WORKSHEET for Evidence-Based Review of Science for Veterinary CPCR

1. Basic Demographics

Worksheet author(s)

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[redacted]	[redacted]

2. Clinical question:

In dogs and cats with cardiac arrest (P) does the specific etiology (anesthetic arrest, ICU arrest) (I) compared with all arrests (C), predict outcome in CPR (O) (eg. ROSC, survival to discharge)?

Corresponding ILCOR Worksheets:
BLS-014B

3. Conflict of interest specific to this question:

Do any of the authors listed above have conflict of interest disclosures relevant to this worksheet? No

4. Search strategy (including electronic databases searched):

4a. Databases

-MEDLINE via PUBMED (1950 to present) (performed on April 4th, 2011)

1. Cardiac arrest
2. Etiology
3. Anesthetic arrest
4. Anesthesia
5. ICU arrest
6. Veterinary
7. Dog
8. Cat
9. Canine
10. Feline
11. Human

1 and 6: 24 relevant hits out of 434 total hits
1,2 and 6: 14 relevant hits out of 143 total hits
1,4 and 6: no additional relevant hits out of 65 total hits
1 and 7: 1 additional relevant hit
1 and 8, 1 and 9, and 1 and 10: no additional relevant hits
3 and 6, 3 and 7, 3 and 8, 3 and 9, 3 and 10: no additional relevant hits
1 and 9: no additional relevant hits
1 and 10: no additional relevant hits
Same searches as above with 11: 14 additional relevant hits

CAB (1910 to present) (performed on April 4th, 2011)
-Same search as above: 10 additional relevant hits

4b. Other sources

-GOOGLE SCHOLAR (performed on April 4th, 2011)
Report as for Medline: Waldrop JE, et al. Causes of CPA, resuscitation management, and functional outcome in dogs and cats surviving CPA. J Vet Emer Crit Care. 2004; 14(1): 22-29.

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

1. Cole SG, et al. CPCR in small animals-a clinical practice review Part I. *J Vet Emer Crit Care.* 2002; 12(4): 261-267.
2. Cole SG, et al. CPCR in small animals-a clinical practice review Part II. *J Vet Emer Crit Care.* 2003; 13(1): 13-23.
3. Plunkett SJ. And McMichael M. CPCR in small animal medicine: An Update. *J Vet Intern Med* 2008;22:9-25.

13 additional human references were identified by manual scanning review articles

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

Inclusion criteria:
Peer-reviewed population based studies including all retrospective and observational studies involving target species (feline/canine)
Review articles (these were only used to evaluate for relevant references)

Exclusion criteria:
Non-clinical studies (animal models)
Abstracts only
Editorials
Case reports

4d. Number of articles/sources meeting criteria for further review: 68 after manual review

-Five (5) relevant veterinary (clinical) studies were identified:

1. Hoffmeister EH. Brainard BM. Prognostic indicators for dogs and cats with CPA treated by CPCR at a university teaching hospital. *JAVMA* 2009; 235(1): 50-57.
2. Waldrop JE, et al. Causes of CPA, resuscitation management, and functional outcome in dogs and cats surviving CPA. *J Vet Emer Crit Care.* 2004; 14(1): 22-29.
3. Wingfield JE, Van Pelt DR. Respiratory and CPA in dogs and cats; 265 cases (1986-1991). *J Am Vet Med Assoc.* 1992; 200:1993-1996.
4. Kass PH, Haskins SC. Survival following cardiopulmonary resuscitation in dogs and cats, *J Vet Emerg Crit Care* 2 (1992), pp. 57–65.
5. Kern KB, Ewy GA, Sanders AB, et al. Neurologic outcome following successful cardiopulmonary resuscitation in dogs. Resuscitation 1986;14:149-155.

