WORKSHEET for Evidence-Based Review of Science for Veterinary CPCR

1. Basic Demographics

Worksheet author(s)

[redacted]

2. Clinical question:

In dogs and cats with cardiac arrest (P), does the use of compressions first (CAB) (I) compared with ventilations first (ABC) (C), improve outcome (eg. ROSC, survival) (O)?

3. Conflict of interest specific to this question:

The authors do not have any conflict of interest specific to the above clinical question.

4. Search strategy (including electronic databases searched):

4a. Databases

PUBMED – Performed on April 26th, 2011, no relevant article amongst 228 retrieved.

1. CAB
2. ABC
3. CPR
4. Dog
5. Chest compression
6. Cardiopulmonary arrest
7. Cardiac arrest
8. Chest compression first

- 1 AND 2 AND 3: 5 articles evaluated.
- 3 AND 4 AND 5: 18 articles evaluated.
- 1 AND 6: 21 articles evaluated.
- 1 AND 7: 22 articles evaluated.
- 7 AND 8: 134 articles evaluated.

WEB OF SCIENCE – Backward and forward searches were performed for *Meursing, Wulterkens et al. 2005*: no relevant article retrieved.

4b. Other sources

Pertinent references from *Meursing, Wulterkens et al. 2005, Khalid, Juma 2010*, *Corral 1999*, *Berg, Hemphill et al. 2010*, were reviewed with no additional relevant hit.

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

Inclusion criteria – Articles in peer-reviewed literature.

Exclusion criteria – Non English articles, abstracts only.

4d. Number of articles/sources meeting criteria for further review: None.

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		Donald 1999, E				*Berg 1993, ABD* *Eftestol 2002, E* *Hallstrom 2000, CD* *Waalewijn 2001, ABC*
Fair						*Babbs, 2002 E* *Clark 1992, E* *Belgian cerebral resuscitation study group 1993, ABC* *Steen 2003, AE* *Turner 2002, E*
Poor		Mithoefer 1967, E				
	1	**2**	**3**	**4**	**5**	**6**
Level of evidence (P)						

A = Return of spontaneous circulation
C = Survival to hospital discharge
E = Other endpoint

B = Survival of event D = Intact neurological survival *Italics = Non-target species studies*

Evidence Opposing Clinical Question

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

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

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

No direct evidence could be gathered in order to address whether or not chest compressions should be initiated prior to endotracheal intubation during CPR (CAB vs. ABC) in veterinary patients. Review of the literature re-emphasized the importance of uninterrupted chest compression during CPR in order to improve chances of ROSC. Some studies addressed the delay in initiation of chest compressions due to prolonged intubation time (*Heidenreich, Higdon et al. 2004*, *Wang, Simeone 2009*) or misinterpretation of agonal breaths (*Clark, Larsen et al. 1992*) and discussed its potential negative impact on ROSC. The American Heart Association 2010 guidelines (*Hemphill et al. 2010)* justified the change from ABC to CAB with the following statement: "*While no published human or animal evidence demonstrates that starting CPR with 30 compressions rather than 2 ventilations leads to improved outcomes, it is clear that blood flow depends on chest compressions. Therefore, delays in, and interruptions of, chest compressions should be minimized throughout the entire resuscitation. Moreover, chest compressions can be started almost immediately, while positioning the head, achieving a seal for mouth-to-mouth rescue breathing, and getting a bag-mask apparatus for rescue breathing all take time. Beginning CPR with 30 compressions rather than 2 ventilations leads to a shorter delay to first compression"*. It is important to note that most of those studies are conducted in the setting of ventricular fibrillation cardio-pulmonary arrest with non hypoxemic patients.

7. Conclusion

No evidence-based conclusion can be made regarding whether or not the use of compressions first (CAB) compared with ventilations first (ABC) resuscitation methods would improve outcome (eg. ROSC, survival). Nonetheless, review of the literature demonstrates that delaying chest compression while establishing an airway can be detrimental. Intubation should therefore be performed in a timely fashion if an ABC approach is used during CPR. If chest compressions are performed in lateral recumbency, intubation in lateral recumbency while chest compressions are performed should be considered, especially in non-hypoxemic arrest situations.

