis resuscitation
- Yield 1230 items → ***3 relevant items***

2) In addition all references of identified articles and in particular the references of the following relevant review articles were checked:

American Heart Association: Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science 2010;122 (18;S3)
- 2 relevant articles

Plunkett SJ, McMichael M. Cardiopulmonary resuscitation in small animal medicine: an update. J Vet Intern Med 2008;22(1):9-25
- 11 relevant articles

Cole SG, Otto CM, et al. Cardiopulmonary cerebral resuscitation in small animals – a clinical practice review (Part 1). J Vet Emerg Crit Care 2002; 12(4):261-267.
- 5 relevant articles

Cole SG, Otto CM, et al. Cardiopulmonary cerebral resuscitation in small animals – a clinical practice review. Part II J Vet Emerg Crit Care 2003; 13(1):13-23.
- 6 relevant articles

Marks S, Haldane S, et al. Cardiopulmonary cerebral resuscitation: emergency drugs and postresuscitative care. Comp Contin Educ Pract Vet 2004;26(10): 791-799

- 1 relevant article

Holowaychuk M, Martin L. An In-depth look: misconceptions about emergency and critical care: cardiopulmonary cerebral resuscitation, fluid therapy, shock, and trauma. Comp Contin Educ Pract Vet 2006; 420-433

- 1 relevant article

Haldane S, Marks SL. Cardiopulmonary resuscitation: techniques Comp Contin Educ Pract Vet 2004;26(10): 780-790

- 0 relevant article

4c. State inclusion and exclusion criteria for choosing studies and list number of studies excluded per criterion

Inclusion criteria

Peer reviewed journal articles, clinical research

Exclusion criteria

Review, editorials, case reports

4d. Number of articles/sources meeting criteria for further review: 35 articles

5. Summary of evidence

Evidence Supporting Clinical Question

Good						
Fair						
Poor					*MacKie BA 2010 E*	Kempf FC 1984 E
	1	**2**	**3**	**4**	**5**	**6**
Level of evidence (P)						

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

Evidence Neutral to Clinical question

Good						Bajr J 1997 E Ochoa FJ 1998 E
Fair						
Poor				*Waldrop JE 2004 E*		
	1	**2**	**3**	**4**	**5**	**6**
Level of evidence (P)						

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

Evidence Opposing Clinical Question

Good						
Fair						
Poor						Perkins GD 2006 E
	1	**2**	**3**	**4**	**5**	**6**
Level of evidence (P)						

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

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

7. Conclusion

There is little evidence in the veterinary literature that directly speaks to the question of the value of evaluating the ECG vs. other signs of life for diagnosing cardiac arrest. Evidence from 2 LOE 6 studies (Bahr J, #31 and Ochoa FJ #38 in AHA part 10) show that both lay people and health care workers are often not able to perform an accurate pulse check in healthy adults or infants in 10 seconds or less. Both lay people and health care workers do not routinely identify the presence of a pulse when it is present, and often identify a pulse when it is absent. Likewise, abnormal breathing and gasping can be mistaken for a sign that the victim is alive when in fact they are experiencing agonal breathing. One LOE 6 study showed that specific training in recognizing agonal breathing improves the accuracy of checking for signs of circulation as a diagnostic test for cardiac arrest (Perkins GD). Additionally, involuntary muscular activity during cardiac arrest (e.g. myocolonic movements) are not uncommonly mistaken for seizures. So in many instances, institution of CPR is often delayed both by lay people and by health care workers because they believe the patient to be alive. Thus, assessment of the ECG vs. assessment for signs of life alone may add diagnostic accuracy to the problem of diagnosing cardiac arrest.

The opposite problem may also occur: some physical signs such as syncope may be mistaken for cardiac arrest when in fact the patient is alive/has a perfusing rhythm. In these cases, ECG findings would aid in diagnosis. One LOE 4 described use of an implantable loop recorder in dogs with syncope, collapse or intermittent weakness and found a variety of non-arrest rhythms such as slow ventricular escape, SVT, etc (MacKie BA) in these patients who had physical signs that could have been mistaken for cardiac arrest (syncope, collapse). This highlights the importance of ECG monitoring to diagnose CPA.

