Save Your Kidney

Dr. Sanjay & Priti Pandya

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Complete Guide for Kidney Patients

Dr. Sanjay Pandya
Priti Sanjay Pandya

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Complete Guide for Kidney Patients

Save Your Kidney

Comprehensive Information About
Prevention and Treatment of Kidney Diseases

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Save Your Kidney

Publisher

Samarpan Kidney Foundation,
Samarpan Hospital, Near Lodhavad Police Station,
Bhutkhana Chowk, Rajkot 360002(Gujarat, India)
E-mail: saveyourkidney@yahoo.co.in

First edition: 2012

Price: Rupees 150

Exclusive Marketing

Wonderland publication
401/B Sarvottam Complex, Panchanth Main Road
Rajkot- 360001, Gujrat, India.
Mobile: 9898032623
Email: info@wonderlandbooks.co.in
Website : www@wonderlandbooks.co.in

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This book is dedicated to
all kidney patients

Let Us Prevent Kidney Diseases . . .

The book "Save Your Kidney" is an effort to provide basic understanding and guidelines to prevent common kidney diseases.

In the last few decades there has been a dramatic and alarming increase in the incidence of kidney diseases. Chronic kidney disease is common and incurable. Awareness of the causes, symptoms and measures for prevention of these kidney ailments is the best way to counter this disturbing increase. This book is our humble attempt to provide that significant information to a layman in simple words.

Early diagnosis and treatment of this disease is beneficial as it provides long term benefits at low cost. Due to lack of awareness, very few people recognize signs and symptoms indicating a possibility of kidney disease, resulting in hazardous delay in early diagnosis. Treatment of advanced stage of chronic kidney disease such as dialysis and kidney transplantation is prohibitively expensive and in a country like India only less than 10% of patients can afford it. Hence early diagnosis and treatment remains the only and the most feasible option to decrease escalating cases of chronic kidney disease in our country.

When diagnosis reveals that a person is suffering from kidney disease, the patient and his family naturally become seriously worried. The kidney patients and their family members wish to know everything about the disease. But it is not possible for the treating doctor to provide a large volume of detailed information. We hope that this book will provide that missing link between the patient and the doctor. Anyway, it is rather helpful to have an informative book to read at a convenient time and refer to it as often as required. It provides all basic information about symptoms, diagnosis, prevention and treatment of different kidney diseases in simple and easy language. Details of selection and precautions in dietary recommendations for different kidney diseases are also

included here. We need to emphatically and unequivocally state here that the information given in this book is not medical advice; it is for informational purposes only. Self medication or dietary modification by reading the book, without the advice of the doctor can be dangerous and is most certainly not recommended here.

This kidney guide will be useful not only to the kidney patients and their family but also to those at the risk of developing kidney disease. And, indeed, it will also be of educational importance for all those individuals who value awareness. Medical students, doctors, paramedicals are sure to find this book a handy reference guide.

We are thankful to Dr Gaurang and Dr. Susmita Dave, Mr. Ayaazkhan Babi and Neha Babi for their valuable suggestions and help to make this kidney guide easy to read and very clear to understand. We take great delight in making a special mention of our dear children Isha and Rohan who enthusiastically shared our sense of fulfillment and happiness in the preparation of "Save Your Kidney"

I hope the readers will find this book useful and informative. Sugestions to further improve this book are always welcome.

Wishing you all sound health,

Dr Sanjay Pandya
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Rajkot, India

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Dr. Sanjay Pandya is a senior nephrologist practicing in Rajkot (Gujarat - India). He did his M.D. (Internal Medicine) from M. P. Shah Medical College, Jamnagar (Gujarat) in 1986 and DNB Nephrology from the Institute of Kidney Disease and Research Center, Ahmedabad in 1989. From 1990 onwards he is practicing as Nephrologist at Rajkot (Gujarat), India.

Dr. Pandya is actively involved in kidney disease education. Basic educational guides for kidney patients in Hindi and Gujarati language are written by him are the first of their kind. "Kidney Education Foundation" has been formed by Dr. Pandya with the mission to spread awareness amongst a large number of people for prevention and care of kidney disease.

In order to reach out to the largest number of people - more familiar with vernacular languages rather than English - in 2010 Dr Pandya launched websites in Hindi and Gujarati. These Websites received more than 2.5 million hits in less than a year.

In 2011 kidney guides were prepared in Marathi language with the expert help of senior nephrologists Dr. Jyotsna Zope (Mumbai).

For medical professionals Dr. Pandya authored a book titled "Practical Guidelines on Fluid Therapy". It is the first complete book by an Indian on fluid, electrolytes, acid base disorders and parenteral nutrition. More than 36,000 copies of this user-friendly book have been sold up till now. Dr. Pandya is very popular amongst students and clinicians because of his simple, practice oriented and enjoyable lectures on fluid, electrolytes, and acid base disorders.

Priti Sanjay Pandya, B.Sc **Coordinator, Kidney Education**

Priti looks after educational inputs of Dr. Pandya. She assists him in preparation of manuscripts, their editing, publishing and future development of all academic inputs. She also helps in correspondence and promotion. In other words, she plays an invaluable **role** as a life partner in Dr. Pandya's professional and educational endeavours, too.

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How to use the book?

This book is in two parts

Part 1:

Basic details about kidney and prevention of kidney diseases are narrated. Each and every individual is advised to read this part of the book. The information provided can make a difference, as it prepares a lay man for early detection and prevention of kidney diseases.

Part 2:

One can read this part as per one's curiosity and necessity.

- Information about major kidney diseases, and its symptoms, diagnosis, prevention and treatment is discussed.
- Diseases damaging kidney (e.g. diabetes, high blood pressure, polycystic kidney disease etc.) and precautions to prevent it Other useful information is also provided.
- Detailed discussion of diet for chronic kidney disease patients.

Information given in this book is not medical advice. Medication without the doctors advice can be dangerous.

Part 1

Basic Information about Kidney

- **Structure and functions of kidney.**
- **Symptoms and diagnosis of kidney diseases.**
- **Myths and facts about kidney diseases.**
- **Measures to prevent kidney diseases.**

Chapter 1

Introduction

Kidney is an amazing organ that plays a major role in keeping our body clean and healthy by flushing out unwanted excretory and toxic material. Though its primary function is to remove toxins from the body, it is not the only function. The kidney also plays a crucial role in regulating blood pressure, volume of fluid and electrolytes in the body. Although most of us are born with two kidneys, just one suffices to effectively carry out all tasks.

In recent years there is a disturbing increase in patients suffering from diabetes and hypertension that has led to a noticeable increase in the number of patients suffering from chronic kidney disease. This calls for better awareness and understanding of kidney diseases, their prevention and early treatment. This book tries to address just that. It aims to help the patient to understand kidney related diseases and be better prepared to deal with them. It attempts to provide answers to frequently asked questions, too.

The initial part of the book introduces readers to the kidney - a vital organ in the human body and suggests measures for prevention of kidney related diseases. However, a major portion of the book is devoted especially to matters concerning kidney patients and their families. The book deals with causes, symptoms and diagnosis of the dreaded disease, and also informs the readers about treatment options available.

A special chapter focuses on care to be taken during early stages of chronic kidney diseases and how to make an informed attempt to avoid,

or postpone dialysis and even transplantation. Detailed useful information about dialysis, kidney transplantation and cadaver transplantation is also given separately.

In order to make the book a complete guide for kidney patients, it includes information about common kidney problems (other than kidney failure); myths and facts about kidney diseases; golden rules to avoid and prevent kidney diseases; tips about common drugs used by kidney patients and much, much more.

Since diet is a very important area of concern and confusion for the patients of chronic kidney disease (CKD), a separate chapter is devoted to the subject. It advises patients on precautions to be taken and selection of proper and adequate diet. The glossary at the end, explains all abbreviations and technical terms and make it easy to understand the book.

Disclaimer: Information provided in this kidney guide is for educational purpose only. Please do not indulge in any self diagnosis or treatment on the basis of the knowledge gained by the use of this book. You must always consult your doctor or other health professional for treatment.

Chapter 2

Kidney and its Function

Kidney is amongst the most vital organs of the human body. Its malfunction can lead to serious illness or even death. It has very complex structure and functions.

Its two most important functions are to flush out harmful and toxic waste products and to maintain balance of water, fluids, minerals and chemicals.

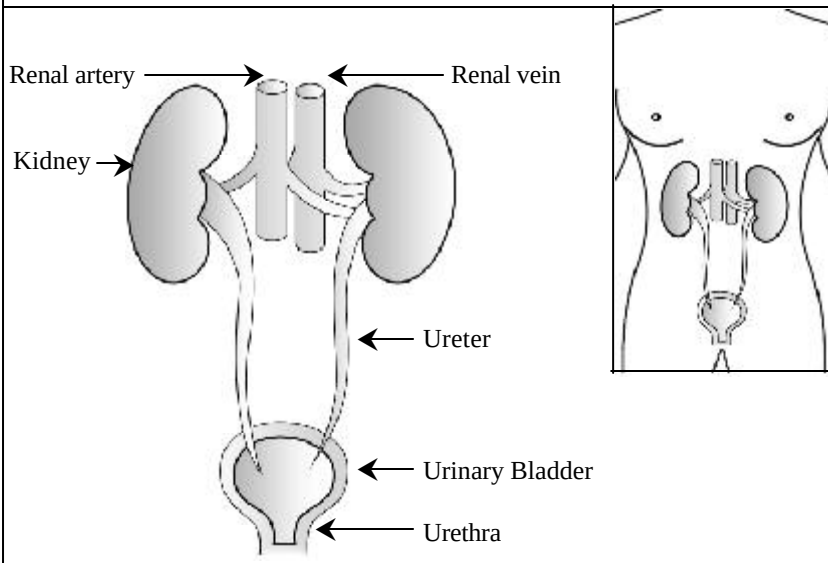
Structure of Kidney

Kidney produces urine by removing toxic waste products and excess water from the body. Urine formed in kidney passes through ureter, flows into bladder before finally being excreted through urethra.

- Most people (males and females) have two kidneys.
- Kidneys are located at upper and back side of the abdomen, on either side of the spine (see diagram). They are protected from damage by the lower ribs.
- Kidneys lie deep inside the abdomen so normally one cannot feel them.
- Kidneys are a pair of bean shaped organs. In adults a kidney is about 10 cm long, 6 cm broad and 4 cm thick. It weighs approximately 150-170 grams.
- Urine formed in kidneys flows down to urinary bladder through ureters. The ureter is about 25 cm long hollow tube like structure made up of special muscles.
- Urinary bladder is a hollow organ made of muscles which lies in the lower and anterior part of the abdomen. It acts as a reservoir of urine.

Location, structure and functions of the kidneys are the same in males and females.

Location of Kidneys and Urinary System



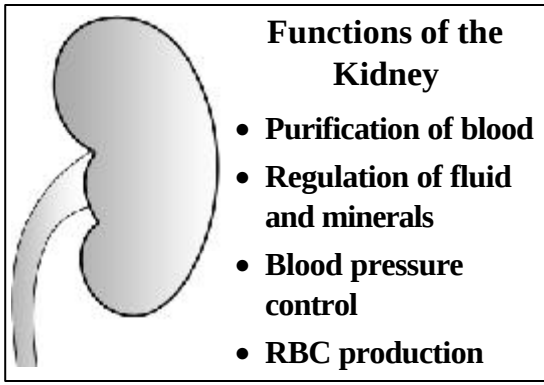
- The bladder in an adult can hold about 400-500 ml of urine and when filled to near capacity, a person feels the urge to pass urine.
- Urine in the bladder is excreted through urethra during urination. In females, urethra is rather short, while it is much longer in males.

Why is kidney essential for the body?

- We consume different quantity and kind of food every day.
- The quantity of water, salts, and acids in our body also varies every day.
- The continuous process of converting food into energy produces harmful toxic materials.
- These factors lead to change in the amount of fluid, electrolytes and acids in the body. This accumulation of unwanted toxic materials can be life threatening.

- Kidneys carry out the extremely essential cleansing job of flushing out harmful and poisonous acidic and toxic products. At the same time, they also regulate and maintain the right balance and levels of water, electrolytes and acid base.

What are the functions of the kidney?



The primary function of the kidney is to make urine and purify the blood. Kidney removes waste materials, extra salts and other chemicals which are not required by the body. Important functions of the kidney are described below.

1. Removal of waste products

Purification of blood by removal of waste products is the most important function of the kidney.

The food that we consume contains protein. Protein is necessary for the growth and repair of the body. But as protein is utilized by the body it produces waste products. Accumulation of these waste products is like poison for the body. Kidney filters blood, and toxic waste products are excreted in the urine.

Creatinine and urea are two important waste products, the amount of which in human body can easily be measured. Their 'value' in blood reflects the function of the kidney. When both the kidneys fail, value of creatinine and urea will be high in blood test.

2. Removal of excess fluid

The second most important function of the kidney is regulation of fluid balance by excreting extra amount of water as urine and retaining

Formation of Urine

Kidneys receive 1200 ml per min or 1700 litre day blood for filtration

↓

Glomerulus form 125 ml/min or 180 liter/ day Urine

↓

Tubules reabsorb 99% (178 liters) of fluid

↓

1-2 liter urine excretes waste products / toxins and extra minerals

necessary amount of water in the body. So the kidney maintains the right amount of water in the body.

When kidneys fail they lose the ability of removing this extra amount of water as urine. Excess water in the body leads to swelling.

3. Balance minerals and chemicals

The kidney plays another important role of regulating minerals and chemicals like sodium, potassium, hydrogen, calcium, phosphorus, magnesium and bicarbonate; and maintains normal composition of body fluid.

Change in the sodium level can affect sensorium, while change in the potassium level can have serious effects on the rhythm of the heart and functioning of the muscles. Maintenance of normal level of the calcium and phosphorus is essential for healthy bones and teeth.

4. Control of blood pressure

The kidney produces different hormones (renin, angiotensin, aldosterone, prostaglandin etc) and regulates water and salt in the body, which plays vital role in control of blood pressure. Disturbances in hormone production and regulation of salt and water in a patient of kidney failure causes high blood pressure.

5. Red blood cells production

Erythropoietin produced in the kidney plays an important role in the production of red blood cells (RBC). In kidney failure production of erythropoietin is less, which in turn leads to decreased production of RBC resulting in low hemoglobin (anemia).

Because of low production of erythropoietin in patients with renal failure the hemoglobin count does not improve inspite of supplementation of iron and vitamins.

6. To maintain healthy bones

The kidney converts vitamin D into its active form which is essential for the absorption of calcium from food, growth of the bones and teeth, and to keep bone healthy. In kidney failure due to decreased active vitamin D, growth of bones is reduced and they also become weak. Growth retardation may be the first sign of kidney failure in children.

How is blood purified and urine formed?

In the process of blood purification the kidney retains all necessary substances and selectively excretes extra fluid, minerals and waste products.

Let us understand this complex and amazing process of urine formation.

- Did you know that every minute 1200 ml of blood enters in both kidneys for purification, which is 20% of the total blood pumped by the heart? So in one day 1700 liters of blood is purified!
- This process of purification occurs in small filtering units known as nephrons.
- Each kidney contains about one million nephrons. Each nephron is made up of glomerulus and tubules.
- Glomeruli are filters with very tiny pores with the characteristic of selective filtration. Water and small-sized substances are easily filtered through them. But large-sized red blood cells, white blood cells, platelets, protein etc. cannot pass through these pores. Therefore, in the urine of healthy people large-sized substances are absent.

The kidney's chief function is to remove waste and harmful products and excess water in the form of urine.

- First step of urine formation occurs in glomeruli, where 125 ml of minute urine is filtered per minutes. It is quite astonishing that in 24 hours 180 liters of urine is formed! It contains not only waste products, minerals and toxic substances, but also glucose and other useful substances.
- The kidney performs the process of reabsorption with great intelligence. Out of 180 liters of fluid that enters the tubules, 99% of fluid is selectively reabsorbed and only the remaining 1% of fluid is excreted in the form of urine.
- By this intelligent process all essential substances and 178 liters fluid are reabsorbed in tubules and in just 1-2 liters of water, waste products, extra minerals and other such harmful substances are excreted.
- Urine formed by the kidney flows to ureter, and passes through the urinary bladder and is finally excreted out through the urethra.

Can there be variation in the volume of urine in a person with healthy kidney?

- Yes. The amount of water intake and atmospheric temperature are major factors which determine the volume of urine in a normal person.
- When water intake is low, urine is concentrated and its volume is less (about 500 ml) but when plenty of water is consumed, more urine is formed.
- In summer because of perspiration caused by high temperature the volume of urine decreases. In winter it is the other way round – low temperature, no perspiration, more urine.
- In a person with a normal intake of water, if the volume of urine formed is less than 500 ml or more than 3000 ml, it is a clear signal that the kidney needs attention and investigation.

Too little or too much volume of urine formation, signifies that the kidney seeks attention and investigation.

Chapter 3

Symptoms of Kidney Diseases

Symptoms of kidney diseases vary from person to person. A lot depends on the type of underlying disease and its severity. Often symptoms are general and vague, and therefore the disease is not diagnosed in the early stages.

Common symptoms of kidney diseases :

- **Swelling of the face**

Swelling of face, feet and abdomen, is a frequent presentation of kidney disease. Characteristic of swelling due to kidney disease is that it starts from the face below the eyelids and is most noticeable in the morning.

Kidney failure is a common and important cause of swelling. But one needs to bear in mind that swelling does not necessarily indicate kidney failure. In certain kidney diseases despite normal kidney function swelling occurs (e.g. nephrotic syndrome). Equally important fact to bear in mind is that swelling may not be seen at all in a few patients with significant kidney failure.

- **Loss of appetite, nausea, vomiting**

Loss of appetite, abnormal taste in the mouth and poor food intake are common problems faced by a person with renal failure. With worsening of kidney failure, due to increased level of toxic substances, a person develops nausea, vomiting and hiccups.

- **High blood pressure - Hypertension**

In patients with kidney failure hypertension is common. If hypertension occurs at a young age (less than 30 years) or blood pressure is very high at the time of diagnosis, the reason may be kidney problem.

Swelling of face below the eyelids is the most common symptom of kidney diseases.

· **Anemia and weakness**

Generalized weakness, early fatigue, poor concentration in work and pallor are common complaints of a person with anemia (low hemoglobin level). At times these may be the only complaints of a person in the early stages of chronic kidney failure. If anemia does not respond to standard treatment, it is essential to rule out kidney failure.

· **Nonspecific complains**

Low back pain, body ache, itching and leg cramps are frequent complains in kidney disease. Retardation of growth, short stature and bending of leg bones are common in children with kidney failure.

· **Urinary complains**

Common urinary complains are :

1. Reduction in urine volume, which causes swelling, is very common in various kidney diseases.
2. Burning sensation in urine, frequent urination and passing of blood or pus in urine are symptoms of urinary tract infection.
3. Obstruction to flow of urine can lead to difficulty and straining in 'voiding' (passing urine), poor stream of urine or drop to drop voiding. In severe conditions, complete inability to pass urine is not uncommon.

Although a person may have some of the above mentioned symptoms and signs, it does not necessarily mean that the person is suffering from kidney disease. However, in the presence of such symptoms, it is highly recommended to consult the doctor and to rule out any possibility of kidney disease by tests and checkups.

It is important to remember that serious kidney problem may exist silently for a long period without significant symptoms and signs.

Rule out kidney problems if severe hypertension is detected at a young age.

Chapter 4

Diagnosis of Kidney Diseases

"A stitch in time saves nine" is true for the treatment of kidney diseases. Disease like chronic kidney disease (CKD) is not curable and the cost of treatment of the end stage kidney disease (ESKD) is exorbitant. A person with such a dreaded disease can be asymptomatic, i.e. no symptoms of the disease may be apparent. If diagnosis of kidney disease is made early, it can be treated easily with medical treatment. So whenever a kidney problem is even suspected, it is advisable to go for immediate check up and early diagnosis.

Who should get their kidneys checked? Who is at high risk for developing kidney problems?

Anyone can develop a kidney problem, but the risk is more if :

- Person has symptoms of kidney disease.
- Person is diabetic.
- Person has uncontrolled hypertension.
- Family history of kidney disease, diabetes and hypertension exists.
- Person is a smoker, obese and/or above 60 years of age.
- Person has taken long term treatment with pain relievers.
- History of congenital defect of urinary tract exists.

Screening in such high risk individuals helps in early diagnosis of kidney disease.

How to diagnose kidney problems? What tests are normally performed?

To diagnose different kidney problems the doctor takes detailed history,

Early stages of chronic kidney disease are usually asymptomatic, laboratory tests are the only way of its detection.

thoroughly examines the person, measures blood pressure and then advises appropriate tests. Routinely performed and most useful tests are urine tests, blood tests and radiological tests.

1. Urine Tests

Different urine tests provide useful clues for the diagnosis of different kidney disease.

Routine urine tests

- It is a simple, inexpensive and very useful diagnostic test.
- Abnormality seen in urine tests provides important diagnostic clues but normal urine report does not rule out kidney problems.
- Presence of protein in urine (proteinuria) is seen in various kidney diseases. It should never be neglected. Presence of protein in urine can be the first, the earliest and the only warning sign of chronic kidney disease (and even of heart disease). For example proteinuria is the first sign of kidney involvement in diabetes.
- Presence of pus cells in urine indicates urinary tract infection (UTI).
- Presence of protein and red blood cells provide diagnostic clue for inflammatory kidney disease (i.e. glomerulonephritis).

Microalbuminuria

Microalbuminuria means that a very small amount of protein is present in urine. This test provides the first and the earliest clue for the diagnosis of kidney involvement in diabetes. At this stage the disease may be reversible with proper and meticulous treatment. Protein (albumin) is absent in routine urine test at this stage.

Urine test is very important for the early diagnosis of kidney diseases.

Other urine tests

- **24 hours urine for albumin:** In patients with the presence of protein in urine, this test is necessary to determine the total amount of protein lost in 24 hours. This test is useful to assess the severity of the disease and also the effect of treatment on the loss of protein.
- **Culture and sensitivity test:** This test takes about 48 to 72 hours time and provides valuable information about the type of bacteria causing UTI, the severity of infection and choice of antibiotic selection for its treatment.
- **Urine test for acid fast bacilli:** This test is useful to diagnose tuberculosis of urinary tract.

2. Blood Tests

Various blood tests are necessary to establish proper diagnosis of different kidney problems.

- **Creatinine and Urea**

Blood levels of creatinine and urea reflects the function of the kidneys. Creatinine and urea are two waste products which are removed from the blood by the kidney. When the kidney function slows down, blood levels of creatinine and urea rise. Normal value of serum creatinine is 0.9 to 1.4 mg/dl and normal value of blood urea is 20 to 40 mg/dl. Their higher values suggest greater damage to kidney. Creatinine level is a more reliable guide of kidney function than blood urea level.

- **Hemoglobin**

Healthy kidneys help in the production of red blood cells which contain hemoglobin. In a blood test when hemoglobin is low, it is called anemia. Anemia is a common and important sign of chronic kidney diseases.

Serum creatinine is a standard blood test used routinely to screen for and monitor renal failure.

However anemia can occur quite frequently in other illnesses. So anemia is not a specific test for kidney disease.

- **Other blood tests**

Different blood tests frequently performed in kidney patients are: blood sugar, serum protein, cholesterol, electrolytes (sodium, potassium and chloride), calcium, phosphorous, bicarbonate, ASO titer, complement etc.

3. Radiological Tests

- **Ultrasound of kidney**

Ultrasound is a simple, useful, quick and safe test which provides valuable information such as the size of kidney and the presence of cyst, stone and tumors. An ultrasound can detect blockage to urine flow anywhere in the kidney, ureters, or bladder. In chronic kidney failure both kidneys are usually found to be small in size.

- **X-ray of abdomen**

This test is useful for the diagnosis of stone in the urinary system.

- **Intra venous urography (IVU)**

IVU (also known as intra venous pyelography-IVP) is a special X-ray test. In this test radio opaque iodine containing dye (fluid which can be seen on X-ray films) is injected into a vein in the arm. This dye injected in blood stream passes through the kidney and gets excreted in to urine. So the urine becomes radio-opaque and this causes visualization of urinary tract i.e. kidneys, ureters and bladder. A series of X-ray pictures are taken at specific time intervals which give a comprehensive view of the anatomy and the functioning of the urinary system. IVU reveals problems such as stone, obstruction, tumor and abnormalities in structure and function of the kidneys.

Most important screening tests for kidney disease are urine test, serum creatinine and ultrasound of kidney.

In case of kidney failure IVU is usually not recommended because the injected dye can damage poorly functioning kidneys. In kidney failure excretion of dye during test may be inadequate, so the purpose of the test to visualize urinary system will not be served. This test is avoided even during pregnancy. Because of availability of ultrasound and CT scan this test is used less frequently nowadays.

- **Voiding cystourethrogram (VCUG)**

Voiding cystourethrogram - VCUG (previously known as Micturating cystourethrogram - MCU) test is most often needed in the evaluation of urinary tract infection in children. In this special X ray test, the bladder is filled with contrast medium through catheter under sterile precautions. After the bladder is filled, catheter is removed and the patient is asked to pass urine. X rays taken at intervals during urination show outline of the bladder and urethra. This test is helpful to diagnose backflow of urine into the ureters, and up to the kidneys (known as vesicoureteral reflux) and structural abnormalities of urinary bladder and urethra.

- **Other radiological tests**

For the diagnosis of certain kidney problems special tests such as CT scan of kidney and urinary tract, renal doppler, radionuclear study, renal angiography, antegrade and retrograde pyelography etc are very useful.

4. Other Special Tests

Kidney biopsy, cystoscopy and urodynamics are special tests which are necessary for the exact diagnosis of certain kidney problems.

Kidney Biopsy

Kidney biopsy is an important test useful in the diagnosis of certain kidney diseases.

A kidney ultrasound is a simple and safe test used to assess the size, shape, and location of the kidneys.

What is kidney biopsy?

In kidney biopsy a small piece of kidney tissue is removed through a needle and examined under a microscope. Kidney biopsy is performed to diagnose the exact nature of certain kidney diseases.

When is kidney biopsy advised?

In certain kidney diseases detailed history, examination and tests are unable to establish proper diagnosis. In such patients a kidney biopsy may be the only test which can clinch the exact diagnosis.

How does kidney biopsy helps?

Kidney biopsy establishes specific diagnosis of certain unexplained kidney diseases. With this information, the nephrologist is able to plan effective treatment strategy and guide patients and their family about the severity and course of the disease.

By which technique is kidney biopsy performed?

The most common method is percutaneous needle biopsy, in which a hollow needle is passed through the skin into the kidney. Another rarely used method is open biopsy which needs surgery.

How is kidney biopsy performed?

- The patient is admitted in hospital and his consent is obtained.
- Prior to biopsy it is ensured that blood pressure is normal and that the blood test reveals normal blood clotting. Medicine used for the prevention of blood clotting (e.g. aspirin) is discontinued for 1- 2 weeks prior to biopsy.
- Ultrasound is done to know the position of kidneys and to determine

Kidney biopsy is a test performed to establish exact diagnosis of certain kidney diseases.

exact biopsy site. This point is below the rib, in upper part of the waist near the back muscles.

- The patient is asked to lie face down – on stomach with the abdomen supported by a pillow/towel. The patient is fully awake during the procedure. In children kidney biopsy is done under anesthesia, so the child is not awake.
- After proper cleaning of the skin, biopsy site is numbed with local anesthesia to minimize pain.
- With the help of hollow biopsy needle, 2 or 3 small thread like pieces are obtained from the kidney. These specimen are sent to pathologist for histopathology examination.
- After the biopsy, pressure is applied to the biopsy site to prevent bleeding. The patient is asked to take rest for 6-12 hours and usually discharged the next day.
- Patient is advised to avoid heavy work or exercise for about 2-4 weeks after biopsy.

Are there any risks in kidney biopsy?

Like any surgical procedure, complications can occur in a few patients after kidney biopsy. Mild pain and passing of reddish urine once or twice is not uncommon, but it usually stops on its own. In rare cases where bleeding continues, blood transfusion is needed. In very rare cases where severe bleeding continues, emergency removal of kidney by surgery may become unavoidable.

Sometimes kidney tissue obtained may not be adequate for diagnosis (about 1 in 20). Repeat biopsy is needed in such cases.

Kidney biopsy is usually performed with thin needle in fully awake state.

Chapter 5

Major Kidney Diseases

Kidney diseases are divided into two groups

- **Medical diseases:** Medical kidney diseases such as kidney failure, urinary tract infection and nephrotic syndrome are treated with medicine by nephrologists. Patients with advance kidney failure need treatment like dialysis and kidney transplantation.
- **Surgical diseases:** Urologists treat surgical kidney diseases such as stone disease, prostate problems and cancer of urinary system by surgery, endoscopy, and lithotripsy.
- **How do nephrologists and urologists differ?**
  Nephrologists are physicians and urologists are surgeons specialized in kidney diseases.

Major Kidney Diseases	
Medical	**Surgical**
Acute kidney failure	Stone disease
Chronic kidney disease	Prostate problems
Urinary tract infection	Congenital urinary anomalies
Nephrotic syndrome	Cancer

Kidney Failure

Reduction in the ability of kidneys to filter and excrete waste products

Acute kidney failure is a rapid loss of kidney function. With short term treatment kidneys usually improve.

and to maintain the electrolyte balance is called kidney (renal) failure. Rise in the value of serum creatinine and blood urea in blood test suggests kidney failure.

Kidney failure is chiefly divided into two types: acute kidney failure and chronic kidney disease (failure).

Acute Kidney Failure

Sudden reduction or loss of kidney function is called acute kidney (renal) failure or acute kidney injury (AKI).The volume of urine decreases in majority of patients with acute kidney failure. Important causes of acute kidney failure are diarrhea, vomiting, falciparum malaria, hypotension, sepsis, certain drugs (ACE inhibitor, NSAIDs) etc. With proper medical treatment (and at times dialysis) kidney function returns to normal in most cases.

