Multisystem

- Bariatric complications
- Comorbidity in patients with transplant history
- End of life and palliative care
- Healthcare-acquired infections (e.g., central line-associated bloodstream infection [CLABSI], catheter-associated UTI [CAUTI], ventilator-associated pneumonia [VAP])
- Infectious diseases
- Multiple organ dysfunction syndrome (MODS)
- Multisystem trauma
- Pain
- Rhabdomyolysis
- Septic shock
- Shock states
- Sleep disruption (including sensory overload)
- Thermoregulation
- Toxic ingestions/inhalations
- Toxic/drug exposure (including allergies)
Holistic Nursing Care
Overdose Care
Multisystem Care/Complications
Shock Continuum

- Pain
- Palliative care
- End-of-life care

“Pain is whatever the experiencing person says it is, existing whenever the experiencing person says it does”

McCaffery and Beebe (1989)
Pain (cont)
- Physiology
- Types
- Assessment
- Management

Holistic Care
- Palliative care
- End-of-life care

Toxic Ingestion/Inhalations/Drug Exposure
- Absorption
- Distribution
- Metabolism
- Elimination
Assessment

- Primary survey
  - ABCs
  - DE and poison control
- Secondary survey
  - Level of consciousness (LOC)
  - Heart rate, respiratory rate, blood pressure
  - Temperature
    - ↑Salicylates and cocaine
    - ↓Barbiturates and opiates

Assessment (cont)

- Full system assessment
- History
- Environment/bystanders
- AMPLE
  - Allergies
  - Medications
  - Past illnesses
  - Last meal
  - Events

Assessment (cont)

- Diagnostic tests
  - Toxicology screens: blood, urine, gastric aspirate
  - CBC, chemistry, liver function tests, coagulation profile, arterial blood gases
  - Chest x-ray, ECG
  - Abdominal x-ray
  - Pregnancy test
Multisystem

Treatment Options

Rapid response
- Unknown substance, unconscious victim
  - Dextrose 50% IV
  - Hypoglycemia
  - Thiamine 100 mg IV
  - Wernicke-Korsakoff syndrome
  - Naloxone 2 mg IV, IM, or ET
  - Narcotic antagonist

Treatment Options (cont)
- Antidote
- Prevent absorption
- Enhance elimination
- Orogastric lavage
- Emetics (not recommended)
- Activated charcoal
- Diuresis
- Whole bowel irrigation
- Hemodialysis

Toxic Exposure: Common Toxins

<table>
<thead>
<tr>
<th>Acetaminophen</th>
<th>Acute liver failure</th>
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</table>

Assessment
- Nausea/vomiting
- Right upper quadrant pain
- Bleeding
- Elevated liver function tests

Treatment
- NAC
- Gastric lavage
- Charcoal

N-acetylcysteine (NAC, Mucomyst)
Toxic Exposure: Common Toxins (cont)

**Alcohol**
- Assessment
  - Altered LOC
  - Alcohol breath history
  - Arterial blood gases
- Treatment
  - Protect airway
  - Nasogastric tube, lavage
  - IV fluids
  - Seizure precautions
  - Manage/treat electrolytes

**Carbon monoxide**
- Assessment
  - Altered LOC
  - Headache, seizure
  - Flu-like complaints
- Treatment
  - 100% oxygen
  - Hyperbaric oxygen
  - Remove from exposure
  - Administer oxygen

**Cocaine**
- Assessment
  - Hypoxia
  - Stroke
  - Head injury
  - High temperature
  - Myocardial infarction
- Treatment
  - Treatment presentation
  - Benzodiazepines—sedation
  - Vasodilators—hypertension
  - Acute confusional state treatment
  - Provide cooling
  - Seizure treatment
**Toxic Exposure: Common Toxins (cont)**

