Kidney Disorders in the Children

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Introduction:

The kidneys play a critical role in the body: Acting as the body's filtering system, they help control water levels and eliminate wastes through urine. They also help regulate blood pressure, red blood cell production, and the levels of calcium and minerals. But sometimes the kidneys don't develop properly and, as a result, don't function as they should. Often these problems are genetic and not due to anything a parent did or didn't do.

Many of these problems can be diagnosed before a baby is born through routine prenatal testing and treated with medication or surgery while the child is still young. Other problems may emerge later, such as symptoms of urinary infections, growth retardation, high blood pressure, etc. In some cases, the problems are more severe and require more extensive surgical treatment

When caring for children with disorders of urinary system, the nurse must realize that the child is suffering from a disease process which causing a variety of physical discomforts.

Definition of Kidney

The kidneys are a pair of bean-shaped organs found along the posterior wall of the abdominal cavity. The left kidney is located slightly higher than the right kidney because the right side of the liver is much larger than the left side.

Function of the kidney:

- The kidney has a role in the excretion of drugs.
- The kidney has a role in acid-base balance regulation through hydrogen ion secretion and bicarbonate reabsorption and generation.
- The kidney has hormonal function as it produces renin hormone which regulates the blood pressure.
- The kidney produces erythropoietin which stimulates the bone marrow to produce red blood cells.
- The kidney converts the inactive form of vitamin D from food into the active form that regulates calcium deposition in bones.

Anatomy and structure of the kidney

The two kidneys are located to the rear of the abdominal cavity on either side of the spine. They normally weigh about 5 onces each, but receive about 20% of the blood flow coming from the heart. The urine produced by each kidney drains through a separate ureter into the urinary bladder, located in the pelvic region. The bladder is emptied in turn by a single urethra, which exits the body.

Each kidney contains 1 million nephrons (nephron = glomerulus +associated tubule). Number of nephrons is completed at birth, but functional maturation occurs later .

Function of the Nephrons

The nephron is the tiny filtering structure in the kidneys. Each of the kidneys contain more than a million tiny filtering nephrons that help clean the blood.

- Filtering blood of small molecules and ions such as water, salt, glucose and other solutes including urea. Large "macromolecules" like proteins are untouched.
- Recycling the required quantities of useful solutes which then re-enter the bloodstream. (A process called reabsorption).
- Allowing waste molecules/ions to flow from the tubules/ureter as urine.

Each nephron is composed of two main structures: the glomerulus and renal (kidney) tubule.

The Glomerulus

The glomerulus is a tiny blood vessel or capillary, which looks like a ball of yarn. Actual filtering of the blood occurs in the glomerulus. Each of the glomeruli acts like a sieve that helps keep normal proteins and cells in your bloodstream and allows wastes, excess fluid and other substances to pass.

The Tubule

The tubule, also called renal or kidney tubule, is a tiny tube where the wastes, extra fluid and other recyclable substances like sodium and potassium filtered out from the glomerulus pass through.

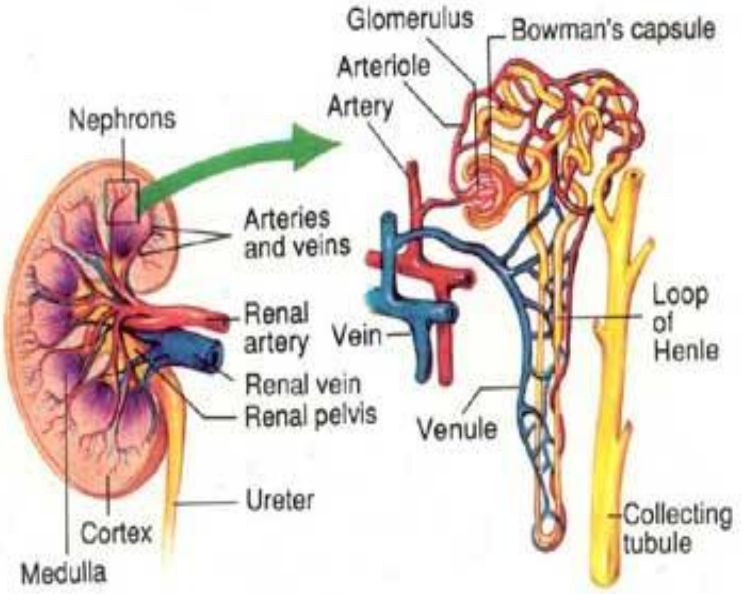
Damage to the Nephrons

Damage to nephrons can lead to kidney disease. Conditions that can affect the glomerulus are:

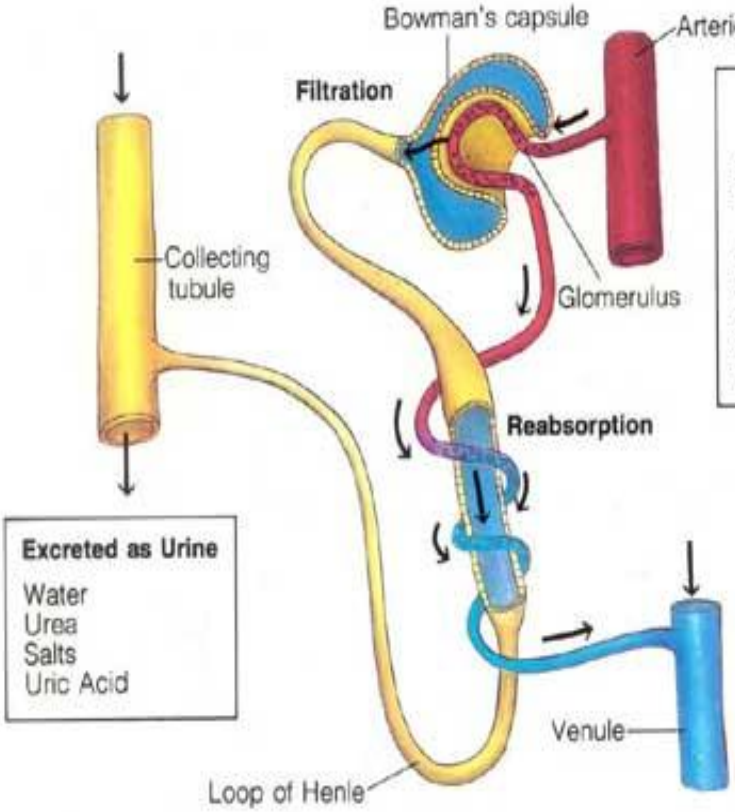
- Glomerular Diseases
- Lupus Nephritis
- Nephrotic Syndrome
- IgA Nephropathy
- Diabetes

66. The Human Kidney

Structure



Function



Filtration
into the nephron

Diffuses into Bowman's capsule:	Remains in blood:
Water	Red blood cells
Amino acids	White blood cells
Glucose	Platelets
Salts	Plasma proteins
Urea	Fats

Excreted as Urine

Water
Urea
Salts
Uric Acid

Reabsorption
into the blood

Water (much, but not all)
Amino acids
Glucose
Salts

Normal finding in morning samples urine analysis:

- **Color:** yellow.
- **Aspect:** clear.
- **Specific gravity** (after 12 hr deprivation from the water: 1,020.
- **Glucose qualitative :** - ve
- **Bilirubin :** - ve **and urobilinogen :** trace
- **Protein :** - ve
- **PH:** affected type of diet, normal 4,5 – 8 (average 6) .
- **Sediment :**
    - ✓ **Cast :** 0-1 \ Hpf
    - ✓ **RBCS:** 0-5 \ Hpf
    - ✓ **WBCS:** 0-5 \ Hpf
    - ✓ **Epith. cells:** few
    - ✓ **Crystals**: few oxalate phosphate (in alkaline urine) and urate (in acidic urine).

1-Urinary tract infection

Febrile UTI is the most common serious bacterial infection in childhood (**Buonsenso D, Cataldi L** ,2012) .In the first three months, UTIs are present in 7.5% of girls, 2.4% of circumcised males and 10% of uncircumcised males who present with a fever (**Shaikh N, Morone NE, Bost JE, et al** ,2008) .In the first year of life (mostly the first three months), UTI is more common in boys than in girls, after which the incidence changes, to approximately 3% of pre-pubertal girls and 1.1% of pre-pubertal boys (European Association of Urology , 2013).

Classification of UTI

Urethritis: inflammation of the urethra

Cystitis: inflammation of the bladder

Ureteritis: inflammation of the ureters

Pyelonephritis: inflammation of the upper urinary tract and kidneys

Etiology

Bacteria cause the large majority of urinary tract infections in children as Escherichia coli accounts for 80% of all cases. Viral infection of the bladder is less common, while fungal infections of the urinary tract are rare and occur most commonly in immunocompromised individuals.

