WORKSHEET for Evidence-Based Review of Science for Veterinary CPCR

1. Basic Demographics

Worksheet author(s)

Kate Hopper	**Date Submitted for review:**

[redacted]

2. Clinical question:

In dogs and cats with cardiac arrest (P), does the use of any other specific timing for interruptions to chest compressions to diagnose the rhythm (I), as apposed to the recommended technique of every 2 minutes (C), improve outcome (eg. ROSC, survival)(O)?

3. Conflict of interest specific to this question:

None

4. Search strategy (including electronic databases searched):

4a. Databases

Pubmed (NLM) (no date restriction) (performed on July 6, 2011)
1. cpr
2. interruptions
3. pause
4. rhythm check

1 and 2: 2 relevant hits out of 76 total hits
1 and 3: 1 relevant hits out of 22 total hits
1 and 4: 0 relevant hits out of 8 total hits

Cab Abstracts (1910 to Feb 2011) (performed on June 10, 2011)
(1) Chest compression
(2) Fatigue
(3) Timing
(1) No relevant hits
(2) No relevant hits
(1) and (3) no relevant hits
(2) and (3) no relevant hits

Google Scholar
Chest compressions AND fatigue – 2 additional relevant hits

4b. Other sources

In addition the references of the review articles Berg 2010 were searched and this revealed two more relevant articles.

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

Inclusion criteria

Evaluation of impact of interruptions to CPR on hemodynamic performance or outcome from CPR

Exclusion criteria

Abstract only, non-English articles.

4d. Number of articles/sources meeting criteria for further review: 5

Two human clinical studies (Kellum 2008; Mosier 2010) and three experimental pig studies (Kern 1998; Berg 2001; Kern 2002)

5. Summary of evidence

Evidence Supporting Clinical Question

Good						
Fair						
Poor						
	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						
Fair						
Poor						
	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						***Kern 1998***; *E = CPP* ***Berg 2001***; *E = CPP* ***Kern 2002***: *A, D* ***Mosier 2010***; *C, D* ***Kellum 2008***; *C, D*
Poor						
	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
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6. REVIEWER'S FINAL COMMENTS AND ASSESSMENT OF BENEFIT / RISK:

There are no animal or human studies that specifically address the optimal duration of CPR before pausing to assess the rhythm. There is evidence that the frequency and duration of interruptions to chest compressions can impact the outcome from CPR. In experimental pig studies it has been shown that it takes approximately 60 seconds of continuous chest compressions to build up maximal coronary perfusion pressure (CPP) and pauses in chest compressions are associated with immediate decreases in CPP (Kern 1998; Berg 2001).

There is some evidence from human clinical trials that a period of BLS CPR is beneficial prior to performing a rhythm check. In a prospective, observational analysis of witnessed arrests, providing 2 minute (200 chest compressions at 100 compressions per minute) blocks of uninterrupted chest compressions, only pausing to perform a rhythm check ± defibrillation, was associated with significant improvement in survival and neurological state when compared to a cohort of patients treated using the 2000 AHA guidelines (Kellum 2008). Mosier et al. reported similar results in a retrospective analysis of the use of the same protocol (Mosier 2010). Unfortunately no randomized controlled trial has been performed to address this issue.

There is insufficient information to determine the optimal timing for interrupting CPR in order to assess the rhythm. Given the negative hemodynamic effects of interrupting chest compressions and the supportive evidence from human clinical trials, the current recommendation of maintaining continuous chest compressions for 2 minutes before a rhythm check is reasonable. As ventricular fibrillation and optimal timing of defibrillation is a major focus of the human studies on this issue, canine and feline specific research would be important to validate these findings for veterinary patients.