**Multisystem Cyclic antidepressants**

**Assessment**
- Electrocardiographic changes
- Hypotension

**Treatment**
- Sodium bicarbonate
- Nasogastric lavage
- Charcoal
- Treat heart rhythm, pacemaker

**Central nervous system Cardiovascular Anticholinergic**

**Sodium bicarbonate**

**Physostigmine**

---

**Opiates**

**Assessment**
- Decreased heart rate
- Decreased blood pressure
- Decreased respiratory rate

**Treatment**
- Administer naloxone

---

**Salicylate**

**Respiratory stimulation**

**Metabolic acidosis**

**Hyperthermia**

**Hypoglycemia**

**Platelets—bleeding**

**No direct drug antidote**

**Sodium bicarbonate**

**Assessment**
- Hyperventilation
- Respiratory alkalosis
- Metabolic acidosis
- Nausea/vomiting
- Hyperpyrexia
- Bleeding

**Treatment**
- Arterial blood gases
- Blood levels
- Chemistry, coagulation profile
- Nasogastric lavage, charcoal
- IV fluids
- Treat metabolic derangement
- Lower temperature
- Treat seizures
- Hemodialysis

---

**Assessment**
- Electrocardiographic changes
- Hypotension

**Treatment**
- Sodium bicarbonate
- Nasogastric lavage
- Charcoal
- Treat heart rhythm, pacemaker

---

**Assessment**
- Decreased heart rate
- Decreased blood pressure
- Decreased respiratory rate

**Treatment**
- Administer naloxone

---

**Assessment**
- Hyperventilation
- Respiratory alkalosis
- Metabolic acidosis
- Nausea/vomiting
- Hyperpyrexia
- Bleeding

**Treatment**
- Arterial blood gases
- Blood levels
- Chemistry, coagulation profile
- Nasogastric lavage, charcoal
- IV fluids
- Treat metabolic derangement
- Lower temperature
- Treat seizures
- Hemodialysis
Review Questions

Question 1

All of the following are anticipated treatments for acetaminophen overdose except:

A. Charcoal  
B. NAC  
C. Acute hemodialysis  
D. Gastric lavage

Question 1—Rationale

All of the following are anticipated treatments for acetaminophen overdose except:

C. Acute hemodialysis—Acetaminophen is not dialyzable, unfortunately
   - Charcoal— Might help to decrease absorption
   - NAC—Only agent used as an antidote
   - Gastric lavage—Might help to enhance elimination and decrease absorption
Question 2
When assessing a patient with suspected cocaine intoxication, a nurse would expect to see:
A. Chest pain, hypothermia, hypoxia
B. Tachycardia, chest pain, hyperthermia
C. Hyperthermia, hypotension, drowsiness
D. Anxiety, hypertension, hematuria

Question 2—Rationale
When assessing a patient with suspected cocaine intoxication, a nurse would expect to see:
B. Tachycardia, chest pain, hyperthermia
  - Cocaine intoxication presents as a hypermetabolic state
  - Hematuria is not a symptom of hypermetabolic state

Holistic Nursing Care
Overdose Care
Multisystem Care/Complications
Shock Continuum
Multisystem Care/Complications

- Healthcare-acquired infections
- Infectious diseases
- Thermoregulation
- Bariatric complications
- Rhabdomyolysis
- Sleep disruption

Multisystem Care/Complications (cont)

- Healthcare-acquired infections
  - CLABSI
  - CAUTI
  - VAP now part of ventilator-associated events (VAE)
  - Opportunistic infections
  - Multidrug-resistant organisms (MRSA, VRE, CRE…)
  - Vulnerable populations

Multisystem Care/Complications (cont)

- Healthcare-acquired infections
  - CLABSI
  - CAUTI
  - VAP now part of VAE
  - Opportunistic infections
  - Vulnerable populations

Prevention!
Identification of at-risk patient
Surveillance
Monitoring
Safety! Safety!

12/2015
Multisystem Care/Complications (cont)

- Therapeutic hypothermia
- Targeted temperature management
  - Who?
  - When?
  - Why?
  - How—and how long?
  - Does it work?