-Seven (7) relevant veterinary (mechanistic) studies regarding anesthetic death were identified:
-see attached reference sheet

-Twenty-two (22) relevant veterinary review studies were identified:
-see attached reference sheet

-Seven (7) studies involving species other than the target species (feline/canine) were identified:
-see attached reference sheet

-Twenty-seven (27) studies involving humans were identified:
-see attached reference sheet

5. Summary of evidence

Evidence Supporting Clinical Question

Good		Hoffmeister 2009; A & C			Cortés 2008; D	Buckley 2011; C
Fair				Waldrop 2004; C & D Kass 1992; C		Rakic 2005; C Meaney 2010; C Nadkarni 2006;C
Poor						Brindley 2002; C
	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						Dumot 2001; C
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:

QUESTION: In dogs and cats with cardiac arrest (P) does the specific etiology (anesthetic arrest, ICU arrest, out-of-hospital arrest, initial arrest rhythm) (I) compared with all arrests (C), predict outcome in CPCR (O) (eg. ROSC, survival to discharge)?

Holahan Melissa 5/21/11 6:13 PM
Comment [1]: Consider adding to initial question? (see below)

ANESTHETIC ARREST & OUTCOME

The overall survival rate in dogs and cats with cardiac arrest, regardless of the specific etiology, (anesthetic arrest, ICU arrest) ranges from 4 to 9.6% (Hoffmeister 2009, Buckley 2008, Kass 1992, Wingfield 1992) compared to survival rates of 10 to 15% in humans with in-hospital cardiac arrest (DeMaio 2003, deVos R 1999, Doig CJ 2000, Fedoruk JC 2002, Stiell IG 2004). However, in animals with anesthetic-related CPA the survival rate has been reported to be as high as 47% (Hoffmeister 2009).

Few reports (Gilroy 1984, Rush 1992, Wingfield 1992, Kass 1992, Waldrop 2004, Hoffmeister 2009, Buckley 2011) have been published on CPCR in veterinary patients. Four of these (Rush 1992, Wingfield 1992, Kass 1992, Waldrop 2004) are retrospective case series, three of which were published in 1992, and in the other report, (Waldrop 2004) discharge from the hospital was the only outcome addressed for dogs and cats that survived CPA. Only one of these studies (Hoffmeister 2009) used statistical models to determine variables to predict success or failure of ROSC and survival to discharge. This prospective observational study (LOE2, Hoffmeister 2009) evaluated 204 veterinary patients (161 dogs; 43 cats) and found that dogs that were anesthetized at the time of CPA were significantly ($P < 0.001$) more likely to have had ROSC and to have survived until discharge (9/19 [47%]) compared to patients not anesthetized at the time of CPA (3/185 [2%]) (Hoffmeister 2009). Cats that were anesthetized at the time of CPA were not significantly ($P = 0.21$) more likely to have had ROSC, but were significantly ($P = 0.003$) more likely to have survived until discharge from the hospital than were cats that were not anesthetized at the time of CPA. Of all animals discharged after successful resuscitation, 9 of 12 were anesthetized at the time of CPA. This included 6 of 9 dogs and all 3 cats discharged from the hospital. In another study (Waldrop 2004) describing 18 patients that survived CPA and were discharged, 10 (55.6%) had CPA while anesthetized. In the Kass study, four dogs and one cat were discharged from the hospital alive following CPA. These five patients with uniquely longer survival all had cardiac arrests associated with drug and/or anesthetic reactions (Kass, 1992). Furthermore, in a clinical prospective observational study in cats (Gilroy 1987); 4/11 (36.4%) cats survived arrests associated with anesthesia, compared to none of the 7 patients who arrested in the ICU. In a case report (Cortes 2008) involving an inadvertent overdose of ketamine to a cat, prompt CPCR and short-term mechanical ventilation achieved a full clinical recovery and subsequent discharge of the animal. A retrospective study (LOE 6, Buckley 2011) involving rabbits showed that 3 of the 5 rabbits experiencing a prolonged ROSC, including the rabbit that survived to discharge, were under anesthesia at the time of CPA. In human patients, no studies evaluating anesthetic arrests and outcome in CPCR were found. Although there are only a small number of veterinary studies available, these studies have all concluded that patients with anesthesia or drug-associated CPA have an increased survival rate compared to all arrests.

