WORKSHEET for Evidence-Based Review of Science for Veterinary CPCR

1. Basic Demographics

Worksheet author(s)

Tara Hammond	**Date Submitted for review:** 6/14/11
[redacted]	

2. Clinical question:

MON11: In dogs and cats undergoing resuscitation for cardiac arrest (P), does the interruption of CPCR to check circulation or ECG rhythm (I) as opposed to no interruption of CPCR (C), improve outcome (O) (e.g. ROSC, survival)?

3. Conflict of interest specific to this question:

NONE

4. Search strategy (including electronic databases searched):

4a. Databases

MEDLINE via PUBMED (1950 to current) (performed on May 1st 2011)

1.) Cardiopulmonary resuscitation AND interruptions – 73 hits (14 relevant)
2.) Cardiopulmonary resuscitation AND circulation check – 27 hits (1 relevant, no additional new references vs. 1)
3.) Cardiopulmonary resuscitation AND EKG rhythm check – 138 hits (3 relevant, no additional new references vs. 1)
4.) Cardiopulmonary resuscitation AND interruptions AND outcome – 27 hits (4 relevant, no additional new references vs. 1)
5.) Cardiopulmonary resuscitation AND hands-off time – 43 hits, (1 relevant, no additional new references vs. 1)
6.) Cardiopulmonary resuscitation AND interruptions AND return of spontaneous circulation – 10 hits (1 relevant, no additional new references vs. 1)

CAB (1910 to current) (performed on May 1st 2011)

1.) Cardiopulmonary resuscitation AND interruptions – 1 hit (1 relevant, already included)
2.) Cardiopulmonary resuscitation AND circulation check – 0 hits
3.) Cardiopulmonary resuscitation AND EKG rhythm check – 0 hits
4.) Cardiopulmonary resuscitation AND interruptions AND outcome – 0 hits
5.) Cardiopulmonary resuscitation AND hands-off time – 0 hits
6.) Cardiopulmonary resuscitation AND interruptions AND return of spontaneous circulation – 0 hits

4b. Other sources

Google scholar: Cardiopulmonary resuscitation AND interruption AND chest compressions AND veterinary – 154 hits

-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)

Fries M, Tang W. (2005). How does interruption of cardiopulmonary resuscitation affect survival from cardiac arrest? Curr Opin Crit Care 11(3):200-3.

Cole SG, Otto CM, Hughes D. (2002). Cardiopulmonary cerebral resuscitation in small animals--a clinical review (Part I & II). J Vet Emerg Crit Care 12(4):261-267 & 13(1):13-23.

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

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

Inclusion criteria
Adult and pediatric populations, human and animal studies, metanalyses, manikin models

Exclusion criteria
Abstracts only, editorials, journal unavailable in English, single case reports, review articles, equipment not available in veterinary medicine, letter to the editor

4d. Number of articles/sources meeting criteria for further review: 12

- Seven relevant human studies were identified: (Valenzuela, 2005), (Pytte, 2007), (Fallaha, 2009), (Mander, 2009), (Sutton, 2009), (Wang HE, 2009), (Krarup, 2011)

-Five relevant animal studies were identified: (Wingfield, 1992), (Berg, 2001), (Kern, 2002), (Waldrop, 2004), (Wang YL, 2009)

5. Summary of evidence

Evidence Supporting Clinical Question

No study supported the hypothesis that interruption of CPCR to check circulation or ECG rhythm as opposed to no interruption of CPCR improved outcome (ROSC, survival, etc).

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

Three studies neither supported/opposed the hypothesis that interruption of CPCR to check circulation or ECG rhythm as opposed to no interruption of CPCR improved outcome (ROSC, survival, etc).

Good						
Fair			(Waldrop, 2004) C (Wingfield, 1992) C			*(Fallaha, 2009) E – no-flow time*
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

Nine studies opposed the hypothesis that interruption of CPCR to check circulation or ECG rhythm as opposed to no interruption of CPCR improved outcome (ROSC, survival, etc).

