NORMAL FUNCTIONS OF THE KIDNEY

• Rid the body of metabolic waste products
• Regulate fluid volume
• Regulate the composition of electrolytes
• Assist in maintaining acid-base balance
• Aid in regulation of blood pressure
• Regulate red blood cell production

CCRN/PCCN
RENAL REVIEW

Corinne Jenkins RN, CCRN
SSN MICU
HCMC

Removal of waste

• Primary means of eliminating waste products of metabolism no longer needed by the body.
• Urea
• Creatinine
• Uric Acid
• End products of HGB breakdown

Water Regulation

• Thirst
• ADH
• Countercurrent mechanism of the kidney

Regulation of Electrolytes

• Sodium 135-148
• Potassium 3.5-5.3
• Magnesium 1.6-2.4
• Calcium 8.8-10.2
• Phosphate 2.5-4.5
• Chloride 92-108

POTASSIUM

<table>
<thead>
<tr>
<th>HYPERKALEMIA</th>
<th>HYPOKALEMIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAUSES</td>
<td>Acidosis, renal failure, hemolysis, cell death</td>
</tr>
<tr>
<td>SYMPTOMS</td>
<td>Diuresis, correction of acidosis, GI losses</td>
</tr>
<tr>
<td>TREATMENT</td>
<td>Nausea, weakness, muscle cramps, flaccid paralysis, peaked T waves, widened QRS, sine wave, ventricular fibrillation</td>
</tr>
<tr>
<td></td>
<td>Fatigue, GI hypomotility, ectopy, broad T waves, cardiac arrest</td>
</tr>
<tr>
<td></td>
<td>IV CaSO4, IV insulin and D5W, HCO3, albuterol, Kayexalate, Dialysis</td>
</tr>
<tr>
<td></td>
<td>IV/PO replacement, ensure Ca and Mg not low</td>
</tr>
</tbody>
</table>
QUESTION

- Which of the following assessment findings would be consistent with a serum potassium level of 7.2 mmol/L?
  1. Muscle cramps, oliguria, short PR interval, bradycardia
  2. Anxiety, hunger, tachycardia, long QT measurement
  3. Confusion, thirst, long PR interval, numb fingers
  4. Anorexia, fatigue, wide QRS complex, tall T-wave

<table>
<thead>
<tr>
<th>SODIUM</th>
<th>HYPERNATREMIA</th>
<th>HYponATREMIA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CAUSE</strong></td>
<td>Fever, dehydration, hypertonic IV’s, polyuria, Diabetes Insipidus</td>
<td>SIADH (syndrome of inappropriate antidiuretic hormone), Volume overload, renal failure, diuretic misuse</td>
</tr>
<tr>
<td><strong>SYMPTOMS</strong></td>
<td>Thirst, dry mucous membranes, lethargy, disorientation</td>
<td></td>
</tr>
<tr>
<td><strong>TREATMENT</strong></td>
<td>D5W or .45% NS slowly, monitor neuro status</td>
<td>NS, 2%, 5%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CALCIUM</th>
<th>Hypocalcemia</th>
<th>Hypercalcemia</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CAUSE</strong></td>
<td>Sepsis, chelation (lysing of cells), PTH insufficiency</td>
<td>Malignancy, hyperparathyroidism, Sepsis, chelation (lysing of cells), PTH insufficiency</td>
</tr>
<tr>
<td><strong>SYMPTOMS</strong></td>
<td>Paresthesia, long QT, tetany, bradycardia, seizures</td>
<td>Weakness, hypotonia, short QT, confusion</td>
</tr>
<tr>
<td><strong>TREATMENT</strong></td>
<td>IV/PO replacement</td>
<td>Fluids, diuresis, mithramycin, pamidronate</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PHOSPHORUS</th>
<th>HyponorPASPHATEMIA</th>
<th>HyperoPHOSPHATEMIA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CAUSE</strong></td>
<td>Renal failure, hyperparathyroidism</td>
<td>Diuresis, high PTH, refeeding syndrome, IV insulin infusion (DKA)</td>
</tr>
<tr>
<td><strong>SYMPTOMS</strong></td>
<td>Paresthesia, Long QT, tetany, Bradycardia, Hypertension, Seizures</td>
<td>Decreased cardiac contractility, respiratory failure, weakness, impaired oxygen delivery</td>
</tr>
<tr>
<td><strong>TREATMENT</strong></td>
<td>Limit intake (renal failure), Phosphate binders</td>
<td>IV/PO replacement, treat underlying cause</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PHOSPHORUS</th>
<th>HyponorPASPHATEMIA</th>
<th>HyperoPHOSPHATEMIA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CAUSE</strong></td>
<td>Renal failure, hyperparathyroidism</td>
<td>Diuresis, high PTH, refeeding syndrome, IV insulin infusion (DKA)</td>
</tr>
<tr>
<td><strong>SYMPTOMS</strong></td>
<td>Paresthesia, Long QT, tetany, Bradycardia, Hypertension, Seizures</td>
<td>Decreased cardiac contractility, respiratory failure, weakness, impaired oxygen delivery</td>
</tr>
<tr>
<td><strong>TREATMENT</strong></td>
<td>Limit intake (renal failure), Phosphate binders</td>
<td>IV/PO replacement, treat underlying cause</td>
</tr>
</tbody>
</table>

What should the nurse consider when implementing orders for intravenous magnesium and potassium replacement therapy?