Evaluation of the anesthetized patient presents a peculiar problem, since on the one hand it is a common setting for CPA and on the other, physical signs of life are very difficult to assess. Although there is little to no evidence that speaks directly to the question, one LOE 4 study (Waldrop JE) described causes and outcomes of cardiac arrest and involved several anesthetized patients where, presumably, the ECG played an instrumental role in diagnosis of CPA since few physical signs would be present because of the anesthetized state of the patient.

Certain rhythms (e.g. pulseless electrical activity, pulseless ventricular tachycardia) may be present and are not associated with a perfusing rhythm. Since CPA is a clinical diagnosis, it is essential that the ECG is not regarded as the sole indicator of life/a perfusing rhythm. There are veterinary papers that describe the incidence of various arrest rhythms but they do not discuss physical sings at the time of arrest and therefore do not address the question at hand. Although it has not been studied in veterinary species, cardiac activity that is premonitory of sudden cardiac arrest has been documented in the human literature via ambulatory electrocardiography (tachycardia, bradycardia, ventricular ectopy), thus monitoring the ECG may elevate the level of awareness of the risk of cardiac arrest for a given patient and thus the likelihood that the team is prepared for institution of CPR (LOE 6 Kempf FC).

Conclusion

- There is little evidence in the human or veterinary literature that speaks directly to the question of whether evaluation of ECG vs. physical signs of life is a reliable tool for diagnosis of cardiac arrest.
- Institution of CPR is often delayed both by lay people and by health care workers because they believe the patient to be alive, based on evaluation of physical signs, which are misinterpreted. Thus, accurate

evaluation for signs of life has to be an integral part of the diagnosis of cardiac arrest, and specific training on accurate pulse identification, recognition of agonal breathing and myoclonic movements may improve the accuracy of the diagnosis.

- There are arrest rhythms that can easily be mistaken for perfusing rhythms, further emphasizing the importance of accurate evaluation of physical signs, which can not be ignored.
- Assessment of the ECG (vs. assessment for signs of life alone) may add accuracy to diagnosing cardiac arrest and may aid in avoiding lethal delays in institution of CPR. It will also enable identification of shockable rhythms. In sum, the use of ECG to clarify the status of a patient with possible clinical signs consistent with cardiac arrest is likely the most accurate way to diagnose cardiac arrest, with the caveat that there are arrest rhythms that can easily be mistaken for perfusing rhythms (e.g. PEA), so physical signs must also be carefully evaluated.

8. Acknowledgement
N/A

9. Citation list

Bajr J, Klingler H, Panzer W, Rode H, Kettler D. Skills of lay people in checking the carotid pulse. *Resuscitation*. 1997;35:23–26.
LOE 6, Quality good, Direction neutral
Abstract: American Heart Association as well as European Resuscitation Council require the carotid pulse check to determine pulselessness in an unconscious victim and to decide whether or not cardiopulmonary resuscitation (CPR) should be initiated. Recent studies on the ability of health professionals to check the carotid pulse have called this diagnostic tool in question and led to discussions. To contribute to this discussion we performed a study to evaluate skills of lay people in checking the carotid pulse. A group of 449 volunteers (most had participated in a first aid course) were asked to check the carotid pulse in a young, healthy, non-obese person by counting aloud the detected pulse rate. Time intervals until correct detection of the carotid pulse were registered. Overall the volunteers needed an average of 9.46 s, ranging from 1 to 70 s. Only 47.4% of the volunteers were able to detect a pulse within 5 s, and 73.7% within 10 s. A level of 95% volunteers detecting the pulse correctly was reached only after 35 s. Based on these findings we conclude that the intervals established for carotid pulse check may be too short and that perhaps the value of pulse check within in the scope of CPR needs to be reconsidered.
Notes/comments: no comment on industry funding