Good			(Wang YL, 2009) A			
Fair			(Berg, 2001) B (Kern, 2002) D			
Poor						*(Valenzuela, 2005) E - interruptions in CPCR efforts* *(Pytte, 2007) E – interruptions in CPCR efforts*

						(Mander, 2009) E – interruptions in chest compressions *(Sutton, 2009) E – pauses in chest compressions* *(Wang HE, 2009) E – interruptions in chest compressions* *(Krarup, 2011) E – interruptions in CPCR efforts*
	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:

Summary:

It has repeatedly been found in human medicine that interruption of CPCR efforts for any reason (to check for circulation or rhythm) does not improve outcome. In fact, several studies have shown that interruptions in chest compression decrease the odds of successful CPCR (defined as ROSC, survival). (Wang 2009, Berg 2001, Kern 2002, Valenzuela 2005, Pytte 2007, Mander 2009, Sutton 2009, Wang HE 2009, Krarup 2001). One study (Kern 2002) revealed that continuous chest compression CPR produces greater neurologically normal 24-hour survival than standard ABC CPR when performed in a clinically realistic fashion. Another (Valenzuela 2005) found that chest compressions were performed only 43% of the time during the resuscitation effort while rescuers were attempting to follow the guidelines for cardiopulmonary resuscitation. Recommendations have been made that providers performing chest compressions switch out every 2 minutes (Mander 2009) to minimize rescuer fatigue but that they are careful during the switch to minimize no-flow time (Sutton 2009). Other studies have found that endotracheal intubation accounts for a large interruptions in chest compressions. In fact in one study (Wang HE 2009) the median duration of the first endotracheal intubation-associated CPR interruption was 46.5 seconds; almost one third exceeded 1 minute. The median total duration of all endotracheal intubation-associated CPR interruptions was 109.5 seconds; one fourth exceeded 3 minutes. Endotracheal intubation-associated CPR pauses composed approximately 22.8% of all CPR interruptions in that study. In yet another study of a 4-minute VF canine model of cardiac arrest (Wang, YL 2009), the order of initial defibrillation or initial chest compressions (200) did not affect outcome (ROSC).

7. Conclusion

Extrapolation of human research to veterinary patients remains difficult given the paucity of veterinary specific literature and the inherent species differences. Although primary VF remains a rare cause of CPA in veterinary patients, evaluation of ECG is valuable for assessment of other arrhythmias, or the occurrence of VF as a result of CPCR efforts. Despite this, it seems prudent to avoid interruptions in chest compression in veterinary species during CPCR efforts. Efforts should also be directed to minimizing time for accurate endotracheal intubation or other actions during CPCR. Further research is indicated to better delineate the effects of interruptions in chest compression.

8. Acknowledgement

9. Citation list

Berg RA, Sanders AB, Kern KB, et al. (2001). Adverse hemodynamic effects of interrupting chest compressions for rescue breathing during cardiopulmonary resuscitation for ventricular fibrillation cardiac arrest. Circulation 104:2465 -70.

Abstract

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.

<u>**LOE:3**</u>

Fallaha JF, Spooner BB, Perkins GD.(2009). Does dual operator CPR help minimize interruptions in chest compressions? Resuscitation 80(9):1011-4.

Abstract

AIMS:

Basic Life Support Guidelines 2005 emphasize the importance of reducing interruptions in chest compressions (no-flow duration) yet at the same time stopped recommending Dual Operator CPR. Dual Operator CPR

(where one rescuer does ventilations and one chest compressions) could potentially minimize no-flow duration compared to Single Operator CPR. This study aims to determine if Dual Operator CPR reduces no-flow duration compared to Single Operator CPR.

METHODOLOGY:

This was a prospective randomized controlled crossover trial. Medical students were randomised into 'Dual Operator' or 'Single Operator' CPR groups. Both groups performed 4 min of CPR according to their group allocation on a resuscitation manikin before crossing over to perform the other technique one week later.