1. Administer the least amount of fluid as possible.
2. Administer the magnesium first.
3. Administer the potassium first.
4. Administer whichever is available first.
### Acid-Base Balance
- Bicarbonate Reabsorption
- Hydrogen Ion Secretion
- Renal Buffers of Hydrogen Ions

### Blood Pressure Regulation
- Maintenance of Volume and Composition of ECF
- Aldosterone –body Sodium Balance
- Renin- Angiotensin-Aldosterone System
- Renal Prostaglandins
- Kallikrein-kinin System

### RBC Production
- Erythropoietin

### Renal failure
- Pre renal
- Intrarenal
- Post renal

### Pre Renal
- The insult is a decrease in renal blood flow
- 30%-40% of all AKI
- Responsive to interventions that augment systemic blood flow
- Bun:Cr > 20:1

### Which of the following conditions would most likely contribute to prerenal acute renal failure
1. Aminoglycoside antibiotics
2. Transfusion reaction
3. Prostate hypertrophy
4. Septic shock
### TREATMENT

- **PREVENTION !!**
- **VOLUME**
- **VASOPRESSOR THERAPY**
- **IMPROVE CARDIAC OUTPUT**
- **DOPAMINERGIC THERAPY(?)**

### Intrarenal

- **Bun:Cr < 10:1**
- **ATN**
- **Rhabdomyolysis**
- **AIN**

### ATN

- 50% of all AKI
- Inflammatory injury in the epithelial lining of the renal tubules
- Manifested by severe sepsis, septic shock, radiocontrast dye, nephrotoxic drugs or rhabdomyolysis

### Rhabdomyolysis

- Characterized by muscle necrosis and release of intracellular muscle constituents into the circulation

### Treatment

- Prevention
- Fluids
- Urine Alkalization
- Loop diuretics and Mannitol
- Treatment of metabolic abnormalities

### AIN

- Inflammatory injury of the renal interstitium
- Caused mainly by hypersensitivity drug reaction but infections can also be involved
- May be caused by Autoimmune disorders
- Drug induced is often accompanied by fever, rash and eosinophilia
- Usually resolves with discontinuation of offending agent.
TREATMENT

- Discontinuation of causative agent
- Immunosuppressive therapy

Post Renal

- Responsible for 10% of AKI cases
- Bun:Cr 10-20:1
- Obstruction Post kidney

ASSESSMENT

- Urine output
- Azotemia (elevated BUN) with significant obstruction
- Flank pain and fever
- Hematuria

TREATMENT

- Relieve the obstruction
- Monitor urine output, BUN, Cr
- Maintain fluid balance
- Avoid nephrotoxins

Why Kidneys Fail

- Inherited or congenital. Polycystic kidney disease (PKD).
- Acute kidney injury (AKI)
- Loss of fluids
- Drugs or poisons
- Blunt trauma
- Hypotension
- When AKI is corrected early most likely reversible
- Chronic kidney disease
- Occurs slowly over time. Mainly due to HTN or Diabetes.
- When kidney function drops <15% the person will need renal replacement therapy.

TESTS FOR KIDNEY FUNCTION

- Urinalysis
- BLOOD UREA NITROGEN (BUN)- normal 8-23.
- CREATINE- normal .7-1.25
- GFR
- BUN-CREATININE RATIO-help to determine cause of acute kidney injury

Creatinine

- Freely filtered so its production is normally equal to its secretion.
- Reliable indicator of renal function
- Significant elevation correlates with percentage of nephrons damaged
BUN

- Unreliable indicator of renal damage on its own.
- Can be influenced by urine flow, hypoperfusion, corticosteroids, GIB, diet and metabolism

KIDNEY IMAGING

- Ultrasound
- CT
- MRI
- Plain Film
- IV Urogram
- Renal arteriography
- Renal venography
- VCUG
- Radionuclide studies
- Retrograde or Anterograde pyelography

KIDNEY BIOPSY

- The collection of tissue either from a percutaneous needle puncture or an open biopsy.
- Tissue examined by a pathologist. Looking for deposits, scarring or organisms.
- Used to help determine how the disease is advancing, or why transplant organs are failing.
- NURSING INTERVENTION
  Consent, Hold ASA and blood thinning medications 1-2 weeks prior. NPO, education of procedure.
- POST PROCEDURE
  Vital sign checks, hematuria for up to 24 hours. Report, hematuria >24 hours, inability to urinate, fever, increasing pain.