In situations in which alveolar partial pressure of oxygen is deemed likely to have been below normal prior to arrest, the authors' recommendation is that a traditional ABC approach to CPCR be taken whenever possible. In veterinary medicine, such conditions might be found in patients experiencing drowning/near-drowning, asphyxiation from any cause, severe airway obstruction or other causes of hypoventilation while breathing ambient air, smoke inhalation, or anesthetic circuit/artificial gas delivery system-related adverse events.

The worksheet authors would advise that the CAB approach be taken when single responder CPCR is initiated while awaiting the arrival of additional personnel. Similarly, for bystander/layperson CPCR a CAB or compression-only approach to resuscitation would appear defensible and at times appropriate.

8. Acknowledgement

None.

9. Citation list

BABBS, C. F. KERN, K. B. 2002. Optimum compression to ventilation ratios in CPR under realistic, practical conditions: a physiological and mathematical analysis. *Resuscitation,* 54**,** 147-57.
LOE 6, quality fair, neutral. Using Monte Carlo simulations, this study investigates the appropriate compression-to-ventilation ratio during human CPR. The results of the study support high ratios. The authors

emphasize the importance of chest compressions but also acknowledge the importance of intubation in hypoxemic cardiac arrest. No comment about industry funding.

BERG, R.A., KERN, K.B., SANDERS, A.B., OTTO, C.W., HILWIG, R.W., EWY, G.A. 1993. Bystander cardiopulmonary resuscitation. Is ventilation necessary? *Circulation,* 88**,** 1907-15.
LOE 6, quality good, neutral. This study uses a pig model of ventricular fibrillation-induced cardio-pulmonary arrest. The authors conclude that there was no difference in ROSC, 24 hours survival and neurological outcome when comparing chest compression plus ventilation and chest compression only CPR techniques. Relevant to our question, this study adds some support to the concept that because of the potential for misinterpretation of agonal breathing as normal respiration (potentially leading to delay in CPR initiation), a CBA approach might be safer for the patient. No comment about industry funding.

CLARK, J. J., LARSEN, M. P., CULLEY, L. L., GRAVES, J. R. & EISENBERG, M. S. 1992. Incidence of agonal respirations in sudden cardiac arrest. *Ann Emerg Med,* 21**,** 1464-7.
LOE 6, quality fair, neutral. This retrospective study demonstrates a 40% incidence of agonal breathes in out-of-hospital, non-traumatic cardiac arrest. This number increases to 46% for arrest caused by cardiac disease. Relevant to this question, the study raises the concern for misinterpretation of agonal respirations as normal respiration and therefore delay in initiation of chest compression in the standard ABC approach compared to CBA. No comment about industry funding.

EFTESTOL, T., SUNDE, K. & STEEN, P. A. 2002. Effects of interrupting precordial compressions on the calculated probability of defibrillation success during out-of-hospital cardiac arrest. *Circulation,* 105**,** 2270-3.
LOE 6, quality good, neutral. Observational, prospective study evaluating the change in probability of ROSC (based on ECG analysis) with increasing time between interruption of chest compressions and defibrillation, in human patients with ventricular fibrillation. They conclude that after interruption of chest compressions, defibrillation, if required, should be performed as early as possible. Study partially supported by the Laerdal Foundation for Acute Medicine.

HALLSTROM, A., COBB, L., JOHNSON, E., COPASS, M. 2000. Cardiopulmonary resuscitation by chest compression alone or with mouth-to-mouth ventilation. *N Engl J Med.,* 342**,** 1546-53.
LOE 6, quality good, neutral. Prospective randomized study based on an emergency medical care system with central dispatching. Upon phone contact with the dispatcher, the lay rescuer witnessing a cardio-pulmonary arrest was, if willing to do so, randomized to perform either chest compression alone or chest compressions plus mouth-to-mouth ventilation. Guidance for "hands only" CPR required 1.4 minutes less than for chest compression plus ventilation. There was no difference in survival rate. Importantly, patients in this study were excluded if a primary ventilatory failure was suspected. No comment about industry funding.