Evaluation Diagnosis

- **Collecting the urine sample**
    - As Suprapubic aspiration (SPA) Catheter Specimens, Clean Catch Urine and Midstream urine (MSU)
- **Ultrasound**:
    - Can accurately assess renal size and outline and identify most congenital abnormalities, renal calculi and hydronephrosis or hydroureter, indicating the presence of obstruction or severe reflux.
    - It is less effective in detecting mild or moderate vesico-ureteric reflux in children with UTIs.
- **Micturating cystography**:
    - Is the gold standard investigation for reflux and is the only imaging technique that provides information about the urethra.
- **DMSA scintigraphy**:
    - Is the gold standard for detecting renal parenchymal defects. The isotope is concentrated in the proximal renal tubules, and its distribution correlates with functioning renal tissue.

Clinical manifestations of UTI

Children less than two years (Signs are characteristically non-specific)

- Failure to thrive
- Vomiting and diarrhoea

- Jaundice
- Pyrexia
- Irritability
- Strong smell from urine
- Persistent nappy rash
- Frequent/infrequent voiding
- Screaming on voiding

Children above two years (Signs are more specific)

- Frequency
- Urgency
- Dysuria
- Small volumes of urine passed
- Lower abdominal or flank pain
- Enuresis in a previously continent child
- Fever
- Haematuria
- Vomiting
- Smell from urine

Management of Urinary Tract Infection Guideline for Infants and Children (Clinical Practice Guidelines ,2011)

- Any child who is unwell, and most children under 6 months, should be admitted for i.v. antibiotics. Include blood culture, electrolytes and consider an LP.
- A shocked child will require fluid resuscitation.
- Recommended iv antibiotics are gentamicin and benzylpenicillin. Drug doses
- Remember to do gentamicin levels pre-the third dose if planning to continue gentamicin for more than 3 doses.

If oral medication is appropriate:

- Trimethoprim 4mg/kg (150mg max) BD (only tablets generally available in community, RCH pharmacy make 10mg/mL suspension for RCH patients) or

- Trimethoprim and sulphamethoxazole (8mg-40mg per mL) 0.5 ml/kg (20ml max) BD or

- Cephalexin 15mg/kg (500mg max) TDS 10 days total if < 2years, 7 days if older

Check antibiotic sensitivities and adjust therapy in 24 to 48 hours.

Nursing care management

Prevention education to parent :

- Practice good hygiene Keep the child's genital area clean to prevent bacteria from entering through the urethra.
- Avoid giving the child bubble baths.
- Teach the child to go the bathroom several times every day.
- Teach the child to wipe the genital area from front to back to reduce the chance of spreading bacteria from the anus to the urethra.
- Avoid tight clothing or diapers
- Cotton panties vs. nylon
- Avoid holding urine
- Empty bladder completely each time
- Avoid straining during defecation
- Encourage generous fluid intake

Monitor urine color changes, monitor the voiding pattern, input and output every 8 hours and monitor the results of urinalysis repeated. To identify the indications of progress or deviations from expected results

Note the location, time intensity scale (1-10) pain. To help evaluate the place of obstruction and cause pain.

Provide convenient measures, such as massage. To Increase relaxation , reduce muscle tension.

Give perineal care. To prevent contamination of the urethra.Divert attention to the fun. To Relaxation, avoid too feel the pain.

Collaboration of analgesics. to control the pain.

Encourage the patient to drink as much as possible and reduce drinking in the afternoon. To support the renal blood flow and to flush bacteria from the urinary tract. The liquid that can irritate the bladder (eg, coffee, tea) is avoided. In order not to wake up frequently at night to urinate.

Encourage the patient to urinate every 2-3 hours and when it suddenly felt. Because it significantly lowers the number of bacteria in the urine, reduced urine status and prevent recurrence of infection.

Observation of vital signs, especially temperature, as indicated. To determine interventions .

2-Nephrotic syndrome

Nephrotic syndrome is a glomerular disorder characterized by:

Proteinuria > 1 gram \ m2\24 hr.

Hypoproteinemia (serum albumin <2.5 g/dL).

Hypercholesterolemia (serum cholesterol >220 mg/dL).

Generalized edema.

Incidence : (http://www.kidney.org)

2 – 7 cases per 100,000 children per year

Higher in underdeveloped countries (South east Asia)

Occurs at all ages but is most prevalent in children between the ages 1.5-6 years.

It affects more boys than girls, 2:1 ratio

Etiology and classification of Nephrotic syndrome

A primary known as Idiopathic nephrotic ,child hood nephrosis , or minimal – change nephritic syndrome (MCNS) occurring in 90% of cases. The cause is unknown, but the disease may occur after or be related to:

- Allergic reactions
- NSAID use
- Tumors
- Vaccinations
- Viral infections

A secondary Nephrotic syndrome secondary to glomerulonephritis occurring in 10 % of cases. A congenital from inherited as an autosomal recessive disorder

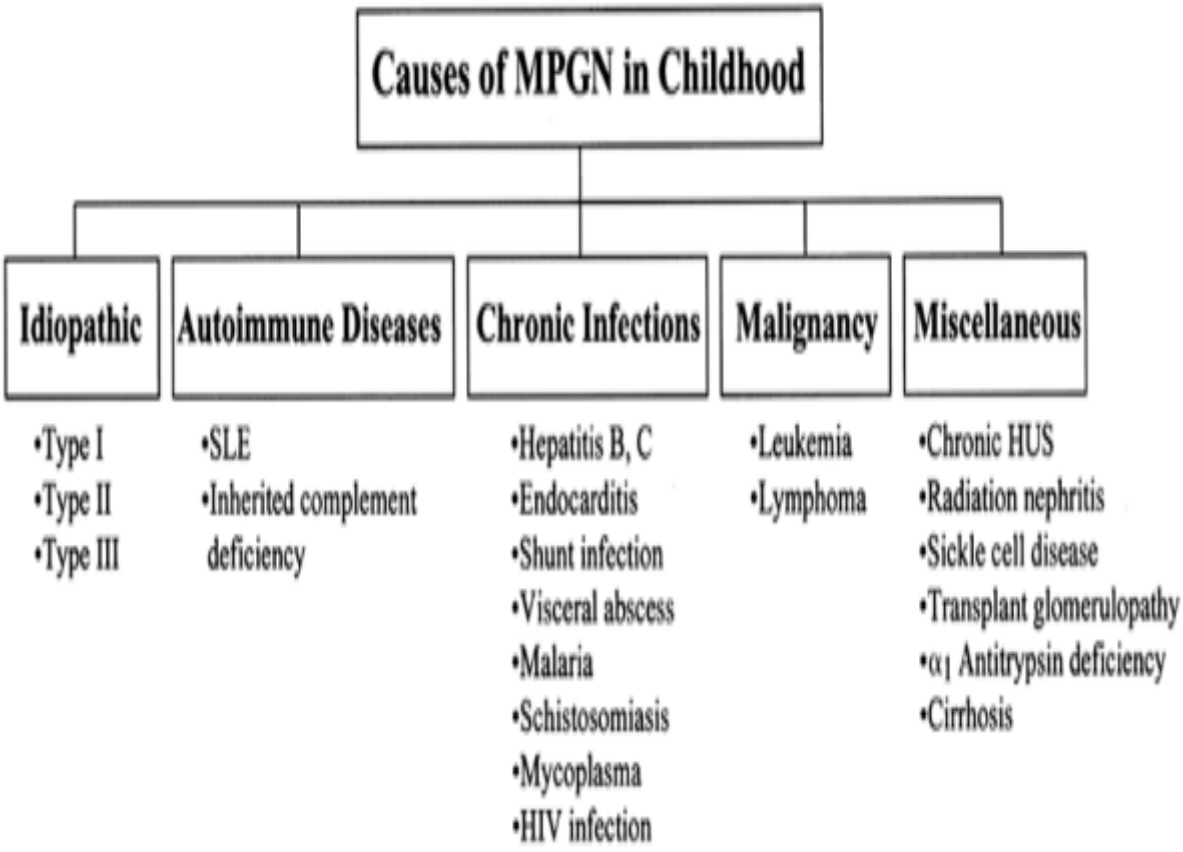


FIGURE 1 Causes of membranoproliferative glomerulonephritis (MPGN) in the pediatric population. SLE = systemic lupus erythematosus; HUS = hemolytic uremic syndrome.