---

Multisystem Care/Complications (cont)

- Bariatric complications
  - National epidemic
  - Medical complications

---

Medical Complications of Obesity

- Pulmonary disease
- Abnormal function
- Obstructive sleep apnea
- Hypoventilation syndrome
- Nephrolithic fatty liver disease
- Steatitis
- Steatohepatitis
- Cirrhosis
- Gastrointestinal disease
- Gastrointestinal symptoms
- Pancreatitis
- Osteoarthritis
- Arthritis
- Skin
- Gout


12/2015
Multisystem Care/Complications (cont)

- Bariatric complications
  - National epidemic
  - Medical complications

Top 10: Clinical Challenges

1. Airway and ventilation
2. Cardiovascular
3. GI: ACS, aspiration
4. Hematological (DVT/PE)
5. Pharmacological dosing
6. Endocrine: Glucose control/nutrition
7. Diagnostic testing
8. Vascular access placement
9. Skin: Pressure ulcers/pressure-induced rhabdomyolysis
10. Sensitive care challenges

Multisystem Care/Complications (cont)

- Healthcare-acquired infections
- Infectious diseases
- Thermoregulation
- Bariatric complications
- Rhabdomyolysis
- Sleep Disruption
Rhabdomyolysis: Rhabdo (striated) myo (muscle) lysis (breakdown)

- Acute kidney injury
- Myoglobinuric renal failure
- Metabolic acidosis
- Coagulopathies
- Electrolyte disturbances

**Causes**
- Trauma—BUT NOT just trauma
- Direct or indirect injury to muscles
- Muscle ischemia
- Extreme temperatures
- Endocrine disorders
- Toxins
- Immobilization
- Exercise
- Burns/lighting

**Assessment/diagnosis**
- BUN:creatinine
- Serum CK
- Myoglobinuria
- Metabolic acidosis

**Treatment**
- Eliminate cause
- Support renal clearance/function
- Urine output >150 mL/hr
- Intraosseous volume expansion
- Alkalization of urine
- Mannitol and furosemide (Lasix)
- Prevent further damage
Multisystem Care/Complications

- Healthcare-acquired infections
- Infectious diseases
- Thermoregulation
- Bariatric complications
- Rhabdomyolysis
- Sleep disruption

Multisystem Care/Complications (cont)

- Sleep disruption
  - Overstimulation (noise, physical, psychological)
  - Sleep apnea (obstructive and central)
  - Delirium
  - Pain
  - Disrupted circadian rhythm
  - Stimulation of the immune and stress responses
  - Acute and chronic physiological and psychological complications

Sleep Disruption

- Causes
  - Everything in acute care

- Treatment
  - Prevention
  - Assessment and monitoring
  - Sleep protocols
  - Noise reduction
  - Patient focused routines
  - Sedatives?
  - Analgesics?
Question 3

When providing care to a bariatric patient, the best weight to use for the tidal volume for the ventilator settings and propofol dosing is the:

A. Total body weight (TBW)
B. Ideal body weight (IBW)
C. Lean body weight (LBW)
D. Adjusted Body weight (ABW)

Question 3—Rationale

When providing care to a bariatric patient, the best weight to use for the tidal volume for the ventilator settings and propofol dosing is the:

B. Ideal body weight (IBW)
   - Best to reflect chest size and total lung capacity, decreasing the risk of over- or underinflating the lungs
   - ABW = IBW + 0.4(actual – IBW)
Question 4

A patient who was unresponsive upon being struck by lightning regained a pulse after an AED was used at the scene. Twenty-four hours after admission to the ICU, the patient’s urine is cranberry/rust-colored. Expected treatment would include:

A. Continuous venovenous hemofiltration
B. Packed red blood cells, fresh frozen plasma
C. High-volume fluid administration, 1 g mannitol
D. Dopamine infusion at 4 mcg/kg/min, 40 mg furosemide

Question 4—Rationale

A patient who was unresponsive upon being struck by lightning regained a pulse after an AED was used at the scene. Twenty-four hours after admission to the ICU, the patient’s urine is cranberry/rust-colored. Expected treatment would include:

C. High-volume fluid administration, 1 g mannitol—Assessment indicates rhabdomyolysis, and infusing an osmotic diuretic will help to “flush” the myoglobin through and out the kidneys:
- Continuous venovenous hemofiltration—Indicated for AKI and patients too hemodynamically unstable to tolerate hemodialysis
- Packed red blood cells, fresh frozen plasma—Indicated for coagulopathy with symptomatic anemia
- Dopamine infusion at 4 mcg/kg/min, 40 mg furosemide—Diuresis is a treatment for rhabdomyolysis; 4 mcg of dopamine is a vasopressor dose
Shock: Colloquial Definition

“A manifestation of the rude unhinging of the machinery of life”
– Gross, 1872

“A momentary pause in the act of death”
– John Collins Warren, 1895

Shock: Clinical Definition

The inability of the circulatory system to supply oxygen and nutrients to the cells of the body

The oxygen demands are greater than the supply

Classifications of Shock

- Hypovolemic
- Anaphylactic
- Cardiogenic
- Septic
- Neurogenic
Hypovolemic Shock

- Most common
- Easiest to treat
- Blood volume is insufficient to fill the intravascular space
- Preload deficit
- Decrease in CO

Hypovolemic Shock: Causes

Absolute/direct loss of volume
- External hemorrhage
- Gastrointestinal volume losses
- Renal volume losses
- Plasma losses

Hypovolemic Shock: Causes (cont)

Relative/indirect loss of volume
- Sequestration of fluid
- Internal hemorrhage/volume losses
- Vasodilation
Hypovolemic Shock: Clinical Presentation

Patient presentation will depend on:
- Percent volume loss
- Duration of hypovolemia
- Activation and response of compensatory mechanisms

Hypovolemic Shock: Therapeutic Goal

- Restore intravascular volume
- Stop loss of volume
- Crystalloid or colloid?

Neurogenic Shock

- Loss of vasomotor tone 2° to inhibition of neural output
- The loss of sympathetic tone allows the parasympathetic nervous system to dominate
  - Vasodilation
  - Bradycardia
  - Decreased CO
Neurogenic Shock: Causes

- Spinal cord injury
- Deep general anesthesia
- Spinal anesthesia
- Damage to the brain
- Prolonged medullary ischemia
- Central nervous system problems

Neurogenic Shock: Clinical Presentation

- Parasympathetic dominance
- Vasodilation
- Bradycardia
- No motor or sensory

Neurogenic Shock: Therapeutic Goal

- Stop cause
- Stabilize spine
- Administer volume
- Beta stimulation (heart rate)
- Alpha stimulation (vasoconstrict)
Anaphylactic Shock

Massive vasodilation occurs because of an antigen–antibody reaction, triggering of mast cells and basophils
- Vasodilation
- Increased capillary permeability
- Hypotension
- Relative hypovolemia

Anaphylactic Shock: Causes

- Immunoglobulin E (IgE)—anaphylaxis
- Non-IgE—anaphylactoid (non antigen–antibody)
- Foods
- Venoms
- Blood products
- Drugs

Anaphylactic Shock: Clinical Presentation

- Hypotension
- Generalized edema
  (increased capillary permeability)
- Laryngeal edema
- Severe bronchoconstriction
- Rash, itching, flushed skin
- Angioedema
Anaphylactic Shock: Therapeutic Goal

- Identify and stop the cause
- Block vasoactive mediators
- Antihistamines
- Vasoconstrictors
- Bronchodilators
- Fluid resuscitation

Septic Shock

Septic Shock: Definitions

Sepsis
The systemic response to infection, manifested by ≥2 of the following conditions as a result of infection:
- Temperature >38°C or <36°C
- Heart rate >90
- Respiratory rate >20 or PaCO₂ <32 mmHg
- White blood cell count >12,000 or <4000 or 10% bands
Septic Shock: Definitions (cont)

Systemic inflammatory response syndrome (SIRS)
The systemic inflammatory response to a variety of severe clinical insults. The response is manifested by ≥2 of the following conditions:

- Temperature >38°C or <36°C
- Heart rate >90
- Respiratory rate >20 or PaCO₂ <32 mmHg
- White blood cell count >12,000 or <4000 or 10% bands

MODS
The presence of altered organ function in an acutely ill patient such that homeostasis cannot be maintained without intervention

Review Questions
Question 5
Which of the following assessment data would increase suspicion that a patient is developing SIRS?