INITIAL ARREST RHYTHM & OUTCOME

Several studies have evaluated the relationship of electrocardiographic rhythm during cardiac arrest with survival outcomes in humans. Three prospective observational studies (Rakic 2005, Nadkarni 2006, Meaney 2010) and 1 retrospective study (Brindley, 2002) concluded that survival to hospital discharge was substantially more likely when the first documented rhythm was shockable (pulseless VT/VF) rather than nonshockable (PEA/asystole), and slightly more likely after PEA than asystole (Meaney 2010, Brindley 2002). In the Rakic 2005 study, more patients with cardiac arrest due to ventricular fibrillation or pulseless ventricular

tachycardia survived than patients with asystole or pulseless electrical activity (47.6% vs 10.7%), respectively (Rakic 2005).
The initial arrest rhythm and outcome in CPCR has not been evaluated in veterinary patients, however, in eighteen animals that were identified to have survived to discharge following CPA the most common initial rhythm at CPA was asystole (72%) (Waldrop 2004). Several veterinary studies have classified the prevalence of initial arrest rhythms during CPA. The most common initial arrest rhythm in veterinary patients appears to be asystole (22.3% - Wingfield & Rush, 48% (50% dogs; 40% cats) – Hoffmeister 2009, 72% Waldrop 2004), followed by pulseless electrical activity (PEA) (23.3 % - Wingfield & Rush, 12% (11% dogs; 19% cats)- Hofmeister), and sinus bradycardia (19% - Wingfield & Rush, 23% (23% dogs; 21% cats) – Hoffmeister). The least common arrhythmias in be encountered are ventricular fibrillation (VF) 19.8% - Wingfield & Rush, 6% (7% dog; 2% cat) – Hoffmeister) and pulseless ventricular tachycardia (1% dogs; 5% cats) – Hoffmeister).

LOCATION OF ARREST (ICU vs. other) & OUTCOME
The location within the hospital where arrest and resuscitation occurred and survival rates at 48 hours and hospital discharge has been evaluated in humans. In one study, 25% of patients who had an arrest on nursing units (floors and ICUs) survived to discharge compared to 16% survival after arrests in other hospital areas (16%) and 5% in the emergency department (Dumot 2001). Another study found that survival to discharge following CPCR was higher in the Coronary Care Unit (29.2%) compared to other departments (7.1%) (Rakic 2005) with in hospital CPA. In a clinical prospective observational study in cats (Gilroy 1987); 4/11 (36.4%) cats survived arrests associated with anesthesia, compared to none of the 7 patients who arrested in the ICU.

There was only one study evaluating out-of-hospital arrest in animals (Hoffmeister, 2009), in which none of the animals that had CPA outside of the hospital survived until discharge. This is in contrast to the discharge rate of 8.1% for humans who have CPA outside of a hospital (Lindholm DJ, Campbell JP. Predicting survival from out-of-hospital cardiac arrest. *Prehosp Disaster Med* 1998;13:51–54). Further studies are needed to evaluate the survival in animals with out-of-hospital CPA.

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: Based on 9 population studies, of which 1 is LOE 2, good (Hoffmeister 2009), 2 are LOE 4, fair (Waldrop 2004, Kass 1992), 1 is LOE 5, good (Cortes 2008) and 4 are LOE 6, 3 of which are fair (DeMos 2006), Rakie 2005, Demot 2001) and 1 good (Buckley 2011). It may be concluded from these studies that, although there are only a small number of veterinary studies available, the benefit of CPCR is apparent in patients with anesthesia-related CPA as there is an increased survival in these patients compared to arrests of all causes. Further studies are needed evaluating the initial arrest rhythm in veterinary patients, location of arrest and outcome prediction.

TREATMENT RECOMMENDATION: The evidence supports that in anesthetized patients with CPA, prompt CPCR should be attempted considering that these patients have a fair prognosis for survival and discharge from a hospital.