Chronic Kidney Disease

Gradual, progressive and irreversible loss of kidney function over several months to years is called chronic kidney disease - CKD (chronic renal failure). In CKD kidney function reduces slowly and continuously. After a long period it reduces to a stage where kidney stops working almost completely. This advanced and life threatening stage of disease is called the end stage kidney (renal) disease (ESKD/ESRD).

Chronic kidney disease is a silent disease and often goes unnoticed. In the early stages of CKD signs or symptoms are few. Common symptoms of CKD are weakness, loss of appetite, nausea, swelling, high blood pressure etc. Two most important causes of CKD are diabetes and hypertension.

Gradual progressive and irreversible loss of kidney function over a long period is called chronic kidney disease.

The presence of protein in urine examination, high creatinine in blood test and small contracted kidneys on sonography are the most important diagnostic clues of chronic kidney disease. The value of serum creatinine reflects the severity of kidney failure and this value increases progressively in this disease.

In the early stage of CKD, the patient needs proper medicine and dietary modifications. There is no treatment which can cure this disease. But the aim of the treatment is to slow down the progression of the disease, prevent complications and thereby keep the patient well for a long period, inspite of the severity of the illness.

When the disease progresses to an advanced stage (End Stage Kidney Disease) - more than 90% of kidney function is lost (serum creatinine is usually more than 8-10 mg/dl). The only treatment options available at this stage are dialysis (hemodialysis and peritoneal dialysis) and kidney transplantation.

Dialysis is a filtering process to remove waste products and excess fluid from the body that accumulate in the body when the kidney stops functioning. Dialysis is not a cure for chronic kidney disease. In the advanced stage of chronic kidney disease (ESKD) the patient needs lifelong regular dialysis treatment (unless kidney is transplanted successfully). Two methods of dialysis are hemodialysis and peritoneal dialysis.

Hemodialysis (HD) is the most widely used form of dialysis. In HD with the help of special machine waste products, excess fluid and salt are removed. Continuous ambulatory peritoneal dialysis (CAPD) is another form of dialysis modality which can be carried out at home or at work place without the help of the machine.

Dialysis is an artificial method of removing waste products and excess fluid from the blood when the kidneys have failed.

Kidney transplant is the most effective treatment option and the only curative treatment modality of end stage kidney disease (advance stage of chronic kidney disease)

Urinary Tract Infection

Burning and frequent urination, pain in lower abdomen and fever are common presentations of urinary tract infection (UTI). Presence of pus cells in urine test suggests UTI.

Most of the patients of UTI respond well to antibiotic therapy. UTI in children needs special consideration. Delay or inadequate treatment of UTI in children can cause irreversible damage to the growing kidney.

In patients with recurrent UTI, it is important to exclude urinary tract obstruction, stone disease, abnormality of urinary tract and genito urinary tuberculosis by through investigation. The most important cause of recurrence of UTI in children is VUR (Vesicoureteral reflux). VUR is a congenital abnormality in which urine flows backwards from the bladder into one or both of the ureters, and up to the kidneys.

Nephrotic Syndrome

Nephrotic syndrome is the kidney disease seen more frequently in children as compared to adults. Frequent attacks of swelling (edema) is the most common symptom.The presence of protein in the urine (more than 3.5 grams per day), low blood albumin levels (hypoalbuminemia), high cholesterol levels, normal blood pressure and normal kidney function are usual features of this disease.

Delay in treatment and inadequate work up of UTI in children can cause irreversible damage to the growing kidney.

This disease shows good response to treatment. A few patients remain symptom free after discontinuation of the treatment but in most cases the disease recurs.

In this way the cycle of response to treatment, treatment free period of remission and frequent relapses causing swelling; are characteristic of nephrotic syndrome.

As cycle of recovery and recurrence repeats for a long period (years), this disease is a matter of worry for both the child and the family. But it is important to remember that long term outcome is excellent in children with nephrotic syndrome. They live a healthy life with normal kidney function.

Kidney Stone

Kidney stone is a common and important kidney problem. Kidney, ureter and bladder are common sites of stone. Common symptoms of kidney stone are severe, unbearable pain, nausea, vomiting, blood in urine etc. However, some people who have had kidney stones, even for a long time, may not have any symptoms (silent stone), at all.

For the diagnosis of stone, abdomen X-ray and ultrasonography are the most important investigations.

Most of the small sized stones pass out naturally with urine by taking plenty of liquids. If stone causes recurrent severe pain, recurrent infection, obstruction of urinary tract or damage to kidney, its removal is necessary. The ideal method for removal of the stone depends on the size, location and the type of stone. Most common methods for the removal of stones are lithotripsy, endoscopy (PCNL, cystoscopy and ureteroscopy) and open surgery.

Kidney stone can exist without symptoms for years.

As the risk of recurrence of stone is as high as 50 - 80%, plenty of fluid intake, dietary restriction and periodic check up are necessary for all.

Benign Prostatic Hyperplasia (BPH)

The prostate gland is present only in males. It is situated just underneath the bladder and surrounds initial portion of urethra. The prostate gland begins to enlarge after the age of 50. Enlarged prostate compresses the urethra and causes problems in urination in elderly males.

The main symptoms of benign prostatic hyperplasia (BPH) are frequent urination (especially at night) and dribbling at the end of the urination. Examination by inserting a finger in rectum (digital rectal examination) and ultrasound are two most important diagnostic methods for BPH.

A large number of patients with mild to moderate symptoms of BPH can be treated effectively for a long period with medicine. Many patients with severe symptoms and very large prostate need endoscopic removal of prostate (TURP).

BPH is the most common cause of urinary problems in elderly male.

Chapter 6

Myths and Facts about Kidney Diseases

Myth: All kidney diseases are incurable

Fact: No, all kidney diseases are not incurable. With early diagnosis and treatment many kidney diseases can be cured. In many, it slows or halts the progression.

Myth: Kidney failure can occur if one kidney fails.

Fact: No, kidney failure occurs only when both kidneys fail. Usually people do not have any problem if one kidney fails completely, and in such cases, value of blood urea and serum creatinine in blood tests are normal. But when both kidneys fail, waste products accumulate in the body and the raised level of blood urea and serum creatinine in blood test suggests kidney failure.

Myth: In kidney disease the presence of edema suggests kidney failure.

Fact: No. In certain kidney diseases edema is present, but kidney function is totally normal (e.g. nephrotic syndrome).

Myth: Edema is present in all patients with kidney failure.

Fact: No. Edema is present in majority of patients with kidney failure, but not in all. A few patients do not have edema even in advance stage of kidney failure. So the absence of edema does not rule out kidney failure.

Myth: All patients with kidney disease should drink a large amount of water.

Fact: No. Reduced urine output leading to swelling is an important feature of many kidney diseases. So water restriction is necessary to maintain water balance in such patients with kidney disease. However, patients suffering from stone disease and urinary tract infection with normal renal function are advised to drink a large amount of water.

Myth: I am all right, so I don't think I have a kidney problem.

Fact: Most of the patients are asymptomatic (showing no symptoms) in early stages of chronic kidney disease. Abnormal values in laboratory tests are the only clue of its presence at this stage.

Myth: I feel fine, so I don't need to continue treatment for my kidney problem.

Fact: Many patients with chronic kidney disease (CKD) feel very well with proper therapy, and so they discontinue medicine and dietary restrictions. Discontinuation of therapy in CKD can be dangerous. It can lead to rapid worsening of kidney failure and in a short time such patients may reach the stage needing dialysis / kidney transplantation.

Myth: My serum creatinine level is slightly above normal. But I am perfectly well so there's nothing to worry about.

Fact: Even mild increase in serum creatinine is an indicator of kidney impairment and needs attention. A variety of kidney diseases can damage the kidneys, so the nephrologist should be consulted without delay. Let us understand the importance of raised value of serum creatinine (even a little) at different stages of chronic kidney disease.

Early stage of chronic kidney disease is usually asymptomatic, and increased value of serum creatinine may be the only clue of underlying kidney disease. Serum creatinine level of 1.6 mg/dl means over 50% of kidney function is already lost, which is significant. Detection of chronic kidney disease and initiation of proper therapy at this stage is most rewarding. Treatment under the care of a nephrologist at this stage of chronic kidney disease helps to preserve kidney function for a very long time.

When serum creatinine level is 5.0 mg/dl, it means 80% of kidney function is lost. This value suggests seriously impaired kidney function. Proper therapy at this stage is beneficial to preserve kidney function. But it is important to remember that this is a late stage of chronic kidney

disease and an opportunity to get the best treatment outcome is unfortunately lost.

When serum creatinine level is 10.0 mg/dl, it means 90% of kidney function is lost and this value suggests end stage kidney disease. At this stage of chronic kidney disease the opportunity to treat a patient with drug therapy is almost lost. Most of the patients need dialysis at this stage.

Myth: Dialysis performed once in patients with renal failure, will subsequently become a permanent need.

Fact: No, how long a patient with kidney failure needs dialysis depends on the type of kidney failure.

Acute kidney failure is temporary and reversible type of kidney failure. A few patients of acute kidney failure need dialysis support for a short period only. With proper treatment and few dialysis the kidney usually recovers completely in acute kidney failure. Delay in dialysis because of fear of permanent dialysis can be life threatening.

Chronic kidney disease is a progressive and irreversible type of kidney failure. Advanced stage of chronic kidney disease (End Stage Kidney Disease) needs regular lifelong dialysis support.

Myth: Dialysis cures kidney failure.

Fact: No, dialysis does not cure kidney failure. Dialysis is an effective and life saving treatment in kidney failure, which removes waste products, extra water and corrects electrolytes as well as acid base disturbances. Dialysis carries out the function that kidney is no longer capable of doing. Dialysis keeps patient asymptomatic, fit and healthy in spite of severe kidney failure.

Myth: In kidney transplantation males and females cannot donate their kidney to the opposite sex.

Fact: Males and females can donate their kidney to opposite sex as the structure as well as the functions of the kidneys are same in both the sexes.

Myth: Donation of a kidney affects health and sexual function.

Fact: Kidney donation is very safe and there is no effect on health and sexual function. Kidney donors live a normal life including marital life and childbirth.

Myth: For kidney transplantation it is possible to buy a kidney.

Fact: Buying or selling a kidney is a crime. Remember that a kidney transplanted from a live unrelated kidney donor carries higher risk of rejection as compared to a live related kidney donor.

Myth: Now my blood pressure is normal so I don't need antihypertensive pills. I feel better if I don't take antihypertensive pills, so why should I take medicine?

Fact: Many patients of high blood pressure discontinue their medicine after blood pressure is controlled, as they don't have any symptoms or they feel better without antihypertensive medicines. But uncontrolled hypertension is a silent killer which in a long term can lead to serious problems like heart attack, kidney failure and stroke. So to protect vital organs of the body, it is essential to take regular medicine and control blood pressure properly even though no symptoms are noticed and the person feels apparently better.

Myth: Only males have kidneys which are located in a sac between the legs.

Fact: In males as well as in females, kidneys are located in upper and posterior part of abdomen with same size, shape and functions. In males the important reproductive organ, testes is located in a sac between the legs.

Chapter 7

Prevention of Kidney Diseases

Kidney diseases are silent killers. They may cause progressive loss of kidney function leading to kidney failure and ultimately require dialysis or kidney transplant to live healthy life. Because of high cost and problems of availability, in developing countries, only 5 -10% of kidney failure patients get treatment like dialysis and kidney transplant, while the rest die without getting any definitive therapy. Chronic kidney disease is very common and has no cure, so prevention is the only option. Early detection and treatment can often keep chronic kidney disease from getting worse, and can prevent or delay the need for dialysis or a transplant.

How to prevent kidney diseases?

Never ignore your kidneys. Important aspects about prevention and care of the kidney diseases are discussed in two categories.

1. Precautions for healthy persons.
2. Precautions for kidney patients.

Precautions for Healthy Person

Seven effective ways to keep the kidney healthy are:

1. Be fit and active

Regular exercise and daily physical activity maintains normal blood pressure and controls blood sugar. Such physical activities cut the risk of diabetes and hypertension and thus reduce the risk of chronic kidney disease.

2. Balanced diet

Eat healthy diet, full of fresh fruits and vegetables. Decrease intake

of refined foods, sugar, fat and meat in diet. Less salt after 40 years of age will help in prevention of high blood pressure and kidney stones.

3. Keep your weight in check

Maintain your weight with a balance of healthy food and proper exercise. This can help in preventing diabetes, heart disease and other conditions associated with chronic kidney disease.

4. Give up smoking and tobacco products

Smoking can lead to atherosclerosis, which reduces blood flow to the kidneys, thus decrease their ability to function at their best.

5. Beware of OTCs

Don't overuse over-the-counter painkillers on a regular basis. Common drugs such as non-steroidal anti-inflammatory drugs like ibuprofen are known to cause kidney damage and kidney failure if taken regularly. Consult a doctor to find a way to control your pain without putting your kidneys at risk.

6. Drink lots of water

Drinking sufficient water (about 3 liters per day) helps to dilute urine, eliminate all the toxic waste from the body and prevent kidney stones.

7. Annual kidney check-up

Kidney diseases are often silent diseases and do not produce any symptoms until they reach an advanced stage. The most powerful and effective but, sadly, underutilized method for early diagnosis and prevention of kidney disease is a regular kidney check-up. Annual kidney check-up is a must for high risk persons who suffer from diabetes, high blood pressure, obesity or have a history of kidney disease in the family. If you love your kidneys (and, more

importantly, yourself), do not forget to get a regular kidney checkup after the age of 40. Simple method for early detection of kidney disease is an annual blood pressure measurement, urine test and a test to measure creatinine in blood.

Precautions for Kidney Patients

1. Awareness about kidney diseases and early diagnosis

Stay alert and watch for symptoms of kidney disease. Common symptoms of kidney disease are swelling of face and feet, loss of appetite, nausea, vomiting, pallor, weakness, frequent urination, blood in urine or presence of protein in urine. In the presence of such complaints, it is advisable to consult a doctor and get tests for kidney check up.

2. Precautions in diabetics

For every diabetic patient precaution for the prevention of kidney disease is essential because diabetes is the leading cause of chronic kidney disease (CKD) and kidney failure throughout the world. About 45% of new cases of endstage kidney disease are due to diabetic kidney disease. For early diagnosis of diabetic kidney disease, a simple and effective way is three-monthly measurement of blood pressure and urine test to check for the presence of protein by dipstick (macroalbuminuria).The best and ideal test for the earliest diagnosis of diabetic nephropathy is the urine test for microalbuminuria (MA), which should be done every year. Measure blood creatinine (and eGFR) to assess kidney function at least once every year.

High blood pressure, presence of protein in urine, swelling, frequent reduction of blood sugar, reduction in insulin requirements and appearance of diabetic eye disease (diabetic retinopathy) are

important clues of kidney involvement in diabetes. Beware of these danger signals and consult your doctor.

To prevent diabetic kidney disease all diabetics should control diabetes meticulously, maintain blood pressure less than 130/80 mm. of Hg (ACE inhibitor or ARB are preferred antihypertensive drugs), reduce the amount of protein in their diet and control lipids.

3. Precautions in hypertensive ptients

Hypertension is the second most common cause of chronic kidney disease, which is preventable. As most people with high blood pressure have no symptoms, many hypertensive patients take irregular treatment or discontinue treatment. A few patients discontinue treatment as they feel more comfortable without medicine. But this is dangerous. Uncontrolled hypertension for a long term can lead to serious problems like chronic kidney disease, heart attack and stroke.

To prevent kidney disease, all hypertensive patients should take regular medication, get blood pressure checked regularly and eat a proper diet with salt restriction. The goal of therapy is to keep blood pressure less than 130/80 mm of Hg. For early diagnosis of kidney damage all hypertensive patients should check urine and blood creatinine every year.

4. Precautions in chronic kidney disease

Chronic kidney disease is a non-curable disease. But early diagnosis and subsequent dietary restrictions, regular follow up and proper treatment will slow down its progression and postpone the stage of dialysis or kidney transplantation.

Round the clock proper control of high blood pressure is the most effective measure to prevent progression of chronic kidney disease.

It is highly recommended to keep blood pressure 130/80 mm Hg or below. The best way to achieve perfect control is to monitor blood pressure regularly at home and maintain a chart, which would help the doctor to adjust blood pressure medication.

In patients with CKD, factors such as hypotension, dehydration, urinary tract obstruction, sepsis, nephrotoxic drugs etc. should be identified. Prompt management of these factors leads to improvement in kidney status even in CKD.

5. Early diagnosis and treatment of polycystic kidney disease

Autosomal dominant polycystic kidney disease (ADPKD) is the most common and serious hereditary disorder of the kidney, accounting for 6-8% of patients on dialysis. An adult with a family history of polycystic kidney disease is at a high risk and should be considered for screening by an ultrasound examination for early diagnosis of the disease. PKD has no cure but measures such as controlling high blood pressure, treatment of urinary tract infections, dietary restrictions and supportive treatment help to control symptoms, prevent complications and slow down the rate of decline in kidney functions.

6. Early diagnosis and treatment of urinary tract infection in children

Urinary tract infection (UTI) should be suspected whenever a child gets unexplained fever, frequent urination, painful burning urination, poor appetite or poor weight gain.

It is important to remember that each UTI, especially with fever carries the risk of damage to the kidney, particularly if undiagnosed, treated late or treated incompletely. Such damage includes kidney

scars, poor kidney growth, high blood pressure and kidney failure later in life. For this reason urinary tract infections in children need not only early diagnosis and prompt treatment, but also careful evaluation to identify underlying predisposing abnormalities or risk factors. Vesicoureteral reflux (VUR) is the most common predisposing cause present in about 50% of urinary tract infections during childhood. Follow up is mandatory in all children with UTI.

7. Recurrent urinary tract infection in adults

All patients of urinary tract infection with recurrence or inadequate response to therapy need to identify the underlying predisposing factors. Certain underlying causes (e.g. urinary tract obstruction, stone disease etc) carry the risk of damage to the kidney, if untreated. So early diagnosis and treatment of underlying causes is important.

8. Proper management of stone diseases and BPH

A large number of patients with stone diseases are asymptomatic and therefore they fail to notice the disease and miss the diagnosis and treatment in time. Many elderly males with benign prostatic hypertrophy (BPH) neglect their symptoms for a long period. Untreated stone diseases and BPH can cause damage to kidney. Proper follow up and timely treatment will help to protect the kidney.

9. Do not ignore hypertension at young age

Hypertension at young age is uncommon and almost always needs intense search for the underlying cause. Kidney diseases are the most likely causes of severe hypertension in the young. In each and every young patient with hypertension, proper evaluation is mandatory for early diagnosis of kidney disease and proper therapy to protect the kidney.

10. Early treatment of acute kidney failure

Important causes of acute kidney failure (sudden reduction of kidney function) are diarrhea, vomiting, falciparum malaria, hypotension, sepsis, certain drugs (ACE inhibitor, NSAID's) etc. Early and proper treatment of these causes can prevent kidney failure.

11. Cautious use of medicine

Be vigilant. Many 'over-the-counter' drugs (especially analgesics and pain killers) carry risk of kidney damage, especially in the elderly. Such drugs are widely advertised, but the likely harmful consequences are rarely disclosed. Avoid the use of over the counter analgesics (pain killers) for headache and body ache. Avoid self medication and unnecessary medicines. Medicines taken under the guidance and supervision of a doctor are safe. It is a wrong belief that all natural medicines (Ayurvedic medicines, Chinese herbs etc.) and dietary supplements are harmless. Heavy metals in Ayurvedic medicines can cause damage to the kidney.

12. Precautions in solitary kidney

Persons with a single kidney live normal healthy life. Because they do not have a spare (second) kidney, certain precautions need to be taken.

The patient should keep blood pressure under control, take plenty of fluids, maintain a healthy diet, restrict salt intake, avoid high-protein diets and avoid injury to the solitary kidney. The most important precaution is to have regular medical checkups. One definitely must consult a doctor once a year to monitor kidney function by checking blood pressure, testing urine and blood and undergo ultra sonogram test, if needed.

Part 2

Major Kidney Diseases and their Treatment

- **Prevention, diagnosis and treatment of kidney failure.**
- **Basic information about dialysis.**
- **Basic information about kidney transplantation.**
- **Important information about major kidney diseases.**
- **Precaution and selection of diet in patients with chronic kidney disease.**

Chapter 8

What is Kidney Failure?

Major functions of the kidney are to filter and excrete waste products, remove excess fluids from the body and maintain the electrolyte as well as acid base balance. Reduction in the ability of the kidney to perform these tasks is known as kidney/ renal failure.

How to diagnose kidney failure?

Blood level of creatinine and urea reflects the function of the kidney. Increase in their value suggests reduction in the adequate functioning of both the kidneys. It is important to remember that even a slight rise in the serum creatinine reflects significant reduction in kidney function. If the value of serum creatinine is just 1.6 mg/dl, it suggests over 50% loss of kidney function.

Can failure of one Kidney lead to kidney failure?

No. Failure or removal of one out of the two kidneys does not affect the overall kidney function because the other healthy kidney takes over the work load of both the kidneys.

Two major types of kidney failure

Acute kidney failure and chronic kidney disease (chronic kidney failure).

Acute Kidney Failure

In acute kidney failure (previously known as acute renal failure - ARF and recently named as acute kidney injury- AKI), the kidney function is

Kidney failure means loss of functions of both kidneys.

reduced or lost within a short period due to a variety of insults to the body. This type of kidney failure is usually temporary. With proper treatment kidney functions return to normal in most patients.

Chronic Kidney Diseases

Gradual progressive and irreversible loss of kidney function over several months to years is called chronic kidney disease (previously known as chronic kidney failure - CRF). In this non- curable disease, kidney function reduces slowly and continuously. After a long period it reduces to a stage where the kidney stops working almost completely. This advanced and life threatening stage of disease is called end stage kidney disease - ESKD (or end stage renal disease - ESRD).

When kidney failure is diagnosed,
over 50% of kidney function is already lost.

Chapter 9

Acute Kidney Failure

What is acute kidney failure?

In acute kidney failure (acute kidney injury or acute renal failure-ARF) reduction or loss of kidney functions occur within a short period (over hours, days or weeks) and is temporary, and usually reversible.

What causes acute kidney failure?

Acute kidney failure may occur due to many causes. Important causes are:

1. Reduced blood supply to the kidneys: severe dehydration due to diarrhea, blood loss, burns or fall in blood pressure due to a variety of reasons.
2. Severe infection, serious illness or after a major operation.
3. Sudden blockage of the passage of urine: a kidney stone is the most common cause of urinary tract obstruction.
4. Other important causes: Falciparum malaria, leptospirosis, snake bite, certain kidney diseases, pregnancy, complications and side effects of some medication (NSAIDs, aminoglycosides, radio contrast etc).

Symptoms of acute kidney failure

In acute kidney failure, kidney function worsens within a short period leading to rapid accumulation of waste products and disturbances in fluid and electrolyte balance. Because of the sudden interruption in kidney function, the patient develops early and significant symptoms.

Acute kidney failure is a rapid and usually temporary loss of kidney functions.

The type of symptoms and their severity differ from patient to patient.

1. Symptoms due to underlying condition (diarrhea, blood loss, fever, chills etc.) causing kidney failure.
2. Decreased urine output (though urine output remains normal in a few patients). Fluid retention causes swelling of ankles or feet and weight gain.
3. Loss of appetite, nausea, vomiting, hiccups, fatigue, lethargy and confusion.
4. Severe and life threatening symptoms such as breathlessness, chest pain, convulsions or coma, vomiting of blood and abnormal heart rhythm due to high potassium.
5. In the early stage of acute kidney failure some patients are symptom free and the disease is detected accidently when blood tests are done for other reasons.

Diagnosis of acute kidney failure

Many patients with acute kidney failure have nonspecific symptoms or are asymptomatic. So in patients with disease which can cause acute kidney failure or in the case of slightest doubt regarding symptoms, one must always suspect and investigate for acute kidney failure.

Diagnosis of kidney failure is confirmed by blood tests (rise in creatinine and blood urea), urine output measurements, urine test and ultrasound. In patients of acute kidney failure detailed history, examination and different investigations are performed to evaluate causes, complications and progress of the disease.

Treatment of acute kidney failure

With proper management acute kidney failure can be cured completely

Symptoms of acute kidney failure are due to both underlying causes and severe kidney problems.

in most patients. But delay or improper treatment of severe acute kidney failure can be life threatening.

Major steps for the management of acute kidney failure are:

1. Correction or treatment of the causes of kidney failure
2. Drug therapy and supportive measures
3. Dietary advice
4. Dialysis

1. Correcting/ treating the causes of kidney failure:

- Identification and treatment of the underlying cause is the most important aspect of management of acute kidney failure.
- Specific treatment of underlying causes such as hypotension, infection, urinary tract obstruction etc. is essential for recovery from kidney failure.
- Such therapy prevents further damage to the kidney and subsequently allows it to recover.

2. Drug therapy and supportive measures:

- The goal is to support the kidneys and to prevent or treat any complications.
- Treatment of infections and avoidance of drugs which are toxic and harmful to the kidney (e.g. NSAIDs).
- The use of diuretics: drugs such as frusemide help to increase the volume of urine and prevent swelling of the body as well as breathlessness.
- Supportive therapy: drugs are given which help to correct low or high blood pressure, control nausea and vomiting, control blood potassium, reduce breathlessness and control convulsion.

In acute kidney failure kidney usually recovers completely with proper treatment.

3. Dietary advice

- Proper dietary restriction prevents or reduces symptoms or complications of acute kidney failure.
- Measured fluid intake. Daily fluid intake should be planned, keeping in mind urine volume and body fluid status. Usually restriction of fluid is necessary to prevent edema and complications such as breathlessness.
- Restriction of potassium intake. Avoid potassium rich food e.g. fruits, fruit juices, dry fruits etc. to prevent high potassium level in blood (hyperkalemia), which is a very serious life threatening complication of acute kidney failure.
- Restriction of salt intake. Salt restriction helps to reduce thirst, edema and complications such as high blood pressure and breathlessness.
- Provide adequate nutrition and caloric supplementation.

4. Dialysis

Short term replacement of the kidney function by dialysis (artificial kidney) may be necessary in a few patients of acute kidney failure till the kidney recovers its function.

What is dialysis?

Dialysis is the artificial process to replicate the functions of the damaged kidney. It helps to sustain life in people with severe kidney failure. The most important functions of dialysis are to remove wastes, remove excess fluid and correct acidosis and electrolyte disturbances. There are two main types of dialysis - hemodialysis and peritoneal dialysis.

In acute kidney failure with early and proper drug therapy kidney can recover without dialysis.

When is dialysis needed in acute kidney failure?

Dialysis is needed in certain patients with severe form of acute kidney failure where symptoms and complications of acute kidney failure increase inspite of adequate conservative management. Dialysis maintains good health inspite of severe kidney failure. Severe fluid overload, uncontrollable hyperkalemia, severe acidosis are the most common indications of dialysis in acute kidney failure.

For how long is dialysis treatment needed in acute kidney failure?

- Certain patients of acute kidney failure need temporary dialysis (hemodialysis or peritoneal dialysis) support till kidney function recovers.
- Patients of acute kidney failure usually recover within 1 - 4 weeks, during which they need dialysis support.
- Dialysis performed once in patients with renal failure, will subsequently become a permanent need is a wrong concept in acute kidney failure. Delay in dialysis because of fear of permanent dialysis can be life threatening in acute kidney failure.

Prevention of acute kidney failure

- Early treatment of potential causes and frequent check up of kidney functions in such patients.
- Prevention of hypotension and its prompt correction.
- Avoid nephrotoxic drugs and treat infection and reduced urine volume quickly.

Need of dialysis is only for a few days,
but delay in dialysis can be life threatening.

Chapter 10

Chronic Kidney Disease: Causes

Amongst different kidney diseases chronic kidney disease (CKD) is a dreaded disease for which medical science has no remedy. Chronic kidney disease and kidney failure are increasing at an alarming rate all over the world. One in ten persons has some form of chronic kidney disease. Rising prevalence of diabetes, hypertension, obesity, smoking, and high cholesterol is major reason for increasing incidences of CKD.

What is chronic kidney disease?

Gradual and permanent loss of kidney function over months to years is called chronic kidney disease (CKD). Raised value of serum creatinine in blood tests, and on sonography both kidneys small and contracted are the hallmarks of chronic kidney disease.

Chronic renal failure (CRF) is a previously used popular term which is almost synonymous with CKD. CKD is a better term as the word kidney failure creates wrong impression that the kidneys have totally stopped working. In most cases of CKD this is not so. In most people who have CKD there is only a mild or moderate reduction in kidney function but the kidneys have not actually 'failed'.

What is end stage kidney disease?

Advanced stage of chronic kidney disease (Stage 5 CKD) is also referred to as kidney failure, endstage kidney disease (ESKD), or end-stage renal disease (ESRD). In the end stage kidney disease there is

Chronic kidney disease is a gradual, progressive and permanent loss of kidney functions.

complete or almost complete loss of kidney functions. End-stage kidney disease usually occurs as CKD worsens to the point where kidney function is less than 10% of the normal. Endstage kidney disease is irreversible. It cannot be controlled by conservative management alone, and requires dialysis or kidney transplantation to maintain life.

What causes chronic kidney disease?

A number of conditions can cause permanent damage to the kidneys. But the two main causes of chronic kidney disease are diabetes and high blood pressure. They account for about two third cases of CKD. Important causes of chronic kidney disease are:

1. Diabetes. Diabetes is the most common cause of kidney failure, accounting for nearly 35-40 % of all chronic kidney diseases. Roughly every third person with diabetes is at the risk of contracting chronic kidney disease!
2. High blood pressure. Untreated or poorly treated high blood pressure is the leading cause of CKD accounting for nearly 30 % of all chronic kidney diseases. Whatever may be the cause of CKD, high blood pressure will definitely cause further damage to kidney function.
3. Glomerulonephritis. These disorders are the third in line of ailments that cause most chronic kidney diseases.
4. Polycystic kidney disease. This is the most common hereditary cause of CKD characterized by multiple cysts in both kidneys.
5. Other causes: ageing of the kidneys, renal artery stenosis (narrowing), blockages to the flow of urine by stones or an enlarged prostate, drug-induced and toxin-induced kidney damage, recurrent kidney infection in children and reflux nephropathy.

