

Basics of CPR for Animals

Definitions:

Cardiopulmonary: having to do with the heart and lungs.

Cardiopulmonary Arrest: cessation of spontaneous and effective breathing and blood circulation.

Cardiopulmonary Resuscitation (CPR): provides artificial breathing and circulation of blood, until either advanced life support can be established, spontaneous cardiopulmonary function is restored, or the patient is pronounced dead.

Basic Life Support (BLS): CPR

Advanced Life Support (ALS): mechanical ventilation, defibrillation, IV fluids, and drugs that support and sustain effective cardiopulmonary function.

Direct Cardiac Compressions: massaging the heart directly, after opening the chest. Should be limited to cases of trauma or anesthetic arrest, where the patient is basically healthy at the time of arrest.

Indirect Cardiac Compressions: massaging the heart through the chest wall.

Crash Cart: kit for administering BLS and some ALS (drugs, fluids, defibrillator).

EKG or ECG: instrument that measures electrical activity of the heart.

Pulse oximeter: instrument that measures oxygen saturation of the blood.

Oxygen Saturation: percentage of the hemoglobin in red blood cells that is carrying oxygen. Normal is high 90's to 100%.

Blood Gases: testing levels of oxygen and carbon dioxide in the blood. When a dog is breathing room air, oxygen in the arteries should be 100 ppm, and when a dog is intubated and breathing pure oxygen, oxygen in the arteries should be 350-400 ppm.

Electromechanical Dissociation: the EKG is normal, but heart contractions are not effective. Not very common.

Success Rates: Studies show that only 4-9% of animals in referral institutions who receive CPR are ultimately discharged from the hospital. First episode CPR success rates are as high as 22%, but those animals who are resuscitated successfully are often at risk for repeated arrest. Patients with respiratory arrest have a much higher rate of successful resuscitation than those with complete cardiopulmonary arrest. Patients who are resuscitated with BLS are much more likely to be discharged than those requiring ALS. Patients who require open chest cardiac compressions are not likely to survive. THE MAJOR REASON FOR FAILURE OF CPR IS DELAY IN DETECTION AND TREATMENT OF ARREST—SECONDS COUNT!!!

When Should CPR be attempted? Most critical care facilities require that any patient that enters ICU be "coded" as to whether CPR should be attempted if the patient arrests. Owner's wishes and long term prognosis should be considered.

CAUSES OF CARDIOPULMONARY ARREST (by no means a complete list)

1. not enough oxygen getting to the body (hypoxia)
 - a. failure to breathe
 - i. anesthesia
 - ii. paralysis due to infection, toxicity or injury
 - b. airway blockage
 - i. poor positioning during sedation
 - ii. extubated before recovered from anesthesia
 - iii. short nosed breeds (pugs, bulldogs, boxers, Pekingese, Shih Tsu, etc)
 - iv. foreign body/choking/strangulation
 - v. near drowning
 - vi. secretions in the airway
 - vii. tumor occluding the airway
 - viii. mass in the chest occluding the airway
 - ix. bleeding into the airway/swallowing blood
 - c. collapsing of the lungs (atelectasis)
 - i. anesthesia
 - ii. pneumonia/pleuritis

- iii. fluid in the chest
 - iv. air in the chest
 - d. fluid in the lungs
 - i. pulmonary edema
 - 1. heart failure
 - 2. head/spinal cord trauma
 - 3. lack of oxygen/damage to the lungs (ARDS)
 - 4. anaphylaxis/severe allergic reaction
 - 5. trauma/crushing the lungs
 - ii. pneumonia
 - iii. lung tumors or metastasis in the lung
 - iv. rat poisoning (bleeding into the lungs)
 - v. clot in the lungs--pulmonary thromboembolism (heartworm disease, clotting disorder, etc.)
 - e. fluid compressing the lungs (pleural effusion)
 - i. bacterial infection/pus
 - ii. heart failure
 - iii. bleeding due to poor clotting, injury, tumor or infection
 - iv. tumor in the chest
 - v. low protein levels
 - f. air compressing the lungs
 - i. trauma/hole in the chest wall or esophagus
 - ii. lung tumor that ruptures
 - iii. lung abscess that ruptures
 - iv. emphysema that ruptures
 - g. ineffective circulation
 - i. heart failure
 - ii. shock/dilation of blood vessels.
2. vagal stimulation (surge of the parasympathetic nervous system)
 - a. brain disease (increased spinal fluid pressure)—injury or inflammation
 - b. abdominal inflammation
 - c. severe retching or vomiting
 - d. after extensive surgery of the chest or abdomen
 - e. during surgery of the abdomen, chest or eyes
3. blood pH and electrolyte abnormalities
4. anesthesia

SIGNS OF IMPENDING ARREST

1. change of rate, depth or pattern of respiration
2. weak or irregular pulse
3. slowing of the heart rate
4. collapse (especially after retching or vomiting)
5. unexplained changes in depth of anesthesia
6. cyanosis (blue mucous membranes)
7. pallor (pale mucous membranes)
8. dropping temperature
9. restlessness/anxiety

SIGNS OF ARREST

1. no breathing
2. no pulse or heartbeat
 - a. can't feel pulses when average (mean) blood pressure falls under 60 mm Hg
 - b. can't hear heart beats when MPB falls under 50 mm Hg.

