

RENAL FAILURE: AN UPDATE FOR HEALTHCARE PROFESSIONALS

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Objectives

- Review normal kidney function.
- Define the pathophysiology of acute kidney injury and renal failure.
- Explore the collaborative management of patients with acute kidney injury and renal failure.
- Investigate new advances in renal care, such as slow nocturnal hemodialysis and continuous renal replacement therapy.

Functions of the kidney

- Filtration of blood to regulate fluid, electrolyte and acid-base balance
- Production of erythropoietin
- Secretion of renin and regulation of blood pressure
- Activation of vitamin D

Renal failure

- Definition: the partial or complete impairment of kidney function
- Classified as acute (rapid onset) or chronic (develops slowly over months to years)

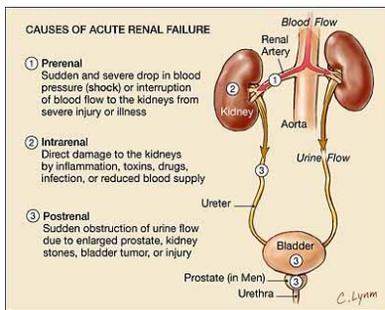
Acute Kidney Injury (AKI)

- A clinical syndrome characterized by the rapid loss of renal function with a progressive accumulation of nitrogenous waste products (azotemia)
- Uremia is the onset of **systemic** symptoms related to the accumulation of waste products
- Formerly known as acute renal failure

Categories of AKI

- Prerenal
 - Caused by factors external to the kidneys that reduce renal blood flow and decreases glomerular perfusion and filtration
- Intrarenal
 - Caused by conditions that cause direct damage to the renal tissues, impairing nephron functions
- Postrenal
 - Mechanical obstruction of urinary outflow

AKI Causes



4 Phases of AKI

- Initiating phase (AKA: Onset phase)
- Oliguric phase
- Diuretic phase
- Recovery phase

Initiating phase

- Begins at time of renal insult
- Continues until S & S are apparent
- Duration: hours to days

Oliguric phase

- Urine production of < 400 ml in 24 hours
- Oliguria is often the initial manifestation of ARF caused by reduction in GFR
- Occurs within 1 to 7 days of precipitating event
- Duration: 10 to 14 days, but can last months
- The longer this phase, the poorer the prognosis of regaining renal function

Diuretic Phase

- Urine production occurs
- Osmotic diuresis from high urea levels and kidneys inability to concentrate urine
- Initial urine output of 1-3 liters/day and may increase to 3-5 liters/day
- Duration: 1 to 3 weeks
- Acid-base, electrolyte, BUN and creatinine values begin to normalize as phase ends

Recovery Phase

- Begins when the GFR increases
- BUN and creatinine levels plateau and then decrease
- Duration: lasts up to 12 months
- Some patients never reach this phase and progress to chronic renal failure

Collaborative Care

- #1 goal: eliminate the cause, treat the signs and symptoms and prevent complications such as infection
- Administer diuretics with caution
- Manage fluid, electrolyte and acid-base imbalances
- Dialysis, drug and nutrition therapy, if indicated

Chronic Kidney Disease

- Involves a progressive, irreversible destruction of the kidneys' nephrons.
- Stages of CKD are based upon kidney function and GFR.
- Symptoms appear when 80% of nephron function is lost; dialysis is required when 90% of nephron function is lost (we are born with 2 million nephrons)

Stages of CKD

- Stage I: Diminished Renal Reserve
 - Reduced renal function, no accumulation of waste products
 - Decreased ability to concentrate urine (nocturia and polyuria results)
- Stage II: Renal Insufficiency
 - Accumulating waste products in blood
 - Not responsive to diuretics (oliguria and edema)
 - Requires medical treatment
- Stage III: End-Stage Renal Disease

End-stage Renal Disease

- Final stage of kidney failure
- Excessive accumulation of waste products, unable to maintain homeostasis-dialysis
- Occurs when GFR is <15 ml/min (normal 125ml/min)
- Leading cause of ESRD is diabetes and hypertension

Urinary Manifestations

- Progression from polyuria, to oliguria to anuria
- Depending upon the cause of kidney disease, protein, casts, blood and WBC's may be found in the urine
- Risk for UTI due to decrease in urine flow that removes bacteria from urinary tract

Metabolic Manifestations

- BUN and serum creatinine increase
- BUN also affected by protein intake, steroids, fever and catabolism, so serum creatinine and creatinine clearance (urine) are best indicators of renal function
- Insulin resistance before starting dialysis
- Elevated triglycerides from insulin impairment, leads to hyperlipidemia

Electrolyte, & Acid-base Imbalances

- Hyperkalemia
- Normal or low sodium levels
- Hypocalcemia
- Hyperphosphatemia
- Hypermagnesemia
- Metabolic acidosis (kidneys are not able to excrete accumulating acids)

