RECOVER: Standardizing Veterinary CPR

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RECOVER Overview

- RECOVER
  - Reassessment Campaign on Veterinary Resuscitation
- Published in 2012, reevaluating in 2017
- Main goal
  - Develop a set of clinical consensus guidelines for the practice of CPR in dogs and cats based upon an extensive, systematic review of the literature in the context of our target species
### Clinical Guideline Class Descriptors

<table>
<thead>
<tr>
<th>Class</th>
<th>Risk:benefit ratio</th>
<th>Clinical recommendation</th>
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<tbody>
<tr>
<td>I</td>
<td>Benefit &gt;&gt;&gt; Risk</td>
<td>Should be performed</td>
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<tr>
<td>IIa</td>
<td>Benefit &gt;&gt; Risk</td>
<td>Reasonable to perform</td>
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<tr>
<td>IIb</td>
<td>Benefit ≥ Risk</td>
<td>May be considered</td>
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<tr>
<td>III</td>
<td>Risk &gt; Benefit</td>
<td>Should not be performed</td>
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### Clinical Guidelines Level Descriptors

<table>
<thead>
<tr>
<th>Level</th>
<th>Populations studied</th>
<th>Criteria for recommendation</th>
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<tbody>
<tr>
<td>A</td>
<td>Multiple populations</td>
<td>Multiple high quality and/or high level of evidence studies</td>
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<tr>
<td>B</td>
<td>Limited populations</td>
<td>Few to no high quality and/or high level of evidence studies</td>
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<tr>
<td>C</td>
<td>Very limited populations</td>
<td>Consensus opinion, expert opinion, guideline based on physiologic/anatomic principles, standard of care</td>
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Clinical Guideline Class & Level Examples

- Crash cart – standardization and regular audit of the location, storage, and content of resuscitation equipment is recommended – I-A

- Supplemental Oxygen Administration – during CPR in dogs and cats, the use of an FiO\textsubscript{2} of 100% is reasonable – IIa-B

- Corticosteroids – the routine use of corticosteroids during CPR is not recommended – III-C

Emergency Preparedness

- Staff cardiopulmonary resuscitation (CPR) training (didactic components & hands-on skills), at a minimum, every six months

- Organized and frequently audited crash cart
  - Review contents and drug expiration dates at the end of each shift
  - Apply a piece of tape across all of the drawers with the date and your initials once it has been audited

- Presence of cognitive aids
  - Emergency drugs and doses chart (cage cards too)
  - CPR algorithm
CPR Status

- Ensure that a CPR status is obtained on all patients, especially those that are being admitted to the hospital and/or undergoing anesthesia

- SFVC
  - CPR
  - DNR (do not resuscitate)

- Other method
  - Green: open or closed chest CPR
  - Yellow: closed chest CPR only
  - Red: DNR

Team Dynamics

- Leader
  - Distributing tasks, enforcing rules and procedures
  - Does not need to be a doctor; does not change during code

- Compressor(s) (thoracic +/- abdominal)
  - Performing external cardiac compressions
  - Changes every two minutes

- Ventilator
  - Adequately ventilating the patient

- Advanced Life Support (ALS)
  - Monitoring equipment, vascular access, drug administration

- Recorder
  - Document all details of CPR
Closed Loop Communication

- Closed loop communication is imperative
- The leader will give a request, whomever is performing the task should repeat it to verify accuracy, and then perform it
- Results in a reduction of medical errors

Critical Care Monitoring Sheet
"CPR Flow Sheet"

- Recommended to use whenever working with a critical patient, but required for use during CPR
- Aids in tracking crucial information, including, but not limited to:
  - CPR start and end times
  - Drug administration quantities and times
- Become familiar with the form so that it is not your first time seeing it during a code
Crash Cart – Exterior & Drawer 1

- Exterior
  - Monophasic defibrillator
  - Multi-parameter monitor
  - 5 fully stock drawers
  - Tape indicating recent audit