RESULTS:

Fifty participants were recruited. Dual Operator CPR achieved slightly lower no-flow durations than the Single Operator CPR (28.5% (S.D.=3.7) versus 31.6% (S.D.=3.6), P<or=0.001). Dual Operator CPR was associated with slightly more rescue breaths per minute (4.9 (S.D.=0.5) versus 4.5 (S.D.=0.5), P=0.009. There was no difference in compression depth, compression rate, duty cycle, rescue breath flow rate or rescue breath volume.

CONCLUSIONS:

Dual Operator CPR with a compression to ventilation rate of 30:2 provides marginal improvement in no-flow duration but CPR quality is otherwise equivalent to Single Operator CPR. There seems little advantage to adding teaching on Dual Operator CPR to lay/trained first responder CPR programs.

<u>LOE: 6</u>

Kern B, Hilwig RW, Berg RA, et al. (2002). Importance of continuous chest compressions during cardiopulmonary resuscitation: improved outcome during a simulated single lay-rescuer scenario. Circulation 5;105(5):645-9.

Abstract

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.

<u>**LOE: 3**</u>

Krarup NH, Terkelsen CJ, Johnsen SP, et al. (2011). "Quality of cardiopulmonary resuscitation in out-of-hospital arrest is hampered by interruptions in chest compressions—a nationwide feasibility study." Resuscitation 82(3):263-9.

Abstract

AIM OF THE STUDY:

Quality of cardiopulmonary resuscitation (CPR) is a critical determinant of outcome following out-of-hospital cardiac arrest. The aim of our study was to evaluate the quality of CPR provided by emergency medical service providers (Basic Life Support (BLS) capability) and emergency medical service providers assisted by paramedics, nurse anesthetists or physician-manned ambulances (Advanced Life Support (ALS) capability) in a nationwide, unselected cohort of out-of-hospital cardiac arrest cases.

METHODS:

We conducted a prospective, observational study of out-of-hospital cardiac arrest with non-traumatic etiology (>18 years of age) occurring from the 1st to the 31st of January 2009 and treated by the primary Danish emergency medical service operator, covering approximately 85% of the population. One hundred and ninety-one cases were eligible for analysis. Follow-up was up to one year or death. Quality of CPR was evaluated using measurements of transthoracic impedance.

RESULTS:

The majority of patients were treated by ambulances with ALS capability (54%). Interruptions in CPR related to loading of the patient into the emergency medical service vehicle were substantial, but independent of whether patients were managed by ALS or BLS capable units (222s versus 224s, P = 0.76) as were duration of interruptions during rhythm analysis alone (20s versus 22s, P = 0.33) and defibrillation (24s versus 26s, P = 0.07).

CONCLUSIONS:

Nationwide, routine monitoring of transthoracic impedance is feasible. CPR is hampered by extended interruptions, particularly during loading of the patient into the emergency medical service vehicle, rhythm analysis and defibrillation.

LOE: 6

Mander S, Geijsel FE. (2009). Alternating providers during continuous chest compressions for cardiac arrest: every minute or every two minutes?. Resuscitation 80(9):1015-8.

Abstract

Studies have shown that the quality of chest compressions for cardiac arrest decreases markedly after only a brief time. This is thought to be an important contributor to an adverse outcome of resuscitation, which has led to recommendations to alternate chest compression providers. This study compared alternating rescuers every 1 min versus every 2 min in a manikin simulation. Forty pairs of rescuers were randomly assigned to either scenario. The main outcome measure was the number of effective compressions. The results were analysed using one-way analysis of variance. Over the full 8 min, no significant difference was found in the number of

effective chest compressions (p=0.707). Furthermore, no significant difference was found when comparing each 2 min block. An explanation for this may be that the compressions lost due to fatigue in the 2 min scenario are approximately offset by compressions lost due to the practicalities of changing over. Power calculations with these results show that an unfeasibly large number of scenarios would be needed to definitively demonstrate the superiority of one of the scenarios. It seems reasonable to alternate chest compression providers every 2 min, to prevent the loss of effective compressions due to fatigue and to minimise interruptions of chest compressions. The ideal time to do this would be during the rhythm and pulse check as dictated by current guidelines.