Hematologic Manifestations

- Anemia: decreased erythropoietin production
- Risk for bleeding due to platelet dysfunction
- Risk for infection due to leukocyte dysfunction and impaired immune system

Cardiovascular Manifestations

- Hypertension
- Left ventricular hypertrophy and heart failure (peripheral and pulm. edema)
- Accelerated atherosclerosis
- Cardiac arrhythmias (peaked T wave on EKG)
- Risk for pericarditis (friction rub, chest pain and low-grade fever)

Respiratory Manifestations

- Dyspnea
- Pulmonary edema
- Pleural effusion on CXR
- Risk for pulmonary infections

GI Manifestations

- Nausea and vomiting
- Anorexia
- Uremic fetor (urine odor of breath)
- Stomatitis
- Weight loss
- Risk for GI bleeding
- Constipation or diarrhea

Neurological Manifestations

- Depression of the CNS: lethargy, apathy, decreased concentration, irritability and fatigue
- Restless legs
- Muscle twitching

Musculoskeletal Manifestations

- Bone disease from hypocalcemia
- Decreased phosphate excretion
- Hyperparathyroidism
- Calcium deposition in blood vessels, joints, lungs, heart and eyes

Integumentary Manifestations

- Darkening or yellowing of skin tone
- Pallor
- Dry, scaly skin
- Pruritus
- Dry, brittle hair
- Petechiae and ecchymoses

Psychological Manifestations

- Depression is common
- Change in personality and behavior
- Altered body image
- Grieving for loss of kidney function, change in lifestyle and family responsibilities and altered financial status

Diagnostic Studies

- Laboratory studies (electrolytes, BUN, serum creatinine, CBC)
- Urinalysis
- Creatinine clearance over 24 hours
- Radiologic studies
- Renal biopsy

5 D's of Managing Renal Failure

- Diet
- Drugs
- Dialysis or Donated Kidney
- Discipline
- Dying with Dignity

Collaboration Required

- Patient
- Family/Significant Others
- Nurses
- Physicians
- Social Workers and Psychologists
- Dietician/Nutritionist
- Occupational and Physical Therapists
- Case Managers

Conservative Therapy

- Goal: preserve remaining renal function, treat symptoms, prevent complications, and maintain comfort
- Manage hyperkalemia, hypertension, anemia, and calcium-phosphorous imbalance
- Eliminate nephrotoxin exposure (avoid NSAIDs-leads to vasodilation and decreases renal perfusion)

Nutritional Therapy (AKI)

- Adequate caloric intake to prevent catabolism of body protein
- Intake of carbohydrates and fats to prevent ketosis
- Restrict or encourage sodium, calcium, phosphorus, fluid and potassium based upon stage of AKI
- Consider GI symptoms

Nutritional Therapy (CKD)

- Fluid restriction
- Potassium restriction
- Sodium restriction
- Phosphate restriction
- Calcium, iron, and folic acid supplements
- Increase protein intake if on dialysis to avoid low albumin levels

Hypoalbuminemia

- A significant number of patient on dialysis have low albumin levels
- May be due to dialysis losses, inflammation, and decreased nutritional intake
- Low albumin levels leads to increased morbidity and mortality
- Even small increases in albumin levels can lead to improved patient outcomes
- Kidney Disease Outcomes Quality Initiative recommends maintaining a serum albumin level of 4 g/dL

Pharmacologic Therapy

- Erythropoetics: Epogen, Procrit
- Iron supplementation (I.V. or po)
- Phosphate binders: Phos-Lo, Renagel
- Vitamin D supplementation (I.V. or po)
- Calcium supplements
- Anti-hypertensives
- Folic acid and vitamins

Physical and Occupational Therapy

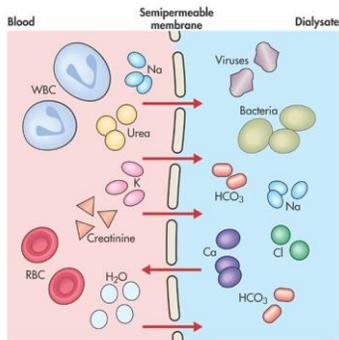
- Deconditioning is a significant problem in this population and starts in the pre-dialysis stage
- Assists in building muscle, improving VO_2 peak values, cardiac functioning, and heart rate variability
- Exercise is often not part of the patient's plan of care
- Decreased albumin can also lead to protein-energy malnutrition

Psychological Therapy

- Depression and grieving over the loss of kidney function can be expected responses to renal failure
- Changes in financial security, employment, and family responsibilities can be permanent or temporary
- The adjustment to dialysis therapy is variable for each patient
- Counseling and provision of support services can assist the patient and family

