**SUBJECT CODE :DIETETICS-II**

**SUBJECT CODE: 16SCCND8**

**UNIT-II**

**RENAL DISORDERS**

**Introduction**

Like the liver, kidneys play a vital role in maintaining the body’s normal state (homeostasis). There are two kidneys in the human body. The **nephron** is the basic functional unit of the kidney. Each kidney has about a million nephrons. Each nephron has two main parts. Bowman’s capsule (a cupshaped top of the nephron) with a network of capillaries called the **glomeruli** (plural of the word glomerulus) in it, and the **renal tubule**. The tubule is a long winding tube, the first part of which surrounds the glomerulus. The fluid is driven by a pressure gradient from glomerulus into the tubule and the filtration begins. As the filtrate moves along, the materials needed are returned to the blood and waste material is carried to the bladder for storage and discharge at normal intervals.

Each nephron functions independently to produce urine. The glomerulus part of each nephron filters only a small drop of fluid a day. But the volume of plasma filtered by two million glomeruli amounts to a formidable 150-180 liters in 24 hours. The **Glomerular Filtration Rate (GFR)** is the total amount of fluid filtered each minute by all the glomeuli of both kidneys. This is normally about 125 ml. per minute and is one index of kidney function. Most of the fluid (approx. 98.9 to 99.4 per cent) that passes through the winding tubule is reabsorbed; only **1 to 2 liters of urine** gets excreted each day. This means that over 99 per cent of the filtered water, all the glucose and vitamin C, almost all amino acids, sodium and other substances are returned to the blood. But if the intake of salt exceeds the body’s needs the excess is excreted and extra water is needed to excrete it.

**Functions of Kidneys**

The kidneys help to regulate the internal harmony by performing the following functions:

1. **Filtration:** The kidneys are the filters through which all dissolved substances pass and selectively absorb those to be retained. Figure 30.1 depicts the urinary system. The end products of protein metabolism (urea, creatinine, uric acid and urates) are removed from blood by filtration to be discarded in urine. Excess of chloride, potassium, sodium and hydrogen ions are also filtered out from the blood. By being selective filters, kidneys try to maintain a constant blood composition and volume.

2. **Maintenance of Fluid, Electrolyte and Acid-base Balance.** Ions from the blood are secreted into the urine to maintain acid-base balance In this process they monitor the composition and volume of blood and other body fluids. Kidneys maintain fluid electrolyte and acid-base balance as they carry out selective filtration.

3. **Excretion:** The kidneys excrete dissolved unwanted substances filtered out of the blood as urine.

4. The kidneys help **regulate the blood pressure**.

5. **Kidneys produce erythropoietin (a hormone),** which stimulates maturation of red blood cells in the bone marrow.

6. **The conversion of vitamin D to its most active form calcitriol** occurs in the kidneys. Activated vitamin D regulates the absorption of calcium and phosphorus and thus helps regulate calcium and phosphorus levels in the blood. When kidney function is disturbed due to disease or trauma, all the above functions are affected adversely.

**Causes of Kidney Disease**

Several ailments may cause kidney disorders. These include infection, degenerative changes, chronic diseases (e.g., diabetes mellitus, cardiovascular disorders such as atherosclerosis, hypertension), medications, toxic metal consumption, cysts, renal stones or trauma. Surgery, burns and poisons are some traumas, which may cause kidney damage. Obesity increases the risk of renal disease. Habitual intake of high protein diet may increase the work of kidneys and cause damage. Reducing weight, decreasing protein intake to normal level can decrease the risk of kidney disease.

**Chemical Damage.** Environmental agents such as pesticides, solvents, etc. may cause kidney damage. Animal venom, certain plants and drugs may also damage kidney tissue.

**Infection and Obstruction.** Bacterial infection in urinary tract may cause mild discomfort, which can be alleviated by medication, if treated promptly. If not treated, it may cause more involved chronic disease. Kidney stones may block drainage and may cause further infection and tissue damage. Diet therapy in renal disease is based on the nature of the disease and individual response.

**Kidney Ailments**

Any disease that affects the function of the glomerulus or tubule disturbs the body’s ability to utilise food and can cause havoc.