- c. It is possible to have no detectable heartbeat or pulses while the heart is still beating, but you'd better act fast if you want it to keep beating.
- 3. dilated pupils begins within 20 minutes of arrest, and maximizes in 45 seconds
- 4. pupillary dilation AFTER successful resuscitation is OK—sympathetic surge, atropine and epinephrine cause the pupils to stay dilated for some time.

STEPS OF CPR

1. try to arouse the patient. If not response, note the time, call for help, and quickly go to the next step.
2. AIRWAY: establish an open airway and check for breathing for 5-10 seconds
 - a. position the head straight and pull the tongue out, to open the airway (note color of mucous membranes—anything but pink is not good)
 - b. clean out the mouth if necessary
 - c. check for breathing by watching the chest and listening and feeling for air flow
 - d. place an endotracheal tube (inflate cuff) if not breathing or breathing is not effective
 - e. if the endotracheal tube can not be placed through the mouth due to injury or other obstruction, the doctor will have to do a tracheotomy
 - f. turn the oxygen on and make sure the anesthesia is OFF
 - g. quickly check cats for strings/rubber bands around the neck
 - h. If there is a second person, they can suction the mouth and airway if needed. If you are by yourself, you can come back to this after you assess breathing and circulation.
3. BREATHING: Check for heartbeat for 5-10 seconds
 - a. if no breathing, give 2 breaths for 1.5 to 2 seconds each, to 20 cm H₂O (called *Sighs*). This will re-inflate collapsed lungs.
 - b. If there is a heartbeat, begin giving 10 breaths per minute (every 6 seconds) and check pulses every 30 seconds until help arrives.
 - 1) check for heartbeat with your hand on the chest or with a stethoscope on the chest or in the esophagus.
 - 2) Check for pulses on the tongue, inner thigh, top of the hock, or bottom of the foot.
 - 3) Connect EKG and pulse oximeter if you have them. DO NOT USE ALCOHOL ON THE EKG LEADS IF YOU HAVE A DEFIBRILLATOR THAT YOU MAY USE!!! If animal is defibrillated, their skin and hair will be burned where the alcohol is. Use EKG cream.
 - 4) If cardiovascular system is in good shape (color is good, oxygen levels are good, and pulses are strong, slow down to 4 breaths per minute after a minute or two. Give 4 breaths per minute for 2 minutes, then stop for one minute to watch for breathing, and repeat this until the patient begins breathing on his own. As soon as patient begins to make attempts to breathe (no matter how small), reduce breathing rate to 2 times per minute, still breathing for 2 minutes and watching for one.
 - 5) If you notice fluid in the endotracheal tube, TELL THE DOCTOR. Pink fluid means pulmonary edema.
 - 6) If the lungs are resistant to inflating, TELL THE DOCTOR. There may be fluid in the lungs or air in the chest which needs to be removed if CPR is going to be successful.
 - c. Place a 25 gauge needle in the crease in the front of the nose to stimulate breathing. This an acupuncture point (GV26). Twirl it and move it up and down for increased effect.
 - d. If there are no pulses, a second person can begin giving 10-20 breaths per minute, and the first person goes on to establish artificial circulation. For maximal effects, give breaths when the chest is being compressed. If you are by yourself, give 15 compressions, then 2 breaths (sighs), and repeat.
 - e. If the patient was on anesthetic gas and there is no heart beat, turn it off. If the patient was given an injectable anesthetic, give a reversal agent if possible. If there is only

respiratory arrest, the doctor may or may not want to cut back on anesthesia, depending on how the patient is doing.

