



## Cardiopulmonary resuscitation

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### Topics

- Cardiopulmonary arrest (CPA)
- Prevention
- Basic life support



## CPA

- CPA definition
  - Cessation of effective ventilation and circulation
- Goal
  - Provide artificial ventilation and circulation until return of spontaneous circulation (ROSC)

## CPA and CPR

- Prognosis in non-anesthetized animals
  - Overall poor discharge rate
  - Dogs – 3-6%
  - Cats – 2-10%
- Prognosis in anesthetized animals
  - Much better discharge rate
  - Dogs – 47%
  - Cats – 44%

## Causes of CPA

- Hypotension
  - Hypovolemia
  - Sepsis
  - Trauma
  - RX (anesthesia)
- Hypoxemia
  - Lung disease
  - Hypoventilation (mechanical vs. obstruction)
- Metabolic disease
  - Metabolic acidosis (DKA, etc)
- Electrolyte imbalances
  - Hyperkalemia (blocked cats, AKI)

## Common causes to perform CPR - anecdotal

- Respiratory distress cats
  - Feline asthma
  - Congestive heart failure
- Heat stroke
- Elevated vagal tone
  - Severe vomiting
  - Upper airway disease
    - Brachycephalic disease
    - Laryngeal paralysis
    - Obstruction
- Metabolic disease
  - DKA, hyperkalemia (blocked cats)

## Preparation

- Train ALL staff in rapid patient assessment
  - Getting baseline vitals
  - Trending vitals during resuscitation
- Reward “over-triage”
- Train pertinent staff in CPR

## Preparation

- Identify at-risk patients
  - Geriatric patients
  - Underlying metabolic disease
  - Brachycephalic patients
    - Bulldogs, etc
  - Small patients
    - Hypothermia
  - Juvenile patients
    - Hypoglycemia
  - Risky anesthetic procedures
    - Sepsis, traumatic injuries requiring immediate sedation

## Codes for hospitalized patients

- Code red – no CPR
- Code blue – yes CPR
- Educate clients upon admission
  - Severe disease – neoplasia, sepsis, trauma, chronic disease

## Preparation

- Have a PLAN!
  - Adjust anesthetic dosages appropriately
    - BCS, age, procedure, etc
  - Monitor sedation
  - Have reversal agents drawn up pre-sedation
- If anesthetic arrest – REVERSE
- Anesthetic arrests ideally high survival rate
- Have “post-arrest” meetings
  - What went well?
  - How can we improve?

## Preparation

- Post charts of resuscitative doses of RX in prominent locations
  - INCLUDE reversal agents

**CPR Emergency Drugs and Doses**

Weight (kg)	2.5	5	10	15	20	25	30	35	40	45	50
<b>Epinephrine (mg)</b>	0.25	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5
<b>Atropine (mg)</b>	0.1	0.2	0.5	1	1.5	2	2.5	3	3.5	4	4.5
<b>Amiodarone (mg)</b>	5	10	15	20	25	30	35	40	45	50	55
<b>Flumazenil (mg)</b>	0.2	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5
<b>External Defib (J)</b>	20	30	50	100	200	200	200	200	200	200	200
<b>Internal Defib (AED)</b>	2	3	5	10	20	30	30	30	30	30	30

Adapted with permission from the Military Emergency & Critical Care Society (m2cc.org). AHA/ACCPM retains CPR Emergency Drugs and Doses chart.

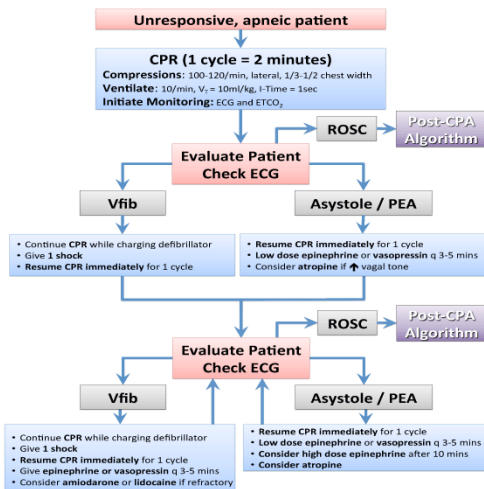
## Preparation

**EMSC Emergency Drug Worksheet & CPR Form**

Record Resuscitation Here

# Preparation

## CPR Algorithm



Reprinted with permission from the Veterinary Emergency & Critical Care Society (veccs.org)  
 RECOVER Initiative CPR Algorithm.

# Preparation



## Crash cart



## Initial evaluation





## Initial evaluation

- Rapid change in vitals/mentation
- Rapid recognition – less than 10 seconds
  - Evaluation of mental state
  - Evaluation of breathing
  - Evaluation of peripheral pulses

## Recognition of CPA

- Mental state
  - Obtunded
- Temperature
  - Hypothermia
- Respirations
  - Change from eupneic to dyspneic/agonal
- Heart rate
  - Normal HR → bradycardia
- Blood pressure
  - Increasingly hypotensive

## Once recognized...

- Announce your concern
- Start Basic Life Support (BLS)
  - Chest compressions



## Basic life support (CAB)

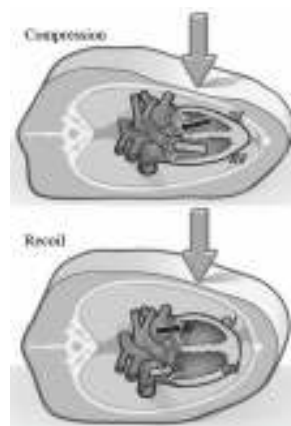
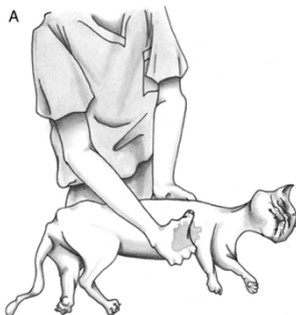
- Circulation (C)
  - Chest compressions
- Airway (A)
  - Establish and maintain
- Breathing (B)
  - Artificial ventilation
  - Supplemental oxygen