Pathophysiology and Mechanism of edema: (NCP NANDA ,2012) In

- nephrotic syndrome, hypersensitivity reaction occurs in which the immune complex precipitated in the tissue.
- Activation of the complement system also stimulates vaksoaktive amines (including histamine) and this substance causes retraction of endothelial cells thus increasing vascular permeability.
- Changes in membrane glomerolus, causing increased permeability, allowing the proteins (especially albumin) out through the urine (proteinurine).
- Decreased oncotic pressure causing albumin moves from intra vascular space into interstitial
- Transfer of proteins to the interstitial cavity causing lipoproteinemia.

- It stimulates the liver to compensate by increasing the production of lipoproteins and increased concentrations of blood fats (hyperlipidemia).
- When the liver is not able to compensate for damage in fat and protein metabolism.
- Transfer of protein exit the vascular system, causing fluid to move into the space plasma interstitisel resulting edema and hypovolemia.

Decrease in vascular volume stimulates renin angiotensin system, which allows the secretion of aldosterone and antidiuretic hormone (ADH). Aldosterone stimulates increased reabsorsi distal tubules of the sodium and water, leading to increased edema.

Clinical Manifestations

- Weight increased
- Facial edema , especially around the eyes specially at morning or subside during the day
- Abdominal swelling
- Edema of intestinal mucosal causing ,anorexia, diarrhea poor intestinal absorption
- Edema ankle or leg swelling
- Volume urine decreased, sometimes colored thick and frothy
- The child becomes irritable, tiredness / lethargy
- Blood pressure is usually normal / up slightly

Guidelines for management of children with nephrotic Syndrome and glomerulonephritis according to Indian Pediatric Nephrology Group and Indian Academy of Pediatrics (2008)

Recommendations:

1- Initial Evaluation

It is necessary before starting treatment with corticosteroids.

- Monitoring of blood pressure, weight, urine volume and proteinuria.
- Physical examination is done to exclude infections

Investigations recommended at the initial episode include:

Urinalysis, CBC, blood levels of albumin, cholesterol

Kidney function test as urea nitrogen, creatinine, creatinine clearance, urea ratio, sodium and potassium.

Chest X-ray and tuberculin test for associated conditions.

Urine culture if patient has clinical features of UTI.

2-Treatment of the Initial Episode

- Prednisone is the drug of choice for treatment of nephrosis.
- It should be administered after meals to reduce GIT side effects.
- The initial dose of prednisone is 2 mg/kg per day for 6 weeks, followed by 1.5 mg/kg/day as single morning dose on alternate days for the next 6 weeks.
- Prednisone should not be stopped abruptly at 12 weeks, but tapered over next 2-4 months to sustain remission and avoid relapse.

3-Treatment of Relapse

Prednisone is administered 2 mg/kg/day until urine protein is trace or nil for three consecutive days. Then, it is given in single morning dose of 1.5 mg/kg for 4 weeks, and then discontinued.

4-Frequent Relapse and Steroid Dependence

- Following treatment of relapse, prednisone is gradually tapered to maintain patient in remission on alternate day dose of 0.5-0.7 mg/kg, which is administered for 9- 18 months.
- A close monitoring of steroid toxicity is essential.
- In case of corticosteroid toxicity immuno-modulators is suggested as Levamisole.

5-Supportive Care

Balanced diet, adequate calories.
Patients with persistent proteinuria should receive 2-2.5 g/kg of protein daily.
Salt restriction until edema resolved.
Since treatment with corticosteroids stimulates appetite, parents should be advised regarding ensuring physical activity and preventing excessive weight gain.

Wong (2013) added:

Give protein according to the degree of dysfunction of the kidney measured by serum creatinine.

N.B: Fluids should be given according to urinary output.

For edema,diuretics should not be given to patients with diarrhea, vomiting or hypovolemia.
Blood pressure should be monitored.
Monitoring of serum electrolytes patients receiving diuretics.
Edema not respond to above therapy should be managed at hospital.

- Provide skin care is important particularly the edematous area as keep skin clean and dry.
- Wash genitalia several times day and dust it with soothing powder.
- Avoid the use of adhesive tape on edematous skin.
- Place pillow between the knees when child is lying on his side.
- Use cotton to separate skin surface.
- Irrigate the eyes with warm saline solution.
- Change position frequently to prevent tissue breakdown.
- Weigh child daily under the same circumstances.
- Intake and output should be monitored
- Emotional support
- Allows parents to visit and stay with the child and help in his care.
- Stay with the child to help him to express his feelings

In case of ascitis : Put child in semi-sitting position if ascitis interfere with respiration.

In case of paracentesis:

- Help the child to void before the procedure.
- Assist in procedure.
- Apply abdominal binder, observe and chart child's condition, amount and color of drainage.

In heart failure

- Bed rest, put child in semi-setting position and give O_2 therapy.

Protect child from infection

- Keep child warm and avoid expose him to children with common cold or sore throat.

Patient and parent education:
Ensure normal activity and school attendance.
Patients should receive appropriate immunization and prevent of infection.
Dietary restriction.
Administration of medication.
Skin care.
Explain how to test the urine for albumin.
Immunization:
Patients receiving prednisone for more than 14 days are considered immunocompromised. Such patients should not receive live attenuated vaccines. Live vaccines are administered once child is off immunosuppressive medications for at least 4 weeks. All children with nephrotic syndrome should receive pneumococcal vaccine.
Treatment of complications
Thrombosis: Arterial or venous thrombosis:

(Due to increased certain coagulation factors and increased platelet aggregation). Decrease intravascular volume, immobilization, and diuretic, and predispose use increase the risk of thrombus formation, especially following episode of dehydration.

Infections:

Nephritic patients are more susceptible to infection because of presence of edema fluid in tissues which is good media of micro-organism. Immunosuppressive therapy, hypoproteinemia, decrease splenic function and it decrease immunoglobulin level.

Common infections include peritonitis, cellulitis and pneumonia.

Hypertension:

This may be detected at the onset of nephrotic syndrome or later due to steroid toxicity. Therapy is initiated with medication as ACE inhibitors.

Hypovolemic shock:

This complication can occur due to unsupervised use of diuretics. The diagnosis is suggested by hypotension, tachycardia, cold extremities and poor capillary refill.Management consists of rapid infusion of normal saline 15-20 mL/kg over 20-30 minutes. Infusions 20% albumin (0.5-1 g/kg) may be used in children not respond despite two boluses of saline.

Calculating the daily maintenance fluids:
Corticosteroid side effects:
Prolonged steroid therapy associated with significant side effects.
Increased appetite, impaired growth, behavioral changes, risk of infections, salt and water retention, hypertension, bone demineralization, diabetes mellitus, Cushing syndrome, cataract.
All patients should be monitored for Cushing features and blood pressure, and yearly evaluation for cataract. Patients on prolonged (>3 months) treatment with steroids should receive daily supplements of oral calcium and vitamin D.

Post Streptococcal Acute Glomerulonephritis (PSAGN)

Is a disorder of the kidneys that occurs after infection with certain strains of *Streptococcus* bacteria. PSGN is more frequent in children aged 2-12 years, with a peak prevalence in individuals aged approximately 6-7 years, and boys out number girls two to one .(Wong's ,2013)

Etiology

Acute poststreptococcal glomerulonephritis (APSGN) results from an antecedent infection of the skin (impetigo) or throat (pharyngitis) caused by nephritogenic strains of group A beta-hemolytic streptococci.
Pathophysiology

Immune complexes are deposited in the glomerular basement membrane. The glomeruli become edematous and infiltrated with polymorph nuclear leukocytes, which occlude capillary lumen. The resulting decreases in plasma filtration result in excessive accumulation of water and retention of sodium that expands plasma and interstitial fluid volumes leading to circulatory congestion and edema. The cause of hypertension associated with AGN cannot be completely explained by fluid retention. Excess rennin may also be produced.

Clinical Manifestations (Wong's ,2013)

- Mild edema around eyes rarely is generalized (periorbital puffiness).
- Anorexia
- Pallor
- Irritable
- Lethargy
- Vomiting
- Hypertension
- Urine contains albumin, RBCs. Urine smoky brown (resemble tea or cola) and its volume decreased.
- Older child complain of headache ,abdominal discomfort and dysuria

Diagnostic Evaluation

1- Urine analysis: hematuria with red cell casts and mild Proteinuria.
2- Elevated Blood Urea Nitrogen and creatinine levels.
3- Electrolyte disturbances.
4- Complete blood count reveals mild anemia.
5- Low Serum Complement (C3).
6- Positive antistreptolysin O titer (ASO).
7- Culture of the throat or skin lesion.
8- Chest x-ray shows cardiac enlargement, pulmonary congestion, or pleural effusion.