LOE: 6

Pytte M, Pederson TE, Ottem J, et al. (2007). Comparison of hands-off time during CPR with manual and semi-automatic defibrillation in a manikin model. Resuscitation 73(1):131-6.

Abstract

BACKGROUND:

Rhythm analysis with current semi-automatic external defibrillators (AEDs) requires mandatory interruptions of chest compressions that may compromise the outcome after cardiopulmonary resuscitation (CPR). We hypothesised that interruptions would be shorter when the defibrillator was operated in manual mode by trained and certified ambulance personnel.

MATERIALS AND METHODS:

Sixteen pairs of ambulance personnel operated the defibrillator (Lifepak((R))12) in both semi-automatic (AED) and manual (MED) mode in a randomised, cross-over manikin CPR study, following the ERC 2000 Guidelines.

RESULTS:

Median time from last chest compression to shock delivery (with interquartile range) was 17s (13, 18) versus 11s (6, 15) (mean difference (95% CI) 6s (2, 10), p=0.004). Similarly, median time from shock delivery to resumed chest compressions was 25s (22, 26) versus 8s (7, 12) (median difference 13s, p=0.001) in the AED and MED groups, respectively. While sensitivity for identifying ventricular fibrillation (VF) in both modes and

specificity in the AED mode were 100%, specificity was 89% in manual mode. Thus, some unwarranted shocks resulting in hands-off time (time without chest compressions) were given in manual mode. However, mean hands-off-ratio (time without chest compressions divided by total resuscitation time) was still lower, 0.2s (0.1, 0.3) versus 0.3s (0.28, 0.32) in manual mode, mean difference 0.10s (0.05, 0.15), p=0.001.

CONCLUSION:

Paramedics performed CPR with less hands-off time before and after shocks on a manikin with manual compared to semi-automatic defibrillation following the 2000 Guidelines. However, 12% of the shocks given manually were inappropriate.

LOE:6

Sutton RM, Maltese MR, Niles D, et al. (2009). "Quantitative analysis of chest compression interruptions during in-hospital resuscitation of older children and adolescents. Resuscitation 80(11):1259-63.

AIM:

To quantitatively describe pauses in chest compression (CC) delivery during resuscitation from in-hospital pediatric and adolescent cardiac arrest. We hypothesized that CPR error will be more likely after a chest compression provider change compared to other causes for pauses.

METHODS:

CPR recording/feedback defibrillators were used to evaluate CPR quality for victims >/=8 years who received CPR in the PICU/ED. Audiovisual feedback was supplied in accordance with AHA targets. Etiology of CC pauses identified by post-event debriefing/reviews of stored CPR quality data.

RESULTS:

Analysis yielded 205 pauses during 304.8 min of CPR from 20 consecutive cardiac arrests. Etiologies were: 57.1% for provider switch; 23.9% for pulse/rhythm analysis; 4.4% for defibrillation; and 14.6% "other." Provider switch accounted for 41.2% of no-flow duration. Compared to other causes, CPR epochs following pauses due to provider switch were more likely to have measurable residual leaning (OR: 5.52; CI(95): 2.94, 10.32; p<0.001) and were shallower (43+/-8 vs. 46+/-7 mm; mean difference: -2.42 mm; CI(95): -4.71, -0.13;

p=0.04). Individuals performing continuous CPR>or=120 s as compared to those switching earlier performed deeper chest compressions (42+/-6 vs. 38+/-7 mm; mean difference: 4.44 mm; CI(95): 2.39, 6.49; p<0.001) and were more compliant with guideline depth recommendations (OR: 5.11; CI(95): 1.67, 15.66; p=0.004).

