Caring for Patients with Common Health Problems of the Renal System
Celeste Armenta RNNP
Nursing 210

Renal System
Primary function of kidney is to maintain a stable internal environment for optimal cell and tissue metabolism.

Renal System
Kidneys accomplish life sustaining tasks by balancing solute and water transport,
• Excreting metabolic waste products
• Conserving nutrients
• Regulation of acids and bases

Renal System
Kidneys also have an endocrine function:
• Secrete the hormone renin
• Erythropoietin
• Regulation of BP
• Erythrocyte production
• Calcium metabolism

The Renal System
• Functions:
  • Maintains balance of water, salts & acids in the body fluids.
  • By removing excess fluids or reabsorbing water as needed.
  • Constantly filters blood to remove urea and other waste.
  • Converts waste products and excess fluids into urine for excretion.

Renal System
Formation of urine is achieved by process called filtration, reabsorption and secretion by the glomeruli and tubules within the kidney.
Bladder stores the urine that it receives from the kidney by way of ureters. Urine is then removed from the body through the urethra.

The Structures of the Renal System
Kidneys are paired organs located on the posterior abdominal wall outside the peritoneal cavity.
They lie on either side of the vertebral column with their upper and lower poles extending from the twelfth thoracic to the third lumbar vertebrae.

Structures continued
• Each kidney is 11cm long, 5 to 6 cm wide, and 3-4 cm thick
• A renal capsule surrounds each kidney and it is embedded in a mass of fat
• Cushion of fat protects from trauma
• The right kidney is slightly lower than the left, displaced by the liver

The Nephrons
• Functional units of the kidneys Approximately 1.2 million nephrons in each kidney
• They form urine through filtration, reabsorption & secretion.
• Each nephron contains a glomerulus – a cluster of capillaries surrounded by a membrane called bowman’s capsule.
Urochrome is a pigment that gives urine its yellow-amber straw color.

**Structures**
- Glomerular Capsule (Bowman's capsule) surrounds glomeruli
- Glomerulus: Tuft of capillaries within each nephron, filter large plasma proteins and blood cells.
- Glomerular filtrate: fluid filtered by the glomeruli, similar to plasma, made up of water, electrolytes, glucose, amino acids, and metabolic wastes

**Continued**
- The glomerular filtration membrane has three layers
  - An inner capillary endothelium
  - A middle basement membrane
  - Outer layer of capillary epithelium

**Structures of the Nephron**
- Proximal convoluted tubule: unit of the nephron, located in renal cortex, receives filtrate from glomerular capsules, reabsorbs water and electrolytes

**Structures of the Nephron**
- Loop of Henle: forms renal pyramid in the medulla-U shaped portion of the renal tubule
  - Descending loop of Henle: removes water and filtrate
  - Ascending loop of Henle: removes Na and Cl from filtrate, helps maintain osmolality

**Structures of the Nephron**
- Distal convoluted tubule: Convoluted portion of the tubule beyond loop of Henle, located in renal cortex, removes more Na and H2O.

**Structures of the Nephron**
- Distal Tubules: reabsorb Na by active and passive transport in smaller amounts than proximal tubules
- Collecting Ducts: prevent water from leaving the filtrate use active and passive reabsorption
- Tubular Secretion: movement out of the blood into the tubular fluid, tubule cells secrete certain substances in addition to performing reabsorption

**Renal Blood Flow**
- Kidneys highly vascular organs receive 1000 to 1200ml of blood per minute, or about 20% to 25% of the cardiac output.
- From renal plasma flow, 20% (approximately 120 to 140ml/min) is filtered at the glomerulus and passes into Bowmans capsule.
- Filtration of plasma per unit of time is glomerular filtration rate (GFR), related to perfusion pressure in the glomerular capillaries

**Autoregulation**
- In the kidney a local mechanism tends to keep the rate of blood flow and therefore the GFR fairly constant
- Changes in afferent arteriolar resistance and arteriolar pressure occur in the same direction EX: As systemic blood pressure increases, the afferent arterioles constrict, preventing an increase in glomerular blood flow and filtration pressure.

