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Field Techniques for Resuscitation of Foals

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I. INTRODUCTION

Cardiopulmonary cerebral resuscitation (CPCR, previously called CPR) is the restoration of spontaneous circulation (a heartbeat) with the preservation of neurologic (brain) function. The most common and immediate case requiring CPCR is an asphyxiated foal. Clinical signs that resuscitation is needed for a newborn foal include the absence of breathing; irregular gasping; respiratory rate less than 10 breaths/minute; irregular or absent heart rate, or one less than 40 beats/minute; muscle flaccidity; and the lack of a response to tactile stimulation. Foals delivered by cesarean section often need CPCR. It is important to always assess the glucose levels on a foal that may have arrested because hypoglycemia is one of the most common causes requiring resuscitation.

II. MATERIALS AND METHODS

Preparation

There will be few moments in your veterinary career when preparation is more vital than when dealing with a compromized neonate. The 5 P’s of Prior Planning Prevents Poor Performance rings true in this medical situation. The goal of CPCR is the restoration of spontaneous circulation with preservation of neurologic function. Successful treatment is defined as the return or establishment of normal function, not just the restoration of spontaneous circulation and survival to discharge. Many veterinarians feel inadequate because of their low success rates for CPCR. We must, however, realize the odds for survival after CPCR in humans are also low, with 6% survival from out of hospital arrests to 15% success during in hospital arrests.1-4

It is of the utmost importance to also educate clients about providing basic CPR because the veterinarian may not be present at foaling.

All emergency supplies should be organized into a dedicated, easily accessible and portable “resuscitation kit”.

The “resuscitation kits” must be organized and stocked with all the medications and supplies needed to provide emergency resuscitation (Fig. 1). The resuscitation kit should include the following items:

- Full Oxygen tank (OPTIONAL)
- Ambu resuscitator with 3 ft corrugated tubing tail piece
- Endotracheal tubes (7,8 and 9 mm for foals)
  a. 10 ml syringe to inflate the cuff
- Fluids
  a. Hydroxyethyl starch volume expander
  b. Hypertonic Saline
  c. Isotonic polyionic fluids (Lactated Ringer’s Solution, etc.)
- Fluid Administration sets
  a. Include a pressure bag for rapid administration of fluids
- Fluid Additives
  a. 50% Dextrose
  b. 50% Magnesium Sulfate
- Oxygen Supplies
  a. Tubing
  b. Nasal cannula
  c. Humidifier and connectors
- Intravenous Catheters
- Feeding Tubes
  a. 24 Fr, 60 inches long (Harris Flush Tube or Stallion Urinary Catheter)
- Sedatives for the mare
  a. Xylazine
  b. Detomidine
  c. Romifidine
- Tackle box with emergency medications already drawn up and labeled
  a. Epinephrine 1 mg/ml
    i. Dose: .01 to .02 mg/kg IV (50 kg Foal: 0.5 to 1 ml IV at 3 minute increments if until return of circulation)
    ii. Have three 1 cc syringes drawn up
  b. Doxapram 20 mg/ml (Respiratory stimulant)
F—breathing; C—circulation.

The concept of the ABCs is important: A—assessment/airway; B—breathing; C—circulation.

Assessment/Airway

The first step is to clear the airway and remove membranes and mucus from the nose. If this does not work, the airway can be suctioned with a bulb syringe (like a turkey baster) or a 60-mL syringe and rubber tubing. Suctioning should only be performed if meconium is present and then only for less than 10 seconds as it may cause bradycardia and cardiac arrest via vagal reflexes.

Don't worry about suctioning the mouth because horses are obligate nasal breathers. Vigorous rubbing with dry towels can provide tactile stimulation and initiate breathing. Slapping, shaking, spanking, and holding the foal upside down are strongly advised against in horses (and humans). The foal should start to have a regular breathing pattern within 30 seconds of birth. It is not unusual for foals to have arrhythmias for the first 10-15 minutes of life. In one study, 50 newborn foals were evaluated electrocardiographically during their adaptive period, immediately after birth. In 48 foals there were paroxysmal arrhythmias or mixed arrhythmias. The most common arrhythmias were sinus arrhythmia including wandering pacemaker (32/50) and atrial premature contractions (30/50). The others observed were atrial fibrillation (15/50), ventricular premature contractions (10/50), partial atrioventricular block (7/50), ventricular tachycardia (4/50), atrial tachycardia (3/50) and idioventricular rhythm (1/50). The duration of the arrhythmias was approximately 5 min, and in all cases the arrhythmia disappeared within 15 min of birth. With the exception of 2 cases, all foals have continued to grow and develop normally. These arrhythmias are considered normal physiological processes in newborn Thoroughbred foals during the adaptive period, immediately after birth. In 48 foals there were paroxysmal arrhythmias or mixed arrhythmias. The most common arrhythmias were sinus arrhythmia including wandering pacemaker (32/50) and atrial premature contractions (30/50). The others observed were atrial fibrillation (15/50), ventricular premature contractions (10/50), partial atrioventricular block (7/50), ventricular tachycardia (4/50), atrial tachycardia (3/50) and idioventricular rhythm (1/50).