8. Acknowledgement

none

9. Citation list

1. Brindley PG, Markland DM, Mayers I, Kutsogiannis DJ. Predictors of survival following in-hospital adult cardiopulmonary resuscitation. CMAJ. 2002 Aug 20;167(4):343-8.
Level 6, supporting, funding; none
Abstract
BACKGROUND: This study was undertaken to provide up-to-date survival data for Canadian adult in-patients following attempted resuscitation from cardiac or respiratory arrest. We hope that objective data might encourage more meaningful dialogue between physicians, patients and their families regarding resuscitation wishes.
METHODS: We reviewed all records of adult cardiopulmonary arrest that occurred between Jan. 1, 1997, and Jan. 31, 1999, at the 3 main teaching hospitals in Edmonton. We then abstracted data from the full inpatient medical records to describe patient characteristics, type of arrest and survival details. The family physicians of survivors were contacted to confirm the outcomes. We included only adults admitted to hospital but not to a critical care bed.
RESULTS: There were 247 arrests during the study period; 143 (57.9%) were witnessed, and 104 (42.1%) were unwitnessed). Of the patients whose arrests were witnessed, 48.3% (95% confidence interval [CI] 39.8%-56.8%) were able to be resuscitated, 22.4% (95% CI 1 5.8%-30.1%) survived to hospital discharge, and 18.9% (95% CI 12.8%-26.3%) were able to return home. Survival was highest after primary respiratory arrest and lowest after pulseless electrical activity or asystole. Of the patients with unwitnessed arrests, 21.2% (95% CI 13.8%-30.3%) were able to be resuscitated, but only 1 patient (1.0% [95% CI 0.0%-5.2%]) survived to hospital discharge and was able to return home. This patient survived an unwitnessed respiratory arrest. No patient who had an unwitnessed cardiac arrest survived to discharge. Most of the respiratory arrests were witnessed (93.1%), and most of the pulseless electrical activity or asystole arrests were unwitnessed (54.6%). We did not find age or sex to be independent predictors of survival. However, the risk of not returning home was higher among patients whose arrest occurred between 2301 and 0700 than among those whose arrest was between 0701 and 1500 (adjusted OR 3.2, 95% CI 1.0-10.1). Survival was significantly decreased after pulseless ventricular tachycardia or ventricular fibrillation arrest (adjusted OR 4.2, 95% CI 1.4-12.5) and even more so after pulseless electrical activity or asystole arrest (adjusted OR 21.0, 95% CI 6.2-71.7) than after respiratory arrest.
INTERPRETATION: Overall, survival following cardiopulmonary resuscitation in hospital does not appear to have changed markedly in 40 years. The type of arrest is highly predictive of survival, whereas age and sex are not.

2. Buckley GJ, DeCubellis J, Sharp CR, et al., 2011. Cardiopulmonary Resuscitation in Hospitalized Rabbits: 15 Cases. J of Exotic Pet Medicine, 20(1), p. 46-50.
Level 6, supporting, funding: none sought or received
Three of the 5 rabbits experiencing a prolonged ROSC, including the rabbit that survived to discharge, were under anesthesia at the time of CPA. Although it was not significantly different (*P* - 0.28), 71.4% (5/7) of rabbits provided ventilation by facemask experienced ROSC versus 33% (2/6) ventilated by other means (e.g., intubation, tracheostomy).

3. Cortés, Y. E. and Holm, J. L., 2008, Successful cardiopulmonary resuscitation and use of short-term mechanical ventilation following inadvertent ketamine overdose in a cat. Journal of Veterinary Emergency and Critical Care, 18, p. 165–169.
Level 5, supporting, funding: none sought or received
Abstract
Objective: To describe the clinical manifestations and successful outcome following an inadvertent overdose of ketamine to a cat.
Case summary: A 4-year-old neutered male domestic shorthair cat was evaluated for a urethral obstruction. Because of an inadvertent miscalculation of ketamine, 20 times the intended dose was administered intravenously, which resulted in cardiopulmonary arrest. Cardiopulmonary-cerebral resuscitation was successful, and short-term mechanical ventilation, fluids and intensive monitoring were utilized to achieve full recovery and subsequent discharge of the animal.
New or unique information provided: Ketamine is a common anesthetic agent used in cats that is considered to have a wide therapeutic index and minimal cardiopulmonary depressant effects at recommended doses. Successful management of inadvertent ketamine overdose has been reported in children, but not in cats. Prompt CPCR and short-term mechanical ventilation may be necessary to treat a significant ketamine overdose. In cats, yohimbine may act as a partial antagonist of ketamine.
Key Point: 5 month follow-up clinical normal per owner.