- Drawer 1
  - Emergency drugs
  - Defibrillator gel
  - Venipuncture supplies
  - Vascular access supplies
Crash Cart – Drawers 2 & 3

- **Drawer 2**
  - Endotracheal intubation supplies
  - Airway suction supplies

- **Drawer 3**
  - Pericardiocentesis kits
  - Thoracocentesis kits
  - Trochar catheters

Crash Cart – Drawers 4 & 5

- **Drawer 4**
  - Fluid therapy supplies (crystalloids and colloids)
  - Aerokat (albuterol sulfate)

- **Drawer 5**
  - Ventilation supplies
  - Stomach pump
  - Gastric decompression/lavage tubes
CPR Algorithm

- Step-by-step approach to initiating CPR in a patient that is in cardiopulmonary arrest (CPA)
- Intended to be used as a quick reference
Basic Life Support (BLS)

- BLS includes
  - Recognition of CPA
  - Chest compressions
  - Airway management
  - Ventilation

- When thinking of BLS, remember the mnemonic “CAB”
  - C: circulation
  - A: airway
  - B: breathing

- BLS cycles last 2 minutes
Cardiopulmonary Arrest

- Cessation of cardiac output and respirations
  - Respiratory arrest first, cardiac shortly thereafter

- CPA should be detected within 5-10 seconds
  - Evaluate airway, breathing, circulation (ABC)
  - In humans, pulse palpation is a poor indicator of CPA
  - Auscult your patient
  - Agonal breath indicate that CPR should be started

- If there is uncertainty in CPA detection, initiate CPR
  - Starting CPR on a patient not in CPA carries minimal risks

Cardiopulmonary Resuscitation

- Goal of CPR is return of spontaneous circulation (ROSC)

- ROSC is achieved 35-45% of the time in canine and feline patients

- Survival to discharge rates range between 2-10% in canine and feline patients
Patient Positioning

- Dorsal recumbency (barrel-chested dogs)
- Lateral recumbency (left or right is acceptable; most dogs and cats)
- Dorsal recumbency (barrel-chested dogs)

Compression Techniques

- Small dogs and cats (<10 kg)
  - 1-handed technique, hand circumferentially around the sternum, directly over the heart

- Alternate technique ("larger" small dogs and cats, lower thoracic compliance)
  - 2-handed technique directly over the heart
Compression Techniques

- Small dogs and cats (<10 kg); compliant chests
- “Larger” small dogs and cats, lower thoracic compliance

- Medium, large, and giant breed dogs
  - Point of maximum intensity (widest portion) of the chest

- Keel-chested (i.e. greyhounds)
  - Directly over the heart

- Barrel-chested (i.e. English bulldogs)
  - Sternal compressions directly over the heart
Compression Techniques

- Medium, large, and giant breed dogs
- Keel-chested (i.e. greyhounds)
- Barrel-chested (i.e. English bulldogs)

Technique Critique
Cardiac Pump Theory

- Dorsal recumbency: cardiac ventricles are directly compressed between the sternum and spine
- Lateral recumbency: cardiac ventricles are directly compressed between the ribs
- Most cats and small dogs (with thoracic wall compliance), barrel-chested and keel-chested dogs

Thoracic Pump Theory

- Chest compressions increase the overall intrathoracic pressure, which in turn compresses the aorta and collapses the vena cava; this process causes blood flow out of the chest
- Most medium, large, and giant breed dogs
Chest Compressions

- Don’t delay compressions for ET intubation
- Compressions rate: 100-120 per minute (cats & dogs)
- Compression depth: 1/3 to 1/2 width of the chest
- Allow full elastic recoil between compressions
  - Reduced coronary and cerebral perfusion in pigs if full elastic recoil is not allowed
  - High prevalence of leaning in human CPR
- Switch compressors every 2 minutes to avoid fatigue

Interposed Abdominal Compressions

- Perform abdominal compressions opposite of chest compressions
- Facilitates venous return from the abdomen, thus increasing cardiac output
- Minimal evidence of abdominal trauma
- Reasonable when there are enough team members
Open-Chest CPR