7. Conclusion

DISCLAIMER: Potential possible wording for a Consensus on Science Statement. Final wording will differ due to other input and discussion.
CONSENSUS ON SCIENCE: There are no animal or human studies directly addressing this issue. Two experimental pig studies (LOE 6) (Kern 1998; Berg 2001; Kern 2002) demonstrated the negative hemodynamic effects of interrupting chest compressions. One of these studies also found it took approximately 60 seconds of uninterrupted chest compressions to generate maximal CPP (LOE 6) (Kern 1998). Human clinical trials suggest that 2 minutes of uninterrupted chest compressions before checking the rhythm is beneficial (LOE 6) (Kellum 2008; Mosier 2010) to survival and neurological outcome compared to more frequent interruptions to check the rhythm. There is insufficient information to determine the optimal timing for interrupting CPR in order to assess the rhythm.

8. Acknowledgement

9. Citation list

Cardiocerebral resuscitation is associated with improved survival and neurologic outcome from out-of-hospital cardiac arrest in elders.
Mosier J, Itty A, Sanders A, Mohler J, Wendel C, Poulsen J, Shellenberger J, Clark L, Bobrow B.
Acad Emerg Med. 2010;17(3):269-75.

BACKGROUND:
Recent studies have shown that a new emergency medical services (EMS) protocol for treating patients who suffer out-of-hospital cardiac arrest (OHCA), cardiocerebral resuscitation (CCR), significantly improves survival compared to standard advanced life support (ALS). However, due to their different physiology, it is unclear if all elders, or any subsets of elders who are OHCA victims, would benefit from the CCR protocol.
OBJECTIVES:
The objectives of this analysis were to compare survival by age group for patients receiving CCR and ALS, to evaluate their neurologic outcome, and to determine what other factors affect survival in the subset of patients who do receive CCR.
METHODS:
An analysis was performed of 3,515 OHCAs occurring between January 2005 and September 2008 in the Save Hearts in Arizona Registry. A total of 1,024 of these patients received CCR. Pediatric patients and arrests due to drowning, respiratory, or traumatic causes were excluded. The registry included data from 62 EMS agencies, some of which instituted CCR. Outcome measures included survival to hospital discharge and cerebral performance category (CPC) scores. Logistic regression evaluated outcomes in patients who received CCR versus standard ALS across age groups, adjusted for known potential confounders, including bystander cardiopulmonary resuscitation (CPR), witnessed arrest, EMS dispatch-to-arrival time, ventricular fibrillation (Vfib), and agonal respirations on EMS arrival. Predictors of survival evaluated included age, sex, location, bystander CPR, witnessed arrest, Vfib/ventricular tachycardia (Vtach), response time, and agonal breathing, based on bivariate results. Backward stepwise selection was used to confirm predictors of survival. These predictors were then analyzed with logistic regression by age category per 10 years of age.
RESULTS:
Individuals who received CCR had better outcomes across age groups. The increase in survival for the subgroup with a witnessed Vfib was most prominent on those<40 years of age (3.7% for standard ALS patients vs. 19% for CCR patients, odds ratio [OR]=5.94, 95% confidence interval [CI]=1.82 to 19.26). This mortality benefit declined with age until the >or=80 years age group, which regained the benefit (1.8% vs. 4.6%, OR=2.56, 95% CI=1.10 to 5.97). Neurologic outcomes were also better in the patients who received CCR (OR=6.64, 95% CI=1.31 to 32.8). Within the subgroup that received CCR, the factors most predictive of improved survival included witnessed arrest, initial rhythm of Vfib/Vtach, agonal respirations upon arrival, EMS response time, and age. Neurologic outcome was not adversely affected by age.
CONCLUSIONS:
Cardiocerebral resuscitation is associated with better survival from OHCA in most age groups. The majority of patients in all age groups who survived to hospital discharge and who could be reached for follow-up had good neurologic outcome. Among patients receiving CCR for OHCA, witnessed arrest, Vfib/Vtach, agonal respirations, and early response time are significant predictors of survival, and these do not change significantly based on age.
Key Points: LOE 6, opposing, fair: Retrospective study of human clinical CPR patients which found the use of uninterrupted chest compressions for 2 minute periods and minimal duration of interruptions for a rhythm check ± defibrillation was associated with increased survival and neurological state.