4. Dumot JA, Burval DJ, Sprung J, Waters JH, Mraovic B, Karafa MT, Mascha EJ, Bourke DL., 2001, Outcome of adult cardiopulmonary resuscitations at a tertiary referral center including results of "limited" resuscitations. Arch Intern Med, 23;161(14), p. 1751-8.
Level 6, supporting, funding: none

Background: The results of in-hospital resuscitations may depend on a variety of factors related to the patient, the environment, and the extent of resuscitation efforts. We studied these factors in a large tertiary referral hospital with a dedicated certified resuscitation team responding to all cardiac arrests.
Methods: Statistical analysis of 445 prospectively recorded resuscitation records of patients who experienced cardiac arrest and received advanced cardiac life support resuscitation. We also report the outcomes of an additional 37 patients who received limited resuscitation efforts because of advance directives prohibiting tracheal intubation, chest compressions, or both.
Main Outcome Measures: Survival immediately after resuscitation, at 24 hours, at 48 hours, and until hospital discharge.
Results: Overall, 104 (23%) of 445 patients who received full advanced cardiac life support survived to hospital discharge. Survival was highest for patients with primary cardiac disease (30%), followed by those with infectious diseases (15%), with only 8% of patients with end-stage diseases surviving to hospital discharge. Neither sex nor age affected survival. Longer resuscitations, increased epinephrine and atropine administration, multiple defibrillations, and multiple arrhythmias were all associated with poor survival. Patients who experienced arrests on a nursing unit or intensive care unit had better survival rates than those in other hospital locations. Survival for witnessed arrests (25%) was significantly better than for non-witnessed arrests (7%) (*P*=.005).
There was a disproportionately high incidence of non-witnessed arrests during the night (12 AM to 6 AM) in unmonitored beds, resulting in uniformly poor survival to hospital discharge (0%). None of the patients whose advance directives limited resuscitation survived.
Conclusions: Very ill patients in unmonitored beds are at increased risk for a non-witnessed cardiac arrest and poor resuscitation outcome during the night. Closer vigilance of these patients at night is warranted. The outcome of limited resuscitation efforts is very poor.

5. Hoffmeister EH. Brainard BM., 2009, Prognostic indicators for dogs and cats with CPA treated by CPCR at a university teaching hospital. *J of Am Vet Med Assoc*, 235(1), p. 50-57.
Level 2, supporting, funding: none sought or received

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/Clinical Relevance-The prognosis was grave for animals with CPA, except for those that had CPA while anesthetized.
Author's Summary: For patients that were anesthetized at the time of CPA, the rate of survival until discharge from the hospital (9/19 [47%]) was dramatically and significantly higher than the rate (3/185 [2%]) for patients not anesthetized at the time of CPA. For the 12 patients that survived and were discharged from the hospital, 9 had CPA while anesthetized; this proportion is higher than the proportion (18 patients survived and were discharged, of which 10 had CPA while anesthetized) in another report.[8] This suggests that in anesthetized patients with CPA, CPCR should be attempted because these patients have a fair prognosis for survival and discharge from a hospital.
Key point: Larger study with standardized form (prospective observational study). None of the animals that had CPA outside of the hospital survived until discharge. This is in contrast to the discharge rate of 8.1% for humans who have CPA outside of a hospital. The rate of CPA in anesthetized animals is 0.167% (16.7/10,000 anesthetized animals) with a fatality rate of 0.088% (8.8/10,000 anesthetized animals) for in-hospital patients.

6. Kass PH, Haskins SC.1992, Survival following cardiopulmonary resuscitation in dogs and cats, *J Vet Emerg Crit Care* 2, p. 57–65.
Level 4, supporting, funding: none sought or received

Summary: Dogs and cats receiving cardiopulmonary resuscitation (CPR) were evaluated for factors leading to cardiac arrest and for survival following the procedure. One-hundred-thirty-five canine and forty-three feline patients seen at the University of California, Davis Veterinary Medical Teaching Hospital that received CPR between August 1987 and December 1991 were studied. Initial resuscitation attempts were unsuccessful in 72% of dogs and 58% of cats. Five dogs and one cat were still alive 3 days after CPR.