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Fig. 1. Example of “resuscitation cart” set up.
Breathing

The ideal rate of ventilation for the neonatal foal can be rather subjective as controlled studies have not been established. Experience suggests that 20-40 BPM with a tidal volume of 6-10 ml/kg is appropriate. An adult human AMBU bag with a volume of 1000-1200 ml should be used. Excessive inflation of the lungs should be avoided as this can cause barotrauma to the alveoli and increase intrathoracic pressure therefore decreasing perfusion.

The use of 100% oxygenation versus room air has been in debate for years. Multiple animal studies have shown that room air might be as beneficial as 100% oxygen for resuscitation of newborns (Fig. 2). Illustrative studies include those of Bagenholm et al who induced hypoxic ischemic encephalopathy (HIE) in rats by ligation of the left common carotid artery and compared the effects of ventilation with room air with those of ventilation with 100% oxygen. There was no difference in weight of the left cerebral hemisphere, a general indicator of cerebral damage, between rats given room air and those given 100% oxygen. Rootwelt et al studied re-oxygenation in newborn piglets made hypoxemic with 8% oxygen. They found no significant differences between the room air and 100% oxygen groups in blood pressure, heart rate, base deficit, or plasma hypoxanthine. Pathologic examination of the brain after 4 days showed no differences in brain damage between groups. On-hundred percent oxygen has theoretical advantages when diffusion barriers are present and may promote pulmonary vasodilation, but researchers also noted that 100% oxygen can be associated with delay in spontaneous respiration, drop in blood pressure, and generation of hyperoxia-induced free radicals. Ventilation alone may resolve most of the problems related to apnea and bradycardia. In the author’s experience when oxygen is available I would use it during the initial CPCR with the goal of attaining normoxia - NOT hyperoxygenation.

![Fig. 2. Different routes of administering oxygenation. a; Intranasal oxygenation through a 24 fr feeding tube, b: Ambu bag 100 ml capacity and c: oxygen demand valve. BE CAREFUL WITH THE DEMAND VALVE AS IT CAN CAUSE HYPERINFLATION OF THE LUNGS AND BAROTRAUMA.](image)

During ventilation, check for spontaneous breathing and heart rate every 30-60 seconds, but do not stop CPCR for longer than 10 seconds to assess the foal. Ventilation can be stopped when the heart rate is above 60-70 beats/minute and spontaneous respiration is well established.

Circulation

In the literature it has been referenced that chest compressions are indicated if the heart rate is below 40 beats/minute and should be instituted in foals only after the initial 15-30 seconds of ventilation and reassessment of heart rate. The author could not object more to these statements. Having performed resuscitation in hundreds of neonates, I rarely have to resort to chest compressions to restore circulation. The use anticholinergic agents such as glycopyrrolate and/or vasopressors have been able to resolve most bradyarrhythmias.

The foal’s ribs should be checked for fractures before starting chest compressions. Feel over the chest with your hands while applying gentle pressure. If there’s a marked indentation or a displacement of the ribs, then at least one is most likely fractured. If fractures are noted over the heart, then thoracic compressions could make the situation worse.

The individual performing compressions should kneel with his/her shoulders over the foal. The heel of one hand should be placed directly behind the triceps mass (behind and just above the elbow) at the level of the foal’s shoulders with the other hand placed on top of the first hand. A rate of 100-120 compressions per minute (1.7-2 times per second) should be attempted. It's not necessary to coordinate chest compressions with breathing. Rib fractures are the most common complication, followed by lung and heart bruising. Monitor a central pulse, heart rate, and pupil size every two to three minutes during compressions (a dilated pupil is indicative of severe oxygen deprivation and circulation collapse). Ventilation should be stopped when the heart rate is above 60 BPM and spontaneous breathing has been established. Spontaneous breathing is a rate of 16 BPM with a regular respiratory pattern and normal lateral excursions of the chest.

With CPCR in humans, the success rate is between 10-15%; in veterinary medicine, the success is less than 10%. Resuscitation is only the beginning. Owners must realize that the initial event causing respiratory or cardiac arrest as well as hypoxia (reduction of oxygen supply to tissues) that occurs during arrest can cause more problems for the foal. It is thus appropriate to refer a resuscitated foal to an intensive care facility for further evaluation.

REFERENCES

2. Casalaz DM, Marlow N, Speidel BD. Outcome of resuscitation following unexpected apparent stillbirth.