**Glomerulonephritis**

Nephritis is a general term used to indicate inflammation of the kidneys. When capillaries in

glomeruli are inflamed, it is called **glomerulonephritis**. An acute form of glomerulonephritis often follows a streptococcal infection of the respiratory tract, tonsillitis, pneumonia or scarlet fever. It occurs mostly in children and young adults. If the infection is very mild, it may not be detected and treated, resulting in permanent damage to the system, which may be detected after many years. The symptoms include nausea, vomiting, fever, rise in blood pressure, albumin (**proteinuria**) and small amounts of blood in the urine (**hemanuria**) and edema. Usually recovery is complete.

**Diet Therapy:** When there is nausea and vomiting in the acute stage, sweetened fruit juices,

sweetened tea, ginger-lemon sherbet, high carbohydrate, low electrolyte supplements are given. These help to reduce tissue breakdown. Fluid intake is monitored **in proportion to the urine output**. As soon as the patient is able to eat, a diet to maintain weight containing sufficient calories is given. If urine volume is decreased (as in **oliguria**) fluid is limited. Protein is also restricted to 40g. The proteins included must be of high biological value. Sodium is limited to 1g/day..

**Chronic Glomerulonephritis**

It can either be an untreated acute glomerulonephritis or an immunological cause of unknown origin. In the early stages, abnormal urine analysis results such as protein, red and white blood cells are observed in the urine. As the ailment advances, the patient may suffer from tiredness, edema, increase in blood pressure and blurred vision. As the kidneys cannot concentrate urine, there is frequent urination and need to urinate often in the night, thus disturbing sleep. If not checked by treatment, it can lead to chronic renal failure.

**Diet Modification:** The diet must be planned to suit the patient’s kidney capacity. Normal intake of protein is planned when kidneys are able to excrete wastes. If proteins are excreted in the urine, the protein losses must be covered by appropriate increase in the diet of proteins of high biological value. When the blood urea nitrogen rises with the worsening of kidney function, the protein in the diet must be reduced to 30-40 g or less. At the same time, the energy intake through carbohydrate and fat must be enough to prevent tissue breakdown.

If there is edema, sodium intake needs to be restricted. Due to poor reabsorption of the nutrients, loss of iron can lead to anemia. Hence iron supplements are needed.

**Nephrotic Syndrome**

This includes lipoid nephrosis, a rare condition, which affects children. It may also be due toprogression of chronic glomerulonephritis or be related to toxins of streptococci.There is a degeneration of kidney tissue, which permits protein loss through the filtrate. Largeamounts of proteins (albumins) are thus lost through the urine from the body.In the beginning, there is swelling of eyelids and legs due to fluid retention in the body. Loss of albumin in urine leads to low serum albumin values, at the same time, cholesterol level in the blood

increases. In this rare disease, mortality is high.

**Diet Modifications**: Diet treatments must rectify edema, excessive protein loss and malnutrition

(anemia, etc.)

**• Protein** allowance is increased to 2-3g/kg for children and 75-100g for adults, provided through high quality proteins High protein intake may sometimes hasten worsening of renal condition. Hence some authorities recommend 1.6 to 1.8g/kg of protein of high biological value. High protein supplements with low sodium content are useful.

**• Energy** allowance must be adequate to permit use of protein from the diet for tissue synthesis. About 50-60 calories/kg body weight need to be given.

**• Sodium** level needs to be kept at about 500 mg to prevent edema. Low sodium sources of vegetables and fruits are given in

**•** Dietary fat and cholesterol may be limited to control hyperlipidemias*.* The patients may not have good appetite and may need encouragement from attending relativesand dietitian to consume the diet presented completely. Appetizing and acceptable preparations will helpthe patient to enjoy the diet planned.

