



Cardiopulmonary Resuscitation

The RECOVER Guidelines
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Terms to Know

- CPA- Cardiopulmonary Arrest
- CPR- Cardiopulmonary Resuscitation
- CPCR- Cardiopulmonary Cerebral Resuscitation
- ABC- Airway, Breathing, Circulation
- ROSC- Return of Spontaneous Circulation
- RECOVER- Reassessment Campaign on Veterinary Resuscitation
- PEA- Pulseless Electrical Activity



Recover Guidelines

1. Preparedness and prevention
2. Basic life support (BLS)
3. Advanced life support (ALS)
4. Monitoring
5. Post cardiac arrest care (PCA)



Education and Leadership

- Refresher training is recommended every 6 months
- Recover authors developed an online BLS/ALS CPR course through Cornell
- The program is endorsed by the Veterinary Emergency and Critical Care Society & American College of Veterinary Emergency and Critical Care
- Leadership training is recommended for those who lead CPR
- Veterinarians and Technicians can lead
- Debriefing is recommended to discuss what went well or wrong



Domain 2: Basic Life Support

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



Recognition of CPA

- When a patient becomes unresponsive and apneic immediate and aggressive CPR should be initiated
- Confirming CPA with ECG and pulse palpation is not recommended
- At 4 minutes ischemic damage begins



Rapid Intervention: ABC's

- 30 sec history
- Ischemic damage begins at 4 min , irreversible damage begins at 10 min
- Airway - Visualize, clear oropharynx, palpate
- Note any obstructive /restrictive breathing patterns
- Note orthopnea
- Breathing- Visualize, touch chest, note that some breathing does not equal ventilation
- Circulation- Pulse checks for unresponsive/apneic patients is not recommended. Immediately begin compressions. Assess 5-10 seconds max



Chest Compressions



- Initiated in lateral recumbency
- A rate of 100 to 120 is recommended for both dogs and cats
- Compression depth should be approx. 1/3 to 1/2 the width of the chest
- Perform without leaning on patient, allowing full recoil of thoracic cavity
- Compressions should be performed without interruptions for 2 minute cycles
- Change compressor every 2 min cycle to ensure high quality compressions



Hand Placement for CPR

- Cardiac Pump Theory
- Thoracic Pump Theory



Choosing your Technique



- Thoracic pump theory
- Large breed dogs may benefit from compressions over the widest part of their thorax
- Cardiac pump theory
- Small breeds, keel chested, and cats benefit most from compressions directly over the heart
- Ventrodorsal
- Barrel chested dogs like the infamous bulldog may benefit from compressions in dorsal recumbency



Ventilation

- Regardless of compression technique, simultaneous ventilation should be provided via a cuffed endotracheal tube (with cuff inflated) at a rate of 10 breaths per minute, with a tidal volume of 10 mL/kg and an inspiratory time of 1 second



Domain 3: Advanced Life Support

- Vasopressor therapy
- Vagolytic therapy
- Electrical cardioversion
- Correction/reversal of condition(s) that lead the CPA



Vasopressor Therapy

- Vasopressor therapy is aimed at increasing systemic vascular resistance & coronary/cerebral blood flow
- Epinephrine is a nonselective adrenergic agonist most commonly used for CPA
- Epi effects both alpha & beta adrenergic receptors
- Alpha adrenergic stimulation causes peripheral vasoconstriction
- Beta adrenergic stimulation has positive inotropic and chronotropic effects, which increase myocardial oxygen demand and, therefore, may be detrimental in CPA patients



Epinephrine

- Low-dose epinephrine (0.01 mg/kg) is recommended for routine use every other BLS cycle or every 3 to 5 minutes.
- High-dose epinephrine (0.1 mg/kg) may be considered after prolonged CPR.
- *Data suggests no benefit or reduced survival with use of high-dose epinephrine and may cause irreversible, ischemic damage.*



Vasopressin

- Unlike epinephrine, vasopressin does not affect heart rate or contractility and, therefore, does not increase myocardial oxygen demand.
- Vasopressin (0.8 U/kg) may be considered as a substitute or in combination with epinephrine per the RECOVER guidelines.
- While vasopressin is advocated for use in CPR, research regarding its benefits is mixed. The only prospective veterinary study showed no benefit over epinephrine use.