Kempf FC, Josephson MD. Cardiac Arrest Recorded on Ambulatory Electrocardiograms Am J Cardiol 1984;53:1577-1582
LOE 6, Quality poor, Direction supporting
Abstract: To characterize the events that precede and precipitate sudden cardiac death (SCD), the long-term electrocardtograms of 27 patients who had SCD while being monitored were analyzed. In 20 patients, SCD was associated with ventricular tachyarrhythmias (ventricular tachyardia [VT]/ventricular fibrillation [VF]) and in 7 it was associated with bradyarrhythmias. Seventeen of the patients were men and 10 were women. Twenty-one patients had coronary artery disease, 2 had idiopathic dilated cardiomyopathy, 2 had mitral stenosis and 1 patient had mitral valve prolapse. Four patients with VT/VF had a previous nonfatal cardiac arrest. In the 20 patients with tachyarrhythmia-related SCD, 3 or more VT beats always preceded degeneration to VF. In 5 patients, the frequency or complexity of ven- tricular arrhythmias increased in the hour before SCD. In 11 of 20, there was a 20% or greater increase in underlying heart rate in the hour before SCD. The R-on-T phenomenon was observed in 4 patients. The long-short phenomenon initiated VT/VF in 2 patients. Only

2 patients with VT/VF were resuscitated. No patient with bradyarrhythmia-re- lated SCD had manifest atrioventricular block or bundle branch block. Two of 7 patients had an epi- sode of nonsustained bradycardia in the hour before arrest. No patient was resuscitated. In conclusion, VT that degenerates into VF is the most common arrhythmia associated with SCD. VT/VF is frequently preceded by an increase in heart rate and complex ectopy. VT is most often initiated by late ventricular premature complexes. Twenty-five percent of patients who have SCD have associated bradyarrhythmias that may occur without premonitory events.
Notes/comments: this study was included because it documented electrocardiographic premonitory events prior to sudden cardiac death that, with monitoring, may elevate the awareness of risk of CPA. No comment on industry funding.

MacKie BA, Stepien EL. Kellihan HB. Retrospective analysis of an implantable loop recorder for evaluation of syncope, collapse, or intermittent weakness in 23 dogs (2004-2008). *Journal of Veterinary Cardiology* 2010;12:25-33
LOE 5, Quality poor, Direction neutral
Abstract: Objectives: Cardiac arrhythmias as a cause of syncope, collapse, or intermittent weakness can be challenging to diagnose. The purpose of this paper is to retrospectively review the diagnosis and outcome of 23 cases of syncope or collapse in dogs that had a Revealâ Plus ILR recorder placed as part of the diagnostic evaluation. Animals, materials and methods: Medical records of 23 client-owned dogs that were presented for evaluation of syncope, collapse, or intermittent weakness were retrospectively reviewed. Results: Recurrent syncope occurred in 13/23 (57%) and a positive diagnosis of the cause of the event was made in 11/13 (48% of all dogs). Diagnoses included 6/11 with prolonged periods of sinus arrest with slow ventricular escape rate and one each of sub-optimal fixed heart rate by endocardial pacing, high grade second degree atrioventricular block, supraventricular tachycardia, normal ECG during multiple episodes, and high grade second degree atrioventricular block or sinus arrest. Conclusions: The Revealâ Plus ILR device was successful in diagnosing a high percentage of cases of syncope or collapse in which signs recurred and implantation had a low complication rate. The Revealâ Plus ILR device is a useful tool to diagnose the etiology of recurrent syncope, collapse, or intermittent weakness in the dog.
Notes/comments: this study was included because it examined ECG findings in syncopal animals. Syncope is a clinical sign that can be confused with CPA; in this case documentation of a perfusing rhythm would aid in accurate diagnosis of (lack of) CPA. No comment on industry funding.

Ochoa FJ, Ramalle-Gomara E, Carpintero JM, Garcia A, Saralegui I. Competence of health professionals to check the carotid pulse. *Resuscitation*. 1998;37:173–175.
LOE 6, Quality good, Direction neutral
Abstract: Our objective was to establish the proportion of Emergency Room and Intensive Care doctors and nurses able to locate the carotid pulse in less than 5 s, and identify the variables that influence this ability. The method followed was locating the carotid pulse in a healthy male adult volunteer with normal blood pressure in two situations (stretcher or floor) and with the neck in either a neutral or in an extended position. We recorded the gender, age, and previous training in cardiopulmonary resuscitation (CPR) of each participant and the time spent in detecting the pulse in each of the four possible positions. A model of logistic regression was constructed to determine if the patient's position had any influence on the proportion of health workers capable of finding the pulse within 5 s. The average age of the 72 subjects studied was 33.4 years (SD=6.6); 80% of the participants had CPR training. Thirty-one participants (43.1%; CI 95%, 31.4–55.3%) required more than 5 s to detect the pulse, although only three (4.2%; CI 95%, 0.9–11.7%) required more than 10 s. The variable 'no CPR training' was associated with the inability to detect the pulse within 5 s. The detection of the pulse was easier with an extended neck. A significant proportion of nurses and doctors were slow to locate the carotid pulse on a healthy, young volunteer with normal blood pressure. No relation was found between gender or age of the participants. More attention should be given to carotid pulse detection in CPR training. No comment on

industry funding.