MITHOEFER, J. C., MEAD, G., HUGHES, J. M., ILIFF, L. D. & CAMPBELL, E. J. 1967. A method of distinguishing death due to cardiac arrest from asphyxia. *Lancet,* 2**,** 654-6.
LOE 3, quality poor, neutral. In this multicenter report, the authors compared the oxygen partial pressure in the left ventricle in dogs that had either primary respiratory arrest or cardiac arrest. There was a large degree of heterogeneity in their protocols. Dogs with cardiac arrest without prior hypoxemia had arterial oxygen partial pressure of oxygen above 40 mmHg in the first 10 minutes after death. Furthermore, they showed that 6 dogs with cardiac arrest without prior hypoxemia would tend to have oxygen arterial partial pressures in the left ventricle above 50 mmHg up to one hour after death. No comment about industry funding.

SHAFFNER, D. H., ELEFF, S. M., BRAMBRINK, A. M., SUGIMOTO, H., IZUTA, M., KOEHLER, R. C. & TRAYSTMAN, R. J. 1999. Effect of arrest time and cerebral perfusion pressure during cardiopulmonary resuscitation on cerebral blood flow, metabolism, adenosine triphosphate recovery, and pH in dogs. *Crit Care Med,* 27**,** 1335-42.
LOE 3, quality good to fair, neutral. In this study, 24 anesthetized and oro-tracheally intubated dogs are used as a CPR following ventricular fibrillation model. The results underline the importance of early (6 *vs.* 12 minutes) initiation of chest compression and also the effect of cerebral perfusion pressure on resistance to reflow following ROSC. The animals were anesthetized and intubated prior to induction of ventricular fibrillation; therefore this study does not directly address the question. No comment about industry funding.

STEEN, S., LIAO, Q., PIERRE, L., PASKEVICIUS, A. & SJOBERG, T. 2003. The critical importance of minimal delay between chest compressions and subsequent defibrillation: a haemodynamic explanation. *Resuscitation,* 58**,** 249-58.
LOE 6, quality fair, neutral. This study uses a swine model of ventricular fibrillation (18 pigs). The outcomes evaluated are successful defibrillation and ROSC. The results emphasize the superiority of uninterrupted CPR prior to defibrillation over defibrillation alone or CPR interrupted for 40 seconds prior to defibrillation. The animals were anesthetized and intubated prior to induction of ventricular fibrillation; therefore this study does not directly address the question. No comment about industry funding.

TURNER, I., TURNER, S. & ARMSTRONG, V. 2002. Does the compression to ventilation ratio affect the quality of CPR: a simulation study. *Resuscitation,* 52**,** 55-62.
LOE 6, quality fair, neutral. This study uses a mathematical model of CPR to investigate the appropriate compression to ventilation ratio during CPR. Relevant to this question, during the first two minutes of CPR, the authors found that a chest-compression-only approach created the best tissue oxygen delivery compared to other techniques (with various compression-to-ventilation ratios). This study used normal blood gas values prior to cardiac arrest. No comment about industry funding.

VAN HOEYWEGHEN, R. J., BOSSAERT, L. L., MULLIE, A., CALLE, P., MARTENS, P., BUYLAERT, W. A. & DELOOZ, H. 1993. Quality and efficiency of bystander CPR. Belgian Cerebral Resuscitation Study Group. *Resuscitation,* 26**,** 47-52.
LOE 6, quality fair, neutral. The results of this study underline the positive impact of well-performed bystander CPR in out of hospital cardiac arrests. The chest-compression-only approach seemed to not impact outcome. No comment about industry funding.

WAALEWIJN, R. A., TIJSSEN, J. G. & KOSTER, R. W. 2001. Bystander initiated actions in out-of-hospital cardiopulmonary resuscitation: results from the Amsterdam Resuscitation Study (ARRESUST). *Resuscitation,* 50**,** 273-9.
LOE 6, quality good, neutral. This prospective observational study evaluates bystander-initiated CPR in out of hospital cardiac arrests. Their main findings support the beneficial effect of early start of CPR after recognition of cardio-pulmonary arrest, with better outcomes achieved with training and experience. Relevant to our question, regarding hospital discharge, they did not find a significant difference between chest compression + ventilation CPR and chest-compression-only CPR (but the last group had a small number of patients). No comment about industry funding.