

The Initial Approach to Patient Resuscitation and Reversal of Shock

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Major questions

- Is the patient in shock?
- What do I need to do to reverse shock?
  - Medically
  - Surgically

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Triage

- Rapid assessment
- Shock
- Other conditions needing urgent therapy



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Major Body Systems

- Ensure stability of
  - Heart
  - Brain
  - Lungs

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Heart

- Tachycardia or bradycardia
- Arrhythmia
- Poor pulse quality
- Abnormal mucous membranes

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Brain

- Alert, oriented, ambulatory
- Disoriented or dull, weak
- Comatose, paralyzed

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Lungs

- Labored breathing
- Short or shallow breathing
- Noisy breathing

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Capsule history

- Why are they here now...
- Any major history...
  - HBC 30 minutes ago
  - On heart pills, vomiting for last 3 days



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Rationale

- Shock of undefined origin is common in emergency and critical care patients

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**Shock-Definition**

- A syndrome characterized by reduced tissue perfusion, impaired oxygen delivery and inadequate cellular energy production

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**Types of Shock**

- Many classification systems described
- Hypovolemic**
- Septic**
- Cardiogenic**

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**Identifying Shock**

- Abnormalities with the heart, brain or lungs apparent on physical examination
- CLEAR evidence of systemic disease

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### When do you call it Shock?

Normal                      Dead



A diagram with a yellow background. At the top, the text 'When do you call it Shock?' is written. Below it, the words 'Normal' and 'Dead' are separated by a large, thick orange arrow pointing from left to right. The arrow starts under 'Normal' and ends under 'Dead'.

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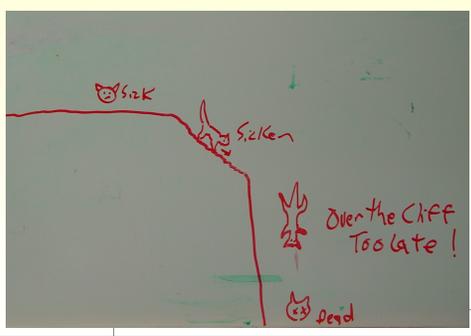
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### Cliff version- or when to intervene



A hand-drawn diagram on a chalkboard background. A red line starts at a level labeled 'Shock' with a small red cat icon. The line goes up slightly, then down to a cliff edge labeled 'Silken' with a red cat icon. The line then drops vertically over the cliff edge to a level labeled 'Dead' with a red cat icon. Next to the cliff edge, the text 'Over the Cliff Too late!' is written in red. There are some green scribbles on the board.

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### Mechanisms of Shock

- Intravascular volume loss
- Loss of vascular tone
- Cardiac pump failure
- Others

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Clinical signs of shock

- Altered mentation
- Tachypnea
- Tachycardia
- Cool extremities
- Hypotension (late)

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Hypovolemic Shock

- Hemorrhage
- Massive fluid losses



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Identification of Hypovolemic Shock

- History
- Physical examination findings
- Tachycardia (>140 bpm)
- Pale mm
- Tachypnea

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### Hypovolemic Shock

- Compensatory mechanisms exist to attempt to maintain BP and cerebral perfusion
- Increased heart rate
- Increased stroke volume
- Increased vascular tone



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### Treatment of Hypovolemic Shock

- Place iv catheter
- Choose fluid type and rate
- Address underlying cause
- Monitor for response to therapy

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### Place intravenous catheter

- Large bore, short over the needle catheter  
14-18ga in dogs, 22-20 ga in cats
- Place rapidly- **“best person”**
- ± 2 or more catheters
- Collect “Big 4” from hub (±CBC/ Profile)