Perkins GD, Walker G, Christensen K, et al. Teaching recognition of agonal breathing improves accuracy of diagnosing cardiac arrest. *Resuscitation* 2006;70:432—437
LOE 6, quality poor, direction opposing
Abstract*:* *Objective* - Agonal breathing is present in up to 40% of pre-hospital cardiac arrests and is commonly mistaken as a sign of circulation leading to omission of bystander resuscitation. The aim of this study was to test the hypothesis that specific tuition on agonal breathing improves the accuracy of checking for signs of circulation as a diagnostic test for cardiac arrest.
Methods: First year medical students were randomised to control or intervention groups. The control group were taught standard CPR according to current guidelines. The intervention group received standard CPR training plus specific tuition on the characteristics of agonal breathing. Two weeks after initial training, the students' ability to recognise cardiac arrest was tested using a simulated cardiac arrest victim demonstrating normal, absent or agonal breathing. Diagnostic accuracy, sensitivity and specificity for the decision to start CPR was calculated.
Results: Sixty-four students were equally randomised to intervention and control groups. The intervention group had greater diagnostic accuracy for cardiac arrest compared to the control group (90% versus 78%, P = 0.03). The intervention group were more likely to recognise cardiac arrest correctly and initiate CPR than the control group (sensitivity 90% versus 78%, P = 0.02). The improved results were pre- dominantly due to recognition that agonal breathing is a sign of cardiac arrest (75% intervention group versus 43% control group, P = 0.01).
Conclusion: This study demonstrates improved diagnostic accuracy and sensitivity of ''checking for signs of circulation'' by teaching CPR providers to recognise agonal breathing as a sign of cardiac arrest.
Notes/comments: this study evaluated the effects of training people to more accurately recognize agonal breathing, since many people mistake it for sign that the patient is alive. Being able to accurately check for signs of life and to recognize agonal breathing makes ECG diagnosis. No comment on industry funding.

Waldrop JE, Rozanski EA, Swanke ED, et al. Causes of cardiopulmonary arrest, resuscitation management, and functional outcome in dogs and cats surviving cardiopulmonary arrest. Journal of Veterinary Emergency and Critical Care 2004; 14(1):22-29
LOE 4, Quality poor, Direction neutral
Abstract: Objective: To describe the functional outcome of canine and feline survivors of cardiopulmonary arrest (CPA) and the clinical characteristics surrounding their resuscitation. Design: Retrospective study. Setting: Veterinary teaching hospital. Animals: Client-owned dogs (15) and cats (3) with CPA. Interventions: None. Measurements and main results: Eighteen animals were identified to have survived to discharge following CPA. Cardiopulmonary arrest was associated with anesthesia with or without pre- existing disease in 10 animals, cardiovascular collapse in 5 animals, and chronic disease with an imposed stress in 3 animals. All CPAs were witnessed in the hospital. The most common initial rhythm at CPA was asystole (72%). Return of spontaneous circulation (ROSC) was achieved in less than 15 minutes from the onset of cardiopulmonary cerebral resuscitation (CPCR) in all animals. No animals had a recurrence of CPA after the initial CPA. Animals were of a wide range of ages (0.5–16 years) and breeds. Two animals were neurologically abnormal at discharge, one of which was normal at 2 months following CPA. Conclusions: A good functional recovery after CPCR was documented in the small number of CPA survivors presented in this study. This may be due to the reversible nature of their inciting cause of CPA, early detections of CPA ('witnessed'), and/or the animal's underlying normal health status.
Notes/comments: many of the survivors of CPA in this series arrested under anesthesia where, presumably, physical signs of life were more difficult to appreciate, thus reliance on ECG findings may have played a more important role in diagnosis of CPA. No comment on industry funding.