Two most common causes of chronic kidney disease are diabetes and high blood pressure.

Chapter 11

Chronic Kidney Disease: Symptoms and Diagnosis

In chronic kidney disease (CKD), the time taken for the loss of kidney function ranges from months to years and therefore the body gets adjusted to the ill-effects of CKD. Additionally, the kidney has remarkable ability to compensate for the problems in its function. Because of these reasons most people with chronic kidney disease do not show symptoms until the kidney function is impaired severely.

Kidneys perform so many different functions (removal of waste products and excess fluid, control of blood pressure, balance chemicals, RBC production etc) for the body. Therefore, depending on the extent of disturbances in different kidney functions, clinical problems and symptoms differ widely from person to person in CKD.

What are the symptoms of chronic kidney disease?

Symptoms of chronic kidney disease vary as per the severity of the disease. For proper understanding and better management strategies, CKD is divided into five stages on the basis of the value of glomerular filtration rate (GFR). GFR reflects how well kidneys are filtering waste from blood, and it can be estimated from the value of creatinine in blood test. GFR is an accurate measure of kidney function and its normal value is greater than 90 ml/min.

Stage	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5
	Normal GFR	Mild CKD	Moderate CKD	Severe CKD	End Stage CKD
GFR	> 90 ml/min	60-89 ml/min	30-59 ml/min	15-29 ml/min	<15 ml/min

In early stage of CKD most people don't have any symptoms.

CKD Stage 1 (kidney function 90-100 %)

Earliest asymptomatic stage of CKD with no kidney damage (serum creatinine normal). Stage 1 CKD can be detected only through routine laboratory measurements or incidental diagnosis while evaluating other diseases. Clues for the Stage 1 CKD may be loss of protein in urine, structural damage seen on an X-ray, ultrasound, MRI or CT, or family history of polycystic kidney disease.

CKD Stage 2 (kidney function 60-89%)

Mild CKD. Patients may be asymptomatic but clues for Stage 2 CKD may be nocturia, elevated blood pressure, urine abnormalities and normal or slightly higher serum creatinine.

CKD Stage 3 (kidney function 30-59%)

Moderate CKD. Patients may be asymptomatic or mild symptoms may be present along with urine abnormalities and elevated serum creatinine.

CKD Stage 4 (kidney function 15-29%)

Severe CKD. In Stage 4 CKD there is a wide range of symptoms varying from mild vague and nonspecific symptoms to quite severe symptoms, often depending on the underlying cause of kidney failure and associated illnesses.

CKD Stage 5 (kidney function less than 15%)

Very severe or end stage kidney failure. In Stage 5 CKD there is a wide range of symptoms varying from moderate or severe symptoms to life threatening complications. At this stage, inspite of vigorous drug

Severe uncontrolled high blood pressure at a young age is a common presentation of CKD.

therapy, sign symptoms of kidney failure increase and most of the patients need dialysis or kidney transplantation.

Common symptoms of kidney diseases are

- Loss of appetite, nausea and vomiting.
- Weakness, fatigue and weight loss.
- Swelling (edema) in lower legs, hands or face around the eyes.
- High blood pressure, especially at young age, or severe uncontrolled hypertension.
- Pallor caused by anemia due to decreased erythropoietin production by kidney.
- Sleep problems, lack of concentration and dizziness.
- Itching, muscle cramps or restlessness and lack of concentration
- Pain in the back just below the ribs.
- Urge to pass urine more often than usual, especially at night (nocturia).
- Pain in bones and fractures in adults and retarded growth in children due to decreased production of active form of vitamin D by kidney.
- Decreased sexual interest and erectile dysfunction in males and menstrual disturbances in females.
- Kidney disease is strongly associated with marked increase in cardiovascular deaths.

When to suspect CKD in a person suffering from high blood pressure?

In persons with high blood pressure (hypertension) suspect CKD if:

CKD is a important cause of low hemoglobin not responding to treatment.

- Age is less than 30 or more than 50 at the time of diagnosis of hypertension.
- If blood pressure is very high at the time of diagnosis (i.e. more than 200/120 mm of Hg).
- Sever uncontrolled high blood pressure even with regular treatment.
- Vision problem due to hypertension.
- Presence of protein in urine.
- Hypertension is associated with symptoms suggesting CKD such as presence of swelling, loss of appetite, weakness etc.

What are the possible complications of advanced stage of chronic kidney disease?

Progressive severe kidney failure in CKD can lead to life threatening complications. Potential complications are:

- Severe difficulty in breathing and chest pain due to marked fluid retention, especially in lungs (pulmonary edema), and very high blood pressure.
- Severe nausea and vomiting.
- Severe weakness.
- Central nervous system complications: confusion, extreme sleepiness, convulsion and coma.
- High levels of potassium in the blood (hyperkalemia), which could impair the heart's ability to function; this could be life-threatening.
- Pericarditis, an inflammation of the sac-like membrane that envelopes the heart (pericardium).

Weakness, loss of appetite, nausea and swelling are common early symptoms of CKD.

Diagnosis of chronic kidney disease

Chronic kidney disease usually shows no symptoms in its early stages. Only lab tests can detect any developing problems. Order a lab test when CKD is suspected on the basis of clinical status or as a routine evaluation of high risk person for chronic kidney disease. Three simple screening tests for the CKD are blood pressure measurement, urine test for albumin and serum creatinine blood test.

1. Hemoglobin

In the blood test of a person with CKD hemoglobin is usually low. Low hemoglobin (anemia) is due to decreased erythropoietin production by kidney.

2. Urine test

The presence of albumin or protein in the urine (called albuminuria or proteinuria) is an early sign of chronic kidney disease. Even small amounts of albumin in the urine, called microalbuminuria, may be the earliest sign of chronic kidney disease in diabetics. The presence of protein in urine could be due to fever or heavy exercise. Therefore, it is best to exclude other causes of proteinuria before stamping diagnosis of CKD.

3. Serum creatinine, blood urea nitrogen and eGFR

These are simple and most commonly used blood tests to diagnose and monitor kidney failure. With the worsening of kidney function, the value of creatinine and urea increases. Regular monitoring of creatinine helps to assess progression and treatment response in CKD.

Three simple tests can save your kidneys.
Check blood pressure, urine for protein and eGFR.

The level of creatinine in the blood is a useful guide to kidney function, but estimated GFR (eGFR) is a more accurate measure. The eGFR test detects kidney disease in its early stages and is more reliable than the creatinine test alone. The eGFR is calculated from age, sex and blood creatinine level. The eGFR test is useful to diagnose and monitor the progression and severity of CKD. On the basis of eGFR, CKD is divided into five stages. This staging is useful to recommend additional testing and suggestions for proper management.

4. Ultrasound of kidney

Ultrasound is a simple and very effective test in the diagnosis of chronic kidney disease. Shrunken kidneys are diagnostic of chronic kidney disease. However, normal or even large kidney size is found when CKD is caused by adult polycystic kidney disease, diabetic nephropathy and amyloidosis. Ultrasound is also used to diagnose CKD due to urinary obstruction or kidney stones.

5. Other tests

CKD causes disturbances in different functions of the kidneys. To evaluate these disturbances different tests are performed. Frequently performed different blood tests in patients with CKD are tests for electrolyte and acid-base balance (sodium, potassium, magnesium, bicarbonate), tests for anemia (hematocrit, ferritin, transferrin saturation, peripheral smear), tests for bone disease (calcium, phosphorus, alkaline phosphatase, parathyroid hormone), other general tests (serum albumin, cholesterol, triglycerides, blood glucose and hemoglobin A1c) and ECG and echocardiography.

Small and contracted kidneys, seen on ultrasound, are the hallmark sign of chronic kidney disease

When should a patient with CKD contact the doctor?

Patient with CKD should contact the doctor immediately if he or she develops:

- Rapid unexplained weight gain, marked reduction in urine volume, aggravation of swelling, shortness of breath or difficulty in breathing while lying down in bed.
- Chest pain, very slow or fast heart rate.
- Fever, severe diarrhoea, severe loss of appetite, severe vomiting, blood in vomiting or unexplained weight loss.
- Severe muscle weakness of recent origin.
- Development of confusion, drowsiness or convulsion.
- Recent worsening of well controlled high blood pressure.
- Red urine or excessive bleeding.

Fever, development of newer symptoms or rapid worsening of kidney symptoms needs urgent attention

Chapter 12

Chronic Kidney Disease: Treatment

The three treatment options in chronic kidney disease are medical management, dialysis or transplant.

- All patients with chronic kidney disease are treated initially by medical management (medicine, dietary advice and monitoring).
- Severe damage in chronic kidney disease (end stage kidney disease) requires kidney replacement by dialysis or transplant.

Medical Management

Why is medical management very important in CKD?

There is no cure for chronic kidney disease. Advanced CKD needs dialysis or kidney transplant to maintain life. Because of the high cost and problems of availability, in India only 5 -10% of kidney patients get treatment like dialysis and kidney transplant, while the rest die without getting any definitive therapy. So early detection and meticulous conservative medical management is the only feasible and less expensive way to treat CKD and delay the need for dialysis or transplant.

Why do many people with CKD fail to take benefit of medical management in CKD?

Initiation of proper therapy at early stages of chronic kidney disease is most rewarding. Most of the patients are asymptomatic or feel very well with proper therapy in early stages of chronic kidney disease. Because of the absence of symptoms many patients and their family fail to recognize the seriousness of the disease and discontinue medicine and dietary restrictions. Discontinuation of therapy may lead to rapid

In CKD with early medical management patients can live a long life.

worsening of kidney failure. Such patients may in a short duration need expensive treatment modality such as dialysis or kidney transplant.

What are the aims of medical management in CKD?

Chronic kidney disease is a progressively deteriorating condition with no cure. The aims of medical management are to:

1. Slow down the progression of the disease
2. Treat underlying causes and contributing factors
3. Relieve symptoms and treat complications of the disease
4. Reduce the risk of developing cardiovascular disease
5. Delay the need for dialysis or transplant

What are the treatment strategies in different stages of CKD?

Treatment strategies and recommended actions in different stages of chronic kidney disease are summarized in the Table.

Stage	Recommended Action
All Stages	• Regular follow up and monitoring • Life style changes and general measures:
1	• Diagnose/treat to slow down the progression • Educate patients on disease management • Treat comorbid conditions, cardiovascular disease risk reduction
2	• Estimate progression; treat co-morbid conditions
3	• Evaluate/treat complications; refer to nephrologist
4	• Educate patients on kidney replacement options Prepare for kidney replacement therapy
5	• Kidney replacement by dialysis or transplant

Chronic kidney disease is not curable,
but early treatment is most rewarding.

Nine Steps of Action Plan in Medical Management of CKD

1. Management of Primary Etiology

Identify and treat underlying primary conditions mentioned below. This may delay, prevent, or reverse the progression of CKD.

- Diabetes mellitus and hypertension
- Urinary tract infection or obstruction
- Glomerulonephritis, renovascular disease, analgesic nephropathy etc.

2. Strategies to Slow Down the Progression of the CKD

In chronic kidney disease important and effective measures to slow down the progression of kidney disease are:

- Strict blood pressure control and ACE inhibitor or angiotensin II receptor–blocker therapy
- Protein restriction
- Lipid lowering therapy and correction of anemia

3. Supportive and Symptomatic Treatment

- Water pill (diuretics) to increase volume of urine and reduce swelling
- Drugs to control nausea, vomiting and gastric discomforts
- Supplementation of calcium, phosphate binders, active form of vitamin D and other drugs to prevent and correct CKD related bone disease
- Correction of low hemoglobin (anemia) with iron, vitamins and special erythropoietin injection
- Prevention of cardiovascular events. Start Daily aspirin advised unless contraindicated

In CKD treatment of underlying causes delay the progression of CKD.

4. Management of Reversible Factors

Search and treat reversible factors that may have aggravated or exacerbated the degree of kidney failure. By correction of reversible factors kidney failure may improve, and kidney function may return to stable base level of function. The common reversible causes are:

- Volume depletion
- Kidney failure due to drugs (non steroidal anti-inflammatory drugs - NSAIDs, contrast agents, aminoglycosides antibiotics)
- Infection and congestive heart failure

5. Identify and Treat Complications of CKD

Complications of CKD require early diagnosis and immediate treatment. The common complications which need attention are severe fluid overload, high potassium level in blood (potassium > 6.0 mEq/L), and severe ill effects of advanced kidney failure on heart, brain and lungs.

6. Life Style Modification and General Measures

These measures are important in reducing overall risk:

- Stop smoking
- Maintain healthy weight, exercise regularly and remain physically active on a regular basis
- Limit alcohol intake
- Follow a healthy eating plan and reduce dietary salt intake
- Take prescribed medication as directed. Adjust doses of medication considering severity of kidney failure.
- Regular follow up and treatment as directed by nephrologist

Treatment of infection and volume depletion is most rewarding in chronic kidney disease.

7. Dietary Restrictions

Depending on the type and severity of kidney disease, dietary restrictions are needed in CKD (discussed in detail in Chapter 25).

- **Salt (sodium):** To control high blood pressure and swelling, salt restriction is advised. Salt restriction includes: not adding salt to foods at the table and avoiding salt rich food such as fast food, papad, pickles and minimizing the use of most canned foods.
- **Fluid intake:** Decreased urine volume in CKD patient can cause swelling and in severe cases even breathlessness. So fluid restriction is advised to all CKD patients with swelling.
- **Potassium:** High level of potassium is a common problem in CKD patients. It can have a serious effect on the function of the heart. To prevent this, restrict intake of potassium-rich foods (such as dry fruit, coconut water, potatoes, oranges, bananas, tomatoes etc.) as per the advice of the doctor.
- **Protein:** Patients with CKD should avoid high-protein diet because its intake may accelerate the rate of kidney damage.

8. Preparation for Kidney Replacement Therapy

- Protect veins of the left forearm (non-dominating side) as soon as CKD is diagnosed.
- No one should be allowed to use the veins of the left forearm (chosen extremity) for blood collection, IV infusions or to insert long lines.
- Educate patients and their families and prepare them for an AV fistula - preferably 6 to 12 months prior to the anticipated need for initiating hemodialysis.

In chronic kidney disease dietary restrictions delay the progression and prevent complications.

- Administration of Hepatitis B vaccination in the early stage of CKD reduces risk of Hepatitis B infection during dialysis or kidney transplantation. Four doses (0, 1, 2 & 6 months) of recombinant hepatisis B vaccine, each of double dose should be given, intramuscularly in deltoid region.
- Educate and plan for dialysis and kidney transplantation. Understand and consider benefits of pre-emptive kidney transplantation. Pre-emptive transplantation means receiving a kidney transplant from a live donor prior to initiation of dialysis.

9. Referral to a Nephrologist

A person with CKD needs early referral to a nephrologist. Early referral to a nephrologist and pre-dialysis education decreases the patient's morbidity and mortality. Early referral reduces the rate of progression to end stage kidney disease and therefore, delays the need to initiate kidney (renal) replacement therapy.

Which is the most important treatment to prevent or delay the progression of CKD?

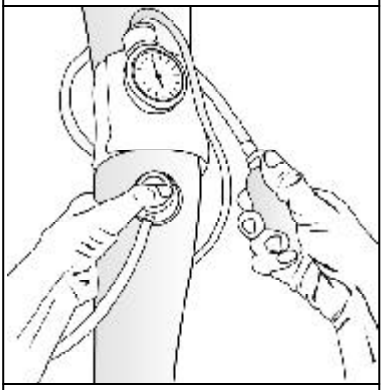
Whatever may be the underlying cause of CKD, strict control of blood pressure is the most important treatment to prevent or delay the progression of CKD. Uncontrolled blood pressure leads to rapid worsening of CKD and complications such as heart attack and stroke.

Which drugs are used to control high blood pressure?

The nephrologist or physician will select appropriate agent to control high blood pressure. The most common drugs used are angiotensin

In CKD protect veins of non-dominating forearm by avoiding blood collection or IV infusions.

Most vital treatment to protect the kidney.



Blood pressure less than 140/80

converting enzyme ("ACE") inhibitors, angiotensin receptor blockers ("ARBs"), calcium channel blockers, beta blockers and diuretics.

ACE inhibitors and ARBs are recommended as first line therapy which reduces blood pressure and has the additional special benefit of slowing the progression of chronic kidney disease and thereby, protect the kidneys.

What is the goal of blood pressure control in CKD?

CKD can cause and aggravate hypertension, which can contribute to the progression of CKD. So always keep blood pressure below 130/80 mmHg.

Which is the best method to assess and monitor blood pressure control in CKD?

Periodic visits to a doctor help to know the blood pressure status. But buying a blood pressure instrument and using it regularly at home is the best method to assess and monitor blood pressure control in CKD. Maintain a chart of blood pressure, which helps the doctor to adjust the dosage and time of its administration.

How do diuretic drugs help CKD patients?

Decrease in urine volume in CKD patients can cause swelling and even breathlessness. Diuretic drugs are medicines which help to increase the volume of urine and reduce swelling and breathlessness. It is important

to remember that these medicines increase the volume of urine but do not improve the function of the kidney.

Why does anemia occur in CKD and how is it treated?

When kidneys are functioning properly, they produce a hormone called erythropoietin, which stimulates the bone marrow to produce red blood cells. In CKD with reduction of kidney function erythropoietin production also reduces, which leads to anemia.

Iron tablets, vitamins and, at times, intravenous iron injections are the first steps to treat anemia due to CKD. Severe anemia, or anemia not responding to drug therapy, needs injections of synthetic erythropoietin, which help bone marrow to produce oxygen-carrying red blood cells. Erythropoietin injection is a safe, effective and the most preferred method of treating anemia due to CKD. Administering blood is a quick and effective method to correct anemia in an emergency but is not the preferred method due to the risk of infection and allergic reactions.

Why does anemia in CKD need treatment?

Red blood cells carry oxygen from lungs to all parts of the body which gives energy for daily activities and keeps the heart healthy. Anemia (low hemoglobin) in CKD leads to weakness, fatigue, poor exercise capacity, breathlessness, rapid heartbeat, loss of concentration, intolerance to cold and chest pain and therefore, this needs early and proper treatment.

The most important treatment to delay the progression of CKD is strict control of blood pressure (less than 130/80).

Chapter 13

Dialysis

When kidneys no longer function, dialysis is an artificial process by which waste products and unwanted water is removed from the body. It is a life saving kidney replacement therapy for patients with severe kidney failure.

How does dialysis help people with severe kidney failure?

Dialysis helps the body by performing the following functions of failed kidneys:

- Purification of blood by removal of waste products such as creatinine, urea etc.
- Removal of excess fluid and maintenance of the right amount of water in the body.
- Correction of imbalances of chemicals such as sodium, potassium and bicarbonate.

However, dialysis cannot perform the functions of normal kidneys such as maintaining normal hemoglobin by production of erythropoietin and ensuring healthy bones.

When is dialysis needed?

When kidney function reduces by 85 to 90 % (endstage kidney disease -ESKD), kidneys no longer remove enough wastes and fluid from the body and that leads to symptoms such as nausea, vomiting, fatigue, swelling and breathlessness. At this stage of CKD response to medical management is inadequate and the patient needs dialysis. A patient with CKD usually needs dialysis when blood test shows 8.0 mg/dl or more serum creatinine.

Dialysis is a prompt and effective treatment modality in symptomatic patients with severe kidney failure.

Can dialysis cure chronic kidney disease?

No. Chronic kidney disease is a incurable disease so. The patient with end stage kidney disease needs lifelong dialysis treatments unless he opts for kidney transplant. However, a patient with acute kidney failure needs dialysis support only for a short period until the kidney recovers.

What are the types of dialysis?

There are two main types of dialysis - hemodialysis and peritoneal dialysis.

Hemodialysis: Hemodialysis (HD) is the most common method used to treat end stage kidney failure. It is a process of removing waste products and excess fluid from blood using an artificial kidney and a dialysis machine.

Peritoneal dialysis: Peritoneal dialysis (PD) is an effective method of treating endstage kidney disease (ESKD). In PD a soft tube called a catheter is inserted in the abdomen. Through the catheter, dialysis solution is infused into the abdominal cavity to remove waste products and excess fluid from the body. PD is done at home, usually without a machine.

Which factors determine selection of dialysis modality in ESKD patients?

Hemodialysis and peritoneal dialysis both are effective modalities in ESKD patients. No single dialysis modality is best suited for all patients. After considering advantages and disadvantages of each dialysis modality, selection of HD or PD is made jointly by the patient, family members and the nephrologist. Major factors determining this selection are cost of therapy, age, comorbid conditions, distance of hemodialysis center, educational status, physician bias and the patient's preferences and lifestyle. Because of low cost and easy availability, hemodialysis is preferred by a large number of patients in India.

Dialysis can not cure kidney failure, but helps patients to live comfortably in spite of kidney failure.

Do dialysis patients need to restrict their diet?

Yes. Common dietary recommendations for dialysis patients are restriction of sodium, potassium, phosphorus and fluid intake. Dialysis patients must follow these dietary advices but dietary restrictions are reduced after dialysis is initiated in CKD. Most people on dialysis are advised to eat high protein diet with adequate calories, water soluble vitamins and minerals.

What is “dry weight”?

The word “dry weight” is routinely used for dialysis patients. It is the weight of a patient after all excess fluid is removed by dialysis. Value of “dry weight” needs to be adjusted from time to time the actual weight of the patient changes.

Hemodialysis

Hemodialysis (HD) is the most popular method to treat end stage kidney disease. In hemodialysis blood is purified with the help of dialysis machine and dialyzer.

How is hemodialysis done?

Most hemodialysis is performed at dialysis centers, under the care of doctors, nurses and dialysis technicians.

- The dialysis machine pumps about 300 ml of blood per minute from the body to the dialyzer through flexible blood tubing. Heparin is constantly infused to prevent clotting of blood.
- Dialyzer (artificial kidney) is a special filter which removes extra

Even after starting dialysis, dietary restrictions must be continued.

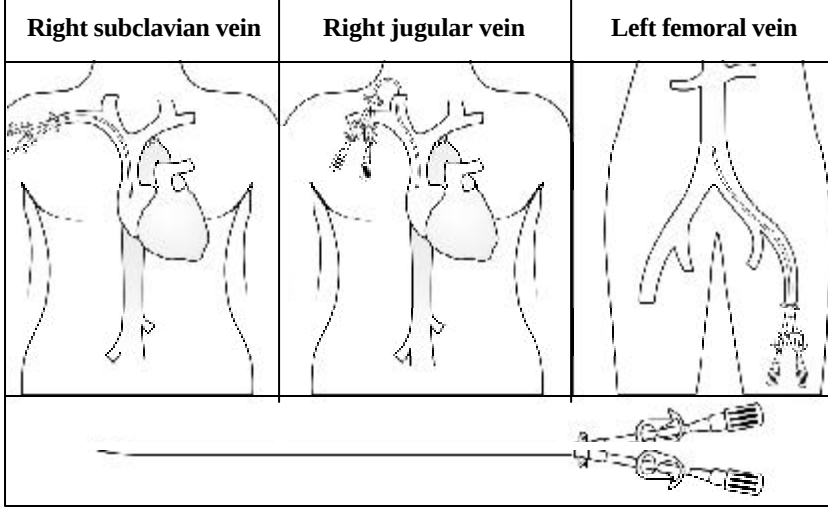
fluids and waste products. Dialyzer purifies blood with the help of special solution called dialysate which is prepared by a dialysis machine.

- Once the blood is cleaned, the machine sends it back to the body.
- Hemodialysis is carried out usually three times per week and each session lasts for about four hours.

How is the blood withdrawn for purification and returned back to the body in the process of hemodialysis?

The three most common types of vascular access for hemodialysis are central venous catheters, native arteriovenous (AV) fistulas and synthetic grafts.

Vascular Access for Hemodialysis

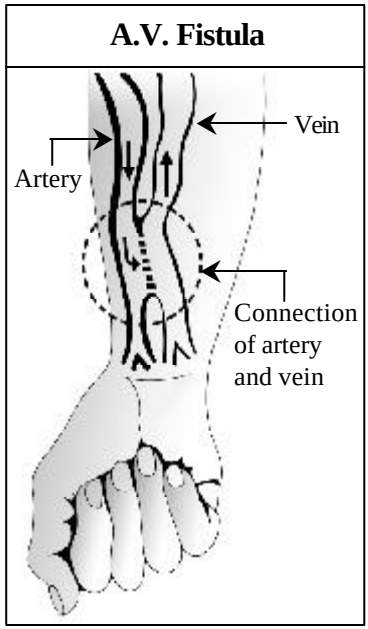


1. Central Venous Catheter

- To start hemodialysis treatment immediately, central venous catheter insertion is the most common and effective method.
- This method of vascular access is ideal for short-term use until a fistula or graft is ready.

- For hemodialysis, catheter is inserted into a large vein in either neck, chest, or leg near the groin (internal jugular, subclavian and femoral veins respectively). With this catheter more than 300 ml/min blood can be withdrawn for dialysis.
- Catheters are flexible, hollow tubes with two lumens. Blood is withdrawn from one lumen, enters the dialysis circuit, and is returned to the body via the other lumen.
- Venous catheters are commonly used for temporary access because of the risk of infection and clotting.
- Two types of venous catheters are available, tunnelled (usable for months) and non-tunnelled (usable for weeks).

2. AV Fistula



- The arteriovenous or AV fistula is the most common and the best method of vascular access for long term hemodialysis because it lasts longer, and is less likely to get clotted or infected.
- In AV fistula process an artery and a vein are surgically connected to each other. An AV fistula is usually constructed in the forearm near the wrist (connecting the radial artery to the cephalic vein).
- From an artery a large amount of blood with high pressure enters into the vein. After a few weeks or months the vein dilates and carries more blood – this process is called maturation. As AV fistula takes time to mature, it cannot be used for hemodialysis immediately after its construction.

- For hemodialysis two large-bore needles are inserted into the fistula, one to carry blood to the dialyzer and the other to return the cleansed blood to the body.
- AV fistula lasts for many years if maintained well. All usual daily activities can be easily performed with the hand having AV fistula.

Why does AV fistula need special care?

- Life of a patient with CKD- end stage kidney disease depends on regular and adequate hemodialysis. Availability of adequate amount of blood from an AV fistula is essential for adequate hemodialysis and therefore, an AV fistula is a "**Life Line**" for the patient on maintenance hemodialysis. Special care of AV fistula ensures adequate blood delivery for a long period.
- Large amount of blood with high pressure flows in the veins of AV fistula. Accidental injury to such dilated veins can lead to profuse bleeding, and sudden loss of blood in large volume can be life threatening. So special care is mandatory to protect veins of AV fistula.

Taking Care of AV Fistula

Proper regular care and protection of AV fistula ensures adequate blood delivery for years. Important precautions to keep a fistula healthy and working for longer period are as follows:

Prevent Infection

- Always keep the site of the fistula clean by washing the vascular access arm daily and before each dialysis treatment.

AV fistula is the "lifeline" in patients of CKD, without which long term hemodialysis is not possible.

Protect AV fistula

- Use access site only for dialysis. Do not let anyone give injections, draw blood or measure blood pressure from the arm with the AV fistula.
- Avoid injury to AV fistula. Don't wear jewelry, tight clothes or a wristwatch on the vascular access arm. Accidental injury to AV fistula can lead to sudden profuse bleeding, which can be life-threatening. To control bleeding, immediately apply firm pressure at the site of the bleeding with the other hand or with a tight bandage. After the bleeding is controlled, contact your doctor. Instead of making efforts to control the loss of blood, rushing to hospital for help is unwise and dangerous.
- Do not lift heavy items with the accessed arm and avoid pressure on it. Be careful; do not sleep on the arm with the A V fistula.

Ensure proper functioning of AV fistula

- Check the blood flow of AV fistula regularly by feeling the vibration (also called a thrill) three times a day (before breakfast, lunch and dinner). If vibration is absent immediately contact your doctor or dialysis center staff. Early detection of failure of AV fistula and timely intervention to dissolve or remove clot may salvage AV fistula.
- Low blood pressure carries the risk of failure of AV fistula, and therefore, should be prevented.

Regular exercise

- Regular exercise of AV fistula can lead to its maturation. Even after initiating hemodialysis, regular exercise of access arm helps to strengthen the AV fistula.

To ensure adequate blood delivery and effective long term hemodialysis, special care of AV fistula is most essential.

3. Graft

- An arteriovenous graft is another form of long term dialysis access, which can be used when persons do not have satisfactory veins for an AV fistula or have a failed AV fistula.
- In graft method, an artery is surgically connected to a vein with a short piece of synthetic soft tube which is implanted under the skin. Needles are inserted in this graft during dialysis treatment.
- Compared to an AV fistula, AV grafts are at a high risk to develop clotting, infection, and usually do not last as long as a fistula.

What are the functions of hemodialysis machine?

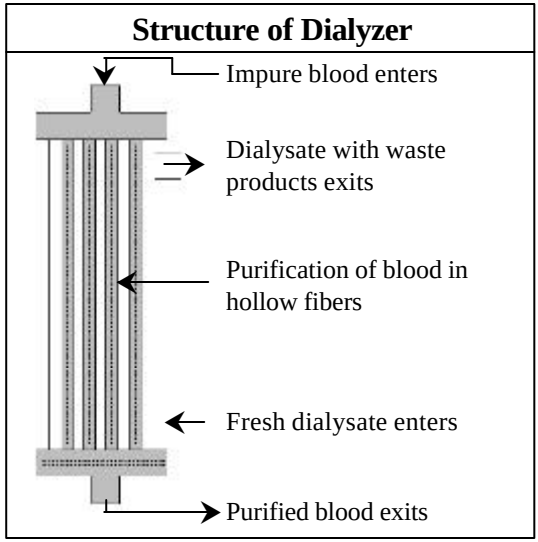
Important functions of hemodialysis machine are as follows:

- The machine pumps and monitors flow of blood from body to the dialyzer for cleaning.
- The machine prepares special dialysis solution (dialysate), which is delivered to the dialyzer for cleaning of the blood. The machine meticulously adjusts and monitors concentration of electrolytes, temperature, volume and pressure of delivered dialysate, which are modified as per the patient's need. Dialysis solution removes unwanted waste products and extra water from the body through dialyzer.
- The machine has, for the safety of the patient, various safety devices such as detection of blood leakage from the dialyzer or the presence of air in blood circuit.
- Computerized models of hemodialysis machine with display of various parameters on front screen and different alarms provide convenience, accuracy and safety to perform and monitor dialysis treatment.