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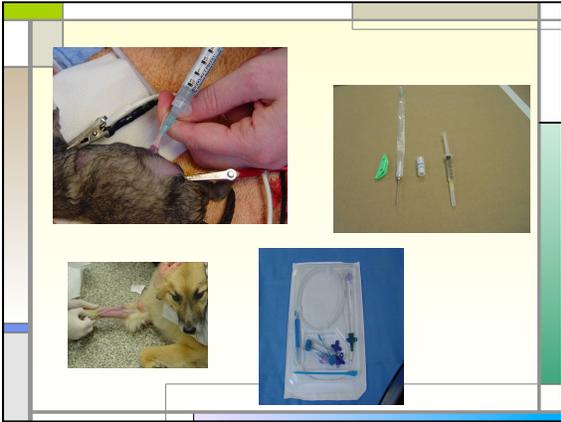
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### Intravenous catheter-trouble-shooting

- Tourniquet
- Different angle
- Mini-cut down
- Full cut-down
- Intra-osseous
- Vein choices

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### Choosing the fluid type

- Hypertonic saline
- Crystalloids
- Colloids
- Oxyglobin®
- Blood/ Plasma

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**Hypertonic Saline**

- Concentrated saline acts to draw fluid from interstitium
- RAPID (but transient) boost to circulating volume
- Requires pre-existing normovolemia
- Preferred: large dogs, small bore iv catheters, ? Head trauma or lung injury

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**Hypertonic Saline**

- Cost: \$
- How supplied: 7.5% solution or 23.4% solution (dilute)
- Shelf life: good
- Dose: 3-5 ml/kg (7.5%), follow with other fluid therapy
- Caveats: VPC, hypernatremia

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**Crystalloids**

- Small molecules in water that freely cross interstitium
- Rapid restoration of circulating volume, will rapidly move to extracellular spaces
- Wide utility
- Preferred: starting fluid for most cases of shock, NEEDED in hypoperfused dehydrated animals

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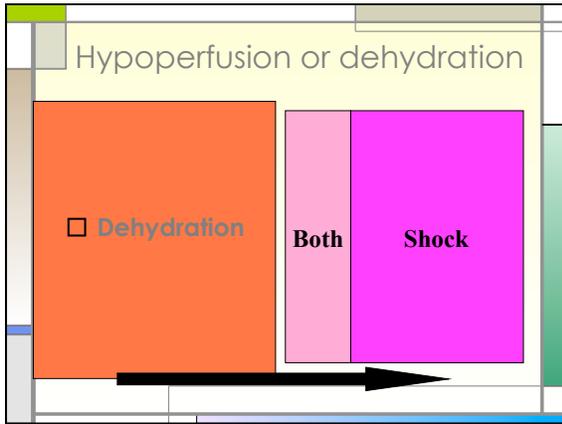
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**Crystalloids**

- Cost: \$
- How supplied; 250ml, 500ml, 1L, 5 L, NaCl, LRS, Plasmalyte, NormR
- Shelf-life: relatively long (rare)
- Dose: 60-90ml/kg/hr; reassess
- Caveats: dilutional effects, ? Volume overload, K<sup>+</sup>

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**Colloids**

- Large molecules that do NOT freely move out of the intravascular space
- Restores circulating volume at 1/4-1/3 the volume of crystalloids
- Useful in poorly responsive shock, pre-existing hypoproteinemia, in combo with hypertonic saline
- Preferred: Non-responsive shock after crystalloids\*\*

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**Colloids**

- Cost \$\$\$-\$\$\$\$
- How supplied: 500 ml (equivalent to 2 liters crystalloids), hetastarch, dextran
- Shelf-life: long
- Dose: 10-20ml/kg/day or 20 ml/kg bolus for shock
- Caveats: Volume overload, coagulation issues

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**Blood**

- Whole blood, packed red cells, plasma may be used to replace losses
- Transfuse EARLY with blood loss and unstable volume
- Indicated in many cases of hemorrhagic shock

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**Blood**

- Cost: \$\$\$-\$\$\$\$
- How supplied: full units and 1/2 units, components
- Shelf-life- 30 days (pRBCs), years (frozen plasma)
- Dose: as needed to maintain hematocrit (\*different from "anemia" only transfusions)
- Caveats: Reactions

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Choosing a fluid rate

- Sufficient volume to restore adequate perfusion NOT a ml/kg dose
- Adjust as needed