**Neural Regulation**
When systemic arterial pressure decreases, increased renal sympathetic nerve activity is mediated reflexively through the carotid sinus and the baroreceptors of the aortic arch. This stimulates renal arteriolar vasoconstriction and decreases both RBF and GFR.

**Ureters**
- 10 – 12 inch tube that carry urine from the kidneys to the bladder.

**Urinary Bladder**
- Hollow muscular organ
- Reservoir for urine
- Stores about 1 pint of urine

**Urethra**
- Tube extending from the bladder to the outside of the body.
- There are 2 urinary sphincters, one on either end of the urethra.
- External opening is the urethra or urinary meatus.
- Female urethra is about 1.5 inches long.
- Male urethra is about 8 inches long.

**The Excretion of Urine**
- Urination also known as micturition or voiding.
- Urination occurs from contraction of bladder muscles and relaxation of the sphincters.

**Vesicoureteral Reflex**
- Refers to the retorograde flow of bladder urine into the ureters
- Increase infection due to increase residual urine
- Primary reflux- Results from congenitally abnormal insertion of the ureters into bladder and predisposes infection
- Secondary reflex- occurs at result of infection, neurogenic bladder or iatrogenic dilation of ureteral. Can lead to upper UTI

**Management**
- Continuous low dose antibacterial therapy with frequent urine cultures
- Surgical Interventions if:
  - Significant anatomic abnormality
  - Recurrent UTI
  - High Grades of VUR
  - Noncompliance with medical therapy
- Nursing: Encourage compliance

**Urinary System**
- Dysuria – painful urination.
- Enuresis – involuntary discharge of urine.
- Anuria – complete suppression of urine formation.
- Uremia – toxic condition caused by excessive amount of urea and other waste products in the bloodstream.

**Urinary System**
- Nocturnal enuresis is bed-wetting.
- Nocturia – excessive urination at night.
Oliguria – scanty urination.
Polyuria – excessive urination.
Urinary retention – the inability to void or empty the bladder.

Urinary Tract Infection
No bacteria except the distal 1/3 of urethra
Site of infection difficult to determine with accuracy
Child peak incidence of UTI 2-6 years (not structural anomalies) females 10-30% Greater risk

Classification of UTI
Bacteruria- growth of bacteria in uncontaminated urine
A symptomatic bacteriuria-significant bacteriuria with no clinical symptoms
Symptomatic-significant bacteriuria with physical symptoms
Recurrent UTI-Repeated UTI
Relapse of UTI- Persistence of the same organism despite therapy

Continued
Urethritis- Inflammation of the urethra
Cystitis- Inflammation of the bladder
Ureteritis- Inflammation of the ureter
Pyelonephritis – Inflammation of kidney and upper tract

Continued
Female short urethra and lack of prostatic fluid that provides protection
Infancy infection has incidence of renal scar
Mechanisms- Stasis of urine

Symptoms
Over 2 years encounter enuresis or daytime incontinence
Fever
Strong- foul smelling urine
Increased frequency in urination
Dysuria
Urgency/ABD Pain/ Flank Pain/ Hematuria

Pyelonephritis
Admit and IV antibiotics
Increase fluid intake 3-4 liters
Nurses: Evaluate for UTI, will see incontinence in toilet trained child
Strong smelling urine
Frequency and or urgency

Prevention
Complete emptying of bladder (prevent urinary stasis)
Teach symptoms of UTI
Need for prompt medical attention
Continue drugs even though symptoms abate, follow up care
Maintenance of fluid intake of 3-4 liters

Pyelonephritis
Bacterial infection of kidney tissue
Usually begins as lower UTI and ascends to kidney Ecoli. Most common organism
Associated with Cystitis, Pregnancy, Obstruction, risk factors-septicemia
Chronic health problems or analgesic, polycystic kidney

Signs and Symptoms
Inflammation/Chills/ Fever/ malaise
Flank pain/ costovertebral tenderness
Leukocytosis
WBC, casts, bacteria, BUN. Creat, Pyuria
Treatment: Check culture and sensitivity, start broad spectrum antibiotics