Hemodialysis machine, with the help of dialyzer, filters blood and maintains fluid, electrolyte and acid base balance.

What is the structure of the dialyzer and how does it purify blood?

Structure of dialyzer

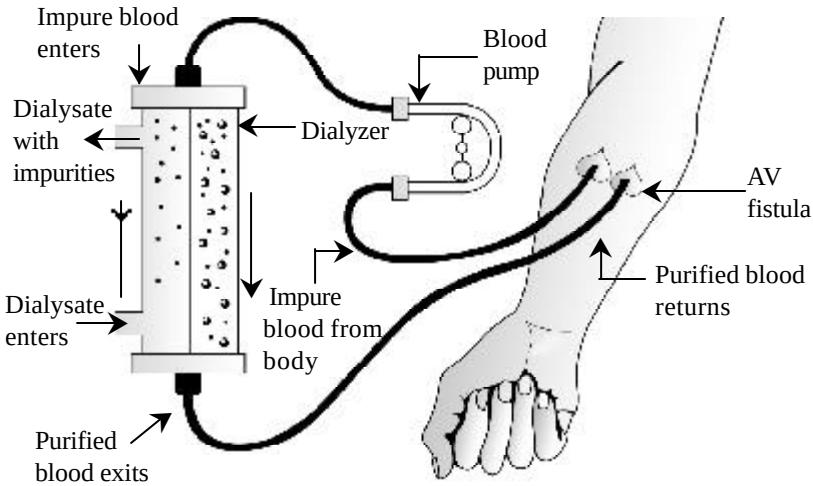


- In the process of hemodialysis, dialyzer (artificial kidney) is a filter where purification of blood occurs.
- Dialyzer is about 20 centimeter long and 5 centimeter wide clear plastic cylinder which contains thousands of tube-like hollow fibers composed of synthetic semi-permeable membrane.
- These hollow fibers are connected with each other at upper and lower end of the cylinder and form the "blood compartment". Blood enters in the "blood compartment" of hollow fibers from the opening or blood port from one end and exits from **the** other end after purification.
- Dialysis solution enters from one end of dialyzer, flows around the outside of the fibers ("dialysate compartment") and exits from the other end.

Purification of blood in dialyzer

- In the process of hemodialysis, blood pumped by the machine enters the dialyzer from one end and is distributed into thousands of capillary-like hollow fibers. Dialysis solution enters from the other end of dialyzer, flows around the outside of the fibers in the "dialysate compartment".

Process of Hemodialysis



- Every minute about 300 ml blood and 600 ml dialysis solution continuously flow in the opposite direction in dialyzer during hemodialysis. Semi-permeable membrane of the hollow fibers which separates blood and dialysis compartments allows removal of waste products and excess fluid from the blood to the dialysate compartment.
- Blood exits from the other end of dialyzer after purification. Dialysis solution with toxic substances and excess fluid which are removed from the blood exits from the end of dialyzer from which blood enters.
- In the process of hemodialysis, all the blood of the body is purified for about 12 times. At the end of four hours of hemodialysis treatment blood urea and serum creatinine reduce substantially, extra fluid in the body is removed and disturbances in electrolytes are corrected.

What is dialysate and its function in hemodialysis?

- Dialysate (dialysis solution) is special fluid used in hemodialysis to remove waste and extra fluid from the blood.

- Composition of the standard dialysate resembles normal extra cellular fluid, but as per the need of the patient, its composition can be modified.
- Dialysate is prepared by dialysis machine by mixing about 30 part highly purified water with one part dialysate concentrate.
- Dialysate concentrate is a special fluid commercially available, usually in a jar, which contains high concentrations of electrolytes, minerals and bicarbonate.
- For the preparation of dialysate, incoming raw water is purified by a sequence of processes such as sand filter, charcoal filter, water softener, reverse osmosis, deionization and ultra violet filtration.
- Water purified by these processes becomes free of dust, suspended impurities, chemical impurities, minerals, bacteria and endotoxins.
- High-quality purified water is necessary for safe dialysis as the patient is exposed to about 150 liters of water during each hemodialysis session.
- To protect hemodialysis patients from the risk of contaminants in the water, careful purification of water and subsequent monitoring of its quality is essential.

Where is hemodialysis done?

Hemodialysis is usually done in a hospital or a dialysis center by trained staff under the supervision of a doctor. In very few patients, hemodialysis treatment is done at home. Home hemodialysis is done in stable patients and needs proper training, family assistance and adequate space and finance.

Dialysate corrects electrolyte imbalance and removes waste products during the process of hemodialysis.

Is hemodialysis painful? What does the patient do during dialysis?

No. Hemodialysis is not painful, except for the pain during needle insertion. The patient on maintenance hemodialysis visits the hospital for dialysis and returns home after it is done. Patients usually spend four hours of dialysis by taking rest or sleep, reading, listening music or watching television. During dialysis patients prefer to take light snacks and hot or cold drinks.

What are the common problems during hemodialysis?

Common problems during hemodialysis are low blood pressure (hypotension), nausea / vomiting, muscle cramps, weakness and headache.

What are the advantages and disadvantages of hemodialysis?

Advantages of hemodialysis:

- Hemodialysis is done by trained nurse or technician so it is safe, less stressful and comfortable for patients.
- Hemodialysis is a faster and more efficient dialysis modality so it takes considerably less time than peritoneal dialysis.
- Hemodialysis centre provides a platform to meet and interact with other patients with similar problems. Such interaction can reduce stress and the patient can enjoy company of fellow patients.
- As hemodialysis is done only three days in a week, the patient has more free time
- There is lesser risk of infection.
- As hemodialysis is less costly than peritoneal dialysis in most of the centres.

The main advantages of hemodialysis are safety, effectiveness and comfort.

Disadvantages of hemodialysis:

- Regular travel to the center for hemodialysis is inconvenient and time consuming, especially when dialysis center is at a distant place.
- A fixed schedule must be followed for hemodialysis. The patient needs to plan all his activities considering the dialysis sessions.
- Needle insertion for the hemodialysis is painful.
- Less dietary freedom-the patient on hemodialysis needs to adhere to restrictions of fluids, salt, and potassium as well as phosphorus rich foods.
- There is a higher risk of hepatitis infection.

Do's and don'ts for hemodialysis patients

- Patients with endstage kidney disease who are on maintenance dialysis need regular, three times a week, hemodialysis. Regular dialysis is essential for long term sound health. Irregular or inadequate hemodialysis can be harmful and at times fatal.
- Restriction of fluids and salt is essential to control weight gain between two dialysis sessions. Restrict diet rich in potassium and phosphorus. Increase protein intake is essential.
- Malnutrition is common in dialysis patients and leads to poor outcome. Inadequate dietary protein and loss of protein during dialysis leads to malnutrition. So high protein diet and increased calorie intake is recommended for dialysis patients.

The main disadvantage of hemodialysis is the need to visit a hospital three times a week.

- Patients on maintenance dialysis should be supplemented with water soluble vitamins, including vitamins B and C. They shoul avoid over-the-counter multivitamins because they may not contain all required vitamins, and the vitamins present may not be in adequate dosage for the dialysis patients and may contain vitamins A, E and K or minerals, which may be harmful for dialysis patients.
- Calcium and vitamin D may be supplemented, depending on calcium, phosphorus, and parathyroid hormone levels.
- The patient should follow life style changes and general measures such as avoiding smoking, maintaining healthy weight, regular exercise, limiting alcohol intake etc.

When should a patient on hemodialysis contact the dialysis nurse or doctor?

The patient on hemodialysis should immediately contact dialysis nurse or doctor in case of :

- Bleeding from AV fistula site or catheter site.
- Vibration, bruit or thrill is not present in AV fistula.
- Unexpected weight gain, significant swelling or breathlessness.
- Chest pain, very slow or fast heart rate.
- Development of severe high blood pressure or low blood pressure.
- Patient become confused, drowsy, unconscious or develop convulsion.
- Fever, chills, severe vomiting, blood in vomiting or severe weakness.

In patients with hemodialysis restriction of fluids and salt is essential to control weight gain between two dialysis.

Peritoneal Dialysis

Peritoneal dialysis (PD) is another form of dialysis modality for the patients with end stage kidney disease which is widely accepted and effective. It is the most common method of at-home dialysis.

What is peritoneal dialysis?

- Peritoneum is a thin membrane that covers abdominal cavity and supports stomach, intestine and other abdominal organs.
- Peritoneal membrane is a natural semi-permeable membrane which allows waste products and toxins in the blood to pass through it.
- Peritoneal dialysis is a process of purification of blood through peritoneal membrane.

What are the types of peritoneal dialysis?

Types of peritoneal dialysis:

1. Intermittent Peritoneal Dialysis (IPD)
2. Continuous Ambulatory Peritoneal Dialysis (CAPD)
3. Continuous Cycling Peritoneal Dialysis (CCPD)

1. Intermittent Peritoneal Dialysis (IPD)

Intermittent peritoneal dialysis (IPD) is a valuable and effective dialysis option for short term dialysis in hospitalized patients. IPD is widely used in acute kidney failure, in children and during emergency in end stage kidney disease.

- In IPD, a special plastic catheter with multiple holes is placed in the patient's abdomen and with special solution - dialysate, dialysis is performed.

CAPD is a type of dialysis that can be carried out by patients at home with specialized fluid.

- IPD lasts for a period of 24- 36 hours and about 30 to 40 liters of dialysate solution is used up during the treatment.
- IPD is repeated at short intervals of 1 -3 days, as per the need of the patient.

2. Continuous Ambulatory Peritoneal Dialysis (CAPD)

What is CAPD?

CAPD means

C - Continuous means the process is uninterrupted (treatment without stopping for 24 hours a day, 7 days a week)

A - Ambulatory means the patient can walk around and perform routine activities

P - Peritoneal membrane in the abdomen works as a filter

D - Dialysis is a method of purification of blood

Continuous Ambulatory Peritoneal Dialysis (CAPD) is a form of dialysis which can be carried out by a person at home without the use of a machine. As CAPD provides convenience and independence it's a popular dialysis modality in developed countries.

Process of CAPD

CAPD catheter: For continuous ambulatory peritoneal dialysis (CAPD), a soft thin flexible silicon rubber tube with numerous side holes called a CAPD catheter is used. Catheter is surgically inserted into the patient's abdomen as a permanent access for peritoneal dialysis. The catheter is usually placed through the wall of the patient's abdomen about an inch below and to the side of the navel. The CAPD catheter is inserted about 10 to 14 days before CAPD starts. Like AV fistula in hemodialysis, PD catheter is the "life line" of CAPD patients.

CAPD must be carried out meticulously every day at a fixed time with no holidays.

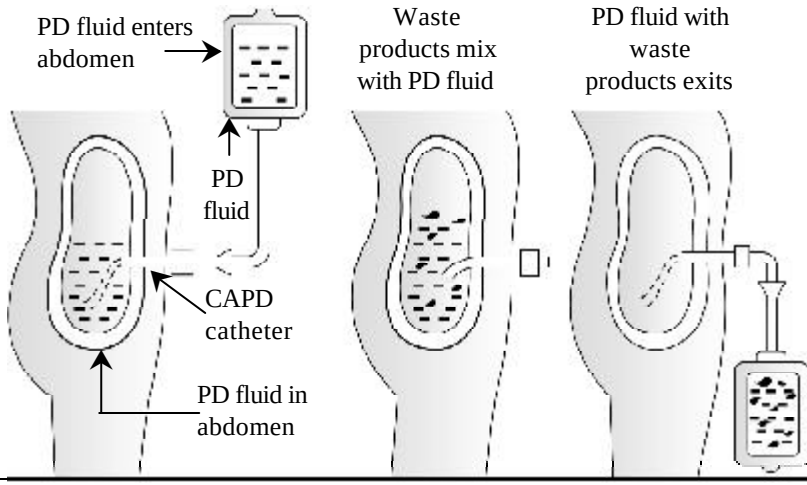
Technique of Continuous Ambulatory Peritoneal Dialysis (CAPD):

CAPD method consists of three steps: fill, dwell and drain.

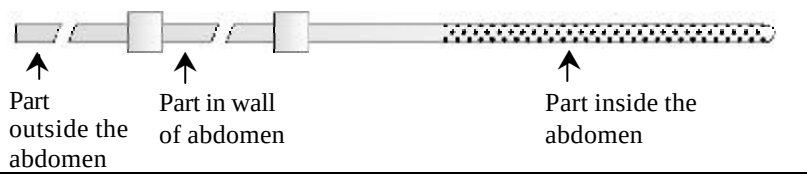
Fill: Through the catheter, two liters of peritoneal dialysis (PD) fluid from sterile plastic tubing and a bag is run into the abdomen by gravity, where it comes in contact with the peritoneum. Once the fluid is in the body, the empty bag of PD fluid is rolled up and placed in the patient's underwear until the next treatment.

Dwell: PD fluid (dialysate) remains in the peritoneal cavity for about 4 to 6 hours during the day and for about 6 to 8 hours at night. The period for which PD fluid remains in the abdomen is called the dwell time. During dwell time process of purification occurs. The peritoneum

Process of CAPD



Structure of PD catheter



works like a filter which allows waste products and extra fluid to pass from blood into the PD fluid. During this period the patient is free to walk around (hence the name of the treatment, ambulatory means walking).

Drain: After the dwell time, the PD fluid with waste products is drained out through the catheter into empty collection bag (which was rolled up and kept in the patient's underwear). Collection bag with drained fluid is weighed and subsequently discarded. The PD fluid that is drained out should be clear in color.

Draining PD fluid from the abdomen and replacing it with fresh solution takes about 30 to 40 minutes. This process of filling and emptying is called an exchange. Exchanges may be done 3 to 5 times during the day, and once during the night. The exchange at night is done right before going to sleep, and the PD fluid is left in abdomen overnight. Process of CAPD is done under strict aseptic precautions.

3. APD or Continuous Cycling Peritoneal Dialysis (CCPD):

Automated peritoneal dialysis (APD) or continuous cycling peritoneal dialysis (CCPD) is a continuous dialysis treatment carried out at home every day with an automated cycler machine. During APD, a machine automatically fills and drains the PD fluid from abdomen. Each cycle usually lasts 1-2 hours and exchanges are done four to five times. APD lasts for about 8 to 10 hours (throughout the night) while the patient is sleeping. In the morning when the machine is disconnected, two to three liters PD fluid is usually left in the abdomen. PD fluid remains in the abdomen during day time and is drained in the evening or night when cycler machine is connected. The main advantages of APD are freedom for regular activity during the day time and as the process consists of attaching and detaching the machine only once in 24 hours, it provides

Continuous Cycling Peritoneal Dialysis is carried out at home with an automated cycler machine.

comfort and reduces risk of peritonitis. The main disadvantages of APD are cost and complexity.

What is PD fluid used in CAPD?

PD fluid (dialysate) is a sterile solution, rich in minerals and glucose, used during peritoneal dialysis. Depending on the dextrose concentration, three different strengths of PD fluids are available in India (1.5%, 2.5% and 4.5%). Glucose in PD fluid allows removal of fluid from the body. Depending on the volume of fluid to be removed, different strength of PD fluid is selected for each individual. For removal of more fluid, PD fluid with higher dextrose concentration is used. Now, newer PD fluids are available which contain icodextrin instead of dextrose. Advantage of this new fluid is that it removes body fluids slowly. This solution is recommended for diabetic or overweight patients and its use is limited to one cycle per day only. The bags of PD fluid are available in different volumes, ranging from 1000 ml to 2500 ml.

What are the common problems during CAPD?

The main complications of continuous ambulatory peritoneal dialysis are:

Infection: The most common serious problem in patients undergoing CAPD is peritonitis, an infection of the peritoneum. Pain in abdomen, fever, chills and cloudy/turbid outflow of PD fluid (effluent) is common presentation of peritonitis. To avoid the problem of peritonitis, the process of CAPD should be done under strict aseptic precautions and constipation should be avoided. The treatment of peritonitis includes broad spectrum antibiotics, culture test of outflow PD fluid (which allows specific antibiotic selection) and in a few patients, removal of PD catheter may be necessary. An infection can also develop at the exit site where the catheter is inserted.

Precautions to avoid infections are of utmost importance in CAPD patients.

Other problems: Abdominal distension, weakening of the abdominal muscles causing hernia, fluid over load, scrotal edema, constipation, back pain, poor outflow drainage, leakage of fluid and weight gain are common problems in CAPD patients.

Advantages of CAPD

- Less dietary and fluid restrictions.
- More freedom. Dialysis can be carried out at home, at work or while traveling. All usual activities can be done while dialysis is taking place. CAPD can be done by the patient himself - no need of machine, hospital staff or family member.
- Freedom from three times a week fixed schedule of hospital visits, travelling and painful needle pricks.
- Better control of hypertension and anemia.
- Gentle dialysis with continuous cleaning of blood, so no ups-and-downs or discomfort.

Disadvantages of CAPD

- Risk of infection of peritoneum and catheter exit site.
- A patient should carefully carry out 3-5 exchanges in a day, for all 365 days a year, with no days off. Following all instructions and high standard of cleanliness strictly, meticulously and regularly is quite stressful.
- Permanent external catheter and fluid in abdomen is uncomfortable and change in appearance may not be acceptable to quite a few patients.
- Sugar in dialysis solution can cause weight gain and hypertriglyceridemia.
- It is rather inconvient to store and handle stock of heavy PD bags at home.

Main benefits of CAPD are freedom in location, convenience in timings and lesser dietary restrictions.

What dietary changes are recommended for a patient on CAPD?

Diet advised for a patient on CAPD is very important and is slightly different from the diet for a patient on hemodialysis.

- High protein diet is essential to avoid protein malnutrition due to continuous protein loss in peritoneal dialysis.
- Restrict calorie intake to avoid weight gain. PD solution has glucose which adds continuously extra carbohydrate to patient on CAPD.
- Less restriction of salt and fluid intake than for a patient on hemodialysis.
- Potassium and phosphate rich diet is restricted.
- Diet containing fibre is increased to prevent constipation.

When should a person on CAPD contact the dialysis nurse or doctor?

The patient on CAPD should immediately contact dialysis nurse or doctor if he/she develops:

- Pain in abdomen, fever or chills.
- Outflow PD fluid (effluent) is cloudy/turbid or bloody.
- Pain, pus, redness, swelling or warmth around exit site of CAPD catheter.
- Flow of PD fluid into or out of abdomen is blocked or constipation occurs.
- Unexpected weight gain, significant swelling, breathlessness and development of severe hypertension (suggestive of fluid overload).
- Low blood pressure, weight reduction, cramps and dizziness (suggestive of fluid deficit).

Patients on CAPD must take high protein diet to avoid malnutrition and reduce risk of infection.

Chapter 14

Kidney Transplantation

Kidney transplantation is the outcome of great advancement in medical science.

Successful kidney transplantation is the best treatment option for the endstage kidney disease (ESKD). Life after successful kidney transplantation is almost normal.

Kidney transplantation is discussed in four parts:

1. Pre-Transplant Information
2. Transplant surgery
3. Post Transplant care
4. Deceased donor (Cadaveric) kidney transplant

Pre-Transplant Information

What is kidney transplantation?

Kidney transplantation is a surgical procedure in which a healthy kidney (from a living donor or deceased - cadaver donor) is placed into the body of a person suffering from endstage kidney disease (recipient).

When is kidney transplant necessary?

Kidney transplantation is necessary for a patient who is suffering from endstage kidney disease.

When is kidney transplant not required in kidney failure?

Kidney transplantation is not necessary in acute (temporary) kidney

Discovery of kidney transplantation has been a blessing for patients with chronic kidney failure.

failure and in case of failure of one out of two normal functioning kidneys.

Why is kidney transplant necessary in endstage kidney disease?

Dialysis along with drug treatment supports the patient with endstage kidney disease, but it is not a curative treatment. Successful kidney transplantation is the most effective and the only curative treatment modality of endstage kidney disease. As kidney transplantation saves lives and enables one to enjoy almost normal life, it is referred to as the "Gift of Life".

What are the advantages of kidney transplantation?

Major benefits of kidney transplantation are:

- Total recovery and better quality of life. The patient lives almost normal and active lifestyle with more energy, stamina and productivity.
- Freedom from dialysis. Freedom from the pain, time consumption and complications of dialysis.
- Longer life. People who undergo a kidney transplantation live longer life than those who survive on dialysis.
- Lesser dietary and fluid restrictions.
- Fewer complications with a transplant. Risk of complications is higher in dialysis therapy.
- Cost effective. Initial cost of kidney transplant is high. But by the second or third year the cost of the therapy reduces for transplant recipients and is usually less than the maintenance dialysis treatment, which is rather expensive.
- Improvement in sexual life in male and higher chance of pregnancy in female.

Successful kidney transplantation is the best treatment option for CKD-ESKD as it offers almost normal life.

What are the disadvantages of kidney transplantation?

Kidney transplantation offers many benefits, but has a few disadvantages, too. These are:

- Risk of major surgery. Kidney transplantation needs major surgical procedure under general anesthesia that has potential risks both during and after the surgery.
- Risk of rejection. There is no 100% guarantee that the body will accept transplanted kidney. But with availability of newer and better immunosuppressant drugs, rejections are less likely than they were in the past.
- Regular medication. Need to take medications regularly and meticulously every day as long as the kidney works. Discontinuation, missing or not taking full dosage of immunosuppressant drugs, carries the risk of failure of transplanted kidney due to rejection.
- High risk of infections, side effects of drugs and malignancy.
- Stress. Waiting for a kidney donor before transplant, uncertainty of success of transplant (the transplanted kidney may fail) and fear of losing function of the newly transplanted kidney after transplant, is stressful.
- Initial high cost.

What are the contraindications for a kidney transplant?

Even in case of a patient who has reached end stage kidney disease, kidney transplant is dangerous and not recommended, if the patient suffers from serious active infection, active or untreated malignancy, severe psychosocial problems or mental retardation, unstable coronary

Kidney transplantation is not performed in CKD patients with AIDS, cancer and other serious diseases.

artery disease or refractory congestive heart failure, severe peripheral vascular disease and other severe medical problems.

What is the age limit for a kidney transplant recipient?

There are no fixed criteria for the age of kidney transplant recipient, but it is usually recommended for persons from 5 to 65 years of age.

What are the likely sources of kidneys for transplantation?

There are three sources of kidneys for transplantation: living related donor living unrelated donor, and deceased (cadaver) donor. Living related donors are the blood relatives of the recipient - a parent, brother or sister, son or daughter, aunt, uncle, or cousin. Living unrelated donors are spouse or a friend. Deceased (cadaver) kidneys are removed from victims of brain death.

Who is the ideal kidney donor?

Identical twins are ideal kidney donors with the best chances of survival after transplantation.

Who can donate a kidney?

Healthy persons with two kidneys can donate one kidney if blood group and tissue types are compatible with the recipient. Generally, donors should be between the ages of 18 and 65 years.

How does blood group determine the selection of a kidney donor?

Blood group compatibility is important in kidney transplantation. The recipient and donor must have either the same blood group or compatible groups as shown below:

Kidney donated by family member donors results in most successful kidney transplantation.

Recipient's blood group	Donor's blood group
O	O
A	A or O
B	B or O
AB	AB, A, B or O

Who cannot donate a kidney?

A living donor should be thoroughly evaluated medically and psychologically to ensure that it is safe for him or her to donate a kidney. Potential living donor cannot donate kidney if he or she has diabetes mellitus, cancer, HIV, kidney disease, high blood pressure or any major medical or psychiatric illness.

What are the potential risks to a living kidney donor?

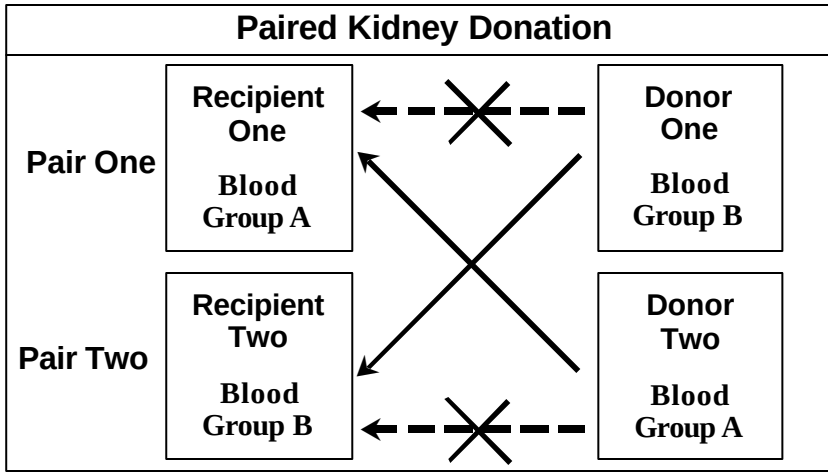
A potential donor is evaluated thoroughly to ensure that it is safe for him or her to donate a kidney. With a single kidney most donors live a normal healthy life. After kidney donation sexual life is not affected. A woman can have children and a male donor can father a child.

Potential risks of kidney donation surgery are the same as those with any other major surgery. Risk of contracting kidney disease in kidney donors is not any higher just because they have only one kidney.

What is paired kidney donation?

Living donor kidney transplantation has several advantages over deceased donor kidney transplantation or dialysis. Many patients with endstage kidney disease have healthy and willing potential kidney donors but the hurdle is blood group or cross match incompatibility.

Kidney donation is safe and saves lives of CKD patients.



Paired kidney donation (also known as "live donor kidney exchange", "living donor swap" or "kidney swap") is the strategy which allows the exchange of living donor kidneys between two incompatible donor/ recipient pairs to create two compatible pairs. This can be done if the second donor is suitable for the first recipient, and the first donor is suitable for the second recipient (as shown above). By exchanging the donated kidneys between the two incompatible pairs, two compatible transplants can be performed.

What is pre-emptive kidney transplant?

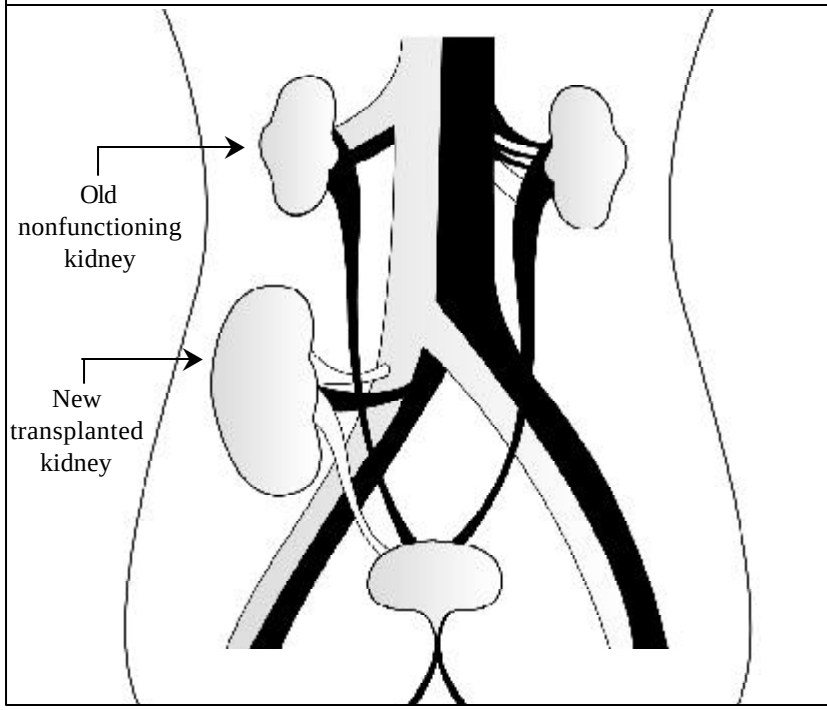
Kidney transplantation usually takes place after a variable period of dialysis therapy. A kidney transplant which takes place before the Initiation of maintenance dialysis is a pre-emptive kidney transplant. Pre-emptive kidney transplantation is considered the best option for kidney replacement therapy in medically suitable patients with end stage kidney disease (ESKD) because it not only avoids the risks, cost, and inconvenience of dialysis, but also is associated with better graft survival than transplantation performed after initiating dialysis. Because of its benefits, one is strongly advised to consider a pre-emptive transplantation in ESKD, if suitable donor is available.

Transplant Surgery

How is a kidney transplanted?

- Before surgery proper medical, psychological and social evaluation is done to ensure fitness and safety of both the recipient and the donor (in living-kidney donor transplant). Testing also ensures proper blood group and HLA matching between the recipient and the donor.

Kidney Transplantation



- Kidney transplantation is a team work of nephrologist, transplant surgeon, pathologist, anesthetist and supporting nursing staff as well as transplant coordinators.
- After thorough explanation about the procedure and careful reading of consent form, consent of both the recipient and the donor (in living-kidney donor transplant) is obtained.

- In living-kidney donor transplant surgery, both the recipient and the donor are operated simultaneously.
- This major surgery lasts from three to five hours and is performed under general anesthesia.
- In living-kidney donor transplant surgery, usually the left kidney is removed from the donor either by open surgery or by laparoscopy. After removal, the kidney is washed with a special cold solution and subsequently placed into right lower (pelvic) part of the abdomen of the recipient.
- In most cases, the old diseased kidneys of the recipient are not removed.
- When the source of kidney is a living donor, usually transplanted kidney begins functioning immediately. But when the source of kidney is deceased (cadaver) kidney donor, transplanted kidney usually takes a few days or weeks to begin functioning. The recipient with delayed functioning transplanted kidney needs dialysis until kidney function becomes adequate.
- After transplant the nephrologist looks after the patient.

Post-Transplant Care

What are the likely post-transplant complications?

Likely post transplant possible complications are rejection, infection, side effects of medication and the risk of surgical procedure.
Major considerations in post-transplant care are:

- Post-transplant medication and kidney rejection

In kidney transplantation, kidney is transplanted in lower abdomen of the recipient without disturbing old kidneys.