Therapeutic Management

About the diet :

- No restriction except in the acute oliguric phase (1-2 weeks) for hypertension, heart failure or renal failure where proteins, sodium, potassium and fluids are restricted.
- Diuretics.
- Peritoneal or haemodialysis may be needed.

Hospitalization and monitoring body weight, BP, urinary output, and renal function.

Restriction of activity: Not needed except in acute renal failure or heart failure.

Treatment of streptococcal infection:

- Procaine penicillin 400.000 IU/day, IM, for 10 days, or
- A single IM injection of 1-200.000 IU benzathine penicillin or
- Oral penicillin V: 200.000-400.000 IU dose, 3 times/day for 10 days or
- Erythromycin: 40 mg/kg/day, orally in 4 divided doses for 10 days or
- Amoxicillin: 30 mg/kg/day, orally in 3 divided doses for 10 days

General Management of APSGN according to Pediatric Clinics of North America , 2009:

Recommendations for the clinical management of PSGN in Indigenous children

1) Child should be admitted into hospital if there is:
   - hypertension
   - combination of oliguria, generalized edema and elevation of serum creatinine or potassium
2) Supportive
3) Fluid restriction
4) Diuretics
5) Antihypertensive medications in presence of hypertension

- calcium channel blockers
- ACE inhibitors

6) Penicillin to prevent spread of disease

Management of PSAGN according to International Society of drug Bulletins 2009

1) Bed rest
2) Maintain a fluid balance chart
3) Monitor blood pressure regularly
4) Record body weight daily
5) Urine analysis daily
6) Diet: low salt, low potassium
7) Investigations: serum creatinine, potassium
8) Observe for complications

Nursing care management(Wong's 2013 & NANDA)

1. Vital signs
   - Monitor and record vital signs frequently.
   - Observe for cerebral manifestations due to hypertension
2. Set priorities will depend on problems (hematuria and hypertension).
3. Provide bed rest is essential during acute phase of glomerulonephritis and until urine is free from blood cells.
4. Prevent chilling of child by dressing him warmly.
5. Keep the child in well-ventilated room.
6. About fluid intake and output
   - Limit fluid intake as ordered by pediatrician.
   - Divide amount of fluid allowed in 24 hours throughout day. Give most of fluids during day so that child can sleep as much as he can during night.
   - Observe signs of dehydration.
   - Record intake and output chart.
   - Give fluid (300-400 cm^3/square meter surface area + fluid loss).
7. For edema: as mentioned in nephrosis
8. Diet
   - Encourage regular diet it permitted in mild cases.
   - Follow dietary restriction depends on severity of condition and pediatrician instructions.

- Restrict salt slightly in patient with hypertension and edema.
- Decrease potassium to prevent cardiac decompansation.
- Give protein according to the degree of dysfunction of the kidney measured by serum creatinine.

N.B: Fluids should be given according to urinary output.

9. Emotional support
   - Play with child to keep him quiet.
10. Parent-nurse conference, on discharge
    - Instruct mother about the diet and fluid.
    - Observe the urine carefully.
    - Follow pediatrician orders as regards drugs.

Renal Failure "RF":

Renal failure is the inability of the kidney to excrete waste material , concentrate urine , and conserve electrolytes. It can occur suddenly (acute renal failure ARF) in response to inadequate perfusion ,kidney disease ,or urinary tract obstruction or can develop slowly (chronic renal failure CRF) as a result of long standing kidney disease or anomaly . Globally, the prevalence of chronic kidney disease (CKD) stage II or lower in children is reported to be approximately 18.5-58.3 per million children. Among children, chronic kidney disease is more common in children older than 6 years than in those younger than 6 years were 19% in children aged 0-1 years; 17% in those aged 6-12 years; 33% in children aged 2-5 years; and 31% in those older than 12 years(Gulatiet. S, Langman .C.al.,2012)

Etiology and Pathophysiology:

The causes of chronic kidney disease (CKD) in children include the following:

- Obstructive uropathy
- Hypoplastic or dysplastic kidneys
- Reflux nephropathy
- Focal segmental glomerulosclerosis as a variant of childhood nephritic syndrome
- Polycystic kidney disease, autosomal-recessive and autosomal-dominant varieties

The Kidney Disease Outcomes Quality Initiative (KDOQI) recommended the following classification of chronic renal disease by stage :

- Stage I disease is defined by a normal glomerular filtration rate (GFR) (> 90 mL/min per 1.73 m^2) and persistent albuminuria

- Stage II disease is characterized by a GFR of 60-89 mL/min per 1.73 m^2 and persistent albuminuria
- Stage III disease is characterized by a GFR of 30-59 mL/min per 1.73 m^2
- Stage IV disease is characterized by a GFR of 15-29 mL/min per 1.73 m^2
- Stage V disease is characterized by a GFR of less than 15 mL/min per 1.73 m^2 or end-stage renal disease (ESRD)

Acute renal failure (ARF)

The kidneys suddenly are unable to regulate the volume and composition of urine appropriately in response to food and fluid intake and the needs of the organism (Wong's ,2013) .Incidence of acute kidney injury severe enough to require dialysis is 0.05 per 1000 (Molitoris BA,2011).

ARF may be caused by prerenal or postrenal factors as well as actue kidney damage.

Prerenal causes Madkour A 2009 :

- Blood loss: acute hemorrhage.
- Plasma loss: burns.
- Fluid loss: dehydration due to diarrhea, vomiting, fever, diabetic ketosis.
- Septic shock.
- Heart failure.
- Hypoxia: pneumonia, respiratory distress syndrome.

Intrinsic renal causes:

- Glomerulonephritis : as poststreptococcal GN .
- Tubular: acute tubular necrosis; decrease renal perfusion, nephrotoxins.
- Interstitial nephritis as drug.
- Vascular: renal vein thrombosis.
- Acute pyelonephritis .
- Leukemic infiltration of kidneys.

Post renal causes:

- Urethral obstruction: posterior urethral valve stricture.
- Bladder : neurogenic dysfunction
- Bilateral ureteral obstruction: calculi, blood clots, bilateral strictures.

Clinical Manifestation:

- Decease urine output: oliguria or anuria .
- Edema (due to salt and water retention).
- Pallor (due to anemia).
- Hypertension (due to increase salt and water retention and increase secretion of rennin) it may progress to hypertensive encephalopathy.
- Uremic encephalopathy: lethargy, drowsiness, behavioral changes, convulsion, coma.
- Gastrointestinal: anorexia, nausea, vomiting.

- Acidosis breathing (deep rapid breathing).
- Manifestation of electrolyte disturbance: Hyperkalemia, hyponatremia,iIncreased blood urea and creatinine .

Diagnostic evaluation (Wong's 2013)

- History
- Laborotary measurement as : blood urea nitrogen , serum creatinine , ph, sodium , potassium , calcium

Complication

- Hyperkalemia
- Hypertention
- Anemia
- Seizures
- Cardiac failure
- Water intoxication
- Hyponatremia
- Metabloic acidosis

Treatment:

Treatment depends on the underlying cause of RF. The goal is to minimize or prevent permanent renal damage, while maintaining fluid and electrolyte balance and managing complications.

- Initial emergency treatment of children with fluid depletion (hypovolemia) focuses on rapid fluid replacement at 20ml/kg of saline or lactated Ringer's solution giver over 30-60 minute, and repeated as needed to ensure adequate renal perfusion and stabilize blood pressure.
- Children with fluid overload (hypervolemia) need diuretic therapy, as well as dialysis if they respond poorly to diuretics.
- Eliminate all potential potassium sources until Hyperkalemia is controlled.
- In children with ARF, dialysis is indicated to treat 3 major conditions:
  (1) hypervolemia unresponsive to fluid restriction or diuretics
  (2) major electrolyte abnormalities unresponsive to medical therapy (hyperkalemia and acidosis)
  (3) signs of uremia.

Nursing consideration:

- Monitor fluid intake and output
- Monitor vital signs.
- Meeting nutritional needs
- Empathic nurse can provide comfort and stability in a threading unnatural environment
- Reduction of body temperature.
- Reduction of anxiety and restlessness.

- Family support emotional and provide explanation regarding to therapeutic regimen

Chronic renal failure (CRF)

The diseased kidney can no longer maintain the normal chemical structure of body fluids under normal conditions. Progressive deterioration over months or years produce a variety of clinical and biochemical disturbances that result in clinical syndrome known as uremia (Wong's ,2013).