**Acute Kidney Failure**

Acute kidney failure is sudden, often reversible in a patient who had limited function earlier. When kidneys are not able to carry out their normal function of maintaining the internal chemical environment of the body by filtering out the wastes and excreting them, it is known as renal failure. It often develops due to gradual destruction of renal tissue by the disease or may occur suddenly as in nephrosis or obstruction of the tract*.* When the glomerular filtration rate rapidly drops to less than 20 ml/minute, there is a fast rise in the serum urea and creatinine. When the rate drops further to 10 ml/minute or less, an excess of urea and other nitrogenous wastes appear in the blood, which are symptoms of **uremia**. Simultaneously, there is inability to urinate, with urine output decreasing to less than 100 ml/day. At this stage, the patients may suffer from drowsiness, weakness, fatigue or may have headache, itching or blurred vision. Acute renal failure leads to death in one-fourth of the cases. The percentage increases to half, if the patient is over 75 years or there is associated trauma. Dialysis has proved to be a boon for such patients. It is instituted until kidney function is regained.

**Dietary Modifications:** In the first 24-48 hours, food and liquid intake by mouth are restricted. Glucose is given intravenously as oral intake is limited due to nausea, vomiting and lack of appetite. Sometimes tube feeding or total parenteral nutrition (TPN) is used. Dialysis is essential when TPN is used. A protein free diet may be given **before** a patient is put on dialysis. Another approach is to give glucose with essential amino acids orally, by tube feeding. The fluid allowance is 500 ml to make up for insensible water losses plus the urine output. More fluid is provided if there is vomiting, diarrhea, fever, etc. to prevent dehydration. Energy intake should be enough to prevent catabolism. 20-40g protein is given with gradual increase to normal levels with improvement in kidney function. The serum electrolytes and urine output are constantly monitored so that appropriate diet and fluid intake adjustments can be made. Diet is modified as the patient regains normal kidney function, in the recovery phase of the ailment. A high-protein, high-calorie diet is needed by patients who have suffered tissue damage . The recovery of kidney function may not be complete in some patients*.*

**Chronic Renal Failure**

Gradual loss of kidney function is the beginning, but if it silently continues, the glomerular filtration rate begins to reduce leading to chronic renal failure. Kidneys have a vast reserve capacity, which allows them to support life through much of this progressive deterioration. When the glomerular filtration rate (GFR) drops from normal 125 ml/minute to less than 30 ml/minute, dietary modification is initiated When the GFR reduces to 3 ml/minute, dietary control is not sufficient and dialysis or kidney transplant is necessary to save the life of the patient.

**Dietary Modifications:** The diet planning takes into account the stage of the disease, its causes, blood levels of urea and electrolytes, nutritional status, other diseases occurring and if the patient is on dialysis. The patients awaiting dialysis have a more severely restricted diet compared to those who are

on dialysis*.*

**Energy:** To prevent tissue breakdown and release of nitrogen and potassium into circulation, an intake of 1900-2000 cal/day is indicated. Main sources of energy are carbohydrates and fats. Their metabolic end products do not pose a problem for the kidneys, as these are excreted through lungs

(CO2), sweat glands (water) and bowel (semisolid residue).

**Protein:** Protein intake is reduced to reduce work of kidneys of excreting end products of protein metabolism ( namely, urea, creatinine, uric acid, sulfate and organic acids) in the urine. Most of the protein (65 to 75 per cent) in the diet should be of high biologic value (Table 30.4).

**Minerals:** Potassium and sodium intakes need to be restricted to avoid hyperkalemia, edema and hypertension respectively. Phosphorus is often restricted to 600-1200 mg/day to prevent metabolic acidosis.

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Supplements of calcium, iron and B vitamins need to be given, as restricted diets are low in these nutrients. Calcitrol may also be given as supplement as the kidney is not able to produce vitamin D hormone.

**Fluid** is restricted when urine output is low. The total fluid intake is equal to the volume of urine output plus about 500 ml for insensible losses. The fluid intake includes water present in foods and beverages also. Thus 100 ml of milk provides 87 ml, 100 g of fruits and vegetables provide 80-90ml of water.

**Dialysis**

Dialysis is used in acute and chronic renal failure for a short or long periods. It does not correct metabolic problems and there is need for modification of diet as also supplements. Most patients with end-stage renal disease lose whatever kidney function is left, after beginning dialysis. In hemodialysis, the patient’s blood circulates outside the body through a semipermeable membrane bathed in dialyzing fluid and removes nitrogenous wastes from it. Three times a week, the patient has to undergo dialysis for 4 hours each time. Some serum amino acids and water soluble vitamins are lost in the dialysate. Between dialysis, dietary control helps to maintain acceptable levels of nitrogenous waste products, potassium, sodium and fluids in the blood. Supplementation of water soluble vitamins are lost in the dialysate.

