

CPCR – postresuscitation care

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The cardiopulmonary arrest is a life threatening condition in medicine. The lot of patients are instable after successful resuscitation and recurrence of cardiac arrest is quite high. On the other hand, cardiac arrest leads to ischemia and consequent reperfusion injury, which are cause of damage of many organs (heart, lungs, kidneys, brain, gastrointestinal system). Careful monitoring and intensive care protect patients and help decreased mortality.

Airway and breathing

Respiratory rate and pattern

A lot of patients hypoventilate after the episode of cardiac arrest and a transient artificial ventilation is necessary to keep normocapnia. Administration of lidocain 1mg/kg (cats 0.5mg/kg) intravenously (IV) is recommended prior extubation (it protects before intracranial pressure increasing). On the other hand, a pathological and irregular ventilation could be the first signal of cardiac arrest recurrence.

Pulse oxymetry

Pulse oxymeter helps us to discover hypoxemia.

Blood gas analysis

Repeated blood gas and acid base analysis in central venous blood give us accurate information about gas exchanges and metabolic situation in a body. On base of these results we can assess development of clinical state and accurate therapy.

Oxygen supply helps to decrease risk of hypoxia, but very high inspiration concentration of oxygen (more than 60%), especially for a longer time induces oxygen toxicity.

Furosemid is used as 1 mg/kg IV bolus in case of overhydratation and post CPCR pulmonary edema. The effect is after 30 minutes. If it is not effective, we can repeat furosemid administration once more in 30 – 60 minutes.

Cardiovascular system

Electrocardiography – ECG monitoring is necessary.

Cardiac arrhythmias are developed at many patients and could be life threatening. Continual ECG monitoring helps us recognize these complications and treat them immediately.

Bradycardia

(HR bellow 60 beats/minute)

Drug of choice is atropine in dose 0.02 – 0.04 mg/kg IV and repeat it rapidly, if no response.

Ventricular tachyarhythmias

(HR over 160 in large dogs, 180 in small dogs and 220 beats/minutes in cats)

Lidocain is used when HR is over 180 with multiform or no isoelectric shelf between complexes.

Recommended dose is 2 – 4 mg/kg IV bolus, then 2 – 3 mg/kg/h constant rate infusion (CRI) for dogs. In cats we use 0.75 – 1 mg/kg IV bolus, then 0.5 – 2 mg/kg/h CRI. Use as low dose as possible.

Procainamide can be used in dogs in dose 5 – 10 mg/kg IV over 10 minutes, then 10 – 40 mcg/kg/min CRI. In cats we use 1 – 2 mg/kg over 15 minutes, and then 12 – 20 mcg/kg/min CRI.

Magnesium sulfate can be used in dogs in dose 30 – 35 mg/kg slowly IV during 30 minutes, then 5 mg/kg/h CRI. In cats we use 30 – 35 mg/kg slowly IV during 30 minutes without consequent CRI.

Amiodarone should be diluted in 5% dextrose in water. We start with bolus 2 – 5 mg/kg over 10 minutes and CRI 1 mg/kg/h for 6 hours, then 0.5 mg/kg/h for next 18 hours. Repeated boluses (2 – 5 mg/kg over 10 minutes) could be given in inadequate response. **Do not exceed 10 mg/kg/h.**

Continuous ECG and blood pressure monitoring is necessary.

Supraventricular tachyarrhythmias

Diltiazem is recommended in these cases for dogs 0.1 – 0.25 mg/kg IV boluses to 0.5 mg/kg, then 1 – 5 mcg/kg/min CRI and for cats 0.1 – 0.2 mg/kg IV bolus, then 1 – 5 mcg/kg/min CRI.

Procainamide can be used in dogs in dose 5 – 10 mg/kg IV over 10 minutes and then 25 – 40 mcg/kg/min CRI. In cats we use 5 - 10 mg/kg over 15 minutes IV q 8 hours.

Blood pressure (BP) monitoring

A lot of patients are hypotensive (systolic BP below 90 mmHg) due to myocardial dysfunction, abnormal vasomotoric tone or hypovolemia. Persistent hypotension increases risk of recurrent cardiac arrest. The arrhythmias treatment improves cardiac output and helps normalize blood pressure.