Etiology:

- Congenital renal and urinary tract malformations.
- Vasoicoureteral reflux associated with recurrent urinary tract infection.
- Chronic pyelonephritis .
- Hereditary disorders.
- Chronic glomerulonephritis and glomerulonephropathy.

Pathophysiology

- The gradual and progressive loss of functional nephrons ultimately results in End-Stage Renal Disease (ESRD). ESRD is characterized by minimal renal function (less than 10% of normal), uremic syndrome, anemia, and abnormal blood values. In ESRD, the kidneys can no longer maintain homeostasis and the child requires dialysis.
- As renal failure progresses, metabolic acidosis occurs as a results of the kidneys' inability to excrete the acids that build up in the body. Elevated blood pressure associated with CRF is caused by retention of excessive sodium and water.
- Renal failure to produce activated Vitamin D and to excrete phosphorus can lead to low serum calcium levels and renal osteodystrophy. Low serum calcium levels induce the parathyroid glands to draw calcium from the bones to maintain adequate serum levels which may lead to more renal osteodystrophy.
- The lack of erythropoietin production from the kidneys may decrease the RBC production which leads to anemia.

Clinical manifestation

Early signs:

- Loss of normal energy
- Increase fatigue in exertion
- Pallor
- Elevated blood pressure sometimes

As the disease progress

- Decreased appetite.
- Less interest in normal activity.
- Increase or decrease urine output with compensatory intake of fluid.

- Pallor.
- Headache, Muscle Cramps, Nausea.

Other signs and symptoms:

- Weight Loss
- Facial Edema
- Malaise
- Bone or Joint Pain
- Growth Retardation
- Dryness or Itching of The Skin
- Bruised skin
- Sensory or motor loss
- Amenorrhea

Uremic syndrome (untreated)

- Anorexia, Nausea, Vomiting.
- Bleeding Tendencies : Bruises ,Bloody Diarrheal Stool, Stomatitis, bleeding from lips and mouth
- Itching
- Uremic frost (deposits of urea crystals on skin)
- Unpleasant uremic breath odor
- Deep respiration
- Hypertension
- Congestive heart failure
- Pulmonary edema
- Neurological involvement, progressive confusion, coma , tremors, muscular twitching, seizures.

Complication

- Retention of weast product
- Water and sodium retention
- Electrolyte abnormalities (e.g., *hyperkalemia,* high levels of potassium in the blood)
- Metabolic acidosis
- Mineral abnormalities (e.g., hypercalcemia (high levels of calcium in the blood) or hyperphosphatemia (high levels of phosphorus in the blood))
- Anemia
- Growth disturbance

Treatment:

- The course of treatment on CRF is variable. Some children progress quickly to ESRD requiring immediate Renal Replacement Therapy "RRT",

some are managed with combination of medications and diet therapy for some time before significant renal impairment occurs.

- Dietary management focuses on maximizing caloric intake for growth while limiting phosphorus, potassium, and sodium intake as needed to keep electrolyte in balance. Adequate calcium intake needs to be part of diet plan.
- Optimal of high-quality protein (meat, fish, and egg whites) is needed by 2-2.5 g/kg/day for infants, and 1.5-2 g/kg/day for older children.
- Complex carbohydrates should be chosen along with vegetables and fruits that are lower in potassium.
- Medications used in CRF are: Vitamin and Mineral Supplements, Phosphate-Binding Agents (calcium carbonate) to reduce phosphorus absorption from the intestine, Epoetin Alfa to stimulate bone marrow to produce RBCs to treat anemia, Growth Hormone, and Iron Supplementation.

The European Guidelines 2004 of Renal Replacement Therapy for Children with Renal Failure

Recommendation 1:

All children with RF require discussion with a pediatric nephrologist. Early transfer for investigation and management is essential in those with rapidly deteriorating renal function or in those with hemodynamic or biochemical disturbances.

Recommendation 2:

All children with ARF as part of multi-organ failure require transfer to a designated regional pediatric ICU where there should be access to pediatric nephrology advice and support.

Recommendation 3:

There is no evidence for the optimum level of renal function neither for starting renal replacement therapy nor for the optimum dialysis modality.

Recommendation 4:

The choice RRT has always to be individualized, balancing advantages against disadvantages.

Nursing care Management of Children with Renal Failure:

Nursing management focuses on preventing complications, maintaining fluid and electrolytes balance, administering medications, meeting nutritional needs, preventing infection, and providing emotional support to the child and parents.

Prevent Complications:

Complications can be prevented by:

1. Ensuring compliance with the treatment plan.
2. Careful monitoring of vital signs.

3. Intake/output charts.
4. Serum electrolytes are monitored.
5. Monitoring level of consciousness.

Maintain Fluid Balance:

1. Daily monitoring of weight.
2. Measuring blood pressure 2-3 times a day.
3. Monitor sodium serum levels.
4. In case of Oliguria, limit fluid intake.

Administer Medications:

Because the kidneys' ability to excrete drugs is impaired, dosages of all medications should be adjusted. The actually dosage of the drug can be decreased or the time intervals between doses can be increased.

Meet Nutritional Needs:

1. High metabolic rate can encounter children to the risk of malnutrition.
2. Sodium, potassium, and phosphorus are restricted depending on the degree of RF.
3. The diet is tolerated to the individual child's needs of calories, carbohydrates, and proteins.
4. Provide small frequent feedings.

Prevent Infection:

1. The child with RF is extremely susceptible for infection because of altered nutritional status, compromised immunity, and numerous invasive procedures.
2. Good hand hygiene and standards precautions are to be followed.
3. Use sterile techniques for all invasive procedures.
4. Assess vital signs continuously.

Provide Emotional Support:

1. RF requires total life-style changes for the child and the family.
2. The need for ongoing dialysis treatment is stressful for the family.
3. Encourage feeling expressions.
4. Refer to support groups.
5. Explain procedures simply and answer all questions honestly.

Dialysis

Is a procedure for cleaning and filtering the blood. It substitutes for kidney function when the kidney can not remove the nitrogenous waste products and maintain adequate fluid, electrolyte and acid base balance.

Dialysate ; is an aqueous fluid ,it`s composition is similar to normal human plasma usually containing isotonic concentration of sodium and chloride ions , low concentration of potassium , calcium , and magnesium ions , and high concentration of bicarbonate and glucose .

The toxic wastes and excess water are removed as a result of different pressure and concentration gradients between the blood and dialysis solution. because the blood has greater concentrations of hydrogen ions and other electrolytes than the dialysate diffuse across the semi permeable membrane into the solution . In the other direction glucose and acetate are more highly concentrated in the dialysate so they diffuse across the semipermeable membrane into the blood .

Indication of dialysis:

Acute indications for dialysis \ Hemofiltration

- Hyperkalemia.
- Metabolic acidosis.
- Fluid overload (pulmonary edema).
- Uremic percarditis.
- Patient without renal failure, acute poisoning with dialyzable drug such as aspirin, lithium.

Chronic indication for dialysis ;

- Symptomatic renal failure.
- Low glomerular filtration rate.
- Difficulty in medically controlling serum phosphorus or anemia when GFR is very low.

Physiological principles of dialysis;

Diffusion: involve the movement of particles from an area of greater concentration to an area of lesser concentration, result in movement of urea ,creatinine and uric acid from the patient blood into the dialysate solution.

Osmosis: involve movement of fluid across a semipermeable membrane from area of lesser to an area of greater concentration of particles m it responsible for movement of extra fluid from the patient , particularly in peritoneal dialysis.

Ultra filtration: involve the movement of fluid across a semi permeable membrane as a result of an artificially created pressure gradient.

Peritoneal Dialysis "PD":

It is the use of the peritoneum, (the semi permeable membrane lining the abdomen) to filter fluid, waste and chemicals. The dialysate is instilled and drained forth the abdominal cavity by means of catheter. Substances pass from the tiny blood vessels in the peritoneal membrane into the dialysate. Peritoneal dialysis used for acute and chronic renal failure.

Care during peritoneal dialysis:

- Maintain aseptic technique to prevent infection.
- Monitor vital sign frequently.
- Maintain intake and output record.
- Assess patient for edema.
- Assess catheter site for infection.

- Maintain accurate record for each cycle: type, amount, time, and characteristic of dialysate.