- More effective than closed-chest CPR in restoring ROSC
- Direct cardiac massage

Indications
- Hemoabdomens
- Intra-operative arrests
- Large dogs
- Pneumothorax
- Pericardial effusion

Disadvantages
- Financial endeavor
- Need experienced team
- Need surgical back-up
- Risk of infection

Airway & Ventilation

- Rapid endotracheal intubation (lateral or dorsal)
  - Suction available, if needed
- Intubate while compressions are being performed
- The use of a laryngoscope is strongly advised
- Secure the ETT and inflate the cuff
- Mouth-to-snout ventilation if performing CPR alone (30:2)
Airway & Ventilation

- Ventilation rate: 10 breaths per minutes
- Tidal volume: 10 mL/kg
- Inspiratory time: 1 second
- FiO$_2$: 100% (unless ABG dictates otherwise)
- If patient is hooked up to an anesthesia circuit, turn off the inhalant, flush the circuit and begin ventilation; not required to switch to an ambu bag

Advanced Life Support

- Should ideally be occurring while BLS is underway
- If BLS and ALS are performed promptly, initial ROSC rates can be as high as 50% in canine & feline patients
- ALS
  - Monitoring equipment
  - Vascular access
  - Drug administration
  - Defibrillation
  - Precordial thump
Monitoring Equipment

- Electrocardiogram (ECG)
  - Subject to artifact during CPR
  - Quickly evaluate during intercycle pauses

- End-tidal carbon dioxide (ETCO₂)
  - Early indicator of ROSC
  - Sudden increases in ETCO₂ can indicate ROSC
  - Dogs: ETCO₂ > 15 mmHg – increased rate of ROSC
  - Cats: ETCO₂ >20 mmHg – increased rate of ROSC

Vascular Access

- Intravenous (IV)
  - Cephalic
  - Saphenous (lateral, medial)
  - +/- jugular
  - +/- cut down

- Intraosseous (IO)
  - Often times easier and quicker than IV access in neonatal & pediatric patients
Drug Administration

- Routes of administration
  - IV/IO (preferred)
  - Intratracheal (IT) if unable to obtain IV/IO access
  - Intracardiac (IC) is not recommended

- IT administration
  - NAVEL (naloxone, atropine*, vasopressin*, epinephrine*, lidocaine); no sodium bicarbonate
  - Increased doses (insufficient data – up to 10x for epinephrine)
  - Dilute with 0.9% NaCl and administer via a red rubber catheter (RRC) down the ETT (RRC should be longer than ETT)

Arrest Drugs

- Epinephrine (1 mg/mL)
  - Can cause myocardial ischemia and arrhythmias
  - Low dose: 0.01 mg/kg every other BLS cycle
  - High dose: 0.1 mg/kg (consider for prolonged CPR)
    - Increased rate of ROSC but not survival to discharge

- Vasopressin (20 U/mL)
  - Works well in acidic environments
  - Decreased risk of myocardial ischemia
  - Can use in conjunction with or in place of epinephrine
    - Dose: 0.8 U/kg
    - Dose every 3-5 minutes (every other round of BLS)

- Atropine (0.54 mg/mL)
  - Parasympatholytic
  - Most likely useful for dogs and cats with asystole or PEA associated with high vagal tone
  - Dose: 0.04 mg/kg
Antiarrhythmic Drugs

- Amiodarone (50 mg/mL)
  - Ventricular fibrillation (VF)/pulseless ventricular tachycardia (pulseless VT) resistant to defibrillation
  - Dose: 5 mg/kg

- Lidocaine (20 mg/mL)
  - Refractory VF/pulseless VT, +/- increased J/kg with monophasic defibrillator
  - Dose: 2 mg/kg