4. CIRCULATION:

- a. If there are no pulses and you don't have an EKG, begin chest compressions at 1-2 per second (80-120 per minute). The smaller the animal, the faster the rate.
 - 1) Some say that any animal that weighs more than 15 pounds should be put on their back. Use tape to position them if you need to. Be careful of the IV catheter when moving the patient.
 - 2) Compress the chest by 25-30% when the patient is lying on their side
 - 3) When the patient is on its back, place your hand on the back third of the sternum, and compress 25-30%
 - 4) Time of release should equal time of compression
 - 5) If a third person is available, pressing on the abdomen alternately with chest compressions can increase blood return to the heart. This is not possible if arrest happens during abdominal surgery, and may not be advisable if there is abdominal pain, disease or trauma.
 - 6) Effectiveness of chest compressions can be tested by feeling for pulses that should be generated with each compression. If pulses are not being generated, alter compression technique, or the doctor will have to go to open chest compressions.
- b. If there are no pulses but EKG is normal, place an IV catheter and begin giving shock dose of fluids. Chances are that the heart is working, but the animal is so shocky that you can't feel pulses.
 - 1) Use a 20 or 18 gauge in cats and small dogs, 16-18 gauge in large dogs. May need to place 2 IV catheters in very large dogs.
 - 2) shock dose of IV fluids is 10 ml/lb given "wide open," then 10 ml/lb/hr until no longer shocky.
- c. If there are still no pulses after a minute or two of giving shock doses of fluids, you need to start chest compressions. You might have EM dissociation.
- d. If the EKG is abnormal, the doctor will instruct you on what drugs to give IV or in the endotracheal tube.
 - 1) atropine for a slow heart rate or flat line due to vagal stimulation (to make it faster)
 - 2) epinephrine and naloxine for EM dissociation
 - 3) defibrillation for ventricular fibrillation. If you don't; have an electrical defibrillator, the doctor may give bretylium or magnesium chloride.
 - 4) Epinephrine and atropine for flat line.
 - 5) IV fluids shock dose for fast heart rate.
 - 6) Lidocaine for V-tach (ventricular tachycardia)
 - 7) Other drugs may be given, depending on what is going on with the patient
 - 8) All should be given IV (occlude the IV above the injection port while injecting, and flushing with syringe full of IV fluids, then remove occlusion and let the IV fluids run to flush further into the dog)
 - 9) If necessary, drugs can be given in the endotracheal tube, until an IV can be established. They will be absorbed by the lungs and taken to the heart if circulation is effective. Don't give bicarbonate in the endotracheal tube, because it is caustic.
 - 10) Never give drugs in the heart unless the chest is open. If given in the heart muscle, most drugs can cause lethal arrhythmias.
- e. if patient has not been resuscitated within 10 minutes, then CPR is not likely to be successful without opening the chest and doing internal cardiac massage.
- f. Almost all cases need a shock dose of fluids, which is life saving to most animals in shock. There are a few exceptions where giving IV fluids can be dangerous:
 - 1) Heart failure
 - 2) Kidney failure when urine is not being produced
- g. if there is blood loss or severe anemia, transfusion is critical to successful CPR

4. DETERMINE STATUS

- a. if the animal presents in arrest, take blood for emergency assessment right away, so the doctor can tell something about what is going on (CBC, panel and urinalysis)
- b. if response is partial, take blood after 10 minutes to see if anything can be corrected to assist in resuscitation (PCV, glucose, pH, electrolytes, etc)
- c. if CPR is successful, take blood for BUN, glucose, electrolytes and pH after resuscitation. Some of these things can be way out of whack after an arrest, and they need to be corrected if another arrest is to be avoided.

WHEN CPR IS FINISHED MAKE SURE THE POP-OFF VALVE IS LEFT OPEN!!!!!!

COMPLICATIONS FOLLOWING SUCCESSFUL CPR

1. pulmonary edema (fluid in the lungs). If you see blood tinged fluid in the endotracheal tube, this means that there is pulmonary edema. You might also hear crackles in the lungs when listening with a stethoscope. If pulmonary edema is due to heart failure, you want to cut way back on IV fluids, or not use them at all. When the lungs are deprived of oxygen, pulmonary edema can result from the damage.
 - a. pulmonary edema from the heart (cardiogenic pulmonary edema) is treated with diuretics and drugs for the heart
 - b. pulmonary edema from lack of oxygen (noncardiogenic pulmonary edema) is treated with oxygen, vasodilators and morphine.
2. abnormal heart rhythm (arrhythmia) from damage to the heart muscle due to lack of oxygen to the heart. This may or may not be reversible with time. Usually treated with lidocaine or similar drugs.
3. brain swelling (cerebral edema) treated with dexamethasone, mannitol, and diuretics.
4. kidney failure, due to lack of blood flow to the kidneys during arrest. Damage may or may not be permanent.
5. bloody diarrhea from lack of blood supply to the gut.

POST ARREST CARE

1. all patients who survive CPR should receive oxygen supplementation, because they are at risk for pulmonary edema due to lack of oxygen to the lungs during arrest.
 - a. Can be given by nasal tube, mask or oxygen cage or tank.
 - b. Give for at least 4 hours if possible, because most patients who arrest again usually do so within 4 hours.
 - c. Some recommend giving dexamethasone and lasix to any patient (unless contraindicated) who survives CPR, to prevent pulmonary edema.
2. watch for signs of pulmonary edema (coughing, blood tinged fluid from the nose or mouth, difficulty breathing, crackles when listening to the chest)
3. EKG should be checked frequently so any secondary arrhythmias can be treated
4. anti-nausea drugs should be given to animals who arrested from vagal surge. Don't let vomiting go untreated.
5. watch for signs of brain swelling (different sized pupils, poor coordination, walking in circles, disorientation, strange vocalization).