WORKSHEET for Evidence-Based Review of Science for Veterinary CPCR

1. Basic Demographics

Worksheet author(s)

Kate Hopper	**Date Submitted for review:**
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2. Clinical question:

In dogs and cats with cardiac arrest (P), does performing chest compressions with the animal in dorsal recumbency (I) compared to lateral recumbency (C), improve outcome (O) (eg. ROSC, survival)?

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

Pubmed (NLM) (no date restriction) (performed on June 10, 2011) textword search:
1. chest compressions
2. position
3. technique
4. cpr
5. dog
6. cat

1 and 2: 0 relevant hits out of 55 total hits
1 and 3: 0 relevant hits out of 99 total hits
1 and 4: 2 relevant hits out of 794 total hits
1 and 5: 1 relevant hits out of 593 total hits
1 and 6: 0 relevant hits out of 36 total hits

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

4b. Other sources

Google Scholar

Chest compressions AND dogs AND lateral – no additional relevant hits
In addition all references of identified articles were checked, no additional relevant hits were identified.

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

Inclusion criteria

Closed chest cpr performed in lateral and dorsal recumbency in animals

Exclusion criteria

Articles without a comparison group, non English language articles, review articles or abstracts only.

4d. Number of articles/sources meeting criteria for further review: 13

Two relevant experimental animal studies were identified (Maier 1984; Bellamy 1984)
One relevant retrospective study of clinical veterinary patients (Hofmeister 2009)

5. Summary of evidence

Evidence Supporting Clinical Question

Good						
Fair						
Poor			**Maier 1984;** E = aortic flow & LV pressure	**Hofmeister 2009;** A		
	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						***Bellamy 1984;*** *E = CO & coronary blood flow*
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						
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

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

In clinical veterinary medicine chest compressions are most commonly performed with the animal in lateral recumbency although the majority of experimental animal studies on cpr are performed with the animals in dorsal recumbency. Unfortunately there has been very little research performed to compare the relative performance of chest compressions in these two body positions.

The one experimental dog study identified reported higher left ventricular pressures and aortic flow when manual compressions were delivered with the dogs in lateral compared to sternal recumbency (Maier, 1984). Unfortunately no raw data or statistical analysis was provided, just a statement that these measurements were increased. This study also reported an observation that cardiac chambers seemed to have greater change in dimension when compressions were performed in lateral recumbency. Given the weakness of this evidence no major conclusions can be drawn. A prospective observational study of cardiopulmonary resuscitation in clinical veterinary patients found that lateral chest compressions were associated with a higher likelihood of return of spontaneous circulation in dogs and cats (Hofmeister, 2009). As this was a non-randomized observational study and lateral chest compressions were performed in a far greater number of animals (88%) than sternal compressions (12%) it is unknown if the body position during CPR directly impacted outcome.

An experimental pig study compared mechanical chest compressions between lateral and dorsal recumbency in three animals and found no difference in cardiac output or coronary blood flow (Bellamy, 1984). All three animals received two cycles of both lateral and sternal chest compressions in a non-randomized order (lateral-sternal-lateral-sternal). The authors reported greater thoracic trauma in this group of animals compared to those that just received lateral chest compressions. Given the small number of animals in this experiment, the non-randomized order of chest compressions and the use of a mechanical thumper these results have limited value.

There is insufficient evidence at this time to support a recommendation regarding the best body position for chest compressions in dogs and cats.

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: One experimental dog study (LOE 3) reported better hemodynamic performance of manual chest compressions with animals in lateral recumbency compared to dorsal recumbency (Maier 1984) but the results provided were weak. One non-randomized observational study in clinical veterinary patients (LOE 4) reported that lateral chest compressions were associated with a greater likelihood of return of spontaneous circulation in dogs (Hofmeister 2009). An experimental pig study (LOE 6) compared mechanical lateral chest compressions with sternal compressions in three animals and found no difference in hemodynamic performance (Bellamy, 1984). As only three studies could be identified and they all have substantial weaknesses, no conclusions can be made regarding the best body position for chest compressions in dogs and cats.

8. Acknowledgement

9. Citation list

Maier GW, Tyson GS Jr, Olsen CO, Kernstein KH, Davis JW, Conn EH, Sabiston DC Jr, Rankin JS.

The physiology of external cardiac massage: high-impulse cardiopulmonary resuscitation.

Circulation. 1984 Jul;70(1):86-101.

Abstract

In intact chronically instrumented dogs, left ventricular dynamics were studied during cardiopulmonary resuscitation (CPR). Electromagnetic flow probes measured cardiac output and coronary blood flow, ultrasonic transducers measured cardiac dimensions, and micromanometers measured left ventricular, right ventricular, aortic, and intrathoracic pressures. The dogs were anesthetized with morphine, intubated, and fibrillated by rapid ventricular pacing. Data were obtained during manual external massage with dogs in the lateral and supine positions. Force of compression was varied from a peak intrathoracic pressure of 10 to 30 mm Hg, and compression rate was varied from 60 to 150/min. Increasing force of compression increased stroke volume up to a peak intrathoracic pressure of approximately 20 mm Hg, beyond which stroke volume remained constant or declined. Stroke volume appeared to result primarily from direct transmission of manual compression force to the heart rather than from positive intrathoracic pressure because peak cardiac or vascular pressures or the change in these pressures were consistently two to four times greater than the corresponding intrathoracic pressures during manual compression. With increasing compression rate, stroke volume remained relatively constant, and total cardiac output increased significantly: 425 +/- 92 ml/min at 60/min, 643 +/- 130 ml/min at 100/min, and 975 +/- 219 ml/min at 150/min (p less than .05). Left ventricular dimensions decreased minimally at higher manual compression rates. In four patients undergoing CPR, systolic and diastolic arterial blood pressure increased with faster compression rates, correlating well with data obtained in the dog. Dynamic coronary blood flow in canine experiments decreased to zero or negative values during compression. Antegrade coronary flow occurred primarily during noncompression periods and seemed to be related to diastolic aortic perfusion pressure; coronary flow at a compression rate of 150/min averaged 75% of control. Therefore stroke volume and coronary blood flow in this canine preparation were maximized with manual chest compression performed with moderate force and brief duration. Increasing rate of compression increased total cardiac output while coronary blood flow was well maintained. Direct cardiac compression appeared to be the major determinant of stroke volume during manual external cardiac massage.