CONCLUSIONS:

Provider switches account for a significant portion of no-flow time. Measurable residual leaning is more likely after provider switch. Feedback systems may allow some providers to continue high quality CPR past the recommended switch time of 2 min during in-hospital resuscitation attempts.

LOE: 6

Valenzuela TD, Kern KB, Clark LL, et al. (2005). Interruptions in chest compressions during emergency medical systems resuscitation. Circulation 30;112(9):1259-65.

Abstract

BACKGROUND:

Survival after nontraumatic out-of-hospital (OOH) cardiac arrest in Tucson, Arizona, has been flat at 6% (121/2177) for the decade 1992 to 2001. We hypothesized that interruptions of chest compressions occur commonly and for substantial periods during treatment of OOH cardiac arrest and could be contributing to the lack of improvement in resuscitation outcome.

METHODS AND RESULTS:

Sixty-one adult OOH cardiac arrest patients treated by automated external defibrillator (AED)-equipped Tucson Fire Department first responders from November 2001 through November 2002 were retrospectively reviewed. Reviews were performed according to the code arrest record and verified with the AED printout. Validation of the methodology for determining the performance of chest compressions was done post hoc. The median time from "9-1-1" call receipt to arrival at the patient's side was 6 minutes, 27 seconds (interquartile range [IQR, 25% to 75%], 5 minutes, 24 seconds, to 7 minutes, 34 seconds). An additional 54 seconds (IQR, 38 to 74 seconds) was noted between arrival and the first defibrillation attempt. Initial defibrillation shocks never restored a perfusing rhythm (0/21). Chest compressions were performed only 43% of the time during the resuscitation effort. Although attempting to follow the 2000 guidelines for cardiopulmonary resuscitation, chest compressions were delayed or interrupted repeatedly throughout the resuscitation effort. Survival to hospital discharge was 7%, not different from that of our historical control (4/61 versus 121/2177; P=0.74).

CONCLUSIONS:

Frequent interruption of chest compressions results in no circulatory support during more than half of resuscitation efforts. Such interruptions could be a major contributing factor to the continued poor outcome seen with OOH cardiac arrest.

LOE:6

Waldrop JE, Rozanski EA, Swanke ED, et al. (2004). "Causes of cardiopulmonary arrest, resuscitation management, and functional outcome in dogs and cats surviving cardiopulmonary arrest." J Vet Emerg Crit Care 14(1):22-29.

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.

LOE:4

Wang HE, Simeone SJ, Weaver MD, et al. (2009) Interruptions in cardiopulmonary resuscitation from paramedic endotracheal intubation. Ann Emerg Med 54(5):645-652

Abstract

STUDY OBJECTIVE:

Emergency cardiac care guidelines emphasize treatment of cardiopulmonary arrest with continuous uninterrupted cardiopulmonary resuscitation (CPR) chest compressions. Paramedics in the United States perform endotracheal intubation on nearly all victims of out-of-hospital cardiopulmonary arrest. We quantified the frequency and duration of CPR chest compression interruptions associated with paramedic endotracheal intubation efforts during out-of-hospital cardiopulmonary arrest.

METHODS:

We studied adult out-of-hospital cardiopulmonary arrest treated by an urban and a rural emergency medical services agency from the Resuscitation Outcomes Consortium during November 2006 to June 2007. Cardiac monitors with compression sensors continuously recorded rescuer CPR chest compressions. A digital audio channel recorded all resuscitation events. We identified CPR interruptions related to endotracheal intubation efforts, including airway suctioning, laryngoscopy, endotracheal tube placement, confirmation and adjustment, securing the tube in place, bag-valve-mask ventilation between intubation attempts, and alternate airway insertion. We identified the number and duration of CPR interruptions associated with endotracheal intubation efforts.