A. Temperature = 39°C, platelets = 72,000, positive D-dimer
B. WBC 13.7, HR 127, RR 37
C. Hospital-acquired pneumonia, WBC 11.5, pH 7.24
D. Temperature = 37.4°C, HR 54, glucose 210

Question 5—Rationale
Which of the following assessment data would increase suspicion that a patient is developing SIRS?

B. WBC 13.7, HR 127, RR 37—SIRS criteria include high/low WBC, high/low HR, high/low RR, and high/low temp
  • Temperature 39°C, platelets 72,000, positive D-dimer—D dimer is not part of the SIRS criteria
  • Hospital-acquired pneumonia, WBC 11.5, pH 7.24—This diagnosis and pH are not part of SIRS criteria
  • Temperature 37.4°C, HR 54, glucose 210—Hyperglycemia is not part of SIRS criteria

Septic Shock: Definitions (cont)
- General variables
- Inflammatory variables
- Hemodynamic variables
- Organ dysfunction
- Tissue perfusion variables
Septic Shock: Causes
- Infection
- Bacteria, virus, fungi
- Local → systemic → sepsis → septic shock

Septic Shock: Clinical Presentation
- Systemic reaction
- Endotoxin and mediators
- Inflammation
- Inadequate delivery of oxygen
- Massive vasodilation

Septic Shock: Clinical Presentation (cont)
- Relative hypovolemia and hypoperfusion
- Increased capillary permeability and edema
- Myocardial depression
- Lactic acidosis
Septic Shock: Clinical Presentation (cont)
- Pulmonary capillary leak leading to ARDS
- Activation of complement system → microthrombi
- Platelet abnormalities
- Gluconeogenesis and insulin resistance

Septic Shock: Therapeutic Goal
- Identify and stop cause
- Block effects of inflammatory mediators
- Antibiotics
- Fluid resuscitation
- Vasopressors
- Ventilation and oxygenation
- Restore hemopoietic balance

Surviving Sepsis Campaign Guidelines for Management of Severe Sepsis and Septic Shock
18 evidence-based recommendations for caring for septic patients
2008 and 2012 Revisions of Surviving Sepsis Campaign Guidelines for Management of Severe Sepsis and Septic Shock

Multisystem Review Questions

A. HR 131, SVR 3500, CO 2.8 L/min
B. HR 61, SVR 600, 7.1 L/min
C. HR 127, SVR 450, CO 9.2 L/min
D. HR 140, SVR 2700, CO 10.2 L/min

Question 6
Which of the following hemodynamic variables would most likely be assessed in a patient with early septic shock?
A. HR 131, SVR 3500, CO 2.8 L/min
B. HR 61, SVR 600, 7.1 L/min
C. HR 127, SVR 450, CO 9.2 L/min
D. HR 140, SVR 2700, CO 10.2 L/min
Question 6—Rationale

Which of the following hemodynamic variables would most likely be assessed in a patient with early septic shock?

C. HR 127, SVR 450, CO 9.2 L/min—High HR due to decreased O2 delivery, low SVR from vasodilation from inflammatory mediator release, high CO from decrease afterload from vasodilation
- HR 131, SVR 3500, CO 2.8 L/min—SVR would be low
- HR 61, SVR 600, 7.1 L/min—HR would be high
- HR 140, SVR 2700, CO 10.2 L/min—SVR would be low

Question #7

Which of the following symptoms best describes the clinical assessment found with hypovolemic shock?

A. Tachycardia, hypotension, oliguria
B. Tachycardia, hyperthermia, hypotension
C. Hypertension, bradycardia, pitting edema
D. Hypotension, hyperglycemia, bibasilar rales

Question 7—Rationale

Which of the following symptoms best describes the clinical assessment found with hypovolemic shock?