- Precautions after kidney transplant to keep transplanted kidney healthy and to prevent infections.

Post-transplant Medication and Kidney Rejection

How does post surgical management of kidney transplant differs from other routine surgery?

In most of routine surgery, post surgical medication and care are needed for about 7 -10 days. But after kidney transplant, lifelong regular medication and meticulous care is mandatory.

What is kidney rejection?

Immune system of the body is designed to recognize and destroy foreign objects like bacteria and viruses that may be harmful. When the recipient's body recognizes that the transplanted kidney is not 'its own', immune system attacks the transplanted kidney and tries to destroy it. This attack of the body's natural defense on a transplanted kidney is known as rejection. Rejection of the kidney occurs when a transplanted kidney is not accepted by the body of the transplant recipient.

When does kidney rejection occur and what is its effect?

Rejection of the kidney can occur at any time after the transplant, but most often occurs in the first six months. The severity of rejection varies from patient to patient. Most rejections are mild and easily treated by proper immunosuppressant therapy. But in a few patients rejection may be severe and may not respond to therapy and such severe rejection will destroy the kidney.

Major post-transplant complications are kidney rejection, infection and side effects of drugs.

What medications should a patient take after transplant to prevent rejection?

- Because of the immune system of the body, there is always a risk of rejection of the transplanted kidney.
- If the immune system of the body is suppressed completely, there will not be a risk of rejection. But the patient is likely to suffer from life threatening infection.
- Special drugs are given to patients after kidney transplantation which selectively alter the immune system and prevent rejection, but minimally affect the ability of the patient to fight against infection. Such special drugs are known as immunosuppressant drugs.
- The most widely used immunosuppressant drugs are prednisolone, cyclosporine, azathioprine, mycophenolate mofetil (MMF), tacrolimus and sirolimus.

How long does the patient need to continue immunosuppressant drugs after kidney transplant?

To prevent rejection of the kidney, immunosuppressant drugs are given lifelong. Usually several immunosuppressant medications are given initially. But the number of drugs and their dosage are reduced gradually with time.

Does the patient need any other medication after kidney transplant?

Yes. After kidney transplant, in addition to immunosuppressant drugs, antihypertensive drugs, diuretics, calcium, vitamins, medication to treat or prevent infection and anti-ulcer medication are commonly prescribed.

After kidney transplantation lifelong drug therapy is mandatory to prevent kidney rejection.

What are the common side effects of immunosuppressant drugs?

Common side effects of immunosuppressant drugs are as summarized below

Drugs	Common side effects
Prednisolone	Weight gain, high blood pressure, gastric irritation, increased appetite, increased risk of diabetes, osteo porosis, cataract
Cyclosporine	High blood pressure, mild tremor, excess hair growth, swelling of gum, increased risk of diabetes, kidney damage
Azathioprine.	Bone marrow suppression, increased risk of infection
MMF	Abdominal pain, nausea, vomiting and diarrhea
Tacrolimus	High blood pressure, diabetes, tremor, headache, kidney damage
Sirolimus	High blood pressure, low blood cell count, diarrhea, acne, joint pain, increased cholesterol, triglycerides

What happens if transplanted kidney fails?

When a transplanted kidney fails, there are two treatment options: second transplant or dialysis.

Precautions after Kidney Transplant

Successful kidney transplant provides new, normal, healthy and independent life. But it is necessary to live a disciplined life with certain precautions to protect the transplanted kidney and prevent infection.

If a transplanted kidney fails, initiation of dialysis and second transplant are two treatment options.

General guidelines to keep transplanted kidney healthy

- Never stop taking medication or modify its dosage. Remember that irregularity, modification or discontinuation of medication is one of the most common reasons for transplant failure.
- Always keep a list of your medications and maintain adequate stock. Do not take any over-the-counter drugs or herbal therapies.
- Measure blood pressure, volume of urine, weight and blood sugar (if advised by doctor) every day and record it.
- Regular follow up with doctor and laboratory tests as per advice, is mandatory.
- Get blood tested in reputed laboratory only. If laboratory reports are not satisfactory, rather than changing the laboratory, it is advisable to consult your doctor at the earliest.
- In emergency, if you need to consult a doctor who is unaware about your disease do not fail to inform him that you are a transplant recipient and brief him about the medication.
- Dietary restrictions are much less after transplant. Eat balanced diet with adequate calories and proteins as recommended and keep regular meal timings. Eat foods low in salt, sugar, and fat and high in fiber to avoid weight gain.
- Drink more than 3 liters of water every day.
- Exercise regularly and keep weight under control. Avoid heavy physical activity and contact sports e.g. boxing, football.
- Safe sexual activities can be resumed after about two months, after consulting the doctor.
- Avoid smoking and do not consume alcohol.

Keys for success in post-transplant period are regularity, precautions and watchfulness.

Precautions to prevent infections

- Stay away from crowded places such as cinemas, shopping malls, public transportation and people who have infections.
- Always wear a sterile mask in public places for the first three months of the post-transplant period.
- Always wash your hands with soap and water before you eat, before preparing or taking medications and after using the bathroom.
- Drink filtered boiled water.
- Eat fresh home-cooked cooked food in clean utensils. Avoid taking outside and uncooked food. Avoid raw fruits and vegetables for the first 3 months after transplant.
- Maintain proper cleanliness at home.
- Take good care of teeth by brushing twice a day.
- Do not neglect any cuts, abrasions or scrapes. Promptly clean them with soap and water and clean dressing.

Consult or call the doctor or transplant clinic in case of:

- Fever over 100 °F and flu-like symptoms such as chills, body aches or persistent headache.
- Pain or redness around the transplanted kidney.
- Significant decrease in urine output, fluid retention (swelling) or rapid weight gain (more than 1 kg in a day).
- Blood in the urine or burning during urination.
- Cough, breathlessness, vomiting or diarrhea.
- Development of any new or unusual symptoms.

Immediate contact of doctor and prompt therapy for any new or unusual problem is mandatory to protect kidney.

Why only a few patients with kidney failure are able to get kidney transplant?

Kidney transplant is the most effective and best treatment option for patients with chronic kidney disease - end stage kidney failure. A large number of patients need and wish to get kidney transplant. Three important reasons for its limited feasibility are:

1. Unavailability of kidney: Only a few patientsout of many are lucky to have either living (related or non-related) or deceased (cadaveric) kidney donor. Availability of a living donor is a major problem and the waiting list is very long for the deceased kidney donor.

2. Cost: Cost of transplant surgery and post transplant lifelong medicine is very high, which is a major hurdle for a large number of patients in developing countries.

3. Lack of facilities: In many developing countries facility for kidney transplantation is not available easily.

Deceased (Cadaveric) Kidney Transplantation

What is deceased kidney transplantation?

An operation in which a healthy kidney donated by a person with brain death or cardiac death is transplanted in a patient with chronic kidney disease is known as deceased or cadaver transplantation. A deceased (cadaveric) kidney comes from a person who has recently died and the person or family has expressed a wish to donate his/her organs after death.

The scarcity of kidney donors is a major hurdle which deprives patients from the benefits of a transplant.

Why deceased kidney transplantation necessary?

A large number of patients with chronic kidney disease keen and waiting for kidney transplantation are on maintenance dialysis because of the acute shortage of availability of living kidney donors. The only hope for such patients is a kidney from deceased or cadaver donor. If a person can save life of others after his or her death by donating kidney, it is the most noble human service. Deceased kidney transplant also helps to eliminate illegal organ trade.

What is "Brain Death"?

Simple understanding of "Death" is that the heart and respiration stop irreversibly and permanently. "Brain Death" is a complete and irreversible cessation (stopping) of all brain functions that lead to death. Diagnosis of "Brain Death" is made by doctors in hospitalized unconscious patients on ventilator support.

Criteria for diagnosis of brain death are:

1. The patient must be in a state of coma and the cause of the coma (e.g. head trauma, brain hemorrhage etc) is firmly established by history, clinical examination, laboratory testing, and neuroimaging. Certain medication (e.g. sedatives, anticonvulsants, muscle relaxants, anti-depressants, hypnotics and narcotics), metabolic and endocrine causes can lead to unconscious state that can mimic brain death. Such causes are excluded before confirming diagnosis of brain death. The doctor corrects low blood pressure, low body temperature and low body oxygen before considering brain death.
2. Persistent deep coma in spite of proper treatment under care of experts for an adequate period to "exclude the possibility of recovery".

In "Brain Death" damage is irreversible with no chances of improvement by any medical or surgical treatment.

3. No spontaneous breathing, patient is on ventilator support.
4. Respiration, blood pressure and blood circulation is maintained with ventilator and other life supporting device.

What is the difference between brain death and unconsciousness?

Unconscious patient may or may not need support of ventilator and is likely to recover after proper treatment. Whereas in a patient with "Brain Death", damage is severe and irreversible and he/she will not recover with any medical or surgical treatment. In patient with "Brain Death" as soon as the ventilator is switched off respiration stops and the heart stops beating. But remember that the patient is already legally dead and removing the ventilator is not the cause of death. Patients with "Brain Death" cannot remain on ventilator support indefinitely, as their heart will stop relatively soon.

Can anybody donate kidney after death?

No. Like eye donation, after death kidney donation is not possible. When death occurs the heart stops and at the same time blood supply to kidney also stops. It leads to irreversible severe damage to kidney, which prevents its use for kidney transplantation.

What are the common causes for "Brain Death"?

Common causes of brain death are head injuries (accident), intracranial brain hemorrhage, brain infarct and brain tumor.

When and how is "Brain Death" diagnosed? Who diagnoses "Brain Death"?

When a deeply comatose patient on ventilator and other life supporting

In "Brain Death" the body's respiration and blood circulation are artificially maintained after death.

device for adequate period does not show any improvement on clinical and neurological examination, possibility of "Brain Death" is considered. Diagnosis of brain death is made by a team of doctors who are not involved in kidney transplantation. This team of doctors consists of a treating physician of the patient, a neurophysician, a neurosurgeon etc. who after independent examination of the patient declare "Brain Death". By detailed clinical examination, various laboratory tests, special EEG test for brain and other investigations, all possibilities of recovery from brain damage are explored. When all examinations and investigations confirm no chance of any recovery, "Brain Death" is declared.

What are the contraindications for kidney donation from a patient with "Brain Death"?

Under the following conditions a kidney cannot be accepted from a donor with brain death:

1. A patient with active infections.
2. A patient suffering from HIV or hepatitis B.
3. A patient with long standing hypertension, diabetes mellitus, kidney disease or presence of kidney failure.
4. Cancer patient (except brain tumor).
5. A patient less than 10 years or more than 70years old.

Which other organs can be donated by cadaver donors?

Cadaver donors can donate both kidneys and save lives of two patients. Besides kidney, other organs which can be donated are eye, heart, liver, skin, pancreas etc.

One deceased donor saves lives of two CKD patients as he donates both his kidneys.

Who are the team members of deceased kidney transplantation?

For deceased (cadaveric) kidney transplantation proper team work is necessary. It includes:

- Relatives of the deceased kidney donor for legal consent
- Treating physician of the donor
- Cadaver transplant coordinator, who explains and helps the relatives of the patient for kidney donation
- Neurologist who diagnoses the brain death
- Nephrologist, urologist and their team who perform the kidney transplant

How is deceased kidney transplantation performed?

Important aspects of deceased kidney transplantation are:

- Proper diagnosis of brain death is mandatory.
- With necessary investigation to confirm that both kidneys are perfectly healthy and that there is no systemic disease in donor which is contraindicated.
- Consent of the relative of the donor.
- Donor is kept on ventilator and other life supporting device to maintain respiration, heart beat and blood pressure until both kidneys are removed from the body.
- After removal, the kidney is washed properly with a special cold fluid and is preserved in ice.
- One deceased donor can donate both kidneys, so two recipients can have deceased kidney transplant.

After kidney transplantation
the patient can enjoy a normal and active life.

- By blood group, HLA matching and tissue cross matching appropriate recipients are selected from the waiting list for deceased kidney transplantation.
- As early transplantation is beneficial, immediately after preparation, operation of kidney transplantation is performed in both the recipients.
- Method of operation of kidney transplantation in recipient remains the same for deceased or living kidney donation.
- Preservation of kidney before transplantation causes some damage to kidney due to lack of oxygen as there is no blood supply and exposure to cold due to storage in ice. Due to such damage, the deceased kidney may not function immediately after transplantation and a short term dialysis support may be necessary during this phase in many patients.

Is there any payment made given to the donor's family?

No. Donor's family does not receive any payment and kidney recipient need not pay for the kidney to anybody. If even after death, kidney donation can give life to someone is in itself an invaluable gift. Reward of such kindness and humanitarian gesture is a matter of immense joy and satisfaction. Satisfaction of saving life of needy diseased person is far more than any financial gain.

In which centers facilities of deceased kidney transplant are available in India?

Those hospitals recognized by state and central government for deceased kidney transplantation are eligible for such organ transplantation. Major centers where this facility is available in India are Ahmedabad, Bangalore, Chennai, Delhi, Mumbai, Kolkata, Hyderabad and others.

Organ donation is a spiritual act.
What can be more sacred than saving a life!

Chapter 15

Diabetic Kidney Disease

The number of people suffering from diabetes mellitus is increasing in India and all over the world. The important impact of growing number of diabetic patients is increase in the incidence of diabetic kidney disease. Diabetic kidney disease is one of the worst complications of diabetes and carries high mortality.

What is diabetic kidney disease?

Persistent high blood sugar damages small blood vessels of the kidney in long-standing diabetes. This damage initially causes loss of protein in the urine. Subsequently it causes hypertension, swelling and symptoms of gradual damage to the kidney. Finally, progressive deterioration leads to severe kidney failure (End stage kidney disease). This diabetes induced kidney problem is known as diabetic kidney disease. Diabetic nephropathy is the medical term used for diabetic kidney disease.

Why is it important to know about diabetes kidney disease?

- Incidence of diabetes is growing very fast in India and throughout the world. India will be the world capital of diabetes.
- Diabetes kidney disease (diabetic nephropathy) is the most leading cause of chronic kidney disease.
- Diabetes mellitus is responsible for 40-45 % of newly diagnosed patients of end stage kidney disease (ESKD).
- The cost of the therapy of ESKD is very high which patients in a developing country like India cannot afford.

Diabetes is the most common cause of chronic kidney disease.

- Early diagnosis and treatment can prevent diabetes kidney disease. In diabetics with established chronic kidney disease, meticulous therapy can postpone the stage of dialysis and transplantation significantly.
- There is an increased risk of death from cardiovascular causes in patients with diabetic kidney disease.
- So early diagnosis of diabetic kidney disease is the extremely essential need.

How many diabetics develop diabetic kidney disease?

Diabetes mellitus is divided in to two major types, with different risks of developing diabetic kidney disease.

Type 1 Diabetes (IDDM - Insulin Dependent Diabetes): Type 1 diabetes usually occurs at a young age and insulin is needed to control it. About 30 - 35% of Type 1 diabetics develops diabetic kidney disease.

Type 2 Diabetes (NIDDM - Non Insulin Dependent Diabetes): Type 2 diabetes usually occurs in adults and is controlled without insulin in most of the patients. About 10 - 40% of Type 2 diabetics develop diabetic kidney disease. Type 2 diabetes is the number one cause of chronic kidney disease, responsible for more than one of every three new cases.

Which diabetic patient will develop diabetic kidney disease?

It is difficult to predict which diabetic patient will develop diabetic kidney disease. Bur major risk factors for its development are:

- Type 1 diabetes with onset before 20 years of age.

Diabetes is the cause of end stage kidney disease in one out of three patients on dialysis therapy.

- Poorly controlled diabetes (higher HbA1c levels).
- Poorly controlled high blood pressure.
- Family history of diabetes and chronic kidney disease.
- Vision problem (diabetic retinopathy) or nerve damage (diabetic neuropathy) due to diabetes.
- Presence of protein in urine, obesity, smoking and elevated serum lipids.

When does diabetic kidney disease develop in a diabetic patient?

Diabetic kidney disease takes many years to develop, so it rarely occurs in the first 10 years of diabetes. Symptoms of diabetic kidney disease manifest 15 to 20 years after the onset of Type 1 diabetes. If a diabetic person does not develop diabetic kidney disease in the first 25 years, the risk of it ever developing decreases.

When to suspect diabetic kidney disease in a diabetic patient?

Suspect diabetic kidney disease in a diabetic patient if there is:

- Passing of foamy urine or presence of albumin/protein in the urine (seen in early stage).
- Development of high blood pressure or worsening of pre-existing high blood pressure.
- Development of swelling of the ankles, feet and face; reduced urine volume or weight gain (from accumulation of fluid).
- Decreased requirement of insulin or antidiabetic medications.
- History of frequent hypoglycemia (low sugar level). Better control

Signs of harmful effects of diabetes on kidney are excess protein in urine, high blood pressure and swelling.

of diabetes with the dose of antidiabetic medications with which diabetes was controlled poorly in the past.

- Diabetes controlled without medicine. Many patients feel proud and happy with the cure of diabetes, but the unfortunate and actual fact is that the person has worsening kidney failure.
- Presence of symptoms of chronic kidney disease (weakness, fatigue, loss of appetite, nausea, vomiting, itching, pallor and breathlessness), which develops in later stages.
- Value of creatinine and blood urea is high in blood test.

How is diabetic kidney disease diagnosed and which test detects it at the earliest?

Two most important tests used to diagnose diabetic kidney disease are the urine test for protein and the blood test for creatinine (and eGFR). The ideal test to detect diabetic kidney disease at the earliest is a microalbuminuria test of urine. The next best diagnostic test is the urine test for albumin by standard urine dipstick test, which detects macroalbuminuria. Blood test for creatinine (and eGFR) reflects function of the kidney and the value of serum creatinine increases in the later stage of diabetic kidney disease (usually after the development of macroalbuminuria).

What is microalbuminuria and macroalbuminuria?

Albuminuria means the presence of albumin (type of protein) in urine. Microalbuminuria means the presence of tiny amount of protein in urine (urine albumin 30 to 300 mg/day) which cannot be detected by routinely performed urine test but is only detected by special tests. Macroalbuminuria means loss of large amount of protein in urine (urine

Warning: Frequent reduction of blood sugar or diabetes controlled without medication - suspect diabetic kidney disease.

albumin >300 mg/day) which can be detected by routinely performed urine dipstick test.

Why is urine test for microalbuminuria the most ideal test for the diagnosis of diabetic kidney disease?

As urine test for microalbuminuria can diagnose diabetic kidney disease at the earliest, it is the most ideal test for the diagnosis. The special benefit of making diagnosis of diabetic kidney disease at this stage (known as high risk stage or incipient stage) is that the disease can be prevented and reversed with meticulous treatment.

The microalbuminuria test can detect diabetic nephropathy 5 years earlier than standard dipstick urine tests and several years before it becomes dangerous enough to cause symptoms or high value of serum creatinine. In addition to the risk to kidney, microalbuminuria independently predicts a high risk of developing cardiovascular complications in diabetic patients.

Early diagnostic ability of the microalbuminuria warns patients about developing the dreaded disease and gives opportunity to doctors to treat such patients more vigorously.

When and how often should urine test for microalbuminuria be done in diabetics?

In Type 1 diabetes, microalbuminuria test should be done after 5 years of onset of diabetes and every year subsequently. In Type 2 diabetes, microalbuminuria test should be done at the time of diagnosis and every year subsequently.

Two most important diagnostic tests of diabetic kidney disease are urine test for protein and serum creatinine.

How is urine tested for microalbuminuria in diabetics?

Microalbuminuria is a method to detect very small amount of protein in urine, which cannot be detected by a routine urine test. For screening of diabetic kidney disease, random urine is tested first by standard urine dipstick test. If protein is absent in this test, a more precise urine test is preformed to detect microalbuminuria. If urine albumin is present in routine test then there is no need to go for microalbuminuria test. To diagnose diabetic nephropathy correctly, two of the three tests for microalbuminuria need to be positive in a three- to six-month period in the absence of a urinary tract infection.

Three most common methods used for the detection of microalbuminuria are:

Spot urine test: This test is performed by a reagent strip or tablet. It is a **s**imple test which can be performed in an office practice and **is** less expensive. But this test is less accurate. So when microalbuminuria test is positive by a reagent strip or tablet, it should be confirmed by a urine albumin to creatinine ratio.

Albumin-to-creatinine ratio: Urinary albumin-to-creatinine ratio (ACR) is the most specific, reliable and accurate method of testing microalbuminuria. ACR estimates 24-hour urine albumin excretion. In early morning urine sample, albumin-to-creatinine ratio (ACR) between 30-300 mg/g is diagnostic of microalbuminuria (normal value of ACR < 30 mg/g). Because of the problem of availability and cost, the number of diabetic patients in whom diagnosis of microalbuminuria is established by this method is limited in developing countries.

Urine test for microalbuminuria is the first and best test for the diagnosis of diabetic kidney disease.

24-hour urine collection for microalbuminuria: Total urine albumin 30 to 300 mg in 24 hour urine collection suggests microalbuminuria. Although this is a standard method for the diagnosis of microalbuminuria, it is cumbersome and adds little to prediction or accuracy.

How does standard urine dipstick test help in the diagnosis of diabetic kidney disease?

Standard urine dipstick test (often reported as "trace" to 4+) is most widely and routinely used method for detection of protein in urine. In patients with diabetes, standard urine dipstick test is an easy and quick method to detect macroalbuminuria (urine albumin >300 mg/day). Presence of macroalbuminuria reflects stage 4 - overt diabetic kidney disease.

In the development of diabetic kidney disease macroalbuminuria follows microalbuminuria (stage 3 - incipient diabetic kidney disease), but usually precedes more severe kidney damage, i.e. nephrotic syndrome, and the rise in serum creatinine due to chronic kidney disease.

For the diagnosis of diabetic kidney disease, detection of microalbuminuria is the earliest and best test. Detection of macroalbuminuria by urine dipstick test suggests the next stage of diabetic kidney disease.

But in developing countries because of the cost and unavailability, microalbuminuria test is performed in very few diabetic patients. In such a scenario, urine dipstick test to diagnose macroalbuminuria is the next best diagnostic option for diabetic kidney disease.

Annual urine test for microalbuminuria is the best strategy for the early diagnosis of diabetic kidney disease.

Urine dipstick test is a simple and cheap method, which is available even in small centers and therefore is an ideal and feasible option for the mass screening of diabetic kidney disease. Vigorous management even at this stage of diabetic kidney disease is rewarding and delays stage of dialysis or kidney transplantation.

How is diabetic kidney disease diagnosed?

Ideal method: Annual screening of diabetic patients by microalbuminuria urine test and blood test for creatinine (and eGFR).

Practical method: Three monthly measurement of blood pressure and urine dipstick test; and annual blood test for creatinine (and eGFR) in all diabetic patients. This method of detection of diabetic kidney disease is easily affordable and possible even in small towns of developing countries.

How can diabetic kidney disease be prevented ?

Important tips to prevent diabetic kidney disease are:

- Regular follow up with the doctor.
- Achieving the best control of diabetes. Keep HbA1C level less than 7.
- Keep blood pressure below 130/80 mmHg. Early use of angiotensin-converting enzyme (ACE) inhibitors and angiotensin receptor blockers (ARBs) group of antihypertensive drugs.
- Restrict sugar and salt intake and eat diet low in protein, cholesterol and fat.

Urine dipstick test to diagnose macroalbuminuria is the most feasible diagnostic option for developing countries.

- Check kidney at least once a year by urine test for albumin and the blood test for creatinine (and eGFR).
- Other measures: Exercise regularly and maintain ideal weight. Avoid alcohol, smoking, tobacco products and indiscriminate use of painkillers.

Treatment of diabetic kidney disease

- Ensure proper control of diabetes.
- Meticulous control of blood pressure is the most important measure to protect kidney. Measure blood pressure regularly and maintain it below 130/80 mm Hg. Treatment of hypertension slows the progression of chronic kidney disease.
- Angiotensin-converting enzyme (ACE) inhibitors and angiotensin receptor blockers (ARBs) are antihypertensive drugs that have special advantage in diabetic patients. These antihypertensive drugs have additional benefit of slowing the progression of kidney disease. For maximum benefit and kidney protection, these drugs are administered at the earliest stage of diabetic kidney disease when microalbuminuria is present.
- To reduce swelling, drugs which increases volume of urine (diuretics) are given along with restriction of salt and fluid intake.
- Patients with kidney failure due to diabetic kidney disease are prone to hypoglycemia and therefore need modification in drug therapies for diabetes. Short acting insulin is preferred to control diabetes. Avoid long acting oral hypoglycemic agents. Metformin is usually avoided in patients with serum creatinine levels more than 1.5 mg/dl, due to risk of lactic acidosis.

Maintain blood pressure less than 130/80 and use ACEI and ARBs - antihypertensive drugs early.

- In diabetic kidney disease with high creatinine, all measures of treatment of chronic kidney disease (discussed in Chapter 12) should be followed.
- Evaluate and manage cardiovascular risk factors aggressively (smoking, raised lipids, high blood glucose, high blood pressure etc).
- Diabetic kidney disease with advance renal failure needs dialysis or kidney transplant.

When should a patient with diabetic kidney disease contact doctor?

The patient with diabetic kidney disease should immediately contact doctor in case of :

- Rapid unexplained weight gain, marked reduction in urine volume, worsening of swelling or difficulty in breathing.
- Chest pain, worsening of pre-existing high blood pressure or very slow or fast heart rate.
- Severe weakness, loss of appetite or vomiting or paleness.
- Persistent fever, chills, pain or burning during urination, foul-smelling urine or blood in urine.
- Frequent hypoglycemia (low sugar level) or decreased requirement of insulin or antidiabetic medications.
- Development of confusion, drowsiness or convulsion.

Meticulous treatment of cardiovascular risk factors is an essential part of management of diabetic kidney disease.

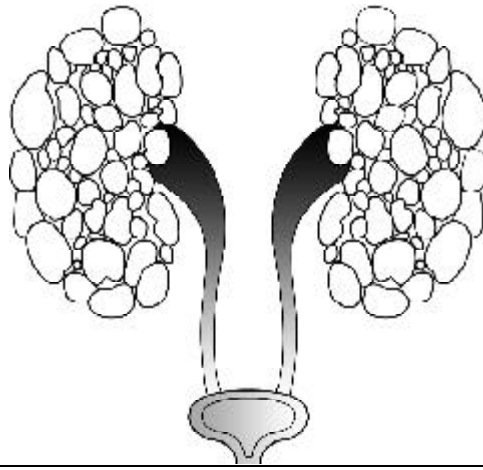
Chapter 16

Polycystic Kidney Disease

Autosomal dominant polycystic kidney disease (ADPKD) is the most common genetic or inherited disease of the kidney, characterized by the growth of numerous cysts in the kidneys. Polycystic kidney disease (PKD) is the fourth leading cause of chronic kidney disease. In PKD, other organs in which cysts can be seen are the liver, brain, intestines, pancreas, ovaries and spleen.

What is the incidence of PKD?

Polycystic Kidney Disease



Incidence of autosomal dominant PKD is the same in all races, occurs equally in males and females and affects about 1 in 1,000 people worldwide. About 5% of all chronic kidney disease patients requiring dialysis or kidney transplantation have PKD.

How is the kidney affected in PKD?

- In autosomal dominant PKD multiple clusters of cysts (fluid-filled sacs) are seen in both kidneys.
- Sizes of cysts in PKD are variable (diameter ranging from a pinhead to as large 10 cm. or more).

- With time the size of cysts increases, which slowly compress and damage healthy kidney tissue.
- Such damage leads to hypertension, loss of protein in urine and reduction in kidney function, causing chronic kidney failure.
- In a long period (after years) chronic kidney failure worsens and leads to severe kidney failure (endstage kidney disease), ultimately requiring dialysis or kidney transplantation.

Symptoms of PKD

Many people with autosomal dominant PKD live for several decades without developing symptoms. Most patients with PKD develop symptoms after the age of 30 to 40 years. Common symptoms of PKD are:

- High blood pressure.
- Pain in the back, flank pain on one or both sides and/or a swollen abdomen.
- Feeling a large mass (lump) in abdomen.
- Blood or protein in urine.
- Recurrent urinary tract infections and kidney stones.
- Symptoms of chronic kidney disease due to progressive loss of kidney function.
- Symptoms due to cysts in other parts of the body such as brain, liver, intestine etc.
- Complications that can occur in a patient with PKD are brain aneurysm, abdominal wall hernias, infection of liver cysts, diverticulae (pouches) in the colon and heart valve abnormalities.

PKD is the most common inherited kidney disease and fourth leading cause of CKD.

About 10% of PKD patients develop brain aneurysm. In brain aneurysm weakening of the wall of blood vessel causes bulging. Brain aneurysm can cause headaches and carry a small risk of rupture which can lead to a stroke or even death.

Does everyone with PKD develop kidney failure?

No. Kidney failure does not occur in all patients with PKD. About 50 % of patients with PKD will have kidney failure by the age of 60, and about 60 % will have kidney failure by the age of 70. The risk of developing chronic kidney disease is high in PKD patients of males onset at younger age high blood pressure, protein or blood in urine and larger kidney size.

Diagnosis of PKD

Diagnostic tests performed in autosomal dominant PKD are:

- **Ultrasound of the kidneys.** This is the most commonly used diagnostic test for PKD because it is reliable, simple, safe, painless and less costly.
- **CT or MRI scans:** These tests are more precise but are expensive. These tests may detect smaller cysts that cannot be diagnosed by an ultrasound.
- **Family screening:** PKD is an inherited disease in which each child has a 50:50 chance of developing the disease. So screening of family members of a patient with PKD helps in early diagnosis.
- **Tests to assess effect of PKD on kidney:** Urine test is done to detect the presence of blood or protein in urine. Serum creatinine blood test is done to assess and monitor the function of the kidney.

Flank and abdominal pain and blood in urine at the age of 40 is the most common presentation of PKD.