Continued
Most common cause of acute bacterial sepsis in older 65 year olds
Structural abnormalities, neurogenic bladder due to strokes
Autonomic neuropathy in diabetic patients
In absence of estrogen, in post menopausal women susceptible to colonization increase adherence of bacteria to vagina and urethra. Estrogen therapy helps with vaginal PH

Nephrotic Syndrome
Most common presentation of glomerular injury
Massive proteinuria, hypoalbuminemia, hyperlipidemia and edema

Sequence of Events in Nephrotic Syndrome
Renal glomerular damage, leads to proteinuria (massive), leads to hypoproteinemia which increases hepatic synthesis of proteins and lipids causes hyperlipidemia.
Hypoproteinemia causes decreased oncotic pressure leading to hypovolemia which decreases renal blood flow, renin is released vasoconstrictor occurs, increased hydrostatic pressure and end result edema

Types of Nephrotic Syndrome
Primary-Restricted to glomerular injury
Secondary- When it develops as part of a systemic illness, idiopathic, hypersensitivity reaction
Minimal Change Nephritic Syndrome –most common preschool 2-7 yrs
Secondary Nephritis- cause glomerular damage in acute or chronic glomerulonephritis

Continued
Patho- Glomerular membrane becomes permeable to proteins, especially albumin also immunoglobulins patient susceptible to infection.

Continued
Decrease in colloidal osmotic pressure, and hydrostatic pressure exceeds, fluid accumulates in extravascular spaces (ascites) leads to hypovolemia, renin stimulated, vasoconstrictor, secretion of ADH and aldosterone, increase in NA and water reabsorption to increase intravascular volume

Clinical Manifestations
Well child gains wt over days or weeks
Puffiness in face, especially around eyes
Swelling worst in am’s and subsides during the day (clothes fit tight)=fluid shifts to abdomen and lower extremities
Anasarca- severe generalized edema
Diarrhea- edema of intestinal mucosa
Loss of appetite, poor intestinal absorption
Urine volume decreases, appears darkly opalescent, frothy

Continued
Pale with easy skin breakdown
Irritable easily fatigued or lethargic
BP WNL or low
Child susceptible to infection

Continued
Diagnosis based on history and symptoms/ Renal Biopsy
Edema
Proteinuria 10g/24hrs
Hypoalbuminemia
Hypercholestremia

Management
Reduce the excretion of urinary protein
Prevent or treat any acute infection
Control edema
Establishment of good nutrition
Correct metabolic process

Med Management
ACE inhibitors with diuretics/ Salt poor albumin
Diuretics especially loop (Lasix) control edema or hypertension. Aldactone to supress aldosterone and conserve K.
Antineoplastic agents (Cytoxan)
NA decrease liberal K, to assist in NA/K pump mechanism, reduction of edema
Biologic proteins ( dairy products, eggs, meats) decrease in saturated fats.

Treatment
Bedrest at child level of tolerance
No added salt
Corticosteroid therapy
Prednisone (safest and least expensive)
Complications with steroids
Cataracts/obesity/bone demineralization
Infection/ Hyperglycemia/ GI bleed

Acute Glomerulonephritis
Immunologic mechanisms are primarily responsible for glomerular disease. The onset may be sudden or insidious with HTN, edema, elevated BUN
Can be assymptomatic detected through presence of hematuria routine urinalysis.
Most definite indication obtained by renal biopsy

Continued
Antigen (group A beta hemolytic streptococcus)
Antigen antibody product
Deposition of antigen antibody in glomerulus
Increased production of epithelial cells lining the glomerulus
Leukocytes infiltrate the glomerulus
Thickening of the glomerular filtration membrane
Scarring and loss of glomerular filtration membrane
Decreased GFR rate

Common Manifestations
Oliguria
Hypertension
Hematuria (Primary presenting feature)
Proteinuria
Symptoms occur 7-21 days (7-10 days post infection)

More Manifestations
Puffiness of face (periorbital edema) feet and ankles dependent edema
Anorexia
Pass dark colored urine (smoky brown, tea colored
Decrease in output
Pale irritable and lethargic

Continued
Acute Edematous Phase
Listless, anorexic, and apathetic
Wt fluctuates, urine remains thick and smoky brown
Blood pressure may increase