Vagolytic Therapy

• During CPR, vagolytic therapy is usually provided by atropine.⁶ Limited data is available on atropine use in CPR, with no high-quality data available for dogs or cats.

Current best-evidence suggests that:

- Atropine can be used in patients with CPA related to increased vagal tone and associated asystole or pulseless electrical activity.
- Routine use of atropine may be considered .
- In experimental studies in dogs, high-dose atropine is associated with poor outcomes; therefore, doses above 0.04 mg/kg should be avoided.



CPR Emergency Drugs and Doses

DRUG	DOSE	Weight (kg)										
		2.5	5	10	15	20	25	30	35	40	45	50
Epi Low (1:1000)	0.01 mg/kg	0.03	0.05	0.1	0.15	0.2	0.25	0.3	0.35	0.4	0.45	0.5
	0.1 mg/kg	0.25	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5
Vasopressin (200 units)	0.8 U/kg	0.1	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2
	0.05 mg/kg	0.25	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5
Amlodarone (200 mg/kg)	5 mg/kg	0.25	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5
	2.8 mg/kg	0.25	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5
Naloxone (0.4 mg/kg)	0.04 mg/kg	0.25	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5
	0.01 mg/kg	0.25	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5
Atipamezole (50 ug/kg)	50 ug/kg	0.03	0.05	0.1	0.15	0.2	0.25	0.3	0.35	0.4	0.45	0.5
	2-10 J/kg	20	30	50	100	200	200	200	300	300	300	360
Internal Defib (J)	0.2-1 J/kg	2	3	5	10	20	20	20	30	30	30	50
	2-4 J/kg	6	15	30	50	75	75	100	150	150	150	150
Internal Defib (J)	0.2-0.4 J/kg	1	2	3	5	6	6	8	9	10	15	15

Reprinted with permission from the Veterinary Emergency & Critical Care Society (veccs.org) RECOVER Initiative CPR Emergency Drugs and Doses chart.



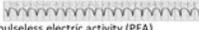
Arrest Rhythms

• Cardiac arrest can be caused by 4 rhythms:

I. ventricular fibrillation (VF)



II. pulseless ventricular tachycardia (pVT)



III. pulseless electric activity (PEA)



IV. asystole.



• Arrest rhythms can be characterized by producing pulses (perfusion) or not and shockable rhythms

• Differentiate asystole and ventricular fibrillation. When compressions pause diagnose rhythm within a few seconds. VF will be a wavy line. Remember D-fib for V-fib.

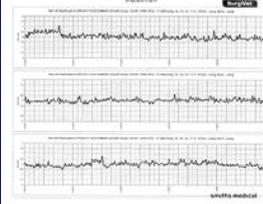
• Pulseless ventricular tachycardia can be recognized when over 200 bpm. A shockable rhythm.

• Pulseless electric activity may look like a sinus rhythm. No pulses are present- compressions

• Asystole- no pulses present, compressions needed



Electric Cardioversion



- Electrical defibrillation is indicated in patients suffering from ventricular fibrillation (VF) or pulseless ventricular tachycardia (VT), and has been shown to significantly improve ROSC in these patients.
- RECOVER guidelines recommend:
 - Use of a biphasic defibrillator has been shown to be more effective than monophasic current
 - Single-shock therapy versus stacked-shock therapy in order to minimize interruption of chest compressions
 - Immediate defibrillation for pulseless VT/VF of less than 4 minutes duration as there is minimal ischemia during this time
 - Two-minute BLS cycle before defibrillation for pulseless VT/VF of greater than 4 minutes duration in order to maximize coronary perfusion
 - Immediate defibrillation may be considered if VF or pulseless VT is diagnosed during an intercycle pause

Arrests During Anesthesia

- Prompt & high-quality CPR should be performed for CPA related to anesthesia due to their higher success rate of 47%
- Plan ahead - Have all emergency drugs calculated and easily accessed to ensure rapid intervention
- Seconds Save Lives



