Caring for Patients with Common Health Problems of the Renal System

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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 11 cm 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 thru filtration, reabsorption & secretion.
- Each nephron contains a glomerulus – a cluster of capillaries surrounded by a membrane called bowman's capsule.
- Urochrome is 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 retrograde 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
- Pylonephritis – 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

Pylonephritis
- 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 hypoproteinemimia 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 vasoconstriction 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.

Clinical Manifestations

- Well child gains wt over days or weeks
- Puffiness in face, especially around eyes
- Swelling worst in arms 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
- Hypercholesteremia
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 asymptomatic 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
- 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.

Table 9.1

<table>
<thead>
<tr>
<th>Types of Stones</th>
<th>Word Parts</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cystolith (SIS-toh-lith)</td>
<td>cysto means bladder</td>
<td>Urinary bladder</td>
</tr>
<tr>
<td>Nephrolith (NEF-ron-lith), also known as renal calculus or a kidney stone</td>
<td>nephro means kidney</td>
<td>Kidney</td>
</tr>
<tr>
<td>Ureterolith (you-REE-tor-oh-lith)</td>
<td>uretero means ureter</td>
<td>Ureter</td>
</tr>
</tbody>
</table>

Figure 9.4 Hydroureter and hydronephrosis resulting from a urethral stricture.
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**
Catherization

Intervenous pyelogram

Bladder

- cystocele – hernia of the bladder through the vaginal wall.
- Urinary tract infections (UTI’s).
- Incontinence – loss of bladder control.

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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.
- **Reflex** 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
Hemodialysis filters waste from the patient's blood. Blood leaves the patient's body through an artery, is filtered, and returned through a vein.
Figure 25-4: An arteriovenous shunt in the forearm. One part of
this shunt remains is placed in an artery, the other part in a vein.
This ends of the shunt cannula are joined when dialysis is not in
progress.

Figure 25-5: A hemodialysis machine. (Courtesy of

Figure 25-6: In a renal transplant the new kidney is placed lower in the abdomen.
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.