Continued
Prognosis- OK, death can occur due to complications
Complications- HTN encephalopathy- headache, dizziness, vomiting, discomfort
Acute cardiac decompensation- hypervolemia, edema
Acute renal failure- Persistent oliguria or anuria

Diagnosis
Urine Sp. Gr. Seldom exceeds 1.020
Proteinuria +3/+4
Gross discoloration- RBC, WBC, Cell Casts
BUN, Creatinine levels- Level and severity of disease related
ASO, ESR, C-reactive protein reflect acute inflammatory process

Therapy
General supportive measures and early recognition and TX
Normal BP and satisfactory UO-TX at home
Substantial edema, HTN, Gross hematuria and significant oliguria- Hospitalization

General
Can ambulate if not lethargic
Fluid restriction only with UO decreased
Lasix only with significant edema and fluid overload
Digitalis- for CHF
Diet- High in carbs to provide energy and decrease protein catabolism

Chronic/ Progressive Glomerulonephritis
Advanced glomerulonephritis- describes advanced glomerular disease, causing progression of renal function and rapid deterioration

Clinical Manifestations
Nephritic Syndrome
HTN
Edema
Proteinuria
Cardiac failure
Dyspnea
Osteodystrophy
Anemia

Kidneys
Pyelitis – inflammation of the renal pelvis.
Pyelonephritis – inflammation of the renal pelvis and of the kidney.
Renal colic – acute pain in kidney area caused by blockage during passage of a kidney stone.
Urolithiasis

- Most common urologic problem
- Most stones formed in kidneys, but bladder stones are common in clients with catheters or inability to empty bladder completely
- Can be single or multiple, large calculi can cause pressure necrosis and lead to obstruction

Risk Factors

- Dehydration
- Infection - change in PH provide and environment for calculi
- Obstruction - urine stasis allows for solid material to collect
- Metabolic factors - increase in uric acid, vitD, calcium

Signs and Symptoms

- Pain, renal colic, fever, chills, abdominal distention, N/V
- Diagnosis - UA, strain all urine, crystal fragments, pyuria, hematuria, KUB, IVP ultrasound, CT scan
- Stones that are too large more than 5mm diameter multiple stones, require surgical intervention.

Treatment

- Extracorporeal shock wave lithotripsy
- Percutaneous nephrostomy
- Transurethral uroscopy
- Hydration 2,500 to 3,000 of water daily if not contraindicated.

Ureters

- Ureterectasis – distention of a ureter.
- Ureterorrhagia – discharge of blood from the ureter.
- Ureterostenosis – stricture of the ureter.

Diagnostic Procedures

- Catherization
- Intervenous pyelogram
- KUB (Kidney, Ureter and Bladder)
- Urinalysis
- Urine culture
- 24 hour urine specimen
• Cystocele – hernia of the bladder through the vaginal wall.
• Urinary tract infections (UTI’s).
• Incontinence – loss of bladder control.

Bladder

• Cystitis – inflammation of the bladder.
• Interstitial cystitis – inflammation within the bladder wall. This is a chronic condition.
• Vesicovaginal fissure – an opening between bladder and vagina.

Urethra

• Epispadias – urethral opening of the male is on the dorsal (upper surface) of the penis.
• Hypospadias - opening is on the undersurface of the penis. In female the urethra opens into the vagina.
• Reflux is a back up of urine into the bladder from blockage of the urethra.
• Paraspadias – congenital abnormality in males in which urethral opening is on one side of the penis.

Signs and Symptoms

• Abdominal or flank pain
• Hematuria
• Palpable kidneys
• Enlarged kidneys
• Recurrent UTI with chills and fever
• Intravenous Pylography to confirm diagnosis

Wilm’s Tumor

Symptoms

• Abdominal pain
• Swelling in the abdomen (hernia or mass)
• Blood in urine
• Fever/Loss of appetite/NV
• HTN/Constipation

Treatment
Surgical exploration and removal of tumor is scheduled as soon as possible.

With treatment the disease has a high cure rate. Children with a localized tumor have a 90% cure rate when treated with surgery and chemotherapy.