



Quick Guide Vasodilatory/Septic Shock Resuscitation

Louis A DelGiudice, DVM, DACVECC

- **THERAPEUTIC TARGETS**

- DOGS:

- Cardiovascular:

- HR < 140 BPM
 - Normal or improved pulse
 - Normal-to-injected mucus membrane color
 - Warm skin
 - CRT < 2 seconds
 - Noninvasive arterial pressure systolic (SAP) > 120 mm Hg, mean (MAP) 80-120 mmHg
 - (if used) Direct MAP 80-90+ mm Hg, diastolic blood pressure (DBP) 65-80 mm Hg
 - (if used) Appropriate CVP response to fluid challenge

- Other:

- Temperature > 100 F
 - Urine output > 1-2 ml/kg/hour
 - Alert, oriented mentation
 - Normoglycemia
 - Arterial blood gas analysis: pO₂ > 90 mmHg, pCO₂ 35 to 45 mmHg, lactate concentration < 2.5 mmol

- CATS:

- Cardiovascular:

- HR > 160 BPM
 - Palpable or improved pulse
 - Normal-to-injected mucus membrane color
 - Warm skin
 - CRT < 2 seconds
 - (Noninvasive arterial pressure systolic (SAP) > 120 mmHg, mean arterial pressure (MAP) 80-120
 - (if used) Direct MAP 80-90+ mm Hg, diastolic blood pressure (DBP) 65-80 mmHg
 - (if used) Appropriate CVP response to fluid challenge

- Other:

- Temperature > 100 F
 - Urine output > 1-2 ml/kg/hour

- Alert, oriented mentation
- Normoglycemia
- Arterial blood gas analysis: pO₂ > 90 mmHg, pCO₂ 35 to 45 mmHg, lactate concentration < 2.5 mmol

- **Protocol for resuscitation**

1. Evaluate patient condition and instrumentation
 - a. ECG and SpO₂ monitoring
 - b. Large bore peripheral catheter
 - c. Consider multi-lumen central catheter
 - d. Collect blood for:
 - i. CBC
 - ii. Biochem
 - iii. PCV/TS/BG
 - iv. Arterial (or central venous) blood gas
 - v. Coagulation profile
 - vi. Consider FeLV/FIV or 4Dx Testing
 - vii. Is SpO₂ < 94% or increased respiratory effort: Oxygen via face mask
2. Fluid Challenge, identification of hypoglycemia or electrolyte disturbances
 - a. Fluid Challenge
 - i. **Administer in under 10 minutes**
 - ii. Warm isotonic crystalloid (**LRS or Norm-R**) at **20 to 40 ml/kg (dog) or 10 ml/kg (cat)**
 - iii. If marked hypoproteinemia present consider **Vetstarch 5 to 10 ml/kg (dog) or 2.5 to 5 ml/kg (cat)**
 - iv. **Re-assess every 10 minutes or sooner, see step 4 to 7**
 - b. If hypoglycemic (< 60 mg/dl): administer 0.5 ml/kg of 50% dextrose IV, diluted 1:4
 - i. Recheck within 15 minutes and supplement as needed
 - ii. Maintain BG between above 80 mg/dl (see step 9)
 - iii. Consider a second IV drip just for dextrose supplementation separate from fluid boluses
 - c. Severe hypokalemia (< 3.5 mmol/L)
 - i. Begin supplementation at 0.25 to 0.5 mEq/kg/hr
 - ii. Recheck q1h
 - iii. Consider a second IV drip for potassium supplementation separate from fluid boluses (see step 9)
 - d. If ionized hypocalcemia (< 0.9 mmol/l)
 - i. 10% Calcium gluconate 100mg/kg (1cc/kg) IV as slow injection
 - ii. 10% Calcium Chloride
 - e. Hypothermia or shivering (even with fever):
 - i. Actively rewarm and monitor temperature continuously
3. If sepsis suspected identify source
 - a. Urine for analysis and culture
 - b. Thoracic Radiographs
 - c. Cytology of sputum

