Clinical Case Report: Nutritional Management of Acute Kidney Injury Secondary to Septic Shock

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August - December 2020
Pathology of Primary Disease

Clinical progression & pathophysiology of Septic Shock, Acute Respiratory Failure and Acute Kidney Injury

Relationship Between Conditions
- Systemic inflammation
- Cytokine activation
- Pulmonary edema
- Organ hypoperfusion
Septic Shock

- Dysregulated proinflammatory response to infection
- Initiation: presence of an inflammatory stimulus (bacteria) (Candida Aureus)
- Release of proinflammatory (markers Tumor Necrotic Factor & Interleukin 2)
- Neutrophil Endothelial Cell adhesion
- Progression of septic shock increases severity of metabolic acidosis

RECOGNISE • RESUSCITATE • REFER
Impact on Cardiac Output & Perfusion

- **Alterations in Blood Flow**
  1. Decreased peripheral resistance, increased cardiac output
  2. Cardiac output decreases (peripheral vascular resistance)

**Result**
- Decreased oxygen availability
- Increased carbon dioxide
- Increased accumulation of metabolic waste products
Signs and Symptoms

- Alteration in mental status
- Cardiac dysfunction
- Pulmonary embolism
- Febrile, tachycardiac, tachypnea

With increased immune response

Hemodynamic Instability
- Renal hypoperfusion: oliguria
- Lung hypoperfusion: dyspnea
Risk Factors

- Etiology: Gram negative or positive bacteria
- Co-Morbidities: Diabetes Mellitus, Cirrhosis
- Post Surgical patients with surgical wounds
- Patients with invasive devices: Endotracheal tubes
- Nurse patient contact with invasive devices
- Hospital inquired infections
Acute Respiratory Failure in Relation to Septic Shock

Pathophysiology

- Hypoxemic respiratory failure, nonresponsive to supplemental oxygen
- Decreased perfusion of oxygenated blood to the lungs
- Elevated hydrostatic pressure & pulmonary edema
- Systemic inflammation, proinflammatory cytokines
- Bacterial or lung infiltrates
Signs and Symptoms

- Hypoxemia 2/2 decreased oxygen saturation
- Dyspnea
- Restlessness
- Anxiety
- Alerted mental status
- Diaphoresis
- Tachycardia
- Crackles at the based of the lower left lungs
- Jugular distension
- Pulmonary Edema
Risk Factors

- Hospitalized critically ill patients
- Patients with systemic blood stream infections (sepsis)
- Pneumonia
- Traumatic Injury (head & chest)
- Patients with chronic Alcoholism
Acute Kidney Injury

Pathophysiology

- Rapid loss of renal function over a few days or weeks
- Loss of glomerular filtration rate, accumulation nitrogenous waste
- Anuric or preserved output
Etiology of Acute Kidney Injury

Prerenal: Inadequate Perfusion
Direct damage: glomeruli, blood vessels & tubules
Renal: Acute tubular necrosis, glomerulonephritis, Nephrotoxic drugs
Post Renal: Obstruction In the urinary system
Stages of AKI: prodromal, oliguric, post oliguric
Risk Factors

- Extra Cellular Volume depletion
- Nephrotoxins (ex. IV contrasts)
- Hypoperfusion to the kidney
- Direct damage to the kidney
- Post renal blockage
Evidence Based Medical Nutrition Therapies For Treatment

_Evidence Analysis Library: Supports the use of KDIGO guidelines_

**Energy needs:** indirect calorimetry if available

20-30 kcal/kg (increased needs based on hypercatabolic nature of illness + comorbidities)

**Protein Needs**

- 0.8-1.0g/kg (non catabolic & does not require dialysis)
- 1.0-1.5g/kg - dialysis
- 1.7g/kg - hypercatabolic & on dialysis

Monitor: K, phos, Mg
The American Journal of Kidney Diseases:
Hemodialysis patients receiving 1.0-1.2g pro + 15g had decreased SGA & risk of mortality
Comorbidities

**Congestive Heart Failure**
- Ventricular dysfunction, cardiac remodelling
- Left sided heart failure & Right sided heart failure
- Treatment: Diuretics, Positive Inotropic agents

**Hypertension**
- Elevated systolic & diastolic blood pressure 130/80 mmhg
- Primary hypertension & secondary hypertension
- Treatment: diet (1.5- 2.4g EAL), lifestyle and pharmacologic
Congestive Heart Failure

EAL recommendations
2g Na, 1.5-2.0L H2O
Whole Foods: Fruit, vegetables, lean protein, whole grains & unsaturated oils
Protein: 1.1-1.4g/kg
Hypercatabolic 1.5-2.0 g/kg

What The Literature Says
Journal of Clinical Nutrition
- 3g vs. 7g
- Nonsignificant level of decongestion
- Significant- decrease N-terminal fragment in B natriuretic peptide
Comorbidities