- **Accidental diagnosis:** PKD detected in routine health check up or during ultrasound examination done for another reason.
- **Gene linkage analysis.** This is a very specialized blood test, used to detect which family member carries the PKD gene. This test should be done only if imaging tests do not show anything. As this test is available at very few centers and is very expensive, it is done rarely for diagnostic purposes.

Which family members of PKD patients should be screened for PKD?

Brothers, sisters and children of PKD patients should be screened for PKD. In addition, brothers and sisters of parents from whom the disease is inherited by the patient should be screened.

Will all children of PKD patients carry the risk of developing the same disease?

No. PKD is an inherited disease in which if mother or father has autosomal dominant PKD, the children have a 50% possibility of developing the disorder.

Prevention of PKD

Currently there is no treatment which can prevent formation or slow down the growth of cyst in PKD.

Screening of family members and making early diagnosis before it sets in has several advantages. Early diagnosis provides an opportunity to treat PKD in a better way. Early diagnosis and treatment of high blood pressure prevents development or aggravation of renal failure in PKD. Lifestyle and dietary modification in PKD patients protects their kidney as well as the

PKD is an inherited kidney disease so consider screening of adult family members for PKD.

heart. Major disadvantage of screening is that the person may become very anxious about the disease at a stage when the person neither has the symptoms nor does he need any treatment.

Why is it not possible to reduce incidence PKD?

PKD is diagnosed usually at the age of 40 years or more. Most people have children before this age and therefore it is not possible to prevent its transmission to the next generation.

Treatment of PKD

PKD is a non-curable disease but needs treatment. Why?

PKD is a non curable disease but needs treatment

- To protect kidneys and delay progression of the chronic kidney disease to end stage kidney disease and thereby prolong survival.
- To control the symptoms and prevent complications.

Important measures in the treatment of PKD:

- The patient is asymptomatic for many initial years after diagnosis and does not require any treatment. Such patients need periodic checkup and monitoring.
- Strict control of high blood pressure will slow down the progression of CKD.
- Control of pain with drugs which will not harm the kidney (such as aspirin or acetaminophen). Recurrent or chronic pain occurs in PKD due to cyst expansion.
- Prompt and adequate treatment of urinary tract infections with appropriate antibiotics.

Treatment is aimed to delay progression of CKD and treat kidney infections, stones and abdominal pain.

- Early treatment of kidney stones.
- Plenty of fluid intake, provided the person does not have swelling. It helps in prevention of urinary tract infections and kidney stones.
- Meticulous treatment of chronic kidney disease as discussed in Chapters 10 to 14.
- In a very few patients surgical or radiologic drainage of cysts may be indicated because of pain, bleeding, infection, or obstruction.

When should a patient with PKD contact doctor?

Patient with PKD should immediately contact doctor if he or she develops:

- Fever, sudden abdominal pain or red urine.
- Severe or recurrent headaches.
- Accidental injury to enlarged kidney.
- Chest pain, severe loss of appetite, severe vomiting, severe muscle weakness, confusion, drowsiness, unconsciousness or convulsion.

Asymptomatic person with PKD may not require any treatment for many years initially.

Chapter 17

Living with a Single Kidney

To have a single kidney is a matter of worry. But with a few precautions and healthy lifestyle the person lives a normal life with a single kidney.

What are the problems a person with a single kidney is likely to face in normal life? Why?

Almost all persons are born with two kidneys. But because of extra capacity, even a single kidney is capable of performing normal functions of both kidneys. So a person with a single kidney does not have any problem in routine or sexual activity or strenuous work.

Only one kidney is enough for normal and active life for a lifetime. In most of the cases of a person born with just one kidney the diagnosis of single kidney is made accidentally while performing radiological tests for entirely different reason.

In a few people with single kidney, over long period (years) possible ill effects are high blood pressure and loss of protein in the urine. Reduction in kidney function is very rare.

What are the causes of a single kidney?

Three common circumstances in which a person has a single kidney are

1. A person is born with one kidney.
2. One kidney is removed surgically. Important reasons for removal of kidney are stone disease, cancer, obstruction, pus collection in kidney or severe traumatic injury.
3. One kidney is donated for a kidney transplant.

A person with a single kidney lives a normal and active life.

What are the possibilities of having only one kidney from birth?

Many people are born with a single kidney. The likelihood of having only one kidney from birth is about one out of 750 people. A single kidney is more common in males, and it is usually the left kidney which is missing.

Why are precautions required in people with a single kidney?

People with a single kidney don't have any problem. But it can be compared with a two wheeler without a spare wheel.

In the absence of second kidney, if sudden and severe damage occurs to the solitary functioning kidney, acute kidney failure is bound to occur and all kidney functions will worsen rapidly.

Acute kidney failure can cause many problems and complications and needs prompt attention. Within a short period the severity of problems increases and can cause life threatening complications. Such patients need urgent dialysis. To avoid kidney damage and its consequences, precautions should be taken by all people with a single kidney.

In which circumstances is there a risk of sudden damage to a solitary kidney?

Potential circumstances of sudden and severe damage to a solitary kidney are:

1. Sudden blockage to the flow of urine due to a stone or blood clot in ureter. Because of the blockage urine stops flowing out of the kidney.
2. During abdominal surgery accidental ligation of ureter of solitary kidney, i.e. through ureter urine formed in kidney flows down to urinary bladder.

Many people are born with a single kidney.

3. Injury to a solitary kidney. There is a risk of injury to kidney in heavy contact sports such as boxing, hockey, football, martial arts and wrestling. Single kidney becomes larger and heavier than normal kidney to cope with the requirement of the body. Such enlarged kidney is more vulnerable to injury.

What precautions are recommended to protect a single kidney?

People with a single kidney need no treatment. But taking precautions is wise to protect the solitary kidney. Important precautions are:

- Drink a lot of water (about three liters per day).
- Avoid injury to the solitary kidney by avoiding contact sports such as boxing, hockey, football, martial arts and wrestling.
- Prevention and early appropriate treatment of stone disease and urinary tract infection.
- Before starting any new treatment or abdominal surgery the doctor should be informed that the patient has a single kidney.
- Control of blood pressure, regular exercise, healthy balanced diet and avoid pain killers. Avoid high-protein diets and restrict daily salt (sodium) intake if so advised by doctor.
- Regular medical check ups. The first and most important advice for a person living with one kidney is to have regular medical checkups. Monitor your kidney function by checking blood pressure and testing urine and blood once a year. Regular medical checkups will help to detect any early signs of kidney problems or developing kidney failure. Early detection of kidney problems provides opportunity for timely treatment and care.

Persons with a single kidney should not worry but need proper precautions and regular medical checkups.

When should a patient with a single kidney contact doctor?

Patient with a single kidney should immediately contact doctor if:

- Sudden and total stoppage of urine.
- Accidental injury to solitary enlarged kidney.
- Need to take medicine for pain or need to use X ray dyes for diagnostic test.
- Fever, burning urination or red urine.

Sudden and total stoppage of urine occurs usually due to stone induced obstruction.

Chapter 18

Urinary Tract Infection

Kidney, ureter, bladder and urethra form the urinary system. Urinary tract infection (UTI) is a bacterial infection that affects any part of urinary tract. UTI is the second most common type of infection in the body.

What are the symptoms of a urinary tract infection?

The symptoms of urinary tract infections may vary with severity of infection, age and location of the infection in the tract.

Most Common Symptoms of Urinary Tract Infection

- Burning or pain during urination.
- Frequency of urination and persistent urge to urinate.
- Fever and malaise.
- Foul odour and cloudy urine.

Symptoms due to Infection of Bladder (Cystitis)

- Lower abdomen discomfort.
- Frequent, painful urination with small amount of urine.
- Usually low-grade fever without flank pain.
- Blood in urine.

Symptoms due to Infection of Upper Urinary Tract (Pyelonephritis)

- Upper back and flank pain.

Burning and frequent urination are common signs of urinary tract infection.

- High grade fever with chills.
- Nausea, vomiting, weakness, fatigue and general ill-feeling.
- Mental changes or confusion in elderly people.

This is the most serious form of urinary tract infection. Inadequate and delayed treatment can be life threatening.

What are the causes of recurrent urinary tract infection?
Important causes of frequent or recurrent urinary tract infections are:

1. Urinary tract obstruction: Various underlying causes which can lead to obstruction of urinary tract can cause recurrent UTI.

2. Female gender: Because of shorter urethra women are more susceptible than men to UTI.

3. Intercourse: Women who are sexually active tend to have more urinary tract infections than women who aren't sexually active.

4. Urinary stones: Kidney, ureter or bladder stone can block flow of urine and increases risk for UTI.

5. Urinary catheterization: People with indwelling catheters have an increased risk of UTI.

6. Congenital urinary tract anomalies: Children with congenital urinary tract anomalies such as vesicoureteral reflux (condition in which urine moves backward from the bladder up the ureters) and posterior urethral valve have an increased risk of UTI.

7. Benign prostatic hyperplasia: Men over 60 years are prone to UTI because of enlarged prostate (benign prostatic hyperplasia - BPH).

Obstruction of urinary tract is an important cause of recurrent UTI.

8. Suppressed immune systems: Patients with diabetes, HIV or cancer are at higher risk for UTI.

9. Other causes: Narrowing of the urethra or ureters, tuberculosis of genito urinary tract, neurogenic bladder or bladder diverticulum.

Can recurrent urinary tract infection cause damage to kidney?

Recurrent urinary tract infection usually does not cause damage to kidney in adults.

UTI in adults can cause damage to kidney if predisposing factors such as stone, blockage or narrowing of flow of urine and tuberculosis of genito urinary tract are not corrected.

However, in young children, delay or improper treatment of recurrent urinary tract infection can cause irreversible damage to the growing kidney. This damage may lead to reduction of kidney function and high blood pressure later in life. So the problem of urinary tract infection is more serious in children compared to that in adults.

Diagnosis of Urinary Tract Infection

Investigations are performed to establish diagnosis and severity of urinary tract infection. In a person with complicated or recurrent urinary tract infection different tests are performed to establish diagnosis of predisposing or risk factors.

Basic Investigations for Urine Tract Infection

1. Urine test

Most important screening test for UTI is routine urinalysis. Early morning

UTI usually does not cause damage to kidney in adults in the absence of blockage of flow of urine.

urine sample is preferable for this test. In microscopic examination of urine, presence of significant white blood cells is suggestive of UTI. Presence of white blood cells in urine suggests inflammation of urinary tract but its absence does not exclude UTI.

Special urine dipstick (leukocyte esterase and nitrite) tests are useful screening tests for UTI which can be done at the office or home. Positive urine dipstick test suggests UTI and such patients need further evaluation. The intensity of color change is proportional to the number of bacteria in the urine. Urine dipstick for UTI is not widely available in India.

2. Urine Culture and sensitivity test

The gold standard for the diagnosis of UTI is urine culture test and it should be done before starting antibiotics therapy. A urine culture is recommended in complicated or resistant UTI and in a few cases, for the confirmation of clinical diagnosis of urinary tract infection.

Urine culture test takes about 48-72 hours. Significant time delay between collection of sample and availability of the report is a major drawback of this test.

On the basis of the nature of growth of organism in urine culture, the presence as well as severity of infection and type of organism responsible is determined.

Urine culture identifies the specific bacteria causing infection and determines which type of antibiotics to use for the treatment.

To avoid potential contamination of the urine sample, the person is asked first to clean genital area and to collect midstream urine in a sterile container. Other methods used for sample collection for urine culture

Urine culture and sensitivity is a valuable test for the diagnosis and treatment of UTI.

are supra-pubic aspiration, catheter-specimen urine and bag specimen urine.

3. Blood tests

Blood tests usually performed in UTI are hemoglobin, total and differential white cell count, blood urea, serum creatinine, blood sugar and C reactive protein.

Investigations to Diagnose Predisposing or Risk Factors

If the infection does not respond to treatment or if there is repetition of infections further investigations as mentioned below, are required to detect underlying predisposing or risk factors:

1. Ultrasound and X-rays of the abdomen.
2. CT scan or MRI of the abdomen.
3. Voiding cystourethrogram - VCUG (Micturating cystourethrogram – MCU).
4. Intravenous urography (IVU).
5. Microscopic examination of urine for tuberculosis.
6. Cystoscopy: it is a procedure in which urologist looks inside the bladder by a special instrument called a cystoscope.
7. Examination by a gynecologist.
8. Urodynamics.
9. Blood Cultures.

Prevention of Urinary Tract Infection

1. Drink plenty (3-4 liters) of fluids daily. It dilutes urine and helps in flushing of bacteria from the bladder and urinary tract.

For successful treatment of UTI, it is essential to diagnose underlying predisposing factors.

2. Urinate every two to three hours. Do not postpone going to bathroom. Holding urine in the bladder for a long period provides opportunity to bacteria to grow.
3. Consume food containing vitamin C, ascorbic acid or cranberry juice to make urine acidic which reduces bacterial growth.
4. Avoid constipation or treat it promptly.
5. Women and girls should wipe from front to back (not back to front) after using toilet. This habit prevents bacteria in the anal region from spreading to the vagina and urethra.
6. Clean genital and anal areas before and after intercourse. Urinate before and after intercourse and drink a full glass of water soon after intercourse.
7. Women should wear only cotton undergarments, which allow air circulation. Avoid tight-fitting pants and nylon underwear.
8. Recurrent urinary tract infection in women after sexual activity can be effectively prevented by taking a single dose of an antibiotic after sexual contact.

Treatment of Urinary Tract Infection

General measures

Drink plenty of water. If a person is very ill, dehydrated or unable to take adequate oral fluid due to vomiting, he needs hospitalization and administration of IV fluids.

Take medications to reduce fever and pain. Use of heating pad reduces the pain. Avoid coffee, alcohol, smoking and spicy foods, all of which irritate the bladder. Follow all preventive measures of urinary tract infection.

It is essential to drink plenty of water to prevent and treat urinary tract infection.

Treatment of lower Urinary Tract Infection (cystitis, mild infections)

In a healthy young female short term antibiotics for three-day is usually enough. Some doctors prefer a seven-day course of antibiotics. Occasionally, a single dose of an antibiotic is used. Adult males with UTI require 7 to 14 days of antibiotics. Commonly used oral antibiotics are trimethoprim, cephalosporins, nitrofurantoin, or fluoroquinolones.

Treatment of severe kidney infection (Pyelonephritis)

Patients with moderate-to-severe acute kidney infection, those with severe symptoms or sick patients need hospitalization. Urine and blood cultures are obtained before initiating therapy to identify causative bacteria and proper selection of antibiotics. Patients are treated with IV fluids and intravenous antibiotics for several days, followed by 10-14 days of oral antibiotics. If response to IV antibiotics is poor (marked by persistent symptoms and fever, worsening kidney function) imaging is indicated. Follow up urine test is necessary to assess response of therapy.

Treatment of recurrent urinary tract infection

In patients with recurrent UTI, proper identification of the underlying cause is essential. According to the underlying cause, specific medical or surgical treatment is planned. These patients need follow-up, strict adherence to preventive measures and long term preventive antibiotics therapy.

Treatment of severe kidney infections (pyelonephritis) needs hospitalization and intravenous antibiotics.

When should a patient with UTI contact the doctor?

Patient with UTI should immediately contact the doctor if:

- The volume of urine decreases or in case of total stoppage of urine.
- Persistent high fever, chills, back pain and cloudy urine or blood in the urine.
- All patients with severe vomiting, severe weakness or fall of blood pressure.
- All children with UTI
- All patients with a single kidney and previous history of stones.
- No response to antibiotics 2 to 3 days of treatment

Persistent high fever, chills, back pain, cloudy urine, burning sansation need urgent attention.

Chapter 19

Stone Disease

Stone disease is a very common urological disease. Kidney stone can cause most unbearable pain. But some time kidney stones can exist silently without any symptom. Stone disease can cause urinary tract infection and damage to kidney in some of the patients, if not treated in time. Once stone occurs, its recurrence is common. So understanding, prevention and care of stone disease is essential.

What is a kidney stone?

A kidney stone is a hard crystal mass formed within the kidney or urinary tract. Increased concentration of crystals or small particles of calcium, oxalate, urate, phosphate etc in urine is responsible for stone formation. Millions of crystals of these substances in urine aggregate which gradually increase in size and in a long period of time form stone.

Normally, urine contains substances that prevent or inhibit the aggregation of crystals. Reduced level of stone inhibitor substances contribute to the formation of stone. Urolithiasis is the medical term used to describe urinary stones. It is to be noted that gallstones and kidney stones are different.

What is the size, shape and location of urinary stones?

Kidney stones vary in size and shape. They can be smaller than a grain of sand or can be as large as a tennis ball. The shape of the stone may be round or oval with smooth surface, such stones cause less pain and chances of natural removal is high. Kidney stones can be irregular or

Stone in urinary tract is an important cause of unbearable abdominal pain.

jagged with rough surface. Such stones cause more pain and are less likely to come out on their own.

Stone can occur anywhere in urinary system but occurs more frequently in kidney and then descends into ureter.

What are the types of kidney stones?

There are four types of kidney stones:

1. **Calcium Stones:** This is the most common type of kidney stone, which occurs in about 70 - 80% cases. Calcium stones are usually in the form of calcium oxalate and less common in the form of calcium phosphate. Calcium oxalate stones tend to form when the urine is acidic.
2. **Struvite Stones:** Struvite (Magnesium ammonium phosphate) stones are less common (about 10 - 15%) and result from infections in the kidney. A struvite stone is more common in women and grows only in alkaline urine.
3. **Uric Acid Stones:** Uric acid stones are not very common (about 5 - 10%) and more likely to form when there is too much uric acid in the urine and urine is persistently acidic. Uric acid stones can form in people with gout, who eat a high animal protein diet, are dehydrated or have underwent chemotherapy. Uric acid stones are radiolucent, so are not detected by an X-ray of the abdomen.
4. **Cystine Stones:** Cystine stones are rare and occur in an inherited condition called cystinuria. Cystinuria is characterized by high levels of cystine in the urine.

Urinary stone occurs most frequently in kidney and ureter.

What is a staghorn stone?

A staghorn calculus is a very large struvite stone occupying a large part of the kidney and resembling horns of a stag (deer), therefore it is named staghorn. As staghorn stone cause minimal or even no pain, diagnosis is missed in most of the cases and end result is damage to kidney.

Which factors contribute to the formation of urinary stone?

Everyone is susceptible to stone formation. Several factors that increase risk of developing kidney stones are:

- Reduced fluid - especially water intake and dehydration.
- Family history of kidney stones.
- Diet: consuming a diet high in animal protein, sodium and oxalate, but low in fiber and potassium rich citrus fruits.
- 75 % of kidney stones and 95% of bladder stones occur in men. Men between the age of 20 to 70 years and those who are obese are most vulnerable.
- A person who is bed-ridden or immobile for a long period.
- A person living in hot humid atmosphere.
- Recurrent urinary tract infections and blockage to the flow of urine.
- Metabolic diseases: hyperparathyroidism, cystinuria, gout etc.
- Use of certain medications: diuretics and antacids.

What are the symptoms of a urinary stone?

The symptoms of urinary stone may vary with size, shape, and location of the urinary stone. Common symptoms of urinary stone are:

Reduced water intake and family history of kidney stones are two most important risk factors for stone formation.

- Abdominal pain.
- No symptoms. Accidental detection of urinary stone on routine health checkups or during the workup for unrelated conditions. Stones that do not cause any symptoms and are detected accidentally on radiological test are known as “silent stones”.
- Frequency of urination and persistent urge to urinate.
- Nausea or vomiting.
- Passage of blood in urine (haematuria).
- Pain and/or burning while passing urine.
- If the bladder stone gets stuck at the entrance to the urethra, the flow of urine suddenly stops during urination.
- Passing of stone in urine.
- In a few cases urinary stone can cause complications such as recurrent urinary tract infection and obstruction of urinary tract, causing temporary or permanent damage to kidney.

Characteristics of abdominal pain due to urinary stone

- The severity and the location of the pain can vary from person to person depending upon the type, the size and the position of the stone within the urinary tract. Remember, the size of the stone does not correlate with the severity of pain. Smaller-sized rough stone usually causes more severe pain than bigger-sized smooth stone.
- Stone pain can vary from a vague flank pain to the sudden onset of severe unbearable pain. Pain is aggravated by change of posture and vehicular jerks. The pain may last for minutes to hours followed by relief. Waxing and waning of pain is the characteristic of kidney stone.

Abdominal pain and blood in urine strongly indicate presence of urinary stone.

- The abdominal pain occurs on the side where the stone is lodged. Classical pain of kidney and ureteric stone is the pain from loin to groin and is usually accompanied by nausea and vomiting.
- A bladder stone may also cause lower abdominal pain and pain during urination, which is often felt at the tip of the penis.
- Many people who experience sudden severe abdominal pain rush to seek immediate medical attention.

Can kidney stones damage the kidney?

Yes. Stones in the kidney or ureter can block or obstruct the flow of urine within the urinary tract. Such obstruction can cause dilatation of kidney. Persistent severe dilatation due to blockage can cause kidney damage in a long term in a few patients.

Diagnosis of urinary stones

Investigations are performed not only to establish diagnosis of urinary stones and to detect complications but also to identify factors which promote stone formation.

Radiological investigations

Ultrasound: It is an easily available, less expensive and simple test which is used most commonly for the diagnosis of urinary stones and to detect the presence of obstruction.

X-ray KUB: Size, shape and position of the urinary stones can be seen on the X-ray of kidney-ureter-bladder (KUB). So X-ray of KUB is the most useful method to monitor presence and size of stone before and after treatment.

Beware of "Silent Stones" which cause no pain, but are most likely to cause kidney damage.

CT scan: CT scan of urinary system is an extremely accurate and the most preferred diagnostic method to identify stones of all sizes and to determine the presence of obstruction.

Intravenous urography (IVU): Less frequently used IVU test is very reliable at detecting stones and obstruction. Major benefit of IVU is that it provides information about the function of the kidney. Structure of the kidney and details about ureteric dilatation is better judged by this test.

Laboratory investigations

Urine tests: Urine tests to detect infection and to measure pH of the urine. 24 hour urine collection to measure total daily urinary volume, calcium, phosphorous, uric acid, magnesium, oxalate, citrate, sodium and creatinine.

Blood tests: Basic tests such as complete blood count, creatinine, electrolytes and blood sugar; and special tests to identify certain chemicals which promote stone formation such as calcium, phosphorus, uric acid and level of parathyroid hormone.

Stone analysis: Stone expelled on its own or removed by different treatment modality is collected. Chemical analysis of stones can establish their composition, which helps to decide preventive measures and therapeutic plan.

Prevention of urinary stones

For kidney stone it is said “Once a kidney stone former, is always a stone former”. Urinary stone recurs in about 50 to 70% of persons. On the other hand, with proper precautions and treatment the recurrence

For diagnosis of stone in urinary tract CT scan, sonography and X ray are the most important investigations.

rate can be reduced to 10% or less. So all patients who suffered from kidney stone should follow preventive measures.

General measures

Diet is an important factor that can promote or inhibit formation of urinary stone. General measures useful to all patients with urinary stones are :

1. Drink lots of fluid

- A simple and most important measure to prevent formation of stone is to drink plenty of water, drink plenty of water and drink plenty of water. Drink 12 - 14 glasses (more than 3 liters) of water per day. To ensure adequate water intake throughout the day, carry a water bottle with you.
- Which water to drink is a dilemma for many patients. But remember, to prevent formation of stone the quantity of water is more important than the quality of water.
- For the prevention of stone, formation of sufficient volume of urine per day is more important than the volume of fluid taken. To ensure that you are drinking enough water, measure total volume of urine per day. It should be more than 2 - 2.5 liters per day.
- Color of urine will tell you how regular you are in drinking water. If you drink enough water throughout the day, the urine will be diluted, clear and almost watery. Diluted urine means low concentration of minerals, which prevents stone formation. Yellow, dark, concentrated urine suggests inadequate water intake.
- To prevent stone formation make a habit of drinking two glasses of

Plenty of fluid intake is the simplest and most essential measure for prevention and treatment of urinary stone.

water after each meal. It is particularly important to drink two glasses of water before going to bed and an additional glass at each night time awakening. drinking water daily at mid night plays a very important role. Setting an alarm to wake up specially and drink water is rewarding.

- Higher fluid intake is recommended in physically active people on hot days, because significant amount of water is lost through perspiration.
- Intake of fluids such as coconut water, barley or rice water, citrate-rich fluids such as lemonade and pineapple juice helps in increasing total fluid intake and prevention of stone.
- **Which fluids are preferred to prevent urinary stone?**

  Intake of fluids such as coconut water, barley or rice water and citrate-rich fluids such as lemonade, tomato juice or pineapple fruit juices helps in the prevention of stone. But remember that at least 50% of the total fluid intake should be water.
- **Which fluids should be avoided by a person with urinary stone?**
  Avoid grapefruit, cranberry and apple juice; strong tea, coffee, chocolate and sugar sweetened soft drinks such as colas; and all alcoholic beverages, including beer.

2. Salt restriction

Avoid excessive salt intake in diet. So avoid pickles, papad, salty snacks etc. Excessive quantities of salt or sodium in the diet can increase the excretion of calcium into the urine and thereby increase the risk of formation of calcium stones. So restrict sodium intake to less than 100 mEq or 6 gram table salt per day to prevent formation of stone.

Clean, transparent, water- like urine denotes adequate intake of fluid.

3. Decrease intake of animal protein

Avoid non-vegetarian food such as mutton, chicken, fish and egg. These animal foods contain high uric acid/purines and can increase the risk of uric acid stones and calcium stones.

4. Balanced diet

Eat balanced diet with more vegetables and fruits which reduces acid load and tends to make urine less acidic. Eat fruits such as banana, pineapple, blueberries, cherries, and oranges. Eat vegetables such as carrots, bitter gourd (karela), squash and bell peppers. Eat high-fiber containing foods such as barely, beans, oats, and psyllium seed.

Avoid or restrict refined foods such as white bread, pastas, and sugar. Kidney stones are associated with high sugar intake.

5. Other advice

Restrict intake of vitamin C to less than 1000 mg per day Avoid large meals late at night. Obesity is an independent risk factor for stone. So avoid obesity with consumption of balanced diet.

Special measures

1. To prevent calcium stone

- Diet: It is a wrong concept that calcium is to be avoided by patients suffering from kidney stone. Eat a healthy diet with calcium, including dairy products to prevent stone formation. Dietary calcium binds with oxalate and is excreted, so absorption of oxalate from intestine and subsequent stone formation is reduced. But when calcium is less in diet, unbound oxalate gets absorbed from the intestine and promotes formation of oxalate stone.

Restriction of salt intake in diet is very important for prevention of calcium stones.

- Avoid calcium supplements as well as a diet which is low in calcium, because both increase the risk of stone development. If calcium supplements are necessary, they should be taken with meals to reduce the risk.
- Medication: Thiazide diuretics are helpful in the prevention of calcium stones.

2. To prevent oxalate stone

People with calcium oxalate stones should limit foods high in oxalate. Foods rich in oxalate are:

- Vegetables: spinach, rhubarb, okra, (lady finger), beets and sweet potatoes.
- Fruits and dry fruits: strawberry, raspberries, chiku, amla, custard apple, grapes, cashew nuts, peanuts, almonds and dried figs.
- Other foods: green pepper, fruit cake, marmalade, dark chocolate, peanut butter, soybean foods and cocoa.
- Drinks: grapefruit juice, dark colas, and strong or black tea.

3. To prevent uric acid stone

- Avoid all alcoholic beverages.
- Avoid foods high in animal protein such as organ meat (e.g. as brain, liver, kidney), fish (e.g. anchovies, sardines, herring, trout salmon), pork, chicken, beef and egg.
- Restrict pulses, legumes like beans or lentils; vegetables like mushrooms, spinach, asparagus and cauliflower.
- Restrict fatty foods such as salad dressings, ice cream, and fried foods.

Beware. Restriction of calcium containing diet will promote stone formation!

- Medication: Allopurinol to inhibit uric acid synthesis and decrease urinary uric acid excretion. Potassium citrate to maintain urine alkaline, as uric acid precipitates and forms stone in acidic urine.
- Other measures: weight reduction.

Treatment of urinary stones

Factors determining the treatment of urinary stones depend on the degree of symptoms; size, position and cause of stone; and presence or absence of urinary infection and obstruction. Two major treatment options are:

A. Conservative treatment

B. Surgical treatment

A. Conservative treatment

Most of kidney stones are small (less than 5 mm in diameter) enough to pass on their own within 3 to 6 weeks of the onset of symptoms. The aim of conservative treatment is to relieve symptoms and to help stone removal without surgical operation.

Immediate treatment of kidney stones

To treat unbearable pain a patient may requires intra-muscular or intravenous administration of NSAIDs or opioids. For less severe pain oral medications are often effective.

Plenty of fluid intake

In patients with severe pain, fluid intake should be moderate and not excessive because it may aggravate pain. But in pain free period, drink plenty of fluid. Drinking as much as 2 to 3 liters of water in a day helps

Plenty of fluid intake will flush out a large number of small stones in urine.

in stone removal without surgical operation. Remember beer is not a therapeutic agent for a patient with stone. Patientn with severe colic and associated nausea, vomiting and fever may require intravenous saline infusion to correct fluid deficit. Patient must save the passed stone for testing. Simple way to collect stone is to urinate through a strainer (sieve).

Other measures

Maintaining proper urine pH is essential. Drugs like calcium channel blockers and alpha-blockers inhibit spasms of ureter and help the patient to pass the stone in ureter on its own. Treat associated problems such as nausea, vomiting and urinary tract infection. Follow all general and special preventive measures (dietary advice, medication etc) discussed.

B. Surgical Treatment

Different surgical treatments are available for kidney stones that can't be treated with conservative measures. Most frequently used surgical methods are extra-corporeal shock wave lithotripsy (ESWL), percutaneous nephrolithotripsy (PCNL), ureteroscopy and in rare cases open surgery. These techniques are not competitive with one another but are complimentary to each other. Urologist decides which method is the best for a particular patient.

Which patient, with urinary stone, needs surgical treatment?

Most patients with small stone can be effectively treated conservatively. But surgery may be needed to remove kidney stone if :

- It causes recurrent or severe pain and does not pass after a reasonable period of time.