Post-operative Management of PD Catheter (Royal Hospital for Sick Children 2010)

• Avoid excessive movement at the exit site.
• The patient should mobilize gently over the following 24 hours.
• The child should not return to school for a week.
• Heavy exercise should be avoided for 6 weeks.
• Swimming is not allowed.
• The initial dressing should be left undisturbed for a week.
• If the dressing comes loose, the parents should be instructed to secure it.
• After one week, the child should shower daily and have the dressing changed daily, following discharge dressing guidelines.
• The exit site should be assessed weekly.
• Written information provided to the family.

Advantage:

- Inexpensive
- Hemodynamic ally well tolerated
- No vascular access well required.
- No anticoagulant therapy will need.
- Any location can be used and machine is not needed.
- The process can be easily taught to the patient and family.
- The procedure can be used for people are hemodynamic ally unstable.
- The patient has more control over daily life.

Disadvantage:

- Slow correction of fluid and electrolyte disturbance.
- High risk of peritonitis.
- May be leakage of peritoneal dialysate.

Complication:

- Hypotension.
- Hypovolemia.
- Inadequate drainage of fluid from peritoneal space.
- Pain, atelectasis , respiratory distress and peritonitis.

Hemodialysis :

Transporting blood from the client through a dialyzer, a semipermeable membrane filter in machine .Water and wastes from the blood move into the dialysate fluid that flows around the fibers, but protein and RBCs do not. The entire cycle takes 4-6 hrs and performed 3 time \ week. For client with CRF are arteriovenous fistula (AV) and AV graft.

Advantage:

- Fluid and electrolyte abnormalities are corrected rapidly.

- It is better tolerated by many patient

Disadvantage:

- More expensive than peritoneal dialysis
- Greater homodynamic risk (hypotension, hypoxia, and hemorrhage).
- Anticoagulant therapy required.
- Vascular access required.

Pre dialysis care:

- Adequate explanation of child of what happen and what will expected from them during dialysis , what type of pain will experience, how long dialysis will occur , what allowed during dialysis , what should feel during and after dialysis.
- Record weight, vital sign.
- Assess fluid overload (neck vein , periorbital edema,)
- Assess vascular access for patency and infection.
- Blood sample is drawn to determine the level of electrolyte and waste product.

Care during haemodialysis:

- Change patient position.
- Oral care is required if there is nausea or vomiting.
- Check blood pressure and pulse every 30 to 60 minute.
- Monitor blood flow and dialyzer pressure setting.
- Withhold rapid acting antihypertensive the morning of dialysis.
- Evaluate the need for withholding medication that predispose to hypovolemia .
- Watch sign of bleeding.
- Monitor clotting time frequently during dialysis.

Post dialysis care

- Record the patient weight to determine the amount of fluid loss during treatment.
- Assess vital signs.
- Teach the family :
    - ✓ Common complication of haemodialysis (infection, constriction, bleeding).
    - ✓ Where to obtain care if complication occurs.
    - ✓ Care of vascular access .(inspect the skin over fistula or graft for sign of infection, wash skin with soap and water, avoid puncture at the same site)

Pediatric Nephrology (Berlin, Germany)
Pediatr Nephrol. 2005 August; 20(8): 1054–1066.

Hemodialysis in children: general practical guidelines

Hemodialysis in children has benefited from major progress over the last 20 years. The morbidity of the sessions has decreased, even disappeared, seizures being exceptional, hypotensive episodes or headaches rare, and pain related to the fistula puncture effectively prevented by xylocaine ointment. The development of urea kinetic modeling enables calculation of the dialysis dose and indirect assessment of protein intake. So the patient benefits from the technological revolution.

The newer machines enable precise control of ultra filtration volumetric assessment and continuous blood volume monitoring during the session, buffered bicarbonate has become a standard technique, synthetic more biocompatible membranes and specific material available for babies/infants have been developed. Non invasive interventions, for example blood volume guided ultrafiltration have provided more adequate dialysis sessions and better dry weight assessment.

Last, the availability of erythropoietin and of growth hormone and the promising results from enhanced dialysis dose on both growth and cardiac function, all give the dialyzed child a real increased quality of life. In theory, reduction of dialysis prescription to only a urea dialysis dose achieved by three short (3-h) dialysis sessions, should be abandoned for long term dialyzed children and replaced by optimum dialysis obtained with longer (4 and more hours) and/or more frequent (daily: 5 to 6) sessions.

But for such a daily dialysis strategy all the costs must be considered. On the one hand the financial cost cannot be neglected. For the patient bearing the burden, on the other hand, such an intensive dialysis prescription is acceptable only as an integrated therapy life project, a dialysis–transplantation program (HD, PD) with special regard for prevention of the vascular calcification.

Daily hemodialysis is one approach, perhaps the only one, to achieve phosphate purification and thereby maintain the calcium×phosphorus product in the optimum range of 3.3 to 4.4 $mmol^2\ mL^{-2}$.

Complications of acute PD:

- Leakages can be a difficult problem and are mostly due to a leakage around the catheter. The incidence can be reduced by proper surgical technique or resuturing around a percutaneous catheter.

- Poor drainage due to mechanical blockage or catheter migration is all too common. Flushing the catheter and preventing fibrin accumulation by increasing the heparin dosage and/or urokinase is suggested initially.
- Hernias can be a problem in neonates and infants, particularly males. They do not usually require interruption of PD and can be repaired electively by laparoscopic or direct measures when the child's clinical condition has improved or stabilized.
- Peritonitis remains a constant threat, especially if there has been a lot of manipulation of the catheter. The standard features of cloudy PD fluid require urgent attention.

Complications occurring during acute HD

- For hypotension, the ultrafiltration should be switched off and isotonic saline infused into the venous line until the blood pressure normalizes; additional 20% albumin 5 ml/kg might be helpful.
- Hypertension is treated according to standard hypertension protocols available elsewhere.
- Hypoglycemia should not occur with the use of glucose-containing dialysis fluid.
- In cases of anemia, Erythropoietin may be given intravenously at the end of dialysis (50–200 IU/kg) to maintain hemoglobin levels.
- Disequilibrium syndrome is now a rare event with adequate control of ultrafiltration and stepwise reduction of uremic toxins.

CDC recommendations for preventing the transmission of infections in dialysis facilities. These recommendations include:

- Surveillance and immunization for hepatitis B
- Using gloves any time contact is made with a dialysis machine
- Carefully monitoring how medications are administered
- Eliminating the use of medication carts and instead using a separate medication preparation area
- Appropriate handling of dirty dialyzers
- Appropriate disinfection of the vascular access prior to cannulation
- Practices that prevent the potential for using supplies between patients (i.e., if something is taken to a patient station for use, it should not then be taken to another patient station).

These infection control practices include the following:

- No food/drink in unit
- Limited family visits
- Handwashing and hand sanitizing
- Double bagging hazard trash
- Disinfection of dialysis equipment and blood spills

- Ensuring equipment is in good working condition and placed in correct storage areas
- Monitoring staff and patient serum status
- Clear designation of clean and dirty areas in the clinic
- Staff education about laundering scrubs at home
- Internal audits with corrective action plans
- Close supervision of new and inexperienced staff
- A strong occupational and post exposure service for staff with a comprehensive facility plan
- Proper barrier and staff PPE Special attention to hemodialysis control panels with regard to blood spills (a high touch area)
- Dressings and antiseptics that are catheter compatible and effective.

Kidney transplant surgery

Kidney transplant surgery takes about 3 hours. During surgery, the donor kidney will be placed in lower abdomen, blood vessels from the donor kidney will be connected to arteries and veins in body, and the ureter from the donor kidney will be connected to bladder. Blood is then able to flow through the new kidney, and the kidney will begin to filter and remove wastes and to produce urine.

The new kidney usually begins to function right away. In most cases, diseased or damaged kidneys are not removed unless you have a severe infection of the kidney.

Post operative medicines:

After the surgery a medicines to suppress immune system, are used to help keep the body from rejecting new kidney. These medicines used for the rest of life.

2011 Journal Citation Reports® (Thomson Reuters, 2011) Ranking: 1/24 KidneyTransplantation; American Journal of Transplantation

Kidney transplantation (KT), this is a procedure that is increasingly being recognized as worthy of refinement, both in optimizing patient selection for the procedure and insuring optimal care, and in developing appropriate organ allocation regulations. A kidney transplant is surgery to replace diseased kidneys with a healthy (donor) kidney. See a picture of a kidney transplant.

There are two types of donors:

1. Living donors. A living donor may be a family member, a friend, a coworker, or any person who is willing to give a kidney to someone in need. A person only needs one healthy kidney to live.