**Kidney Transplant**

When both kidneys of a patient fail, kidney transplant provides a functioning kidney, which permits him/her to lead a normal life. As in any other surgery, postoperatively, dietary progression is from a liquid to solid diet, which is planned to individual tolerance. To help the patient to recover, a high protein, low carbohydrate and sodium restricted diet follows, which counteracts the effects of drugs used in treatment. Reduced fat may also help control hyperlipidemias, while restriction of simple sugars prevents hyperglycemia.

**Kidney Stones**

Kidney stones are also known as **renal calculi, urolithiasis, or nephrolithias**. These may be found in the bladder, kidney, ureter or urethra. Deposition of varied sizes crystals in an organic matrix leads to the formation of these stones. As stones of varied sizes form, they normally move towards the ureter. Small smooth stones pass into the ureter, but large ones can block the ureter opening which impedes normal flow and causes intense pain. The pain may be accompanied by nausea, vomiting, even chills and fever. Only 10 per cent stones are large and cause such reactions. Dietary correlation to kidney stone formation is not easy to prove. They occur in conjunction with other diseases, which infect or weaken the urinary tract. Excessive excretion of calcium (e.g. in osteoporosis) and concentration of urine may promote stone formation. Low intake of water, leading to concentration of urine may lead to the formation and deposition of crystals in the renal tract. Calcium salts (with carbonate, phosphate, ammonium), magnesium oxalate, sulfate etc. account for 90 per cent of the stones; uric acid and rarely cystine or xanthine account for the rest.

**Diet Therapy:** Therapy is planned on the basis of the predominant component of the stone. A very liberal fluid intake of 2500 to 3000ml per day is recommended to avoid formation of concentrated urine from which salts get precipitated out as stones. This recommendation is universal and does not depend on the type of stone.

**Calcium Stones:** If stones are not preceded by other disease (are idiopathic) dietary calcium intake is reduced to 600mg/day or less. Fiber in the diet is increased to bind excess calcium. If water supplies are high in calcium, it may be necessary to use special filter to eliminate it, before using it for drinking and cooking.

**Oxalate Stones:** A diet low in oxalate is indicated. Ascorbic acid content of the diet should be normal. Dietary fat should be reduced to 50g/day or less if the patient suffers from steatorrhea.

**Uric acid Stones:** Altered purine metabolism and sometimes gout may lead to the formation of these stones. A diet reduced in purines is prescribed sometimes. Most of the small stones pass through the ureter. Those which are too large and obstruct function and cause pain need to be removed surgically. A modern procedure (**laproscopy**) in which the stone is broken into bits and flushed out, has done away with the need for painful surgery.

**Dietary Modifications**

It is important to note that dietary modifications cannot dissolve existing stones but it can be helpful in preventing development of new stones. Some of the steps one can take to **prevent formation of kidney stones** are:

(*i*) **Drink lots of water**. Kidneys filter harmful substances out of the blood and flush them out of the body via the ureters. In the presence of fluid, the waste dissolves and flows out from the body. But when the body is dehydrated, the waste products solidify in crystalline form and can react with each other to form a stone of calcium oxalate or uric acid. Fluids are the most important input in the prevention of kidney stones. The aim is to drink enough water to produce two liters of urine per day. Those living in hot climate, will needmadditional two to four glasses of water per day. You can check the colour of the urine, which is an indicator of its concentration. If it is dark yellow, the crystals are not dissolving, and you should increase your fluid (mainly water) intake.

(*ii*) **Increase your potassium intake**. In scientific studies, it was observed that those, who ate a lot of fruits and vegetables rich in potassium reduced their risk of developing kidney stone by 50 per cent. Bananas, citrus fruits, potatoes are good sources of potassium.

(*iii*) **Reduce intake of meat**. The risk of kidney stones is reduced if intake of meat is reduced to a serving of three ounces per day.