Ultimately only four dogs and one cat were discharged from the hospital alive. These five patients with uniquely longer survival all had cardiac arrests associated with drug and/or anesthetic reactions.
Key Point: Follow-up (30 days)

7. Meaney PA, Nadkarni VM, Kern KB, Indik JH, Halperin HR, Berg RA. Rhythms and outcomes of adult in-hospital cardiac arrest. Crit Care Med. 2010 Jan;38(1):101-8.
Level 6, supporting, funding; none
Abstract
OBJECTIVE: To determine the relationship of electrocardiographic rhythm during cardiac arrest with survival outcomes.
DESIGN: Prospective, observational study.
SETTING: Total of 411 hospitals in the National Registry of Cardiopulmonary Resuscitation.
PATIENTS: Total of 51,919 adult patients with pulseless cardiac arrests from April 1999 to July 2005.
MEASUREMENTS AND MAIN RESULTS: Registry data collected included first documented rhythm, patient demographics, pre-event data, event data, and survival and neurologic outcome data. Of 51,919 indexed cardiac arrests, first documented pulseless rhythm was ventricular tachycardia (VT) in 3810 (7%), ventricular fibrillation (VF) in 8718 (17%), pulseless electrical activity (PEA) in 19,262 (37%) and asystole 20,129 (39%). Subsequent VT/VF (that is, VT or VF occurring during resuscitation for PEA or asystole) occurred in 5154 (27%), with first documented rhythm of PEA and 4988 (25%) with asystole. Survival to hospital discharge rate was not different between those with first documented VF and VT (37% each, adjusted odds ratio [OR]) 1.08; 95% confidence interval [CI] 0.95-1.23). Survival to hospital discharge was slightly more likely after PEA than asystole (12% vs. 11%, adjusted OR 1.1; 95% CI 1.00-1.18), Survival to discharge was substantially more likely after first documented VT/VF than PEA/asystole (adjusted OR 1.68; 95% CI 1.55-1.82). Survival to discharge was also more likely after PEA/asystole without subsequent VT/VF compared with PEA/asystole with subsequent VT/VF (14% vs. 7% for PEA without vs. with subsequent VT/VF; 12% vs. 8% for asystole without vs. with subsequent VT/VF; adjusted OR 1.60; 95% CI, 1.44-1.80).
CONCLUSIONS: Survival to hospital discharge was substantially more likely when the first documented rhythm was shockable rather than nonshockable, and slightly more likely after PEA than asystole. Survival to hospital discharge was less likely following PEA/asystole with subsequent VT/VF compared to PEA/asystole without subsequent VT/VF.

8. Nadkarni VM, Larkin GL, Peberdy MA, Carey SM, Kaye W, Mancini ME, Nichol G, Lane-Truitt T, Potts J, Ornato JP, Berg RA; National Registry of Cardiopulmonary Resuscitation Investigators. First documented rhythm and clinical outcome from in-hospital cardiac arrest among children and adults. JAMA. 2006 Jan 4;295(1):50-7.
Level 6, supporting, funding; none
Abstract
CONTEXT: Cardiac arrests in adults are often due to ventricular fibrillation (VF) or pulseless ventricular tachycardia (VT), which are associated with better outcomes than asystole or pulseless electrical activity (PEA). Cardiac arrests in children are typically asystole or PEA.
OBJECTIVE: To test the hypothesis that children have relatively fewer in-hospital cardiac arrests associated with VF or pulseless VT compared with adults and, therefore, worse survival outcomes.
DESIGN, SETTING, AND PATIENTS: A prospective observational study from a multicenter registry (National Registry of Cardiopulmonary Resuscitation) of cardiac arrests in 253 US and Canadian hospitals between January 1, 2000, and March 30, 2004. A total of 36,902 adults (> or =18 years) and 880 children (<18 years) with pulseless cardiac arrests requiring chest compressions, defibrillation, or both were assessed. Cardiac arrests occurring in the delivery department, neonatal intensive care unit, and in the out-of-hospital setting were excluded.
MAIN OUTCOME MEASURE: Survival to hospital discharge.
RESULTS: The rate of survival to hospital discharge following pulseless cardiac arrest was higher in children than adults (27% [236/880] vs 18% [6485/36,902]; adjusted odds ratio [OR], 2.29; 95% confidence interval [CI], 1.95-2.68). Of these survivors, 65% (154/236) of children and 73% (4737/6485) of adults had good neurological outcome. The prevalence of VF or pulseless VT as the first documented pulseless rhythm was 14% (120/880) in children and 23% (8361/36,902) in adults (OR, 0.54; 95% CI, 0.44-0.65; P<.001). The prevalence of asystole was 40% (350) in children and 35% (13 024) in adults (OR, 1.20; 95% CI, 1.10-1.40; P = .006), whereas the prevalence of PEA was 24% (213) in children and 32% (11,963) in adults (OR, 0.67; 95% CI, 0.57-0.78; P<.001). After adjustment for differences in preexisting conditions, interventions in place at time of arrest, witnessed and/or monitored status, time to defibrillation of VF or pulseless VT, intensive care unit location of arrest, and duration of cardiopulmonary resuscitation, only first documented pulseless arrest rhythm remained significantly associated with differential survival to discharge (24% [135/563] in children vs 11% [2719/24,987] in adults with asystole and PEA; adjusted OR, 2.73; 95% CI, 2.23-3.32).
CONCLUSIONS: In this multicenter registry of in-hospital cardiac arrest, the first documented pulseless arrest rhythm was typically asystole or PEA in both children and adults. Because of better survival after asystole and PEA, children had better outcomes than adults despite fewer cardiac arrests due to VF or pulseless VT.