The very important step is a correction of hypovolemia and electrolyte abnormalities by fluid therapy with using of balanced polyionic solutions (e.g. Plasmalyte, Ringerfundin, Ringer lactate). Be careful about decreasing of PCV below 25 and total solids of 50g/l. The fresh blood transfusion is a better choice in patients with low PCV and total solids. **We avoid overhydration.**

If we have persistent hypotension in normovolemic patients, we would have used vasopressors and sympathomimetic drugs.

Dopamine has an influence, especially to beta receptors in heart. Dobutamine could be used only in dogs in dose at 5 mcg/kg/min.

Norepinephrine has a stronger effect to alpha receptors in vessels. Recommended dose is 0.1 – 1 mcg/kg/min. If we have not an access to norepinephrine, the epinephrine could be used in dose 1-10 mcg/kg/minute, but wean them as soon as possible.

We can use those drugs alone or in combination, but we slowly decrease the dose and discontinue the infusion when patients are stable.

Temperature

Hypothermia has some protective effect due to a lower metabolic level and an oxygen requirement. The rewarming has to be slow in mildly hypothermic patients. Keep body temperature at 37 – 38°C.

In all cases we compare the temperature in rectum and extremities as a circulatory parameter. The cold extremities usually indicate poor peripheral perfusion. Temperature dropping during the post resuscitation period could be a poor prognostic signal.

Neurological functions

Severity of neurological damage depends on duration of cardiac arrest, blood pressure, ventilation, metabolic situation and primary disease.

The cardiac arrest leads to cerebral ischemia and hypoxia and neurons death. Hypoventilation during recovery phase results in hypercapnia and consequent vasodilatation and intracranial pressure increasing. On the other hand, hyperventilation leads to hypocapnia and cerebral vasoconstriction and decreasing of cerebral blood flow and hypoxemia. Any reduction of cerebral blood flow (cerebral vasoconstriction, systemic hypotension) results in increasing of intracranial pressure.

Hypertonic saline administration decreases a high intracranial pressure. We can use 5 – 7% hypertonic saline solutions in dose for dogs 1 – 5 ml/kg IV during 10 minutes and for cats 1 – 2 ml/kg over 10 minutes.

Alternatively, mannitol could be used in dose 0.1 – 0.5 g/kg IV over 10 minutes. But we avoid it in animals with pulmonary edema, anuria and overhydration.

Some studies report about neuroprotective effect of lidocaine CRI in dose 1 mg/kg/hour. We should be careful when we use it in patients with a low heart rate.

In patients with vocalization, dementia, restlessness gabapentin could be used in dose 5 – 25 mg/kg per os every 8 to 12 hours.

Renal function

Kidneys are quite common damage organs due to ischemia during the arrest. Acute renal failure could be developed during consequent hours after a successful resuscitation. Patients with a restricted renal function are more susceptible to overhydration.

Normal urine production is 1 – 2 ml/kg/h.

If urine production is lower, check the patient hydration state and blood pressure.

In case of normovolaemia and normotension with oliguria or anuria furosemid administration should be considered.

Furosemid as CRI could be used in dose 0.2 – 1 mg/kg/h in case of oliguria.

Pain management

Pain has a negative influence to all body. The accurate pain management reduces the negative influence of and analgetic drugs.

Butorphanol in dose 0.1 – 0.4 mg/kg IV every 2 – 3 hours is useful for mild pain.

In case of moderate to severe pain fentanyl is a good choice in dose 2 – 4 mcg/kg/h CRI.

Fluid therapy

Balanced solutions like Plasmalyte, Ringerfundin, Ringer-lactate are used. Fluid rate is calculated on base of circulatory and hydration state.

Monitoring of urine output and weighting twice or three times per day are useful for the determination of fluid therapy.

Acid base and electrolyte analysis helps to choose optimal solution for a correction of metabolic and electrolyte disorders.

Glucose supplementation is recommended only in patients with hypoglycaemia.

We have to avoid overhydration.

Gastrointestinal support

Hypotension during cardiac arrest results in gastrointestinal tract ischemia and mucosal damage. During following hours gastrointestinal ulceration is developed. H₂ blockers as famotidin (0.5 – 1 mg/kg IV, PO every 12 – 24 hours) or proton pump inhibitors (omeprazole – 0.7 mg/kg PO every 24 hours) decrease acidity of gastric juice and support mucosal defects healing.

Others

Other medications (e.g. antibiotics, diuretics) depend on primary disease and possible other complications e.g. systemic inflammatory response syndrome.

The careful monitoring with intensive care and effective treatment of complications improve a survival rate in patients after the cardiopulmonary arrest.

References:

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