2. Cadaver donors. A cadaver donor is someone who has recently died. Most donor kidneys come from this source.

In both cases, the key to success is having the closest possible blood and tissue matches. A family member is not always the best match.

Kidney transplantation complication

1. Chronic rejection is a process of gradual, progressive loss of kidney function and can occur many months to several years after surgery. Experts don't fully understand what causes chronic rejection. There is no treatment for chronic rejection. Most people go back on dialysis or have another transplant.

2. Other complication as, severe infection, bleeding, reaction to the anesthesia used for surgery, failure of the donor kidney.

3. Complications of the immunosuppressive medicines as increased risk for serious infections.

• There is also the chance that body may still reject new kidney even with medicines. If this happens, child will have to start dialysis and possibly wait for another kidney transplant.

• Immunosuppressive medicines also increase risk of other diseases, such as skin cancer and lymphoma. A greater risk for diabetes, high blood pressure, heart disease, cataracts, and inflammation of the liver (cirrhosis).

Nutritional Problems in Children with CRF

Nutrition problems are the most visible complication of CRF in children associated with serious medical and psychological co-morbidities. It is estimated that up to 75% of children on hemodialysis are malnourished. Malnutrition, growth delay, and nutritional related metabolic abnormalities are common. Children with CRF frequently have malnutrition which may result from inadequate intake, malabsorption excess, excretion of nutrition and it require modification of dietary nutrients intake to maintain optimal nutrition, growth and development. Nutritional intervention, prevention and treatment of metabolic deficits are the key components in the children who demonstrate nutritional problems .

- **Protein Energy Wasting**
- **Anemia**
- **Growth Failure**
- **Metabolic Acidosis**
- **Nutrition problems**

Nutrition assessment of children with CRF undergoing hemodialysis unit to Al-Shatbey Hospital (Thesis done by Mariam Mohammad in 2012)

I: Physical Assessment

The general appearance of children with CRF. It shows that light, dry and loss of hair were clearly apparent in studied children (58.6%, 51.7% and 46.7 % respectively). Concerning pale conjunctiva, it was observed among 69% of studied children and 31.0 % of them had loss of eye shine. Regarding to mouth changes, it was observed that 64% of studied children had dry lips while 44% of them had cracked lips and 64% of them had dental caries. Considering bone condition, back bone curvature was observed among 30% of the studied children followed by bowed leg among 20% of them. Moreover, the result shows that 82.2% of studied children had pale face and 69% of them had dry skin while only 6.9% of studied children had edematous skin. Finally, muscles weakness was reported by 83.3%of them .

Feeding Pattern and Dietary Intake

The fluid intake pattern of children with CRF. About three quarters of studied children were having a lot of fluids. The most frequently taken fluids were water 95.5%, fruit juice 63.6%, soft drinks 36.4%, milk and tea with milk (18.2% for each). In addition, 56.7% of the studied children were having at least 5 cups of fluids daily while only 16.7% were having 1-2 cups daily.

The 24-hour dietary intake by children with CRF. Regarding protein , 86.7% of studied children had low protein with a mean of 31.78 ± 8.84 gm, while 73.3% of them had low fat with a mean of 18.77 ± 4.18 gm and 80% of the studied children had high CHO with a mean of 151.43 ± 62.28 gm. Hight percentage of studied children (83.3%) consumed low energy with a mean of 787.±370.37 kcal .

The majority of children had a higher percentage of low vitamins such as A ,c and D(93.3%, 93.3% and 100% respectively). In addition, it was observed also a higher percentage of low minerals such as Ca ,P, Na , K ,Iron and zinc(90% , 63.3%, 66.7%, 46.7%, 83.3% and 60% respectively).

Biochemical Tests

the laboratory investigations of children with CRF. Regarding blood urea, 93.3% of the studied children had high blood urea. It ranged from 5.0 – 215.0 mg/dl with a mean of 102.5 ± 54.2 mg/dl while albumin value ranged from 2.30 – 4.60 g/L with a mean of 3.42 ± 0.54 g/L and 63.3 % of the studied children had hypoalbuminaemia.

All studied children were anemic, blood hemoglobin level ranged from 3.5-11.5g/dl with a mean of 7.5867 ± 2.68 g/dl. Random blood sugar level ranged from 81.0 – 121.10 mg/dl with a mean of 121.10 ± 24.28 mg/dl and 53.3% of studied children had hyperglycemic while calcium value ranged from 3.10 –

11.0 mg/dl with a mean of 7.4937 ± 2.051mg/dl ,also high percent of children (76.7%) were hypocalcemia. Blood electrolytes were also measured as phosphorous level which ranged from 1.50 –5.60 mg/dl with a mean of 3.17 ± 0.8039 mg/dl. It was observed that 66.7% of studied children had hypornatremia ranging from 102.0 – 192.0 mEq/L with a mean of 130.80 ± 14.71 mEq/L. Finally, all of them had hypercreatenimia it ranged from 3.60 – 17.0 mg/dl with a mean of 8.01 ± 2.74 mg/dl.

Anthropometric measurements

The percent distribution of children according to their percent standard of anthropometric measurements for age and sex. Concerning the weight, the highest percent of studied children (83.3%) were underweight (i.e. < 90 %) while 16.7% of them had normal weight (90-110 %). The mean weight was of 22.7± 6.5 kg.

Regarding to height in (cm), the highest percentage of the studied children (70.0%) were less than normal (< 90.0%) , while 30 % of them had normal height (90-110 %) . The mean height was 118.4 ± 14.9 cm. In addition, the majority of studied children (80%) had a MAC less than normal (<90 %) while only 20 % of them had normal MAC (90-110 %) with a mean of 16.8 ± 3.4 cm. Furthermore, triceps skin fold thickness was less than normal (<80 %) among 86.7 % of studied children and only 13.3% of them had normal TSFT (80-110 %) with mean of 5.8 ± 2.4 mm.

Finally, with reference to body mass index for age, it was noticed that 73.3 % of the studied children were underweight and considered malnourished, while 26.7% of them were considered normal, their mean BMI was 15.9 ± 2.1 kg/$m^{2.}$.

Role of the Nurses in Managing Nutritional Problems in Children with CRF Undergoing Hemodialysis

The goals of nursing intervention for school age children with CRF are directly to physical and psychological care to minimize complications specially nutrition which is caused by CRF and hemodialysis. So, a competent and qualified pediatric nurse has an important role in the prevention of malnutrition and improvement of nutritional status. She has multiple roles while caring for the child under hemodialysis such as assessment, diagnosising child problems, planning, implementation and evaluation.

Assessment Phase

Assessment of the child with CRF is primarily involved monitoring the health status of child, observation and early detection of any signs of complications such as growth failure, developmental delay, and hypertension. The nurse works with individuals, families and groups to identify health needs and develops plans for addressing those needs. The vital role of nurse to gather accurate data about the child nutritional health to aid in the development of a holistic plan of care of the child . During assessment, the pediatric nurse requires good communication skills

to gather subjective and objective data for the children and other sources such as caretaker and charts. In some practice setting, there is no dietitian in staff, so the nurse needs to be knowledgeable about the component of nutritional assessment. Since malnutrition problem is a common problem for children with CRF, it is important to use assessment of nutritional status to recognize substrate deficiencies early. The U.S Department of Health and Human Services (DHHS) defines nutritional assessment as "the measurement of indicators of dietary status and nutrition –related health status to identify the possible occurrence, nature, and extent of impaired nutritional status".

Nutritional assessment serves as the foundation on which nutritional assessment intervention goals are based. The nurse is ideally situated to facilitate early intervention for children with compromised nutritional health. A complete nutritional assessment comprises four major components relying on historical information, physical examination, anthropometric measurement, biochemical analyses.

- **Diet Histories Information**

One step in evaluating nutritional status is to obtain information about a person's history with respect to health status, socioeconomic status, and diet intake. A diet history provides a record of children eating habits and food intake and can help identify possible nutrient imbalances .In addition it provides valuable clues about how a child will accept diet changes. Information about what and how child eats provides the background for realistic and attainable nutritional goals. Food choice is an important part of lifestyle and often reflects nutritional status. Economic circumstances and Social factors such as ethical background, and educational level also influence food choice and nutritional status. A good nursing history will include a dietary intake record such as 24-hour recall. Twenty-four hour record method is the most practical and clinically feasible way to determine usual daily caloric intake. A diet recall is also called a 24-hour recall because it involves the client's recollection of everything consumed in a set 24-hour time span. The caretaker or children should be prompted to recall in sequence all the food, liquids and snacks through the day. The nurse should ask nonjudgmental questions about eating habits and food intake encourages trust and enhances the likelihood of obtaining accurate information .The nurse also should make note of the time and location of intake, portion sizes, food preparation methods and use of fortified version of food.To determine the amount consumed of protein, fat, vitamins, and minerals are also estimated from the recorded intake.