9. Rakić D, Rumboldt Z, Carević V, Bagatin J, Polić S, Pivac N, Avelini-Perković R, 2005, Approach to Sudden Cardiac Death

Study Investigators. In-hospital cardiac arrest and resuscitation outcomes: rationale for sudden cardiac death approach. Croat Med J, 46(6), p. 907-12.

Level 6, supporting, funding: The study was funded by the Croatian Ministry of Science, Education, and Sports, grant No. 0141021.

Abstract

Aim To assess the frequency of cardiac arrest and outcomes and predictors of survival after cardiopulmonary resuscitation in hospitalized patients.

Methods We prospectively analyzed the data on all patients who experienced cardiac arrest while hospitalized at the Split University Hospital between January and December 2003. Data were collected on patients' demographic characteristics, etiology and presentation of cardiac arrest, time, site, methods, and outcomes of cardiopulmonary resuscitation.

Results Out of 120 cases of cardiac arrest among 32,861 hospitalized patients, 76.7% were witnessed. Ninety-six (80.0%) patients with cardiac arrest underwent resuscitation, and 22.5% of them were discharged alive. The survival rate was 20.0% at the Department of Internal Medicine, 29.2% in the Coronary Care Unit, and only 7.1% in other departments (P=0.058, _2 test). Out of 92 patients with witnessed cardiac arrest, 28.3% survived to discharge, whereas only one of 28 patient with unwitnessed cardiac arrest survived to discharge (P=0.004, Fisher's exact test). More patients with cardiac arrest due to ventricular fibrillation or pulseless ventricular tachycardia survived than patients with asystole and pulseless electrical activity (47.6% vs 10.7%, respectively, P<0.001, Fisher's exact test). None of the patients with unclassified cardiac arrest survived until discharge. Cardiac arrest survivors were significantly younger (60.8±12.9 vs 71.1±11.7 years, P<0.001, Student t-test). Sex had no influence on survival. There were no significant circadian or hospital shift differences in the frequency rate of cardiac arrest, but the rate of successful resuscitation was lower during the night shift.

Conclusion The rate of successful resuscitation was higher in the coronary care unit, during the day and in younger witnessed cardiac arrest patients with ventricular fibrillation or pulseless ventricular tachycardia.

10. Waldrop JE, et al., 2004 Causes of CPA, resuscitation management, and functional outcome in dogs and cats surviving CPA. *J Vet Emer Crit Care*, 14(1), p. 22-29.

Level 4, supporting, funding: none sought or received

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 preexisting 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.

Key points: *Small retrospective study 18pts (15 dogs/3 cats) with no comparison group (CPA survivors only) 6 animals lost to follow-up (median follow-up 8months).*

(18 patients survived and were discharged, of which 10 had CPA while anesthetized) 56%

2 pts had neurologic deficits; 1 euth 4 months later the other recovered.

From the previous studies and the data in this study, it would seem that animals without serious underlying disease prior to CPA and/or reversible causes of CPA are more likely to have a successful outcome following CPCR.