- d. Abdominal and thoracic US- look for effusion centesis for cytology
 - e. Evaluate for wounds
 - f. Antibiotic considerations for sepsis (not a complete list), four quadrant therapy:
 - i. **Amikacin** (15 mg/kg q24h) and **clindamycin** (10 mg/kg q12h)
 - ii. **Ampicillin/Sulbactam** (30 mg/kg IV q8h) and **enrofloxacin** (10 mg/kg or 5 mg/kg for cats q24h)
 - iii. **Ampicillin** (22 mg/kg q8h) and **enrofloxacin** (10 mg/kg or 5 mg/kg for cats, q24h)
 - iv. **Meropenem** (24 mg/kg q24h)
 - v. **Ampicillin** (22 mg/kg IV q8h) and **Ceftazidime** (25 to 50 mg/kg q4-6h)
 - g. If recently on antibiotics consider at high for multi-drug resistant infection
 - h. Always consider possibility of fungal disease – evaluate cytology closely
 - i. Surgery for source control only when therapeutic goals met and stable or need to control active hemorrhage
4. Therapeutic Goals Met??
- a. Best accomplished by using a combination of crystalloid and colloids
 - b. If goals not met after initial bolus consider additional boluses (average 2-3)
 - c. If hypotension responds with fluid boluses then likely need to continue volume replacement
 - i. Consider CVP monitoring
 - ii. Continue fluid replacement until CVP raises 2-3 mmHg (3-4 cmH2O) above baseline and remain elevated for > 5 minutes
 - d. If hypotension stops responding to fluid boluses consider vasopressor therapy
5. Vasopressor Therapy
- a. Need adequate blood volume to respond to vasopressor therapy
 - b. Dogs
 - i. **Norepinephrine: 0.1 to 2 mcg/kg/min**
 - ii. Increase by increments of **0.1 to 0.2 mg/kg/min every 5 minutes**
 - iii. If systolic dysfunction is present or refractory, **Dobutamine 5 mcg/kg/min**, increase at increments of **2.5 mcg/kg/min**
 - iv. May consider **vasopressin 0.5 to 5 mu/kg/min**
 - c. Cats
 - i. Make sure warmed > 100 F
 - 1. Cats need to be warmed to respond to catecholamines, catecholamine receptors shut down in hypothermia
 - ii. If bradycardic (< 160 bpm) administer **atropine 0.04 mg/kg IV**
 - iii. **Norepinephrine: 0.1 to 2 mcg/kg/min**, increase in increments of **0.1 to 0.2 mcg/kg/min q5minute**
 - iv. **vasopressin 0.5 to 5 mu/kg/min** (consider in hypothermia)
6. Maintain Hct > 30%
- a. PRBC or whole blood transfusion as needed
7. Refractory to above
- a. Hypoxemia present – SpO2 or arterial blood gas
 - b. Recurrent hypovolemia – fluid challenge and/or CVP evaluations

- c. Hypoglycemia
 - d. Hypokalemia
 - e. Ongoing hemorrhage
 - f. Arrhythmia
 - g. Pericardial effusion
 - h. Massive PTE
8. Suspected adrenal dysfunction or catecholamine resistant hypotension
- a. Consider **hydrocortisone 1 mg/kg q6h**
9. Continued supportive care and monitoring
- a. Maintain SpO₂ >94% or PaO₂ > 90 mmHg
 - i. Nasal oxygen
 - ii. Oxygen cage
 - b. Maintain blood glucose > 80 mg/dl and potassium > 3.5 mmol/L
 - i. Consider a separate line for supplements
 - c. FFP for coagulopathies
 - d. Maintain COP
 - i. Synthetic or natural colloids
 - ii. TS > 4.5 g/dl
 - iii. **Vetstarch 20 to 50 mls/kg/day**
 - iv. FFP 40 to 50 mls/kg to raise albumin 1 g/dl
 - v. Consider Albumin (how fast patient losing it)
 - 1. **Canine**
 - 2. **Human 25%** (risk of hypersensitivity reaction) **2.5 to 5 ml/kg**
 - e. Consider thromboprophylaxis – hypercoagulable at risk for DVT or PTE
 - i. **Unfractionated heparin**
 - 1. **50 u/kg IV then 25 to 40 u/kg/hr**
 - 2. **200 to 300 u/kg SQ q8h**
 - 3. Monitor PTT
 - ii. Low molecular weight heparin – **dalteparin 150 u/kg SQ q12h**
 - f. Keep sternal or semi-sternal position with passive range of motion therapy
 - g. GI protection (PPI preferred over H₂ antagonist)
 - i. **Pantoprazole 1 mg/kg IV q24h**
 - ii. **Famotidine 1 mg/kg IV q12h**
 - h. Anti-emetics
 - i. **Maropitant (Cerenia) 1 mg/kg IV or SQ**
 - ii. **Ondansetron 0.5 to 1 mg/kg IV or SQ**
 - i. Nutritional Support
 - i. Consider within 12 to 24 hours
 - ii. If surgery required consider placement of E-tube, G-tube, J-tube, J thru G tube, NE, NG
 - iii. In ICU consider NE or NG tube