## Chest compressions

- Cardiac pump
  - <10kg
  - Hand over heart (4<sup>th</sup>-6<sup>th</sup> intercostal)
- Thoracic pump
  - >10kg
  - Hand over widest part of chest

## Cardiac pump theory

- Direct ventricular compression
- Cardiac filling during recoil



## Thoracic pump theory

- Increase intrathoracic pressure
  - Pushes blood out of aorta/vena cavae
  - Recoil phase – “sucks” blood into chest
- No direct compression of heart



## Caveat

- “Thin” dogs
  - i.e. poodles, greyhounds
- Hand directly over heart
- Employs cardiac pump theory



## Chest compressions

- Positioning
  - Lateral recumbency
  - Back of animal towards you



## Chest compressions

- Position
  - Get next to patient (stool/chair/get on table)
  - Hand over hand
  - Lock elbows
  - Shoulders over hands
  - Activate core muscles for compressions
- DO NOT LEAN on patient

## Chest compressions



## Bad form



## Bad form continued...



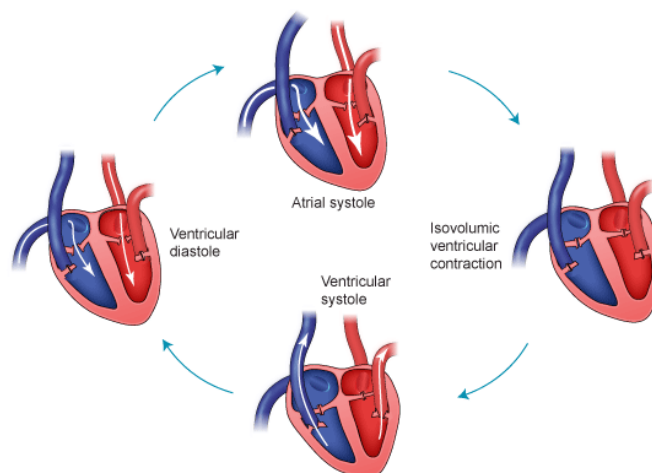
## Circulation

- Chest compressions
  - Goal: maximize cerebral and coronary blood flow
    - Perfuse “vital organs”
  - Laterally recumbent (majority)
    - Exception: brachycephalic dogs
  - 100-120 compressions per minute
    - “Stayin’ Alive”
    - “Another One Bites the Dust”
  - 1:1 ratio compression : relaxation
    - Allow chest to completely expand
  - Compression depth  $\frac{1}{3}$  –  $\frac{1}{2}$  width of chest

## Chest compressions

- Only 25-30% of normal CO is attained
  - Builds up over 1 minute
  - Important to have continuous compressions
- Coronary perfusion occurs during recoil
  - Hence important to allow complete relaxation
- Poor quality chest compressions decrease ROSC

## Chest compressions





## Airway (A)

- Endotracheal intubation
  - Can administer O<sub>2</sub>, RX
- Need to practice in lateral recumbency
- Confirm tube, secure tube, and inflate cuff
- Suction airway



## Intubation



## Last ditch efforts

- Tracheostomy
- Mouth-to-nose



## Ventilation/breathing (B)

- 100% oxygen
- 10-12 breaths per minute (every 6 seconds)
- Give breath over 1 second
- Avoid high volumes and pressures
  - Ambu bag



## Ventilation

- Simultaneous breathing with chest compressions
- Ideally 100% O<sub>2</sub>
  - Room air (21% O<sub>2</sub>)
- Goal: End-tidal CO<sub>2</sub> >15mmHg
  - If <15mmHg?
    - Re-evaluate quality of compressions
      - Rate, depth, recoil

## Circulation recap

- Lateral recumbency – most patients
- Large dogs – hands over widest portion
- Narrow dogs/cats – hands over heart
- 100-120 bpm
- 1/3 – 1/2 width of chest
- Allow for full wall recoil

## Airway recap

- Intubate in lateral recumbency
- Check tube
- Inflate cuff
- Secure

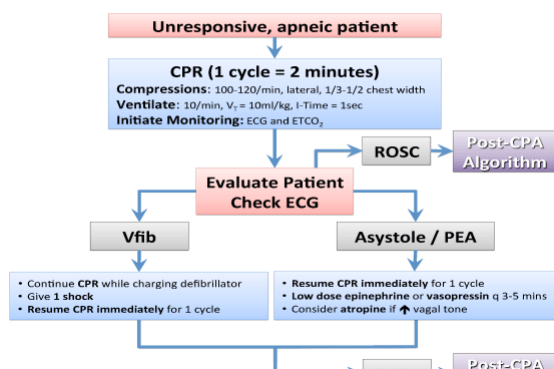
## Ventilation recap

- 10-12 breaths per minute
- 1 breath every 6 seconds
- 1 second per breath

## Cycling

- 2 minute cycles – no interruptions
- Rotate chest compressors
- After one cycle
  - Initiate ALS

### CPR Algorithm



## Single person CPR

- 30 chest compressions : 2 breaths
  - Mouth-to-snout
  - Keep patient's neck extended
- 30:2 – repeat