Type 2 Diabetes
- Hyperglycaemia & Insulin resistance
- Prolonged hyperglycaemia: vascular injury, neuropathy, renal and cardiac manifestation
- Treatment: oral antihyperglycemics, GLP-1 receptor agonists, insulin & carbohydrate-controlled diet

Small Bowel Obstruction (SBO)
- Mechanical Blockage
- Full blockage, partial blockage (possible compromised blood flow)
Comorbidities

Small Bowel Obstruction (SBO)

- Mechanical Blockage
- Full blockage, partial blockage (possible compromised blood flow)
- Diagnosis via X-ray
- Treatment: fluid resuscitation, nasogastric suction, laxatives & possible surgery
Case Presentation

Patient profile & description of hospital course: Female, 67 y/o
1. Dyspnea 2/2 exacerbated heart failure
2. Declining respiratory status (BIPAP- Mechanical Ventilation requiring tracheostomy
3. Septic shock 2.2 Candida Aureus
4. Elevated electrolytes & declining Glomerular Filtration Rate
5. Hemodialysis 3x per week
6. Small Bowel Obstruction

- Ventilated with tracheostomy- Non sedated/ responsive
- No known food allergies
Assessment: Client History

Medical History (Hx)
- Admitting diagnosis: dyspnea, exacerbated heart failure & acute respiratory failure secondary to septic shock
- Past Medical Hx: Heart failure, Hypertension, Type 2 Diabetes Mellitus & Asthma

Social Hx: (Hx)
- 24-hour Home Health Aide
- No other information obtained
Assessment: Food/ Nutrition Related History

- Diet Order (FH-2.1.1): NPO x 3 days
- Rationale for tube feeding: Mechanical Ventilation
- Enteral Nutrition Order (FH- 2.1.1)
  1200 ml Nepro 1.8 @ 50ml x 24hours
  Free water recommendation: I&O + 500ml
  Recent I&O <150ml output
- Tolerance of Tube Feeding
  Abdominal distension, vomiting, recent SBO
<table>
<thead>
<tr>
<th>Medication</th>
<th>Mechanism</th>
<th>Food &amp; Drug Information</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gastric Motility</strong></td>
<td></td>
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<tr>
<td>Metoclopramide</td>
<td>Increases acetylcholine in the GIT</td>
<td>Decreased absorption macro &amp; micronutrients/ B12 deficiency</td>
</tr>
<tr>
<td></td>
<td>Dopamine receptor antagonism</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Propulsive motility</td>
<td></td>
</tr>
<tr>
<td><strong>CHF treatment</strong></td>
<td></td>
<td></td>
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<tr>
<td>Carvedilol</td>
<td>Beta Blocker</td>
<td>Avoid salt substitutes</td>
</tr>
<tr>
<td></td>
<td>Decreases heart rate</td>
<td>Avoid grapefruit</td>
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<tr>
<td></td>
<td>Myocardial contractility</td>
<td></td>
</tr>
<tr>
<td><strong>Diuretic/Antihypertensive</strong></td>
<td></td>
<td></td>
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<tr>
<td>Lasix</td>
<td>Loop diuretic</td>
<td>May decrease sodium, chloride &amp; potassium levels</td>
</tr>
<tr>
<td></td>
<td></td>
<td>May increase BUN, Cr levels</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Increased thirst</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Anorexia</td>
</tr>
<tr>
<td><strong>Antidiabetic</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lispro</td>
<td>Rapid acting insulin</td>
<td>Meal dependent</td>
</tr>
<tr>
<td><strong>Antidiabetic</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glargine</td>
<td>Long-acting insulin</td>
<td>Avoid alcohol</td>
</tr>
<tr>
<td><strong>Antibiotic</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cefepime</td>
<td>Antibiotic</td>
<td>Diarrhea, nausea &amp; vomiting</td>
</tr>
</tbody>
</table>
Assessment: Nutrition Focused Physical Findings

- Generalized Pitting Edema (PD-1.1.6.2)
- Impaired wound healing (PD 1.1.1.7.2.1) bilateral ulcerations/ blisters of left and right arm

ASPEN Malnutrition Criteria

<table>
<thead>
<tr>
<th>Decreased intake</th>
<th>Fluid Accumulation</th>
</tr>
</thead>
</table>

[ASPN logo]
Assessment: Anthropometric Measurements

- **Height (AD 1.1.1):** 64in

- **Weight (AD- 1.1.5.1):** 271lbs (removal 2.9L post HD)
  
  *Edema Free Adjusted Body Weight: 240 lbs*
  
  *Ideal Body Weight: 57kg*

- **Body Mass Index (AD- 1.1.5.1):** 46.5
## Assessment: Biochemical Data, Medical Tests & Procedures