- **Physical examinations**

Physical examination has always been a widely used practical, direct method for trying to assess the nutritional status of children undergoing hemodialysis. (129) The nurse should routinely incorporate the nutritional aspects of physical

assessment into the nursing process .Many physical signs are nonspecific, they reflect any of several nutrient deficient's as well as conditions not related to nutrition .For this reason, physical findings are most valuable in revealing problems for other assessment techniques to confirm other assessment measures. Essentially, assessment by clinical signs is based on examination for changes believed to be related to inadequate or excessive nutritional intake, that can be seen or felt in superficial epithelial tissues, especially the skin, eyes, hair, and mouth, or in organs near the surface of the body such as the thyroid ,and the skull.

- **Anthropometric measurement**

Anthropometry is the most commonly used direct method for assessment of nutritional status and can be used to monitor normal or abnormal growth in childhood. Anthropometric measurement is a series of noninvasive, inexpensive and easy to perform indices including body measurements usually are weight and height.

Standing Height

Percentile charts from the Center for Disease Control and Prevention (CDC) developed for children for children 20 years of age and under. It is used to classify the height based on population .So, the nurses can compare the height of the child with large population age and gender matched peers. The best use of percentile classifications in monitoring of children with CRF over time, being alert to changes in child's percentiles channel.

Standing Weight

Documentation of current weight is vital component of nutritional assessment. The child should be weighed with minimum clothes, no shoes and after voiding. Furthermore, the nurse should be sure that when using standing beams, the child should stand freely without grasping the scales or wall to maintain the balance scale.The nurse should note and qualify the presences of any edema when recording body weight .Assessment of children with CRF undergoing hemodialysis should be done using dry weight obtained following a hemodialysis session.

Body Mass Index

Accurate height and weight are required for calculation of BMI .It is calculated the same way as for adults (BMI = weight (kg) / height 2(m2)), but then compared to typical values for other children of the same age. The BMI percentile allows the nurse to compare between children of the same sex and age.

Triceps Skinfold Thickness Measurement

Triceps skinfold thickness (TSFT) measurement is considered an important factor in assessing nutritional status. It is much more meaningful than weight alone. This method measures only one type of fat (subcutaneous adipose tissue). The nurse should become practiced at doing skinfold measurement before reliably performing it on children .In addition, the nurse must compare the measurement

founded with reference values for children according to their age and gender (Institute of Medicine (IOM), 2000). The nurse should document the measurement in medical records where available. Omitting this portion of the assessment can lead to difficulties in determining the nutritional status or poor references values if nutrition health decline and historical comparison is needed.

Mid Arm Circumference

The anthropometric measurement of the upper arm is an indicator of muscles and nutritional status. Measurements are done at midpoint between the olecranon process and the acromium process . Moreover, the nurse must compare the measurement found with reference values for children according to their age and gender.

- Biochemical Tests

Biochemistry is another approach which aids to assess nutritional status. Because it may give information concerning nutritional status before the appearance of clinical or anthropometric changes . Laboratory tests measure levels of metabolites to evaluate the body's state of health or its response to various treatments. They can provide information about protein –energy balance, vitamins-minerals status, fluid balance, body composition, organ function, and metabolic status. They can also help determine if nutrition therapy is appropriate or not. In addition to provide data for assessment of protein –energy nutritional status , other biochemical parameters frequently are of importance in the dietary and medical management of children receiving hemodialysis such as serum albumin, creatinine, glucose, potassium , sodium, calcium phosphors ,urea , and hemoglobin. The pediatric nurses should have knowledge and skills to interpret biochemical data.

Serum albumin is most abundant protein in the blood, and therefore widely used as nutritional marker. The half-life of serum albumin is approximately 20 days, making a good tool for use in monthly nutritional assessment but relatively unresponsive to acute change in nutritional status.

Serum creatinine is a nutritional screening parameter in children receiving maintenance hemodialysis. Serum creatinine concentration reflects the sum of creatinine by dietary origin (creatinine and creatinine from meat) and that formed endogenously in skeletal muscle tissue. Less creatinine is removed by residual kidney function and hemodialysis. A decline in serum creatinine over time in stable dialyzed children indicates loss of skeletal muscle mass. So that, lower levels of serum creatinine reflect low dietary intake and creatinine as well as low lean body mass.

Serum calcium level is used for nutritional status assessment. Decreased serum calcium level is associated with CRF. If serum calcium falls, calcitonin, parathyroid hormone and vitamin D level immediately respond and increase to enhance calcium absorption and it is released from bone and decrease by diets excretion, until serum levels are within normal.

Serum phosphorus levels were found to be low in malnourished children. Phosphorus in malnutrition has not generally received attention. However, low levels of serum phosphorus occurred in nine of the 10 malnourished children with CRF who died.

Hemoglobin is the iron-containing metalloprotein present in the red blood cells, which has the function of carrying oxygen from one part of the body to another. One of the most common causes of low hemoglobin count is malnutrition. There are many types of nutrition-related alterations to hemoglobin synthesis. So that, the late stage of iron deficiency anemia reflect decreased hemoglobin. The nurse needs to take seriously low hemoglobin in children to prevent any complications.

Sodium test measures the amount of sodium (salt) in blood. It is used to diagnose and manage water and electrolyte disorders. Children with CRF commonly have a marked impairment of sodium excretion, while glomerular filtration may be low.

Potassium test measures the amount of potassium in blood. CRF are the most common type of disorder affecting the body's potassium balance. Tests are performed for routine health screenings or if a disease or toxicity is suspected. The nurse must follow lab tests result to determine a medical condition and treatment plan.

Glucose is the main type of sugar in the blood and is the major source of energy for the body's cells. It is used to diagnose hypoglycemia (low blood sugar), and hyperglycemia (high blood sugar). The relative contributions are impaired insulin secretion and tissue insensitivity to insulin which lead to carbohydrate intolerance of uremic children .Nurse should be aware about causes of nature of disease or malnutrition.

Diagnosis Phase

A number of nursing diagnosis become evident based on assessment of the child. The most relevant in the majority of the cases are increased risk for injury related to accumulated electrolytes and waste products. Fluid volume excess is related to failure of renal regularity mechanisms. In addition, an altered nutrition less than body requirement is related to restricted diet. Furthermore, body image disturbance related to chronic illness, altered family process related to a child with a chronic disease.

Planning Phase

In developing a nutritional care, plan must use the assessment data collaborated with the children and health care team for identifying the nutritional goals. Planning for meeting short term goals among child with CRF as follows; first, prevent weight loss, second, ensure adequate nutritional intake, third, replace nutritional loss from uremic symptoms and fluid electrolyte imbalance.

Long term goals of care for the child with CRF and his family make the child receive encouragement to normal growth and development with minimizing the impact of the disease process, the child will remain free of complications. The child and family will receive appropriate support, guidance, and education.

Implementation Phase

Implementation to manage the multiple complications of CRF is based on medical protocols prescribed which are for the care of those specific problems. The pediatric nurse and dietitian should assume primary responsibility for monitoring the impact of nutrition intervention on the children with CRF undergoing hemodialysis. The nurses take responsibility for teaching the children and family what they need to know in order to promote nutritional requirement for enhancement of growth and development of those children. The pediatric nurse should discuss method for meeting energy intake to prevent weight loss and rebuild body tissue during hemodialysis treatment .Moreover ,the intake of all vitamins and minerals should meet the recommended dietary allowance after assessment the needs of children individually. Fluid balance is most important in children with kidney impairment so, fluid intake or restriction should be according to children condition and needs.

Evaluation Phase

The effectiveness of nursing interventions is determined by continual reassessment and evaluation of care based on the observational guidelines as observing and interviewing family regarding compliance with the medical and dietary regimen. Indeed, monitoring vital signs, growth measurements, laboratory reports, behaviors, and appearance are crucial indicators during evaluation of children undergoing hemodialysis.

Conclusion

Malnutrition is an evident problem in children on hemodialysis. Several factors contribute to the impairment of nutritional status off these children such as loss of appetite and inadequate intake of calories, proteins , fats , vitamins and minerals . Their physical parameters were also greatly affected because of their health condition. The pediatric nurse has a major role in gathering the information and assessing the nutritional status of children with renal failure undergoing hemodialysis.

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