ACUTE RENAL FAILURE

- Abrupt decline or cessation in renal function...
  - Over hours to days
  - Often reversible if:
    - Recognized early
    - Treated appropriately

RENASL REPLACEMENT THERAPY

- PERITONEAL DIALYSIS
- HEMODIALYSIS
- CONTINUOUS RENAL REPLACEMENT THERAPY (CRRT)
  - SCUF: Slow continuous ultrafiltration
  - CVVH: Continuous venovenous hemodialysis
  - CVVHDF: Continuous venovenous hemodiafiltration

QUESTION

A patient with multisystem organ dysfunction has an acute kidney injury. The CVP is 16 and patient is on a norepinephrine infusion. What therapy should the nurse anticipate for this patient?

1. Hemodialysis
2. CRRT
3. Peritoneal Dialysis
4. Kidney Transplant
Hemodialysis would be an appropriate treatment for an overdose of
1. Acetaminophen
2. Tricyclic antidepressant
3. Aspirin
4. Cocaine

CHRONIC RENAL FAILURE
- Progressive decline in renal function
- End-Stage Renal Disease (ESRD)

Five Greatest Risk Factors for ESRD
1. Diabetes- 40% of people with Type I and 5-10% of Type II will develop diabetic nephropathy (accounts for 35% of all causes of ESRD).
2. Hypertension-damage to the glomeruli and the arteriolar walls. Accounts for 30% of ESRD.
3. Proteinuria
4. Family History
5. Increasing Age

Stages of Chronic Renal Failure
- Mildly reduced renal function 50% nephron loss
- Renal insufficiency 75% nephron loss
- ESRD 90% nephron loss
- Uremic syndrome complete nephron loss

THERAPIES/INTERVENTION IN CRF
- Care of the dialysis access
- Fluid restrictions
- Medication dosing for renal failure/dialysis
- EPO; Vitamin B,C,D, folate, calcium, phosphate binders
- Dietary restrictions

Renal Transplant
- Criteria
- Rejection
- Ethical issues

IMMUNOLOGICAL
- Impaired T cell function- Increased levels of uremic toxins can lead impaired immune and inflammatory responses.
- Infection is a common occurrence in patients with ESRD that often results in hospitalization and death.
- PREVENTION!!!!
HEMATOLOGICAL

- Anemia-
  1. Decreased RBC production, kidney's inability to produce adequate amounts of erythropoietin stimulating factor
  2. Shorter RBC life- 2nd to uremia
  3. Iron deficiency- Diminished iron and B12 intake
  4. Dialysis patients have increased blood loss from, frequent blood draws, clotting of the dialyzer and residual blood in the filter.

IMPAIRED PLATELET AGGREGATION- from Uremia. Monitor for bleeding.

PULMONARY

- Infiltrates and pulmonary edema
- Metabolic acidosis
- Low oncotic pressure and low oxygen carrying capacity

CARdiovascular

- Arrhythmias
- CHF
- Hypertension
- Pericarditis

GASTROINTESTINAL

- Increased incidence of gastritis
- Stress ulcers
- Anorexia
- Nausea
- Vomiting
- Halitosis
- Metallic taste in mouth
- Bleeding gums and oral cavity ulcers

NEUROLOGICAL

- Uremic encephalopathy- lethargy, confusion, impaired thinking.
- Peripheral neuropathy- restless legs, impaired gait and fine motor movement
- Hypothermia
- Dialysis disequilibrium

Genitourinary

- Obstruction
- Retention
- Incontinence
RENAL TRAUMA

- MVA
- FALLS
- ASSAULT
- SPORTS-RELATED INJURY
- DECELERATION/ACCELERATION INJURY
- GUNSHOT/STAB WOUNDS
  - Right kidney low-less protection from ribcage.
  - Kidney injury often accompanied by other injuries.
  - L Kidney - spleen
  - R Kidney - Liver

QUESTIONS

The type of renal failure caused by a back-leak of glomerular filtrate is
a. Prerenal failure
b. Postrenal failure
c. Intrarenal failure
d. Obstructive renal failure

The most common reason for beginning dialysis
- a. Fluid overload
- b. Hyponatremia
- c. Hyperkalemia
- d. Metabolic Acidosis

Which diuretic is frequently used to prevent ARF
- a. Mannitol
- b. Furosemide
- c. Spironolactone
- d. Bumetanide

BIBLIOGRAPHY


Thank you
Corinne