Stone recurs in more than 50% cases. Instructions for prevention are emphatically advised.

- It is too large to pass on its own
- It blocks the flow of urine significantly and causes damage to kidney.
- It causes recurrent urinary tract infection or bleeding.

Prompt surgery may be required in patients with kidney failure due to stone obstructing the only functioning kidney or both the kidneys simultaneously.

1. ESWL - Extra-Corporeal Shockwave Lithotripsy

ESWL or extra-corporeal shock wave lithotripsy is the latest, effective and most frequently used treatment for kidney stones. Lithotripsy is ideal for kidney stones less than 1.5 cm in size or upper ureteric stones.

In lithotripsy highly concentrated shock waves or ultra sonic waves produced by lithotriptor machine break up the stones. The stones break down into small particles and are easily passed through the urinary tract in the urine. After lithotripsy the patient is advised to drink fluids liberally to flush out stone fragments. When blockage of the ureter is anticipated after lithotripsy of a big stone, a "stent" (special soft plastic tube) is placed in the ureter to avoid blockage.

Lithotripsy is generally safe. Probable complications of lithotripsy are blood in urine, urinary tract infection, incomplete stone removal (may require more sessions), incomplete stone fragmentation (which can lead to urinary tract obstruction), damage to kidney and an elevation in blood pressure.

Advantages of lithotripsy are that it is a safe method which does not require hospitalization, anesthesia and incision or cut. Pain is minimum in this method and it is suitable for patients of all age groups.

Lithotripsy is an effective and most frequently used non-operative treatment for kidney stones.

Lithotripsy is less effective for large stones and in obese patients. Lithotripsy is not advisable during pregnancy and in patients with severe infection, uncontrolled hypertension, distal obstruction in urinary tract and bleeding disorders.

After lithotripsy regular follow up, periodical checkup and strict adherence to preventive measures against recurrence of stone disease, is mandatory.

2. Percutaneous Nephrolithotomy (PCNL)

Percutaneous nephrolithotomy, or PCNL, is an effective method for removing medium-sized or large (bigger than 1.5 cm) kidney or ureteral stones. PCNL is the most frequently used option when other treatment modalities such as ureteroscopy or lithotripsy have failed.

In this procedure, under general anaesthesia the urologist makes a tiny incision in the back and creates a small tract from the skin to the kidney under image intensifier or sonographic control. For the insertion of instruments the tract is dilated. Using an instrument called nephroscope, the urologist locates and removes the stone (nephrolithotomy). When the stone is big it is broken up using high frequency sound waves and then the stone fragments are removed (nephrolithotripsy).

By and large PCNL is safe, but there are some risks and complications that can arise as with any surgical treatment. Probable complications of PCNL are bleeding, infection, injury to other abdominal organs such as the colon, urinary leak and hydrothorax.

The main advantage of PCNL is that only a small incision (about one centimeter) is required. For all types of stones, PCNL is the most definite

PCNL is the most effective method for removal of medium or large-sized kidney stones.

modality to make the patient totally stone-free and that too in a single sitting. With PCNL hospital stay is shorter and recovery and healing is faster.

3. Ureteroscopy (URS)

Ureteroscopy is a highly successful modality for treating stones located in the mid and lower ureter. Under anaesthesia, the thin lighted flexible tube (ureteroscope) equipped with a camera is inserted via the urethra into the bladder and up the ureter.

Stone is seen through the ureteroscope and, depending on the size of the stone and the diameter of the ureter, the stone may be fragmented and/or removed. If the ureteric stone is small, it is grasped by the grasper and removed. If a stone is too large to remove in one piece, it can be broken into tiny fragments using a pneumatic lithotripsy. These tiny stone pieces pass out on their own in urine. Patients normally go home the same day and can resume normal activity in two to three days.

The advantages of URS are that even hard stones can be broken by this method, and that it does not require incisions. It is safe for pregnant women, obese persons, as well as those with bleeding disorders.

URS is generally safe, but, as with any procedure, risks exist. Probable complications of URS are blood in the urine, urinary tract infection, perforation of the ureter and formation of scar tissue that narrows the diameter of the ureter (ureteral stricture).

4. Open Surgery

Open surgery is the most invasive and painful treatment modality for stone disease requiring five to seven days hospitalization.

Mid and lower ureteric stones can be successfully treated by ureteroscope without surgery.

With the availability of new technologies, the need for open surgery has been reduced drastically. At present, open surgery is used only in extremely rare situations for very complicated cases with very large stone burden.

Major benefit of open surgery is complete removal of multiple, very big or stag horn stones in a single sitting. Open surgery is an efficient and cost-effective treatment modality especially for developing countries where resources are limited.

When should a patient with kidney stone contact the doctor?

A patient with kidney stone should immediately contact the doctor in case of:

- Severe pain in abdomen, not relieved with medication.
- Severe nausea or vomiting which prevents intake of fluid and medication.
- Fever, chills and burning urination with pain in abdomen.
- Blood in urine.
- Urine stops totally.

Reserve open surgery for very few patients with very large kidney stones or when other modalities have failed.

Chapter 20

Benign Prostatic Hyperplasia (BPH)

The prostate gland is present only in males. Enlargement of prostate gland causes problems in urination in elderly males, usually over the age of 60 years. With increase in life expectancy, incidence of benign prostatic hyperplasia (also called BPH) has also increased.

What is the prostate gland? What is its function?

It is a small organ about the size of a walnut and is part of the male reproductive system.

The prostate is situated just underneath the bladder and in front of the rectum. The prostate surrounds initial portion of the urethra (the tube that carries urine from the bladder). In other words, the initial portion of the urethra (about 3 cm. long) runs through the prostate.

The prostate is a male reproductive organ. It secretes fluid that nourishes and carries sperm into the urethra during ejaculation.

What is benign prostatic hyperplasia (BPH)?

"**Benign prostatic**" means the prostatic problem is harmless (not caused by cancer) and

"**Hyperplasia**" means enlargement.

Benign prostatic hyperplasia or benign prostatic hypertrophy (BPH) is a non-cancerous prostatic enlargement which occurs in almost all men as they get older. As men age, the prostate gland slowly grows bigger (or enlarges). An enlarged prostate compresses the urethra, blocks the

Benign Prostatic Hyperplasia is a disease of elderly males.

urine stream and causes problems in urination. Because of narrowing of the urethra, flow of urine becomes slower and less forceful.

Symptoms of BPH

The symptoms of BPH usually begin after age 50. More than half of men in their 60s and up to 90% of men in their 70s and 80s have symptoms of BPH. Most symptoms of BPH start gradually and worsen slowly over the years. The most common symptoms of BPH are:

- Frequent urination, especially at night. This is usually a very early symptom.
- Slow or weak stream of urine.
- Difficulty or straining in starting the urine flow, even when the bladder feels full.
- Urge to urinate immediately is the most bothersome symptom.
- Straining to urinate.
- Interrupted urine flow.
- Leaking or dribbling at the end of urination. Drops of urine are expelled even after urination causing wetting of underclothes.
- Incomplete emptying of bladder.

Complications of BPH

Severe BPH can cause serious problems over a time in a few patients, if left untreated. Common complications of BPH are:

- Acute urinary retention: untreated severe BPH over time can cause sudden, complete and often painful blockage of urine flow (acute urinary retention). Such patients require insertion of a tube called a catheter to drain urine from the bladder.

BPH causes weak stream of urine and frequent urination, especially at night.

- Chronic urinary retention: partial blockage of urine flow for prolonged period can cause chronic urinary retention. Chronic urinary retention is painless and is characterized by an increased residual urine volume. Amount of urine which remains in bladder after normal urination is called residual urine. Its usual presentation is incomplete bladder emptying or frequent void of small amount of urine (overflow of urine).
- Damage to bladder and kidney: chronic urinary retention causes stretching of the muscular wall of the bladder. In the long term the bladder becomes weak and no longer contracts properly.

  Large residual urine volume leads to increased pressure in the bladder. High bladder pressure may lead to a back pressure of urine through the ureters and into the kidneys. Resultant fullness of the ureters and the kidneys eventually may lead to kidney failure.
- Urinary tract infection and bladder stones: inability to completely empty the bladder increases the risk of urinary tract infection and formation of bladder stones.
- Remember, BPH does not increase the risk for prostate cancer.

Diagnosis of BPH

When history and symptoms suggests BPH, following tests are performed to confirm or rule out the presence of enlarged prostate.

- **Digital Rectal Examination (DRE)**

In this examination lubricated, gloved finger is gently inserted into the patient's rectum to feel the surface of the prostate gland through the rectal wall. This examination gives the doctor an idea of the size and condition of the prostate gland.

Digital rectal examination and sonography are two most important tests for the diagnosis of BPH.

In BPH, on DRE, prostate is enlarged, smooth, and firm in consistency. Hard, nodular and irregular feel of prostate on DRE suggests cancer of prostate or calcification of prostate.

- **Ultrasound and Post-void Residual Volume Test**

Ultrasound can estimate the prostate's size and also detect other problems such as malignancy, dilatation of ureter and kidney and abscess.

Ultrasound imaging is used to determine the quantity of urine left in the bladder after urination. Post-void residual urine volume less than 50 ml indicates adequate bladder emptying. Post-void residual urine volume of 100 to 200 ml or higher is considered to be significant and further evaluation is needed.

- **Prostate Symptom Score or Index**

International Prostate Symptom Score (IPSS) or AUA (American Urological Association) symptom index helps in the diagnosis of BPH. In this diagnostic modality, questions related to common symptoms of benign prostatic hyperplasia are asked to evaluate urinary problems in men. On the basis of calculated prostate symptoms score, severity of urinary problem is judged.

- **Laboratory tests**

Laboratory tests do not help in the diagnosis of BPH. But they help in the diagnosis of associated complications and to exclude problems with similar presentation. Urine is tested for infection and blood is tested for kidney function.

Prostate Specific Antigen (PSA) is a screening blood test for cancer of prostate.

Blood PSA test is the most important screening test for the diagnosis of cancer of prostate.

- **Other investigations**

Different investigations performed to diagnose or exclude the diagnosis of BPH are uroflowmetry, urodynamic studies, cystoscopy, prostate biopsy, intravenous pyelogram or CT urogram and retrograde pyelography.

Can a person with symptoms of BPH have prostate cancer? How is prostate cancer diagnosed?

Yes. Many symptoms of prostate cancer and BPH are similar, so on the basis of clinical symptoms it is not possible to differentiate between the two conditions. But remember, BPH is not related to prostate cancer. Three most important tests which can establish the diagnosis of prostate cancer are digital rectal examination (DRE), blood test for prostate-specific antigen (PSA) and prostate biopsy.

Treatment of BPH

Factors determining treatment options of BPH are severity of symptoms the extent to which daily life is affected due to symptoms and the presence of associated medical conditions. Goals of treatment of BPH are to reduce symptoms, improve quality of life, reduce post void residual urine volume and prevent complications of BPH.

Three different treatment options of BPH are:

A. Watchful waiting and lifestyle changes (no treatment)

B. Medical Treatment

C. Surgical Treatment

Many symptoms of prostate cancer and BPH are similar. Thorough investigation required for accurate diagnosis.

A. Watchful waiting and lifestyle changes (no treatment)

"Wait and watch" without any treatment is the preferred approach for men with mild symptoms or symptoms that don't bother them. But watchful waiting does not mean to simply wait and do nothing to reduce symptoms of BPH. During watchful waiting, the person should make changes in life style to reduce symptoms of BPH and also have regular yearly checkups to see if the symptoms are improving or getting worse.

- Make simple changes in the habits of urination and in consumption of liquids.
- Empty bladder regularly. Do not hold back urine for long. Urinate as soon as the urge arises.
- Double void. This means urine is passed twice in succession. First empty the bladder normally in a relaxed way, wait for few moments, and try to void again. Do not strain or push to empty.
- Avoid drinking alcohol and caffeine containing beverages in the evening. Both can affect the muscle tone of the bladder, and both stimulate the kidneys to produce urine, leading to night-time urination.
- Avoid excessive intake of fluid (take less than 3 liters of fluid per day). Instead of consuming lot of fluid all at once, spread out intake of fluids over the day. .
- Reduce fluid intake few hours before bedtime or going out.
- DO NOT take over-the-counter cold and sinus medications that contain decongestants or antihistamines. These medications can worsen symptoms or cause urinary retention.
- Change the timing of medication which increases volume of urine (e.g. diuretics).

BPH with mild symptoms can be managed with "watchful waiting and lifestyle changes and without medical treatment".

- Keep warm and exercise regularly. Cold weather and lack of physical activity may worsen symptoms.
- Learn and perform pelvic strengthening exercises as it is useful to prevent urine leakage. Pelvic exercises strengthen the muscles of the pelvic floor which support the bladder and help in closing the sphincter. The exercises consist of repeatedly tightening and releasing the pelvic muscle.
- Bladder training focused on timed and complete voiding. Try to urinate at regular times.
- Treatment of constipation.
- Reduce stress. Nervousness and tension can lead to more frequent urination.

B. Medical Treatment

Medications are the most common and preferred way to control mild to moderate symptoms of BPH. Medications significantly reduce major symptoms in about two-thirds of treated men. There are two classes of drugs, alpha-blockers and anti-androgens (5-alpha-reductase inhibitors) for an enlarged prostate.

- **Alpha-blockers** (tamsulosin, alfuzosin, terazosin, and doxazosin) are prescription medicines that relax the muscles in and around the prostate, relieve urinary obstruction and allow urine to flow more easily. The most common side effects of alpha-blockers are light headedness, dizziness and fatigue.
- **5-alpha-reductase inhibitors** (finasteride and dutasteride) are medicines that can reduce the size of the prostate gland. These drugs

Simply medical treatment is preferred for mild to moderate symptoms of BPH. Surgery is best avoided

increases urine flow rate, and decreases symptoms of BPH. They do not work as quickly as alpha-blockers (improvement is seen within six months of starting treatment) and generally work best on men with severe prostate enlargement. The most common side effects of 5-alpha-reductase inhibitors are problems with erection and ejaculation, decreased interest in sex and impotence.

- **Combination treatment:** An alpha blocker and an alpha-reductase inhibitor work differently and have an additive effect when given simultaneously. Therefore combination of both drugs leads to significantly greater improvement in the symptoms of BPH, than taking either drug by itself. Combination treatment is recommended in men with severe symptoms, large prostate and inadequate response to the highest dose of an alpha blocker.

C. Surgical Treatment

Surgical treatment is recommended in person with:

- Bothersome, moderate to severe symptoms refractory to medical treatment.
- Acute urinary retention.
- Recurrent urinary tract infections.
- Recurrent or persistent blood in the urine.
- Kidney failure due to BPH.
- Bladder stones along with BPH.
- Increasing or significant post void residual urine in bladder.

Surgical treatment can be divided in to two groups, surgical therapies and minimally invasive treatment. Most common and standard surgical

Severe BPH symptoms, urinary retention, recurrent UTI and kidney failure indicate need of surgery.

method is a transurethral resection of the prostate (TURP). Currently several newer methods are evolving in the surgical management of small to medium sized glands, which aim to achieve results comparable to TURP with lesser morbidity and cost.

Surgical Therapies

Specific surgical procedures commonly used are transurethral resection of the prostate (TURP), transurethral incision of the prostate (TUIP) and open prostatectomy.

1. Transurethral Resection of the Prostate (TURP)

TURP remains the gold standard treatment of prostate surgery and is more successful than medication. It relieves urinary obstruction in at least 85% to 90% of cases, and the improvement is usually long-lasting. TURP is a minimally-invasive operation, performed by urologist to remove part of the prostate gland blocking urine flow. TURP does not require skin incision or stitch. TURP requires hospitalization.

Before surgery

- Before the procedure fitness of the person is ensured.
- The patient is asked to stop smoking, as smoking increases the risk of getting a chest and wound infection, which can delay recovery.
- The patient is asked to discontinue blood-thinning medications (warfarin, aspirin and clopidogrel).

During the procedure

- TURP generally takes about 60 to 90 minutes.

The most effective and popular surgical treatment of BPH is TURP.

- TURP is usually done using spinal anesthesia. Antibiotics are given to prevent infection.
- During TURP, an instrument (resectoscope) is inserted in the urethra through the tip of penis to remove the prostate.
- Resectoscope has a light and camera for vision, electrical loop to cut tissue and seal blood vessels and a channel which carries irrigating fluid into the bladder.
- Prostate tissue removed during procedure is sent to a laboratory for histopathological examination to exclude prostate cancer.

After surgery

- The hospital stay is usually 2 to 3 days after TURP.
- Following surgery, a large triple lumen catheter is inserted through the tip of penis (through the urethra) into the bladder.
- A bladder irrigation solution is attached to the catheter and the bladder is irrigated and drained continuously for about 12–24 hours.
- Bladder irrigation removes blood or blood clots that may result from the procedure.
- When the urine is free of significant bleeding or blood clots, the catheter is removed.

Advice after surgery

Following measures after TURP help in early recovery:

- Drink more fluids to flush out the bladder.
- Avoid constipation and straining at stool. Straining can result in increased bleeding. If constipation occurs, take a laxative for a few days.

TURP is done under spinal anesthesia without making the patient unconscious, however, requiring a short hospital stay.

- Don't start blood-thinning medications without advice of the doctor.
- Avoid heavy lifting or strenuous activity for 4-6 weeks.
- Avoid sexual activity for 4-6 weeks after surgery.
- Avoid alcohol, caffeine, and spicy foods.

Possible complications

- Immediate common complications are bleeding and urinary tract infection; while less common complications are TURP syndrome and problems from surgery.
- Subsequent complications of TURP are narrowing (stricture) of urethra, retrograde ejaculation, incontinence and impotence.
- Ejaculation of semen into the bladder (retrograde ejaculation) is common sequel of TURP, occurring in about 70% of cases. This does not affect sexual function or pleasure but causes infertility.
- Factors which can increase the risk of complications are obesity, smoking, alcohol abuse, malnutrition and diabetes.

After discharge from the hospital, contact the doctor if the patient has:

- Difficulty or inability to pass urine.
- Severe pain which persist even after medication.
- Bleeding with large blood clots or blood plugs blocks the catheter.
- Signs of infection, including fever or chills.

Ejaculation of semen into bladder is a common complication of TURP leading to sterility (inability to father children).

2. Transurethral Incision of the Prostate (TUIP)

Transurethral incision of the prostate (TUIP) is an alternative to TURP for men with smaller prostates or very poor health and therefore, not suitable for TURP.

TUIP is carried out in a similar way to TURP, but rather than removing tissue from the prostate, two or more deep lengthwise incisions (cuts) are made in the prostate. The cuts widen the urethral passage, relieve pressure on the urethra and improve the flow of urine.

Benefits of TUIP are lesser blood loss, lesser surgery-related complications, shorter hospital stays and recovery time; and lesser risk of retrograde ejaculation and urinary incontinence than with TURP. Limitation of TUIP is lesser effectiveness (inadequate symptom relief or symptoms return over time in some patients) and it may require follow-up treatment with TURP. TUIP is not the most effective method for a large-sized prostate.

3. Open Prostatectomy

An open prostatectomy is a type of surgery where an incision is made in the abdomen, to remove the prostate. With availability of many effective and less invasive options, open prostatectomy is rarely used in the treatment of BPH.

An open prostatectomy is reserved only for very few men with severely enlarged prostates and in patients suffering from other problems that need simultaneous correction during surgery.

TUIP is an alternative to TURP for men with smaller prostates or high risk patients for whom TURP is not suitable.

Minimally Invasive Treatments (MITs)

Minimally invasive methods are those that hurt the least. With modern technology and research minimally invasive treatments are aimed to treat BPH in simpler and less morbid way.

These treatment modalities generally use heat, laser, or electrovaporization to remove excess tissue from the prostate. All of these treatments use a transurethral approach (going up through the urethra in the penis).

Benefits of minimally invasive treatments are: shorter hospital stay, need of minimal anaesthesia, lesser risks and complications than standard prostate surgery, and shorter patient recovery times.

Disadvantages of these methods are: lesser effectiveness than standard TURP, more likely to need surgery again after 5 or 10 years, non availability of prostate tissue for histopathological examination (to exclude hidden prostate cancer) and fewer long-term studies for its safety and efficacy. Important additional drawback is that minimally invasive treatments (MITs) are not available in majority of developing countries and are currently more expensive.

Different minimally invasive treatments used in BPH are transurethral microwave thermotherapy (TUMT), transurethral needle ablation (TUNA), water-induced thermotherapy (WIT), prostate stents and transurethral laser therapy.

1. **Transurethral Microwave Thermotherapy (TUMT):** In this procedure, using microwave heat excess prostate tissue blocking urine flow is burned.

MIT benefits: less risks and short hospitalization;
Concerns: cost effectiveness and long term safety.

2. **Transurethral Needle Ablation of the Prostate (TUNA):** In this procedure, using radiofrequency energy excess prostate tissue blocking urine flow is coagulated and necrosed.
3. **Water-Induced Thermotherapy (WIT):** In this technique, hot water causes heat-induced coagulation and necrosis of the excess prostate tissue.
4. **Prostatic Stents:** In this technique, a stent is placed within the narrowed area of the prostatic urethra. The stent keeps the channel open and allows easy urination. Stents are flexible, self-expanding titanium wire devices shaped like small springs or coils.
5. **Transurethral Laser Therapy:** In this technique, laser energy destroys the obstructing portions of the prostate by heating.

When should a patient with BPH contact doctor?

Patient with BPH should contact doctor in case of:

- Complete inability to urinate.
- Pain or burning during urination, foul-smelling urine, or fever with chills.
- Blood in the urine.
- Loss of control of urination causing wetting of underclothes.

Prostatic stent is a safe and effective treatment when medications are ineffective & surgery is contraindicated.

Chapter 21

Drugs and Kidney Problems

Kidney damage due to different drugs is common.

Why is kidney more vulnerable to drug toxicity compared to other organs of the body?

Two most important causes of damage to kidney due to drugs are:

1. Drug excretion by kidney: The kidney is a major organ involved in the removal of drugs and its metabolites. During the process of drug removal some drugs or its metabolites can damage the kidney.

2. High blood flow to kidney: Every minute 20% of total blood pumped by heart (1200 ml blood) enters in both kidneys for purification. Amongst all organs of the body, the kidney receives the highest amount of blood per kg weight of the organ. Because of the rich blood supply, harmful drugs and substances are delivered to kidney in a large amount and in a short time. This can damage the kidney.

Principal drugs that damage kidney

1. Painkillers

For body ache, headache, joint pain and fever, various over the counter (OTC) medicines are available and these drugs are taken freely without doctor's prescription. These drugs are principally responsible for kidney damage.

Painkiller drugs are a major cause of drug induced kidney damage.

What is NSAIDs? Which drugs belong to this group?

Non Steroidal Anti-Inflammatory Drugs (NSAIDs) are common medications used to reduce pain, fever and inflammation. These drugs include aspirin, diclofenac, ibuprofen, indomethacin, ketoprofen, nimesulide, naproxen etc.

Do NSAIDs cause damage to kidneys?

NSAIDs are generally safe provided they are taken in correct doses under the supervision of a doctor. But it is important to remember that NSAIDs rank second to aminoglycosides as the most common cause of drug induced kidney damage.

When can NSAIDs damage kidneys?

Risk of NSAIDs induced kidney damage is high in case of:

- NSAIDs are taken for a long period in high dosage without supervision of a doctor.
- A single pill containing combination of many drugs is used for a long period (e.g. APC which contains aspirin, phenacetin and caffeine)
- NSAIDs are taken by a person with advanced age, kidney failure, diabetes or dehydration.

Which pain killer is safe for kidney failure patients?

Paracetamol (acetaminophen) is a safer drug than other NSAIDs.

Many heart patients are prescribed lifelong aspirin. Can that damage the kidney?

Since a low dose of aspirin is advised for cardiac patients, it is safe.

Self medication of common painkiller drugs can be dangerous.

Is kidney damage caused by NSAIDs reversible?

Yes and No.

Yes. When acute kidney damage is due to short term use of NSAIDs, it is usually reversible by stopping NSAID drugs and proper treatment.

No. Many old patients with joint pain need NSAIDs for a long period. When they are taken in large doses for a long period (years) continuously it can lead to slow and progressive kidney damage. This type of kidney damage is irreversible. Elderly patients, who need large dose of NSAIDs for a very long period, should take it under the guidance and supervision of a physician.

How to diagnose slow but progressive kidney damage due to long term NSAIDs in early stage?

Appearance of protein in urine is the first and only clue of kidney damage due to NSAIDs. When kidney function worsens creatinine level in blood rises.

How to prevent kidney damage due to painkillers?

Simple measures to prevent kidney damage due to painkillers are:

- Avoid the use of NSAIDs in high risk persons.
- Avoid indiscriminate use of painkillers or OTC pain relievers.
- When NSAIDs are necessary for a long period, they should be taken strictly under the doctor's supervision.
- Limit dose and duration of treatment with NSAIDs.
- Avoid a combination of mixture of pain killers for a longer period.
- Drink plenty of fluid daily. Adequate hydration is important to maintain proper blood supply to kidney and to avoid damage to kidney.

Risk of drug induced kidney damage is high in patients having diabetes, kidney failure, dehydration or of advanced age.

2. Aminoglycosides

Aminoglycosides are a group of antibiotics frequently used in practice and a common cause of kidney damage. Kidney damage occurs usually 7 - 10 days after the initiation of therapy. Diagnosis of this problem is often missed because volume of urine is unaltered.

Risk of aminoglycosides induced kidney damage is high in advanced age, dehydration, pre-existing kidney disease, potassium and magnesium deficiency, administration of large doses for prolonged periods, combination therapy with other drugs which can damage kidney, sepsis, liver disease and congestive heart failure.

How to prevent kidney damage due to aminoglycosides?

Measures to prevent the kidney damage due to aminoglycosides are

- Cautious use of aminoglycosides in high risk persons. Correction or removal of the risk factors.
- Once-daily administration of aminoglycosides instead of divided dosage.
- Use of optimum dose and duration of aminoglycosides therapy.
- Dose modification in presence of pre-existing kidney damage.
- Serial monitoring of serum creatinine every other day for early detection of kidney damage.

3. Radiocontrast injections

Radiographic contrast media (X-ray dyes) induced kidney damage is a common cause of acute kidney failure in hospitalized patients, which is usually reversible.

For high risk patients administer aminoglycosides cautiously & monitor serum creatinine serially to prevent kidney damage.

The risk of contrast induced kidney damage is high in the presence of diabetes, dehydration, heart failure, pre-existing kidney damage, advanced age and concurrent use of drugs which can damage the kidney.

Different measures can prevent contrast induced kidney damage. Important measures are use of smallest dose of contrast, use of nonionic contrast agents, maintaining adequate hydration with IV fluids, administration of sodium bicarbonate and acetylcysteine.

4. Other drugs

Other common drugs which can damage kidneys are certain antibiotics, anticancer therapy, antituberculous drugs etc.

5. Other medicines

- The popular belief that all natural medicines (Aurvedic medicines, Chinese herbs etc.) and dietary supplements are harmless is wrong.
- Certain medicines of these groups contain heavy metals and toxic substances which can cause damage to the kidney.
- Use of certain medicines of these groups can be dangerous in patients with kidney failure.
- Certain drugs with high potassium content can be lethal in kidney failure.

It is a wrong belief that all natural medicines are always safe for kidney.

Chapter 22

Nephrotic Syndrome

Nephrotic syndrome is a common kidney disease characterized by heavy loss of protein in urine, low blood protein levels, high cholesterol levels and swelling. This disease can occur at any age but is seen more frequently in children compared to adults. Nephrotic syndrome is characterized by its cycle of response to treatment, manifested by gradual tapering and discontinuation of medication, treatment free period of remission and frequent relapses causing swelling. As the cycle of recovery and recurrence repeats for a long period (years), this disease is a matter of worry for both the child and the family.

What is nephrotic syndrome?

Kidney works as a sieve (filter) in our body which removes waste products and extra water from blood into urine. The size of the holes of these filters is small. So in normal circumstances protein which is large in size does not pass in urine.

In nephrotic syndrome the holes of these filters become large, so protein leaks into the urine. Because of the loss of protein in urine, the level of protein in blood falls. Reduction of protein level in blood causes swelling. Depending on the amount of protein lost in the urine and reduction in protein level of blood, the severity of swelling varies. The kidney function, per se, is normal in most patients of nephrotic syndrome.

What causes nephrotic syndrome?

In over 90% of children the cause of nephrotic syndrome (called primary or idiopathic nephrotic syndrome) is not known. Primary Nephrotic

Most important cause of recurrent swelling in children is nephrotic syndrome.

Syndrome is caused by four pathological types: minimal change disease (MCD), focal segmental glomerulosclerosis (FSGS), membranous nephropathy and membranoproliferative glomerulonephritis (MPGN). Primary nephrotic syndrome is a "diagnosis of exclusion", i.e. they are diagnosed only after secondary causes have been excluded.

In less than 10 % of cases nephrotic syndrome may be secondary to different conditions such as infection, drug exposure, malignancy, hereditary disorders or systemic diseases such as diabetes, systemic lupus erythematosus and amyloidosis.

Minimal change disease

The most common cause of nephrotic syndrome in children is minimal change disease. This disease occurs in 90 percent of cases of the idiopathic nephrotic syndrome in young children (under age six) and in 65% of cases in older children.

In nephrotic syndrome, if blood pressure is normal, red blood cells are absent in urineand value of creatinine and complement 3 (C3) is normal, in blood test there are high chances that minimal change disease is the likely underlying pathological cause of nephrotic syndrome. Of all the causes of nephrotic syndrome, minimal change disease is least stubborn, as over 90% of the patients respond well to steroid therapy.

Symptoms of nephrotic syndrome

- Nephrotic syndrome can occur at any age but is most common between the ages of 2 to 8 years. It affects boys more often than girls.
- The first sign of nephrotic syndrome in children is usually puffiness or swelling around the eyes and swelling of the face. Because of

Nephrotic syndrome commonly occurs in children between the ages of 2 to 8 years.

puffiness around the eyes the patient is likely to contact an ophthalmologist (eye doctor) first.