Cardiocerebral resuscitation improves neurologically intact survival of patients with out-of-hospital cardiac arrest.

Kellum MJ, Kennedy KW, Barney R, Keilhauer FA, Bellino M, Zuercher M, Ewy GA.
Ann Emerg Med. 2008;52(3):244-52.

STUDY OBJECTIVE:
In an effort to improve neurologically normal survival of victims of cardiac arrest, a new out-of-hospital protocol was implemented by the emergency medical system medical directors in 2 south-central rural Wisconsin counties. The project was undertaken because the existing guidelines for care of such patients, despite their international scope and periodic updates, had not substantially improved survival rates for such patients during nearly 4 decades.
METHODS:
The neurologic status at or shortly after discharge was documented for adult patients with a witnessed collapse and an initially shockable rhythm. Patients during two 3-year periods were compared. During the 2001 through 2003 period, in which the 2000 American Heart Association guidelines were used, data were collected retrospectively. During the mid-2004 through mid-2007 period, patients were treated according to the principles of cardiocerebral resuscitation. Data for these patients were collected prospectively. Cerebral performance category scores were used to define the neurologic status of survivors, and a score of 1 was considered as "intact" survival.
RESULTS:

In the 3 years preceding the change in protocol, there were 92 witnessed arrests with an initially shockable rhythm. Eighteen patients survived (20%) and 14 (15%) were neurologically intact. During the 3 years after implementation of the new protocol, there were 89 such patients. Forty-two (47%) survived and 35 (39%) were neurologically intact.

CONCLUSION:

In adult patients with a witnessed cardiac arrest and an initially shockable rhythm, implementation of an out-of-hospital treatment protocol based on the principles of cardiocerebral resuscitation was associated with a dramatic improvement in neurologically intact survival.

Key Points: LOE 6, opposing, fair: A human clinical trial of 2 minute periods of uninterrupted chest compressions, only pausing to check the rhythm ± defibrillation was associated with improved survival and neurological outcome, when compared to the outcomes from cpr of the 3 previous years when a protocol with more interruptions was utilized.

Adverse hemodynamic effects of interrupting chest compressions for rescue breathing during cardiopulmonary resuscitation for ventricular fibrillation cardiac arrest.

Berg RA, Sanders AB, Kern KB, Hilwig RW, Heidenreich JW, Porter ME, Ewy GA.
Circulation. 2001;104(20):2465-70.

BACKGROUND:

Despite improving arterial oxygen saturation and pH, bystander cardiopulmonary resuscitation (CPR) with chest compressions plus rescue breathing (CC+RB) has not improved survival from ventricular fibrillation (VF) compared with chest compressions alone (CC) in numerous animal models and 2 clinical investigations.

METHODS AND RESULTS:

After 3 minutes of untreated VF, 14 swine (32+/-1 kg) were randomly assigned to receive CC+RB or CC for 12 minutes, followed by advanced cardiac life support. All 14 animals survived 24 hours, 13 with good neurological outcome. For the CC+RB group, the aortic relaxation pressures routinely decreased during the 2 rescue breaths. Therefore, the mean coronary perfusion pressure of the first 2 compressions in each compression cycle was lower than those of the final 2 compressions (14+/-1 versus 21+/-2 mm Hg, P<0.001). During each minute of CPR, the number of chest compressions was also lower in the CC+RB group (62+/-1 versus 92+/-1 compressions, P<0.001). Consequently, the integrated coronary perfusion pressure was lower with CC+RB during each minute of CPR (P<0.05 for the first 8 minutes). Moreover, at 2 to 5 minutes of CPR, the median left ventricular blood flow by fluorescent microsphere technique was 60 mL. 100 g(-1). min(-1) with CC+RB versus 96 mL. 100 g(-1). min(-1) with CC, P<0.05. Because the arterial oxygen saturation was higher with CC+RB, the left ventricular myocardial oxygen delivery did not differ.

CONCLUSIONS:

Interrupting chest compressions for rescue breathing can adversely affect hemodynamics during CPR for VF.