RESULTS:

We included 100 of 182 out-of-hospital cardiopulmonary arrests in the analysis. The median number of endotracheal intubation-associated CPR interruption was 2 (interquartile range [IQR] 1 to 3; range 1 to 9). The median duration of the first endotracheal intubation-associated CPR interruption was 46.5 seconds (IQR 23.5 to 73 seconds; range 7 to 221 seconds); almost one third exceeded 1 minute. The median total duration of all

endotracheal intubation-associated CPR interruptions was 109.5 seconds (IQR 54 to 198 seconds; range 13 to 446 seconds); one fourth exceeded 3 minutes. Endotracheal intubation-associated CPR pauses composed approximately 22.8% (IQR 12.6-36.5%; range 1.0% to 93.4%) of all CPR interruptions.

CONCLUSION:

In this series, paramedic out-of-hospital endotracheal intubation efforts were associated with multiple and prolonged CPR interruptions.

<u>LOE:6</u>

Wang YL, Zhong JQ, Tao W, et al. (2009). Initial defibrillation versus initial chest compression in a 4-minute ventricular fibrillation canine model of cardiac arrest. Crit Care Med 37(7):2250-2.

Abstract

OBJECTIVE:

Previous laboratory and clinical studies have demonstrated that chest compression preceding defibrillation in prolonged ventricular fibrillation (VF) increases the likelihood of successful cardiac resuscitation. The lower limit of VF duration when preshock chest compression provides no benefit has not been specifically studied. We aimed to study the effect of order of defibrillation and chest compression on defibrillation and cardiac resuscitation in a 4-minute VF canine model of cardiac arrest.

DESIGN:

Prospective, randomized animal study.

SETTING:

Key Laboratory of Cardiovascular Remodeling and Function Research and Department of Cardiology, QiLu Hospital.

SUBJECTS:

Twenty-four domestic dogs.

INTERVENTIONS:

VF was induced in anesthetized and ventilated canines. After 4 minutes of untreated VF, animals were randomly assigned to receive shock first or chest compression first. Animals in the shock-first group received an immediate single countershock of 360 J for <10 seconds, then 200 immediate compressions before pulse check or rhythm reanalysis. The ratio of compression to ventilation was 30:2. Interruptions to deliver rescue breaths were eliminated in this study. Animals in the chest compression-first group received 200 chest compressions before a single countershock; the other interventions were the same as for the shock-first group. End points were restoration of spontaneous circulation (ROSC), defined as spontaneous systolic arterial pressure >50 mm Hg, when epinephrine (0.02 mg/kg intravenously) was given, and resuscitation, defined as maintaining systolic arterial pressure >50 mm Hg at the 24-hour study end point.

MEASUREMENTS AND MAIN RESULTS:

In the shock-first group, all animals achieved ROSC, and ten of 12 survived at the 24-hour study end point. In the chest compression-first group, 11 of 12 animals achieved ROSC, and nine of 12 survived at the 24-hour study end point.

CONCLUSIONS:

In this 4-minute VF canine model of cardiac arrest, the order of initial defibrillation or initial chest compression does not affect cardiac resuscitation.

LOE: 3

Wingfield WE, VanPelt DR. (1992). "Respiratory and cardiopulmonary arrest in dogs and cats:256 cases (1986-1991)." J Am Vet Med Assoc 200(12):1993-1996.

Summary: Outcomes of cardiopulmonary arrest and resuscitation in clinically affected dogs and cats have not been adequately studied. We examined the records from 200 dogs and 65 cats that had received cardiopulmonary resuscitation for respiratory or cardiopulmonary arrest; none of the animals had been anesthetized or intubated at the time of arrest, and all had been hospitalized in a veterinary critical care facility. Cardiopulmonary arrest was found to be more common that respiratory arrest in dogs and cats. Hospital discharge rates for animals with cardiopulmonary arrest ranged from 4.1% for dogs to 9.6% for cats, and were consistent with those reported from studies of human beings with cardiopulmonary arrest. Hospital discharge rates for dogs and cats with respiratory arrest were 28% and 58.3%, respectively.

LOE:4