Key points: An experimental dog study (LOE 3, supportive, poor) in which various rates, compression force and body positions for chest compressions are compared. Comparison of manual chest compressions with dogs in lateral versus dorsal recumbency found quantitatively higher left ventricular pressures and aortic flow in the lateral position but no raw data or statistical analysis was provided. Cardiac chamber compression was reported to be better when the dogs were in lateral (again no actual data or statistics were provided).

Hofmeister EH, Brainard BM, Egger CM, Kang S.

Prognostic indicators for dogs and cats with cardiopulmonary arrest treated by cardiopulmonary cerebral resuscitation at a university teaching hospital.

J Am Vet Med Assoc. 2009 Jul 1;235(1):50-7.

Abstract

OBJECTIVE:

To determine the association among signalment, health status, other clinical variables, and treatments and events during cardiopulmonary cerebral resuscitation (CPCR) with the return of spontaneous circulation (ROSC) for animals with cardiopulmonary arrest (CPA) in a veterinary teaching hospital.

DESIGN:

Cross-sectional study.

ANIMALS:

161 dogs and 43 cats with CPA.

PROCEDURES:

Data were gathered during a 60-month period on animals that had CPA and underwent CPCR. Logistic regression was used to evaluate effects of multiple predictors for ROSC.

RESULTS:

56 (35%) dogs and 19 (44%) cats had successful CPCR. Twelve (6%) animals (9 dogs and 3 cats) were discharged from the hospital. Successfully resuscitated dogs were significantly more likely to have been treated with mannitol, lidocaine, fluids, dopamine, corticosteroids, or vasopressin; had CPA while anesthetized; received chest compressions while positioned in lateral recumbency; and had a suspected cause of CPA other than hemorrhage or anemia, shock, hypoxemia, multiple organ dysfunction syndrome, cerebral trauma, malignant arrhythmia, or an anaphylactoid reaction and were less likely to have been treated with multiple doses of epinephrine, had a longer duration of CPA, or had multiple disease conditions, compared with findings in dogs that were not successfully resuscitated. Successfully resuscitated cats were significantly more likely to have had more people participate in CPCR

and less likely to have had shock as the suspected cause of CPA, compared with findings in cats that were not successfully resuscitated.

CONCLUSIONS AND CLINICAL RELEVANCE:

The prognosis was grave for animals with CPA, except for those that had CPA while anesthetized.

Key points: An observational study (LOE 4, supportive, poor) of veterinary clinical cardiopulmonary resuscitation. CPR was performed in lateral recumbency in 88% of animals and in dorsal recumbency in 12% of animals. Performance of CPR in the lateral position was associated with a greater likelihood [OR 46.6, 95% CI 4.1-535.6, P = 0.002] of return of spontaneous circulation than sternal compressions.

Bellamy RF, DeGuzman LR, Pedersen DC.

Coronary blood flow during cardiopulmonary resuscitation in swine.

Circulation. 1984 Jan;69(1):174-80.

Abstract

Recent papers have raised doubt as to the magnitude of coronary blood flow during closed-chest cardiopulmonary resuscitation. We will describe experiments that concern the methods of coronary flow measurement during cardiopulmonary resuscitation. Nine anesthetized swine were instrumented to allow simultaneous measurements of coronary blood flow by both electromagnetic cuff flow probes and by the radiomicrosphere technique. Cardiac arrest was caused by electrical fibrillation and closed-chest massage was performed by a Thumper (Dixie Medical Inc., Houston). The chest was compressed transversely at a rate of 66 strokes/min. Compression occupied one-half of the massage cycle. Three different Thumper piston strokes were studied: 1.5, 2, and 2.5 inches. Mean aortic pressure and total systemic blood flow measured by the radiomicrosphere technique increased as Thumper piston stroke was lengthened (mean +/- SD): 1.5 inch stroke, 23 +/- 4 mm Hg, 525 +/- 195 ml/min; 2 inch stroke, 33 +/- 5 mm Hg, 692 +/- 202 ml/min; 2.5 inch stroke, 40 +/- 6 mm Hg, 817 +/- 321 ml/min. Both methods of coronary flow measurement (electromagnetic [EMF] and radiomicrosphere [RMS]) gave similar results in technically successful preparations (data expressed as percent prearrest flow mean +/- 1 SD): 1.5 inch stroke, EMF 12 +/- 5%, RMS 16 +/- 5%; 2 inch stroke, EMF 30 +/- 6%, RMS 26 +/- 11%; 2.5 inch stroke, EMF 50 +/- 12%, RMS 40 +/- 20%. The phasic coronary flow signal during closed-chest compression indicated that all perfusion occurred during the relaxation phase of the massage cycle. We concluded that coronary blood flow is demonstrable during closed-chest massage, but that the magnitude is unlikely to be more than a fraction of normal.

Key points: A study (LOE6, neutral, fair) that primarily evaluated methods for measurement of coronary blood flow in CPR studies. In 3 pigs coronary blood flow was compared when chest compressions were performed in lateral versus dorsal recumbency and no significant difference in cardiac output or coronary blood flow was found. Severe thoracic trauma (bilateral rib fractures) occurred in all animals.