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Address underlying cause

- Control hemorrhage
  - Abdominal wrap
  - Ligation
- Laboratory testing
- Diagnostic imaging as needed
- Surgical intervention

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Monitor response to therapy

- Assess time frame expected to see improve
- Don't leave unstable animal unsupervised
- Document changes

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Case Example

- "ICE" 12 week old white male pit bull puppy
- 4 day history of anorexia, vomiting and diarrhea
- Neighbor's puppy died with similar signs last week

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Case Example- ICE

- T- 98 P 180 R-36 and shallow, barely responsive, bw= 11#
- Lab tests: PCV 50%, TS 6.3 g/dl, Azo 30-40, Glucose 49, 1000 WBC, 57 neutrophils
- ASSESSMENT 
- HYPOVOLEMIC SHOCK**

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Case Example- ICE

- Place iv catheter- 20 ga cephalic
- Chose fluid type- Dehydrated and hypovolemic= crystalloids
- Chose fluid rate- 90ml/kg= 5 kg X 90 ml= 450 ml
- Address underlying cause- dextrose, antibiotics
- Monitor response to Rx

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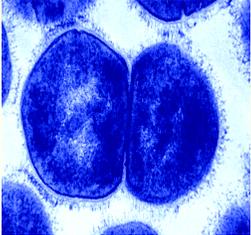
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### Septic Shock

- Endotoxin release into systemic circulation
- Trigger inflammatory mediators



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### Identification of septic shock

- Hyperdynamic
- Hypodynamic
- Cats

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### Hyperdynamic- Dogs

- Fever
- Injected mm
- short CRT
- bounding pulses
- tachycardia

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Hypodynamic- Dogs

- hypothermia
- pale mm
- prolonged CRT
- weak pulses
- possible death

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Septic shock- Cats



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Septic Shock-Cats

- Hyperdynamic phase rarely if ever appreciated
- Usually collapsed, hypothermic, hypotensive
- Hyperglycemia versus hypoglycemia

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Treatment of Septic Shock

- IV fluids
- Antibiotics
- Address underlying cause
- ± Pharmacological interventions
- ± Heparin
- Oxygen
- Steroids (*experimental models or with RAI*)

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Septic shock- IV fluids

- Attempt to normalize heart rate and blood pressure
- Challenges: ↓ vascular tone ± vasculopathy losses
- Options: Colloids, long-range planning

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Septic Shock- Antibiotics

- Cultures
- Broad spectrum coverage
  - Cefalozin -gentamicin -metronidazole
  - Ampicillin - enrofloxacin

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Septic Shock- Underlying cause

- Peritonitis
- Pneumonia
  
- Surgical exploration and drainage as soon as stable

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Septic Shock-Pharmacological interventions

- Increase cardiac output
  - Dobutamine (1-5 ug/kg/min)
  
- Increase vascular tone
  - Dopamine (5-10 ug/kg/min)
  - Phenylephrine
  - Epinephrine

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Septic Shock- Heparin

- Heparin improves the natural efficacy of antithrombin in neutralizing activated coagulation factors (II, IX, X, XI, XII)
  
- Dose unknown
  - 75-100 iu/kg sq q 8 hours
  - 200-300 iu/kg sq q 6 hours
  - 10-20 iu/kg/hr iv

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**Septic Shock- Oxygen**

- Supplemental oxygen often appears beneficial
  
- Methods of supplementation
  - oxygen cage
  - nasal oxygen
  - face mask
  - ventilator

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**Septic Shock- Steroids**

- Glucocorticoids have been shown to be beneficial in experimental models of septic shock (\*given before the insult!)
- Benefits
  - anti-inflammatory
- Risks
  - gastrointestinal irritation
  - immunosuppression

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**Other Definitions**

- SIRS- systemic inflammatory response syndrome
  
- MODS- multiple organ dysfunction syndrome

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**Systemic Inflammatory Response Syndrome**

- Temperature > 103.5 ° F or < 100 ° F
- HR > 160 bpm
- RR > 20 bpm
- WBC > 12,000  $\mu$ l, < 4000  $\mu$ l or > 10% bands
- 2 or more and an underlying disease