Reversal Drugs

- Naloxone (0.4 mg/mL)
  - Opioid reversal
  - Dose: 0.04 mg/kg

- Flumazenil (0.1 mg/mL)
  - Benzodiazepine reversal
  - Dose: 0.01 mg/kg

- Atipamezole (5 mg/mL)
  - α-2 reversal
  - Dose: 100 μg/kg
Electrolyte Therapy

- Hypocalcemia often develops with prolonged CPA, however, calcium should not be administered during CPR (no effect or worse outcome)

- Hyperkalemia often develops with prolonged CPA; in the event of hyperkalemia, treatment can be considered (minimal supporting evidence)

Corticosteroids

- Lack of evidence to prove corticosteroids beneficial

- Potential for side effects, especially with poor perfusion

- Not recommended
Fluid Therapy

- Fluid therapy is not recommended in patients that are euvoletic or hypervolemic.
- Hypovolemic patients should be treated with IV fluids.
- NOTE: Never administer a full shock bolus; administer in increments with reevaluations of the patient in between.

Defibrillation

- Delivery of an electrical shock that depolarizes all myocardial cells.
- Monophasic defibrillation: unidirectional current flows from one electrode to another.
- Biphasic: current initially flows in one direction, then reverses and flows in the other direction.
- Guidelines:
  - No isopropyl alcohol on patient.
  - Patient can not touch metal surfaces.
  - No one should be in direct contact with the patient.
Defibrillation

- Shockable rhythms
  - Ventricular fibrillation
  - Pulseless ventricular tachycardia

- Dose
  - Monophasic (external): 4-6 J/kg
  - Biphasic (external) 2-4 J/kg

- Always follow defibrillation with one full round of CPR

Shockable Rhythms

- Pulseless ventricular tachycardia
- Ventricular fibrillation
Precordial Thump

- Strike the patient with the heel of your hand directly over the heart
- Some efficacy for treatment of VF and pulseless VT
- Defibrillation is recommended (when available) over precordial thump

CPR Emergency Drugs and Doses

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<td>0.03</td>
<td>0.05</td>
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<td>Epi High</td>
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<tr>
<td>Vasopressin (20 U/50)</td>
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<td>0.2</td>
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<td>Atropine (0.4 mg/ml)</td>
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<td>Naloxone (0.4 mg/ml)</td>
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<td>External Defib (J)</td>
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<tr>
<td>Internal Defib (J)</td>
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<td>3</td>
<td>5</td>
<td>8</td>
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Post-Cardiac Arrest (PCA)

- Monitoring
  - ECG
  - ETCO$_2$ (hypocapnia can lead to decreased cerebral blood flow)
  - +/- ABG
  - (N)IBP
  - Glasgow-coma scale
- Mild therapeutic hypothermia (MTH)
  - Organ protecting effects in PCA patients
  - Initiate on patients that remain comatose ASAP after ROSC; maintain for 24-48 hours
  - Need mechanical ventilator
  - Avoid rapid warming

Post-Cardiac Arrest

- Corticosteroids
  - Routine administration is not recommended
  - Hydrocortisone can be considered in canine and feline patients that remain hemodynamically unstable despite fluids and pressors
- Hyperosmotic therapy
  - Cerebral edema identified with people in the PCA period
  - Consider hypertonic saline or mannitol (diuretic effects; adjust fluids accordingly)
Seizure prophylaxis
- Prognostic significance of seizure is uncertain in canine and feline patients
- Can be considered with barbiturates (i.e., Phenobarbital) during the PCA period

PCA care should be sent to referral hospitals, as they require intensive care and monitoring

Post-Cardiac Arrest Care Algorithm

- **RESPIRATORY OPTIMIZATION**
  - Spontaneous breathing?
    - No: Tidal Supplemental Oxygen
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Post-CPR Debriefing

- Should occur after every code
- Review and critique your performance and skills, as well as your team’s performance and skills
- Prevent focusing on blaming individuals
- Can lead to enhancement of CPR performance

Other Terminology

- CCR: cardiocerebral resuscitation
- CPCR: cardiopulmonary cerebral resuscitation

*CPR is the preferred terminology over CPCR
Sources


Questions?

One, two, three, BREATHE

He’s dead, Jim