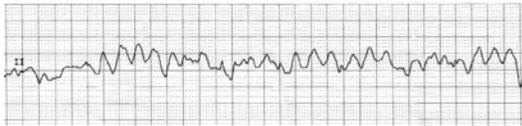
Name that Rhythm



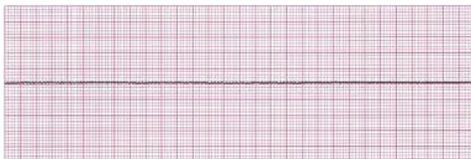
Name that Rhythm



Name that Rhythm



Name that Rhythm



Domain 4: CPR Monitoring

- Diagnosing CPA and confirmation of endotracheal intubation
- Monitoring during CPR



Diagnosing CPA

- Rapid identification of a patient requiring CPR allows more rapid institution of BLS and ALS, which increases the chance of ROSC.
- Pulse palpation to diagnose CPA in unresponsive, apneic patients is not recommended given that:
 - Lack of a palpable pulse does not always indicate CPA
 - Length of time it takes to determine if a patient is pulseless can delay initiation of CPR



ETT Placement Confirmation

- Confirmation of endotracheal intubation
- EtCO2 alone to verify endotracheal intubation is not recommended
- Verification should be accomplished by all 3 of the following:
 - Laryngoscopy
 - Bilateral lung sounds and chest movement
 - EtCO2 readings



Monitoring during CPR

Electrocardiography

- ECG use during CPR is recommended for rhythm evaluation, but should:
 - Only be evaluated during intercycle pauses
 - Not delay resumption of chest compressions



End-Tidal Carbon Dioxide Monitoring

- Since EtCO₂ correlates well with cardiac output, EtCO₂ monitoring during CPR to evaluate efficacy of chest compressions is reasonable if minute ventilation is held constant. Additionally, ROSC will cause a sharp increase in EtCO₂, and EtCO₂ monitoring should be used as an indicator of ROSC during CPR.



Blood Gas and Electrolyte Analysis

- Blood gas and electrolyte analysis may be helpful in evaluating CPR effectiveness and identifying underlying causes.



Additional Medical Therapies

- Routine use of IV fluids, magnesium, corticosteroids, or calcium is not recommended, but these drugs may be beneficial in specific patient populations. Use of these drugs, as well as amiodarone, lidocaine, sodium bicarbonate, reversal agents, and impedance threshold devices are thoroughly covered in the RECOVER guidelines.
- Naloxone should be administered to CPA patients with suspected opioid toxicity and may be considered in all patients that recently received opioids. If IV access is unavailable, intraosseous access is obtained; if intraosseous access is unavailable, intratracheal administration may be performed



Open Chest CPR

- Open-chest CPR may be considered in cases of intrathoracic disease if appropriate resources are available for the intensive PCA care these patients will require



Intratracheal Drug Administration

- When administering drugs via the intratracheal route, dilution with normal saline and use of a long catheter, such as a red-rubber catheter placed through the endotracheal tube to the level of the carina, are recommended. Increase drug doses 2-10 times and dilute with 5-10 mLs NaCl
- Use the mnemonic NAVEL to remember which drugs can be administered intratracheally:
 - Naloxone, Atropine, Vasopressin, Epinephrine, Lidocaine



IVF

- Routine large-volume IV fluid administration is not recommended unless hypovolemia is strongly suspected or documented
- In euvolemic pts - causes poor perfusion (Decreases blood flow/O2 delivery/MAP)



Oxygen

- Oxygen supplementation should be titrated to produce normoxia (PaO₂, 80–100 mmHg, or SpO₂, 94%–98%), but hyperoxia should be avoided. While routine, mechanical ventilation of all PCA patients is not recommended, mechanical ventilation of hypoventilating CPA patients is reasonable.



Team Dynamics/Leadership



- Demonstrates clear/direct closed-loop communication (repeat what was heard)
- Leader is organizer not dictator
- Establishes prompt team roles and focuses on the big picture (ideally not an active part of the code)
- Leader establishes
 1. Compressor
 2. ventilator
 3. Drug handler
 4. Recorder
 5. Other-client communication
- Situation monitor- maintains understanding and communicates patient status
- Solicits input
- Cross monitoring (alert each other when mistakes are made)
- Ends code with debriefing
- Team participates, analyzes and understands, allows team to find solutions, allows silence to linger, summarizes with what went well and what needs improving



Ready to Start Training?

<https://recoverinitiative.org/>

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