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**Multiple Organ Dysfunction Syndrome**

- Alterations in major organ groups
- Increasing numbers of failing organs equals worsening prognosis

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**Case Example**

- "Max" 3 yr old male MIX
- 5 day history of lethargy, vomiting and anorexia
- EATS everything

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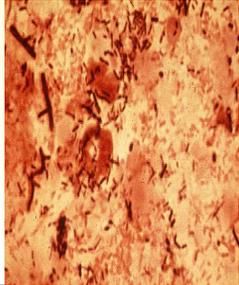
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### Case Example- Max

- T- 104.5, HR -180  
RR- 40, red mm,  
rapid capillary refill  
time, painful in  
abdomen, weak  
but ambulatory,  
88#
- 49/5.9/43/15-26
- CBC/Profile
- Abdominal rads
- Abdominal tap



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### Case Example- Max



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### Case Example- Max

- Stabilize with iv fluids, glucose,  
antibiotics
- Surgical exploration ASAP
- Anesthesia- Narcotics, isoflurane
- Surgery- linear foreign body with  
multiple perforations
- Post-operatively-open abdomen

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Case Example- Max

- Concerns:
  - Tremendous fluid losses into abdomen
  - Hypoproteinemia
  - Second surgery
  - Peripheral edema
  - Potential respiratory/renal/liver issues

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Case Example- Max

- Fluid choices
  - 300 ml/hr LRS, 50 ml/hr HES ? plasma
- Antibiotics
  - Cefazolin, Gentamicin, metronidazole
- Other
  - Oxygen, EKG, urinary catheter, pain medicine

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Cardiogenic Shock

- Diminished cardiac output due to myocardial disease
- Dilated cardiomyopathies/CVD/ PE
- Tachycardia, tachypnea, poor pulses

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### Identification of Cardiogenic Shock- Physical examination

- Tachycardia\*
- Poor pulse quality
- Murmur/gallop
- Crackles
- Jugular venous distension
- Hypothermia

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### Identification of Cardiogenic Shock- EKG

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### Identification of Cardiogenic Shock

- Chest radiographs- failure
- Echocardiography- etiology
- Treatment

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- ### Treatment of Cardiogenic Shock
- Oxygen
    - Cage > nasal oxygen
  - Diuretics
    - Furosemide (1-4 mg/kg)
    - Repeat prn
    - Water

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Treatment of Cardiogenic Shock

- Vasodilators
  - Nitroglycerin paste
  - Nitroprusside\*
  - Hydralazine
- Positive inotropes
  - Dobutamine\*
  - Digoxin

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Treatment of Cardiogenic Shock

- ACE inhibitors
- Treat hemodynamically significant arrhythmias
  - Calcium channel antagonists
  - Lidocaine
  - Pacemakers
  - Digoxin
  - B-blockers (\*)

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Case Example

- "Thunder" 7 year M Doberman Pinscher
- 12 hour history of lethargy, tachypnea and cough
- No previous problems

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Case Example- Thunder

- Temp 99.8, HR 160-200, RR 60, crackles, poor peripheral pulses, 100#
- Chest radiographs- cardiomegaly with pulmonary infiltrates
- EKG- atrial fibrillation

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Case Example- Thunder

- Initial therapy:
  - Lasix 100mg iv q 2 hours
  - Supplemental oxygen
  - Nitroglycerin paste
  - Rest

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Case Example-Thunder

- Therapy if poor initial response
  - Start nitroprusside and dobutamine
  - Total "in" fluid rate 10ml/hr
  - Monitor EKG and blood pressure
  - ? Start enalapril; continue lasix \*

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Monitoring tools for the shocky patient



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Monitoring

- Physical examination
- CVP, PCWP
- Urine output
- BP
- Big 4/CBC/Profile
- Blood gases/pulse oximetry/ET CO2
- Lactate

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Conclusions-  
Successful Management

- Identify and correct underlying cause
- Treat based upon understanding of shock
- Closely follow patient trends

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