Key Points: LOE 6, opposing, fair: Experimental pig study showing that CPP was higher when chest compressions were provided without interruption for ventilation. When chest compressions were paused for ventilations aortic diastolic pressure decreased immediately.

Importance of continuous chest compressions during cardiopulmonary resuscitation: improved outcome during a simulated single lay-rescuer scenario.

Kern KB, Hilwig RW, Berg RA, Sanders AB, Ewy GA.
Circulation. 2002;105(5):645-9.

BACKGROUND:

Interruptions to chest compression-generated blood flow during cardiopulmonary resuscitation (CPR) are detrimental. Data show that such interruptions for mouth-to-mouth ventilation require a period of "rebuilding" of coronary perfusion pressure to obtain the level achieved before the interruption. Whether such hemodynamic compromise from pausing to ventilate is enough to affect outcome is unknown.

METHODS AND RESULTS:

Thirty swine (weight 35 +/- 2 kg) underwent 3 minutes of untreated ventricular fibrillation before 12 minutes of basic life support CPR. Animals were randomized to receive either standard airway (A), breathing (B), and compression (C) CPR with expired-gas ventilation in a 15:2 compression-to-ventilation ratio or continuous chest compression CPR. Those randomized to the standard 15:2 group had no chest compressions for a period of 16 seconds each time the 2 ventilations were delivered. Defibrillation was attempted at 15 minutes of cardiac arrest. All resuscitated animals were supported in an intensive care environment for 1 hour, then in a

maintenance facility for 24 hours. The primary end point of neurologically normal 24-hour survival was significantly better in the experimental group receiving continuous chest compression CPR (12 of 15 versus 2 of 15; P<0.0001).
CONCLUSIONS:
Mouth-to-mouth ventilation performed by single layperson rescuers produces substantial interruptions in chest compression-supported circulation. Continuous chest compression CPR produces greater neurologically normal 24-hour survival than standard ABC CPR when performed in a clinically realistic fashion. Any technique that minimizes lengthy interruptions of chest compressions during the first 10 to 15 minutes of basic life support should be given serious consideration in future efforts to improve outcome results from cardiac arrest.
Key Points: LOE 6, opposing, fair: An experimental pig study which found that interruptions to chest compressions to provide ventilation was associated with a lower rate of ROSC and a poorer neurological outcome at 24 hours.

Efficacy of chest compression-only BLS CPR in the presence of an occluded airway.

Kern KB, Hilwig RW, Berg RA, Ewy GA.
Resuscitation. 1998;39(3):179-88.

Abstract
Reluctance of the lay public to perform bystander CPR is becoming an increasingly worrisome problem in the USA. Most bystanders who admit such reluctance concede that fear of contagious disease from mouth-to-mouth contact is what keeps them from performing basic life support. Animal models of prehospital cardiac arrest indicates that 24-h survival is essentially as good with chest compression-only CPR as with chest compressions and assisted ventilation. This simpler technique is an attractive alternative strategy for encouraging more bystander participation. Such experimental studies have been criticized as irrelevant however secondary to differences between human and porcine airway mechanics. This study examined the effect of chest compression-only CPR under the worst possible circumstances where the airway was totally occluded. After 6 min of either standard CPR including ventilation with a patent airway or chest compressions-only with a totally occluded airway, no difference in 24 h survival was found (10/10 vs. 9/10). As anticipated arterial blood gases were not as good, but hemodynamics produced were better with chest compression-only CPR ($P < 0.05$). Chest compression-only CPR, even with a totally occluded airway, is as good as standard CPR for successful outcome following 6.5 min of cardiac arrest. Such a strategy for the first minutes of cardiac arrest, particularly before professional help arrives, has several advantages including increased acceptability to the lay public.
Key Points: LOE 6, opposing, fair: An experimental pig study that showed it takes approximately 60 seconds of uninterrupted chest compressions to build up maximal CPP and that pausing chest compressions is associated with an immediate decline in CPP.