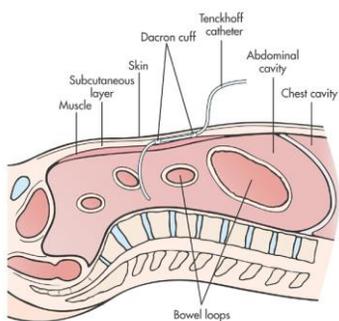
Dialysis

- Definition: technique in which substances move from the blood across a semi-permeable membrane into a dialysis solution.
- Corrects fluid and electrolyte imbalances
- Removes waste products from the blood



Peritoneal Dialysis (PD)

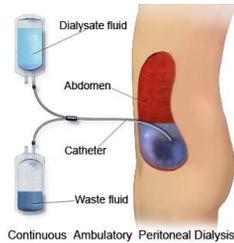
- Peritoneal membrane is the semi-permeable membrane
- Requires a peritoneal dialysis catheter placement through the abdominal wall into the peritoneal cavity
- A daily treatment that the patient is trained to perform at home and also during hospitalization



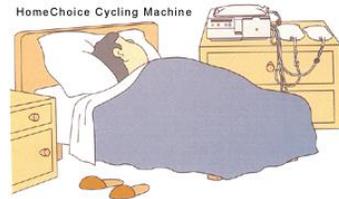
Complications of PD

- Peritonitis: abdominal pain, fever, cloudy peritoneal fluid, diarrhea, vomiting, elevated WBC's of peritoneal fluid
- Exit site infection
- Abdominal pain
- Hernias
- Protein and potassium losses
- Increased blood sugars

CAPD



CCPD



Hemodialysis (HD)

- Requires access to a large blood vessel
- Treatment 3 times a week for 3-5 hours
- Occurs in a dialysis unit, hospital or in a patient's home that is equipped
- Blood is pumped through a dialyzer that contains semi-permeable membranes to remove fluid and toxins

Hemodialysis



Hemodialysis Accesses- "The Patient's Lifeline"

- Arterio-venous fistula
- Arterio-venous graft
- Catheter placed in the internal jugular, subclavian, or femoral vein
- Fistulas and grafts are surgically created

Nocturnal Hemodialysis

- Can be performed at home or in a center
- At home the patients dialyze 3 to 6 times a night and may be connected via a phone modem or internet to a center for monitoring. A partner needs to be trained on the procedure in addition to the patient
- In center NH takes place 3 nights a week for 8 hours. Patient sleep at the center while they dialyze and are monitored by staff

Benefits of Nocturnal Hemodialysis

- Patients take less meds to control BP and phosphorus levels
- Describe more energy, an improvement in quality of life and HD is less intrusive in their lives
- They state they get to know the dialysis staff better and receive more individualized care
- Compliance with dialysis treatments better
- Increased length of life

Continuous Renal Replacement Therapy (CRRT)

- Much slower process than hemodialysis
- Benefits the hemodynamically unstable patient who requires dialysis (patient with MODS and SIRS)
- Continuous therapy that filters blood to remove fluid and toxins similar to hemodialysis
- Performed in the critical care unit
- CVVHD, CVVHDF, CAVH, CAVHD

CRRT Equipment



Palliative Care

- Mortality rates for people with CKD are higher than most cancers
- Advancing age, comorbidities, and high symptom burden are common among people receiving renal care
- Some patients may choose not to start dialysis
- Other patients may choose to start and willingly decide to stop treatment at some point after starting

Nephrology Palliative Care

- Aims to relieve suffering and improve quality of living and dying
- Provided by an interdisciplinary team
- No synonymous with end-of-life care
- Goals: pain and symptom management (pruritis, pain, dyspnea, fatigue), advanced care planning (end of life decisions), and bereavement support for family, staff, other patients, etc.)

Kidney Transplant

- Extremely successful
 - 90% success rate after 1 year for cadaver transplants
 - 95% success rate after 1 year for live donor transplants
- Reverses many of the pathophysiologic conditions associated with renal failure

Transplant Challenges

- Lack of available organs
- Rejection
- Infection
- CAD related to immunosuppressants
- Malignancies
- Recurrence of original renal disease
- Guilt or emotional considerations related to cadaveric or living donor

Healthy People 2020

- CKD and ESRD are significant public health problems in US. Also, a major source of suffering and poor quality of life. Results in premature death and high expenses for private and public sectors
- Nearly 25% of the Medicare budget is used to treat people with CKD and ESRD
- Increased waiting time for transplantation—critical shortage of organs

Healthy People 2020 Goals

- Reduction in kidney disease burden—manage HTN and DM, encourage follow-up care for AKI and manage proteinuria
- Longer lives and improved quality of life for people with CKD—lifestyle modifications and improved vascular access management
- Elimination of disparities among kidney disease patients—earlier medical evaluation and intervention

References

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<http://www.aakp.org>
- American Association of Nephrology Nurses
<http://www.aanurse.org>
- American Kidney Fund
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- National Kidney Foundation
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