<table>
<thead>
<tr>
<th>TEST</th>
<th>RESULTS</th>
<th>NORMAL RANGE</th>
<th>ABNORMAL INTERPRETATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium, Serum</td>
<td>134 (L)</td>
<td>135-145 mEq/L</td>
<td>2/2 fluid overload</td>
</tr>
<tr>
<td>Potassium, Serum</td>
<td>3.4 (L)</td>
<td>3.5-5.3 mEq/L</td>
<td>2/2 diuretic use</td>
</tr>
<tr>
<td>Glucose, Serum</td>
<td>233 (H)</td>
<td>70-99 mg/dL</td>
<td>Dx. Diabetes (type 2)</td>
</tr>
<tr>
<td>Blood Urea Nitrogen, Serum</td>
<td>61 (H)</td>
<td>8-23 mg/dL</td>
<td>Decreased GFR</td>
</tr>
<tr>
<td>Creatinine, Serum</td>
<td>5.7 (H)</td>
<td>.6-1.2 mg/dL</td>
<td>Decreased GFR</td>
</tr>
<tr>
<td>Calcium</td>
<td>9.1 (L)</td>
<td>9.2-11 mg/dL</td>
<td></td>
</tr>
<tr>
<td>Albumin not available to correct calcium for</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glomerular Filtration Rate (GFR)</td>
<td>7 (L)</td>
<td>Kidney failure &lt;15</td>
<td>Intrinsic hypoperfusion of the kidney</td>
</tr>
</tbody>
</table>
### Assessment: Nutrient Needs

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Estimated Nutrient Needs</th>
<th>Based On</th>
<th>Formula Meets Needs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calories</td>
<td>2218 kcal</td>
<td>Pen State Equation Based on energy recommendations of the Evidence Analysis Library for critical illness</td>
<td>TF provides: 20kcal/kg $\times 109.25$ kg = 2185</td>
</tr>
<tr>
<td>Protein</td>
<td>85-97g</td>
<td>1.5-1.7g/kg IBW Based on KDOQI 2019 guidelines for AKI</td>
<td>TF provides 97g protein</td>
</tr>
<tr>
<td>Fluid</td>
<td>Out put + 500mls</td>
<td>Based on Essential pocket guide for Clinical Nutrition</td>
<td>Calorically dense formula provides: 872 ml free H2O + 500 ml free water</td>
</tr>
</tbody>
</table>
Diagnosis & Intervention

**PES STATEMENT**
- Inadequate protein energy intake (NI: 1.2) related hypermetabolic condition as evidenced by need for hemodialysis & recent NPO

**Intervention #1**

**Intervention #1 Enteral Nutrition (ND 2-1)** Initiate enteral nutrition to goal rate

Start enteral feeding at 20ml/hr. and increase 10ml/hr. until goal rate is met. Signs of intolerance and further gastrointestinal obstruction are to be closely monitored

**Medical Intervention:** Hemodialysis. Indicated I&O & renal related labs (electrolytes, BUN, Cr & GFR)
Monitor & Evaluation: Goals

1. *Total Estimated Energy Intake from Enteral Nutrition within 24 hours (F.H.1.1.1.4)*

Patient will tolerate continuous enteral nutrition at goal rate within the next 24 hours.

*Monitor for signs of intolerance including abdominal distention, vomiting & discomfort.*

2. *Total Protein Estimated Intake from enteral Nutrition within 24 hours (F.H.1.1.1)*

Patient will meet protein needs via enteral nutrition within the next 24 hours.
Monitor & Evaluation: Goals

3. Body Composition/ Growth/ Weight History: Estimated Dry Weight (A.D 1.1.1.2.1.0)

No changes in patients post dialysis recorded dry weight within the next 7 days.

4. Nutrition Focused Physical Findings: +2 Edema (PD 1.1.6.2) Impaired wound healing (PD 1.1.1.7.2.1)

Patient will not have more than 4% increase in fluid accumulation between hemodialysis sessions.

Nutrition prescription will provide adequate protein to promote healing of bilateral arm skin ulcerations for the next 14 days. Consider increasing protein if staged pressure ulcer is documented.
Monitoring & Evaluation: Goals

5. Renal Profile (BD 1.2)  

Nutrition related renal labs will maintain within accepted range between dialysis sessions.

6. Glucose/Endocrine profile (B.D 1.5)  

Hyperglycemia will be stabilized by carbohydrate steady formula and medical management within the next 7 days.

7. Energy Intake (FH 1.1.1.1)  

Monitor energy intake x 1 week. Enteral formula provides 20kcal/kg edema free adjusted body weight. Caloric adjustment indicated if weight loss is present at 1-week revaluation.
Monitor & Evaluation: Follow up Care

- Follow-up with Nephrology to evaluate effectiveness of dialysis and guide further treatment
- Follow-up with Cardiology regarding CHF exacerbation
- Follow-up by Internal Medicine to monitor sepsis/inflammatory response
- Follow up and monitor biochemical data within 48-72 hours
- Follow up to adjust nutrition intervention as needed
Works Cited


Any Questions