A. Tachycardia, hypotension, oliguria—High HR because of stimulation of compensatory response from low perfusion, low BP because of dehydration, low UO from decrease GFR and release of ADH to compensate for low BP
- Tachycardia, hyperthermia, hypotension. Hypothermia would occur
- Hypertension, bradycardia, pitting edema. Hypertension and pitting edema would present with hypervolemia
- Hypotension, hyperglycemia, bibasilar rales. Lungs would be dry in hypovolemia
Question #8

Which assessment data would help to differentiate neurogenic from anaphylactic shock?

A. Hypotension
B. Bradycardia
C. Low urinary output
D. Low central venous pressure

Question 8—Rationale

Which assessment data would help to differentiate neurogenic from anaphylactic shock?

B. Bradycardia. Neurogenic shock would have bradycardia from parasympathetic dominance; anaphylactic shock would have tachycardia
- Hypotension. Both would have low BP
- Low urinary output. Both would have low UO from low BP
- Low central venous pressure. Both would have vasodilation
**Hemodynamics in Shock**

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<tr>
<th>SHOCK STATE</th>
<th>HR</th>
<th>BP</th>
<th>CO</th>
<th>PAP</th>
<th>CVP</th>
<th>PAOP</th>
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</table>

**Stages of Shock**

- All cause hypoperfusion
- Inadequate O₂ supply
- Inadequate CO
- Aerobic → anaerobic metabolism
- Lactic acidosis
- Compensation for perfusion deficit

**Stages of Shock (cont)**
Multisystem

Aerobic vs Anaerobic Metabolism

- **Aerobic metabolism**
  - CO₂
  - H₂O
  - 36 ATP

- **Anaerobic metabolism**
  - 2 ATP
  - Lactate

Stages of Shock (cont)

- Compensatory stage
  - Neural
  - Hormonal
  - Chemical
- Decompensatory stage
- Irreversible stage

Stage 1: Neural Compensation

- Decreased O₂ delivery from shock state
- Vasomotor center
- Stimulation of sympathetic nervous system
- Norepinephrine and epinephrine release
- Increasing respiratory rate and tidal volume
- Facial diuretic, increased sweating
- Vasodilation of skeletal muscle
- Vasocstrict of GI tract, skin, kidneys
- Coronary artery vasodilation
- Increase heart rate and contractility
- Goal: Increase cardiac output and improve O₂ delivery
Stage 1: Hormonal Compensation

- Decreased oxygen delivery from shock state
- Stimulation of sympathetic nervous system
- GOAL: Increase water retention, blood pressure, cardiac output, glucose
- Decreased renal GFR: Renin-angiotensin-aldosterone response
- Increase osmolality: Anterior pituitary anti-diuretic hormone release

Stage 1: Chemical Compensation

- Decreased oxygen delivery from shock state
- Decrease blood flow to lungs
- Ventilation > perfusion (dead space)
- Chemoreceptors identify drop in PaO₂
- Increase respiratory rate and tidal volume
- Drop PaCO₂
- Respiratory alkalosis
- Cerebral vasoconstriction
- Cerebral ischemia
- Vasomotor center medulla
- Stimulate sympathetic nervous system
- OUTCOME: Change in LOC, confusion, agitation, lethargy

Stages of Shock: Decompensatory Stage

- Compensatory mechanical failure
- Arteriolar and precapillary sphincters require ATP for vasoconstriction
- Sphincters relax
Multisystem Stages of Shock: Decompensatory Stage (cont)
- Sludging of blood in capillaries
- Microcirculation blocked
- Metabolic acidosis
- Chemical mediators released

Multisystem Stages of Shock: Irreversible Stage
- Refractory phase
- No longer responds to treatment
- Organ dysfunction
- Organ failure

Multisystem Cellular Response to Shock
- Shock is an imbalance between oxygen supply and demand
- Hypoxia and/or ischemia initiate a cascade of tissue, organ, and cellular responses
**Cellular Injury**

Infection/inflammation → Mediator release

- Cap leak
- Free radical release
- Cell death
- Vasodilation

MODS
- ARDS
- Renal insufficiency
- Liver failure

Cardiac Dysfunction
- DIC, GI bleed

**Cellular Injury (cont)**

MODS
- ARDS
- Renal insufficiency
- Liver failure

Cardiac Dysfunction
- DIC, GI bleed

Death