- In nephrotic syndrome swelling of the eyes and the face is most noticeable in the morning and is less marked in the evening.
- With time, the swelling develops in feet, hands, abdomen and all over the body and is associated with increase in weight.
- Swelling may occur after respiratory tract infection and fever in many patients.
- Excluding swelling, the patient is usually well, active and does not seem sick.
- Passing less amount of urine compared to normal is common.
- Frothy urine and white stain on tiles due to albumin in urine may be a revealing feature.
- Red urine, breathlessness and high blood pressure are less common in nephrotic syndrome.

What are the complications of nephrotic syndrome?

Possible complications of nephrotic syndrome are an increased risk of developing infections, blood clots in the veins (deep vein thrombosis), malnutrition, anemia, heart disease due to high cholesterol and triglycerides, kidney failure and different complications due to treatment.

Diagnosis:

A. Basic laboratory tests

In patients with swelling the first step is to establish diagnosis of nephrotic syndrome. Laboratory tests should confirm (1) heavy loss of protein in the urine, (2) low blood protein levels, and (3) high cholesterol levels.

The first sign of nephrotic syndrome in children is swelling around the eyes and swelling of the face.

1. Urine tests

- Urine examination is the first test used in the diagnosis of nephrotic syndrome. Normally, routine examination of urine will show negative or trace protein (albumin). Presence of 3+ or 4+ protein in random urine sample is suggestive of nephrotic syndrome.
- Remember the presence of albumin in urine is not a specific diagnostic confirmation of nephrotic syndrome. It only suggests urinary loss of protein. To determine the exact cause of loss of protein in urine further investigations are necessary.
- After starting treatment, urine is tested regularly to assess its response to treatment. The absence of protein in urine test suggests positive response to treatment. For self monitoring, protein in urine can be estimated by using a urine dipstick at home.
- In microscopic examination of urine, red blood cells and white blood cells are usually absent.
- In nephrotic syndrome the loss of protein in urine is more than 3 gram in a day. The amount of protein lost in 24 hours can be estimated by a 24-hour urine collection or more conveniently by a spot urine protein/creatinine ratio. These tests provide precise measurement of the amount of protein lost and identify whether protein loss is mild, moderate or heavy. Estimation of loss of protein in urine in 24 hours is useful in monitoring response of treatment in addition to its diagnostic value.

2. Blood tests

- The characteristic findings of nephrotic syndrome are low blood albumin level (less than 3 g/dL) and elevated cholesterol (hypercholesterolemia) in blood tests.

Urine test is very important for diagnosis as well as monitoring of treatment of nephrotic syndrome.

- The value of serum creatinine is normal in nephrotic syndrome. Serum creatinine is measured to assess overall kidney function.
- Complete blood count is a routine blood test performed in most of the patients.

B. Additional tests

Once the diagnosis of nephrotic syndrome has been established, additional tests are performed selectively. These tests determine whether the nephrotic syndrome is primary (idiopathic) or secondary to systemic disorder; and to detect the presence of associated problems or complications.

1. Blood tests

- Blood sugar, serum electrolytes, calcium and phosphorus.
- Testing for HIV, hepatitis B and C and VDRL test
- Complement studies (C3, C4) and ASO titer.
- Antinuclear antibody (ANA), anti–double-stranded DNA antibody, rheumatoid factor and cryoglobulins.

2. Radiological tests

- Ultrasound of the abdomen is performed to determine the size and shape of the kidney, and to detect mass, kidney stone, cyst or other obstruction or abnormality.
- X-ray of the chest to rule out infections.

3. Kidney biopsy

Kidney biopsy is the most important test used to determine the exact

Important diagnostic clues are loss of protein in urine and low protein, high cholesterol and normal creatinine in blood tests.

underlying type or cause of nephrotic syndrome. In kidney biopsy a small sample of kidney tissue is taken and examined in a laboratory. (for further information read Chapter 4).

Treatment

In nephrotic syndrome the goals of treatment are to relieve symptoms, correct urinary loss of protein, prevent and treat complications and protect the kidney. Treatment of this disease usually lasts for a long period (years).

1. Dietary advice

- The dietary advice/restriction for a patient who has swelling would be changed after the swelling disappears with effective treatment.
- **In a patient with swelling:** Restriction of dietary salt and avoidance of table salt as well as foods those are high in sodium content, so as to prevent fluid accumulation and edema. Restriction of fluid is usually not required.

  Patients receiving high dose of daily steroid should restrict salt intake even in the absence of swelling to decrease the risk of development of hypertension.

  For patients with swelling, adequate amount of proteins should be provided to replace the protein loss and prevent malnutrition. Also provide adequate amount of calories and vitamins should be provided to these patients.
- **In symptom- free patients:** The dietary advice during symptom-free period is a 'normal healthy diet' and to avoid unnecessary dietary restrictions. Avoid restriction of salt and fluid. Provide adequate

In patients with swelling, salt restriction is necessary but during symptom-free period avoid unnecessary dietary restrictions.

amount of proteins. However avoid high protein diet to prevent damage to the kidney and restrict protein intake in presence of kidney failure. Increase intake of fruits and vegetables. Reduce the intake of fat in diet to control blood cholesterol levels.

2. Drug Therapy

A. Specific drug treatment

- **Steroid therapy:** Prednisolone (steroid) is the standard treatment for inducing remission in nephrotic syndrome. Most children respond to this drug. Swelling and protein in the urine disappear within 1-4 weeks (urine free of protein is labeled as a remission).
- **Alternate therapy:** A small group of children who do not respond to steroid treatment and continue to lose protein in their urine, need further investigation such as kidney biopsy. Alternate drugs used in such patients are levamisole, cyclophosphamide, cyclosporin, tacrolimus and mycophenylate mofetil (MMF). These alternate drugs are used along with steroid therapy and help to maintain remission when the dose of steroid is tapered.

B. Supportive drug treatment

- Diuretic drugs to increase urine output and reduce swelling.
- Antihypertensive drugs such as ACE inhibitors and angiotensin II receptor blockers to control blood pressure and to reduce the urinary loss of protein.
- Antibiotics to treat infections (e.g. bacterial sepsis, peritonitis, pneumonia).
- Statins (simvastatin, atorvastatin) to reduce cholesterol and

Prednisolone (steroid) is the standard first line treatment of nephrotic syndrome.

triglycerides which prevents the risk of heart and blood vessel problems.

- Supplement calcium, vitamin D and zinc.
- Rabiprazole, pantoprazole, omeprazole or ranitidine for protection against steroid induced stomach irritation.
- Albumin infusions generally not used because their effect lasts only transiently.
- Blood thinners such as warfarin (Coumadin) or heparin, may be required to treat or prevent clot formation.

3. Treatment of underlying causes

Meticulous treatment of underlying causes of secondary nephrotic syndrome such as diabetic kidney disease, lupus kidney disease, amyloidosis etc. is important Proper treatment of these disorders is necessary to control nephrotic syndrome.

4. General advice

- Nephrotic syndrome is a disease that lasts for several years. The family should be educated about the nature of the disease and its outcome; type of medication used and its side effects; and benefits of prevention and early treatment of the infection. It is important to emphasize that extra care is necessary during relapse when swelling is present, but during remission the patient should be treated as a normal child.
- The infection should be treated adequately before initiating steroid therapy in case of nephrotic syndrome.
- Children with nephrotic syndrome are prone to respiratory and other

Infection is an important cause of recurrence of nephrotic syndrome, so it is essential to protect children against infection.

infections. Prevention, early detection and treatment of infection are essential in nephrotic syndrome because infection can lead to a relapse of controlled disease (even when patient is receiving treatment).

- To prevent of infection, the family and child should be trained to drink clean water, wash hands thoroughly and avoid crowded areas or contact with infectious patients.
- Routine immunization is advised when steroid course is completed.

5. Monitoring and follow up

- As nephrotic syndrome is likely to last for a long period (years), it is important to have regular follow up with doctor as advised. During the follow up the patient is evaluated by the doctor for loss of protein in urine, weight, blood pressure, height, side effect of medication and development of complications, if any.
- Patients should weigh themselves frequently and record it. Weight chart helps to monitor fluid gain or loss.
- The family should be taught to test urine for protein at home regularly and maintain a diary of all urine test results and dosage and the details of all medications. It helps in early detection of relapse and its prompt treatment subsequently.

Why and how is prednisoloe given in nephrotic syndrome?

- The first drug used in the treatment of nephrotic syndrome is a prednisolone (steroid) that effectively corrects the disease and stops loss of protein in urine.

As nephrotic syndrome lasts for years, regular urine tests and follow up with the doctor are crucial.

- The doctor decides the dosage, duration and method of administration of prednisolone. The patient is advised to take this drug with food to avoid irritation of stomach.
- In the first attack the drug is usually given for about 4 months, divided into three phases. The drug is given daily for 4 to 6 weeks initially, as a single dose on alternate mornings subsequently and finally the dose of prednisolone is gradually decreased and then discontinued. The treatment of relapse of nephrotic syndrome is different from the treatment given on first attack.
- Within 1 to 4 weeks of the treatment the patient is symptom free and the leaking of protein in urine stops. But one must not make the mistake of discontinuing the treatment out of the fear of side effects of prednisolone. It is very important to complete the course as advised by the doctor to prevent frequent relapses.

What are the side effects of prednisolone (Corticosteroids)?

Prednisolone is the most commonly used drug for the treatment of nephrotic syndrome. But because of the possibility of several side effects this drug should be taken strictly under medical supervision.

Short-term effects

Common short-term side effects are increase in appetite, weight gain, swelling of the face, stomach irritation causing abdominal pain, increased susceptibility to infection, increased risk of diabetes and high blood pressure, irritability, acne and excessive growth of facial hair.

Optimum steroid therapy is essential to control the disease, prevent frequent relapses and reduce side effects of steroid.

Long-term effects

Common long-term side effects are weight gain, stunted growth in children, thin skin, stretch marks on thighs, arms, and abdominal area, slow wound healing, development of cataracts, hyperlipidemia, bone problems (osteoporosis, avascular necrosis of the hip) and muscle weakness.

Why are corticosteroids used in the treatment of nephrotic syndrome in spite of multiple complications?

Serious side effects of corticosteroids are known but at the same time untreated nephrotic syndrome has its potential dangers.

Nephrotic syndrome can cause severe swelling and low protein in the body. Untreated disease may cause numerous complications, such as increased risk of infections, hypovolemia, thromboembolism, lipid abnormalities, malnutrition and anemia. Children with untreated nephrotic syndrome quite often die from infections.

With the use of corticosteroid in childhood nephrotic syndrome the mortality rate has reduced to around 3%. The optimal doses and the durations of corticosteroid therapy under proper medical supervision is most beneficial and least harmful. Majority of steroid effects disappear with time after the discontinuation of therapy.

In order to obtain potential benefits of the therapy and avoid life-threatening complications of the disease, the acceptance of some side effects of corticosteroid is unavoidable.

Steroids should be taken strictly under medical supervision to reduce the possibility of side effects.

In the nephrotic child, with initial steroid therapy swelling subsides and urine becomes protein free, but swelling of face is seen again during the third or fourth week of steroid therapy. Why?

Two independent effects of steroids are increased appetite leading to weight gain and redistribution of fat. These lead to a round or swollen face. Steroid induced moon-shaped face is seen during the third or fourth week of steroid therapy, which mimics swelling of the face due to nephrotic syndrome.

How to differentiate swelling of the face due to nephrotic syndrome from steroid induced moon-shaped face?

Swelling of nephrotic syndrome starts with puffiness or swelling around the eyes and the face. Later swelling develops in feet, hands and all over the body. Swelling of the face due to nephrotic syndrome is most noticeable in the morning, immediately after waking and is less noticeable in the evening.

Swelling due to steroids predominantly affects the face and abdomen (because of redistribution of fat), but arms and legs remain normal or thin. Steroid-induced swelling remains the same all throughout the day.

Different characteristics of distribution and time of its maximum appearance helps in the differentiation of these two similar conditions. In certain patients, blood tests are needed to resolve diagnostic dilemma. In patients with swelling, low serum protein/ albumin and high cholesterol indicates relapse while normal value of both the tests suggests steroid effect.

Steroid therapy can increase appetite, weight and cause swelling of the face and abdomen.

Why is it important to differentiate between swelling of the face due to nephrotic syndrome and steroid effect?

To determine precise treatment strategy in a patient, it is important to differentiate between swelling due to nephrotic syndrome starts and steroid side effect.

Swelling due to nephrotic syndrome needs increment of steroid dose, modification in the method of its administration, at times, addition of other specific drugs and temporary supplementation of water pill (diuretics).

While swelling due to steroid effect is the proof of a long term steroid intake, one should neither worry that disease is out of control nor reduce the dose of the steroid rapidly out of fear of the drug toxicity. For long term control of nephrotic syndrome continuation of steroid therapy as per recommendation of the doctor is essential. Diuretics should not be used to treat steroid induced swollen face because it is ineffective and can be harmful.

What are the chances of recurrence of nephrotic syndrome in children? How frequently does relapse occur?

Chances of recurrence or relapse of nephrotic syndrome is as high as 50-75% in a nephrotic child. The frequency of relapse varies from patient to patient.

Which drugs are used when steroid is ineffective in the treatment of nephrotic syndrome?

When steroid is ineffective in the treatment of nephrotic syndrome, other specific drugs used are levamisole, cyclophosphamide, cyclosporine, tacrolimus and mycophenolate mofetil (MMF).

To plan optimum therapy, it is essential to differentiate between swelling due to disease and steroids.

What are the indications suggesting the need of kidney biopsy in children with nephrotic syndrome?

There is no need to do a kidney biopsy before starting steroid treatment in children with nephrotic syndrome. But kidney biopsy is indicated if:

- There is no response to adequate dose of steroid treatment (steroid resistance).
- Frequently relapsing or steroid dependent nephrotic syndrome.
- Presence of atypical features for childhood nephrotic syndrome such as onset in the first year of life, elevated blood pressure, persistent presence of red cells in urine, impaired kidney function and low blood C3 level.
- Nephrotic syndrome of unknown origin in adults usually requires a kidney biopsy for diagnosis before initiating steroid therapy.

What is the prognosis of nephrotic syndrome and what is the expected time factor for its cure ?

The prognosis depends on the cause of nephrotic syndrome. The most common cause of nephrotic syndrome in children is minimal change disease which carries good prognosis. Majority of children with minimal change disease respond very well to steroids and there is no risk of developing chronic kidney failure.

A small proportion of children with nephrotic syndrome may not respond to steroid and require further evaluation (additional blood tests and kidney biopsy). These children with steroid resistance nephrotic syndrome need treatment with alternate drugs (levamisole, cyclophosphamide, cyclosporin, tacrolimus etc) and are vulnerable to a high risk of developing chronic kidney failure.

There is no risk of kidney failure in children with common type of nephrotic syndrome.

In nephrotic syndrome with proper treatment protein leak stops and the child becomes almost normal. In majority of children relapse occurs for many years (throughout childhood). As the child grows, frequency of relapse decreases. Complete cure nephrotic syndrome usually occurs between the age of 11 to 14 years. These children have an excellent prognosis and lead a normal life as adults.

When should a person with nephrotic syndrome contact the doctor?

The family of a child with nephrotic syndrome should immediately contact the doctor if he or she develops:

- Pain in abdomen, fever, vomiting or diarrhoea.
- Swelling, rapid unexplained weight gain, marked reduction in urine volume.
- Signs of illness e.g. if he or she stops playing and is inactive
- Persistent severe cough with fever or severe headache.
- Chicken pox or measles.

Nephrotic syndrome which lasts for years slowly disappears with age.

Chapter 23

Urinary Tract Infection in Children

Urinary tract infection (UTI) is a common problem in children with short term and long term health problems.

Why do urinary tract infections require urgent attention and immediate treatment in children in comparison to that in adults?

Urinary tract infection needs immediate urgent attention in children because:

- UTI is a common cause of fever in children. UTI is the third among the most common infections in children after respiratory infection and diarrhea.
- Inadequate and delayed treatment can be dangerous as it will cause permanent kidney damage. Recurrent UTI causes kidney scars which in the long term can lead to high blood pressure, poor kidney growth and even chronic kidney disease.
- Because of variable presentation, diagnosis of UTI is often missed. High index of vigilance and suspicion are necessary for its diagnosis.
- There is high risk of recurrence.

Which are the predisposing factors of urinary tract infections in children?

The following are common risk factors for UTI in children:

- UTI is more common in girls, because girls have a shorter urethra.
- Girls wipe from back to front (instead of front to back) after toilet.

Urinary tract infection is a common cause of fever in children.

- Children who may have congenital urinary tract anomalies such as, vesicoureteral reflux (condition with an abnormal backward flow (reflux) of urine from the bladder up the ureters and toward the kidneys) and posterior urethral valve.
- Uncircumcised boys are more likely to develop UTI than circumcised boys.
- Structure abnormality of the urinary tract (e.g. posterior urethral valve)
- Stone in urinary system.
- Other causes: constipation, poor perineal hygiene, prolonged catheterization or family history of UTI.

Symptoms of Urinary Tract Infection

Older children can complain about their problems. Common symptoms of urinary tract infections are same in older children as those in adults and are discussed in Chapter 18.

Younger children are unable to complain. Crying while passing urine, difficulty in passing urine, foul smelling urine and frequent unexplained fever are common complains of UTI.

Young children with UTI may have poor appetite, vomiting or diarrhea, poor weight gain or weight loss, irritability or no symptoms at all.

Diagnosis of Urinary Tract Infection

Investigations performed in children with urinary tract infections are:

1. Basic investigations in urinary tract infection

- Screening tests for UTI: Urine microscopy or dipstick tests. Further details are discussed in Chapter 18.

Common symptoms of UTI in children are recurrent fever, poor weight gain and urinary problems.

- Definitive diagnostic test for UTI: Urine culture test for confirmation of diagnosis, identification of the specific bacteria causing infection and selection of the most appropriate antibiotics for the treatment.
- Blood tests: Hemoglobin, total and differential white cell count, blood urea, serum creatinine, blood sugar and C reactive protein etc.

2. Investigations for diagnosis of risk factors of urinary tract infection

- Radiological tests to detect underlying abnormalities: Ultrasound of kidney and bladder, X-rays of the abdomen, Voiding Cystourethrogram - VCUG, CT scan or MRI of the abdomen and Intravenous Urography (IVU).
- Tests to detect scarring of kidney: A DMSA kidney scan is the best method for detecting kidney scarring. DMSA (dimercaptosuccinic acid) scan should be done preferably 3 to 6 months after the attack of UTI.
- Urodynamic studies to assess bladder functions.

What is Voiding Cystourethrogram? When and how is it done?

- Voiding cystourethrogram - VCUG (previously known as Micturating cystourethrogram - MCU) is a very important diagnostic X-ray test for children with urine tract infection and vesicoureteral reflux (VUR).
- VCUG test is the gold standard for diagnosis of vesicoureteral reflux and its severity (grading); and detection of abnormalities of bladder and urethra.
- It should be done for every child below 2 years after the first attack of UTI.

Most important tests to diagnose predisposing factors for UTI are ultrasound, VCUG and IVU.

- VCUG should be done after treating UTI, usually after the first week of diagnosis.
- In this test urinary bladder is filled to its capacity with contrast (radio opaque iodine containing dye fluid which can be seen on X-ray films) through a catheter under strict aseptic precaution and usually under antibiotic cover.
- Series of X-ray images are taken before and at timed intervals during voiding. This test provides comprehensive view of anatomy and the functioning of the bladder and urethra.
- VCUG can detect urine flow from the bladder backwards into the ureters or kidneys, known as vesicoureteral reflux. VCUG is essential to detect posterior urethral valve in male infants.

Prevention of Urinary Tract Infection

1. Increase fluid intake. It dilutes urine and helps in flushing out bacteria from the bladder and urinary tract.
2. Children should pass urine every two to three hours. Holding urine in the bladder for a long period provides opportunity for bacteria to grow.
3. Keep genital area of children clean. Wipe child from front to back (not back to front) after toilet. This habit prevents bacteria in the anal region from spreading to urethra.
4. Frequently change diapers to prevent prolonged contact of stool with the genital area.
5. Children should be made to wear only cotton undergarments to allow air circulation. Avoid tight-fitting pants and nylon underwear.

VCUG is the most reliable X-ray test used in children with UTI to detect vesicoureteral reflux and posterior urethral valve.

6. Avoid giving bubble baths.
7. For uncircumcised boy, the foreskin of his penis should be washed regularly.
8. In children with VUR, double or triple voiding (passing of urine) to prevent residual urine.
9. A low dose daily antibiotic for a long-term as a preventive (prophylactic) measure is recommended for some children who are prone to chronic UTI.

Treatment of Urinary Tract Infection

General measures

- Child should be made to follow all preventive measures of urinary tract infection.
- A child with UTI is advised to drink more water. Sick hospitalized children need intravenous fluid therapy.
- For fever appropriate medications should be given.
- Urine test after completion of treatment is necessary to ensure that infection is controlled adequately. Regular follow up with urine test is necessary in all children to confirm that there is no infection again.
- Ultrasound and other appropriate investigations should be done in all children with UTI.

Specific treatment

- In children, UTI should be treated without delay with antibiotics to protect the developing kidneys.
- Urine culture is sent before initiating treatment to identify causative bacteria and proper selection of antibiotics.

Inadequate and delayed treatment of UTI in children can be dangerous as it can cause irreversible kidney damage.

- Child needs hospitalization and intravenous higher antibiotics if he/she is sick, having high grade fever, vomiting, severe flank pain and inability to take medicine by mouth. Neonates and young infants with UTI need administration and treatment.
- Antibiotics by mouth are given to children more than 3 to 6 months of age, who are not sick and are able to take oral medicine.
- It is important that children are given full dosage of antibiotics as instructed by the doctor. Full course of the prescribed medication must be completed, even if the child does not have any symptoms of UTI

Recurrent Urinary Tract Infection

Children with recurrent, symptomatic UTI need ultrasound, VCUG and at times DMSA scan to identify the underlying cause. Three important treatable problems for recurrent UTI are VUR, the posterior urethral valves and kidney stones. According to the underlying cause, specific medical treatment followed by preventive measures and long term preventive antibiotics therapy is planned. In certain children surgical treatment is planned jointly by nephrologist and urologist.

Posterior Urethral Valves

Posterior urethral valves (PUV) are a congenital abnormality of the urethra which occurs in boys. PUV is the most common cause of obstruction of the lower urinary tract in boys.

Basic problem and its importance: Folds of tissue within the urethra lead to incomplete or intermittent blockage to the normal flow of urine in PUV. A blockage to the urine flow through the urethra causes back

Send urine for culture before initiating therapy to identify causative bacteria & for proper selection of antibiotics.

pressure on the bladder. Size of the bladder increases considerably and its muscle wall becomes very thick.

Grossly enlarged bladder with elevated bladder pressure leads to back pressure up the ureters and kidney. This results in dilatation of ureter and kidney. Such dilatation if not diagnosed and treated timely, it lead to chronic kidney disease (CKD). in the long term About 25% to 30% children born with PUV are likely to suffer from end stage kidney disease (ESKD). So PUV is a significant cause of morbidity and mortality in infants and children.

Symptoms: Common symptoms of posterior urethral valves are weak urine stream, dribbling of urine, difficulty or straining to pass urine, bedwetting, fullness of lower part of abdomen (supra pubic region) due to palpable bladder and urinary tract infection.

Diagnosis: Ultrasound before birth (antenatal) or after birth in a male child provides first clue for diagnosis of PUV. But confirmation of the diagnosis of PUV requires the VCUG test which is carried out in the immediate post-natal period**.**

Treatment: Surgeons (urologists) and kidney specialists (nephrologists) jointly treat PUV.

The first treatment for immediate improvement is to insert a tube into the bladder (usually via urethra and occasionally directly through abdominal wall - suprapubic catheter) to drain urine constantly. Simultaneous supportive measures such as treatment of infection, anemia and kidney failure; and correction of malnutrition, fluid and electrolyte abnormalities helps in the improvement of general condition.

PUV causes obstruction of the lower urinary tract in boys leading to CKD if not treated in time.

Definitive treatment of PUV is surgical treatment which follows supportive measures. Valve in the urethra is removed by urologist with the help of endoscope. All children need regular lifelong follow up with nephrologist subsequently because of the risk of UTI, problems of growth, electrolyte abnormalities, anemia, high blood pressure and chronic kidney disease.

Vesicoureteral Reflux (VUR)

Vesicoureteral reflux (VUR) is "backward flow of urine from bladder into ureter".

Why is it important to know about vesicoureteral reflux?

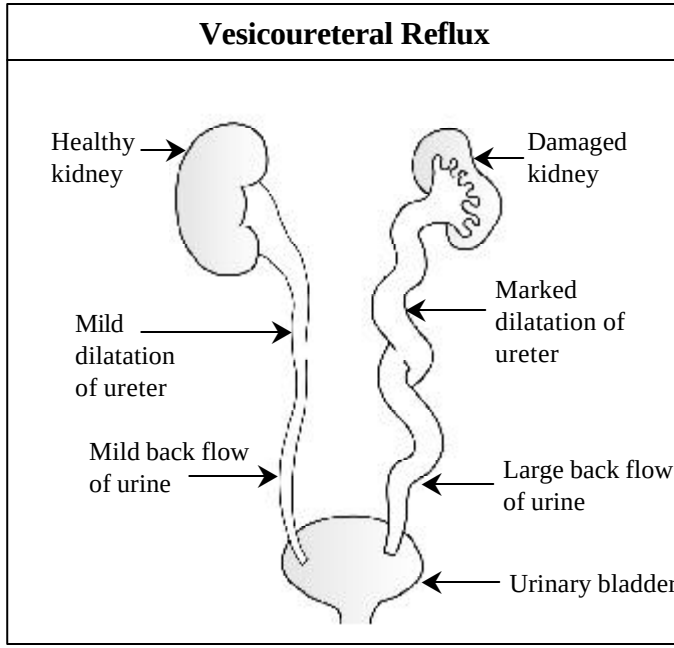
VUR is present in about 30 to 40 % of children with UTI associated with fever. In many children VUR may cause scarring and damage to kidney. Kidney scarring in a long period may cause high blood pressure, toxemia of pregnancy in young females, chronic kidney disease and finally in a few patients end stage kidney disease. VUR is more common in family members of a person with VUR and affects girls more frequently.

What is vesicoureteral reflux and why does it occur?

VUR is a condition with an abnormal backward flow (reflux) of urine from the bladder toward the ureters and possibly up to the kidneys. This can happen either on one or both sides.

Urine formed in kidneys flows down to urinary bladder through ureters. Urine normally flows in one direction, down the ureters and into the bladder.

VUR is very common in children with UTI and carries risk of hypertension and CKD.



During urination and when bladder is filled with urine, valve between bladder and ureter is responsible for the prevention of back flow of urine. VUR is caused by a defect in the mechanism of this valve.

On the basis of back flow of urine from bladder to ureter and kidney, severity of VUR is rated from mild to severe form (Grade I to V).

What causes vesicoureteral reflux?

There are two types of VUR: primary VUR and secondary VUR. Primary VUR is the most common type of VUR and is present at birth. Secondary VUR can occur at any age. It commonly occurs due to obstruction or malfunction in the bladder or urethra with bladder infection.

What are the symptoms of vesicoureteral reflux?

There are no specific signs and symptoms of VUR. But frequent and

recurrent urinary tract infection (UTI) is the most common presentation of VUR. In older children with untreated severe vesicoureteral reflux, signs and symptoms are apparent because of complications such as high blood pressure, protein in urine or kidney failure.

How is vesicoureteral reflux (VUR) diagnosed?

Investigations performed in children with suspected VUR are:

1. Basic diagnostic test for VUR

- Voiding cystourethrogram - VCUG is the gold standard for the diagnosis of vesicoureteral reflux and its severity (grading).
- Vesicoureteral reflux is graded according to the degree of reflux. The grade of VUR indicates how much urine is flowing backward into the ureters and kidneys. Grading is important to determine prognosis and most appropriate therapy in a given patient.
- In mild form of VUR, urine refluxes only to the ureter (Grade I and II). In most severe form of VUR there is massive reflux of urine, with marked tortuosity and dilatation of the ureter and severe kidney swelling (Grade V).

2. Additional investigations in VUR

- Urine test and urine culture - to detect a urinary tract infection.
- Blood tests: basic tests usually performed are hemoglobin, white blood cells and serum creatinine.
- Kidney and bladder ultrasound: to find out the size and shape of the kidneys and to detect scars, kidney stones, obstruction or other abnormalities. It can't detect reflux.
- DMSA kidney scan: this is the best method for detecting kidney scarring.

With regular antibiotics for a long term (years), low-grade reflux resolves without surgery.

How is vesicoureteral reflux treated?

It is important to treat VUR to prevent possible infections and kidney damage. The management of vesicoureteral reflux depends on the grade of reflux, age of children and symptoms. There are three options for treating VUR, which are antibiotics, surgery and endoscopic treatment. The most common first-line treatment of VUR is the use of antibiotics to prevent UTI. Surgery and endoscopic treatment is reserved for severe VUR or in those case where antibiotics have not been effective

Mild VUR: Mild VUR will disappear completely on its own, by the time a child is 5 to 6 years old. So children with mild VUR are less likely to need surgery. In such patients low dosage of antibiotics is given once or twice a day, every day, for a long term to prevent UTI. This is called antibiotic prophylaxis. Antibiotic prophylaxis is usually given till 5 years of age. Remember that antibiotics per se do not correct VUR. Nitrofurantoin and cotrimoxazole are preferred drugs for antibiotic prophylaxis.

All children with VUR should follow general preventive measures for UTI (discussed above) and regular frequent and double voiding. Periodic urine tests are needed to detect UTI. VCUG and ultrasound are repeated yearly to determine if reflux has subsided.

Severe VUR: The severe form of VUR is less likely to resolve on its own. So children with severe form of VUR require surgery or endoscopic treatment.

Correction of reflux by open surgery (ureteral reimplantation or ureteroneocystostorny) prevents the backflow of urine. The main advantage of surgery is its high success rate (88-99%).

Surgery and endoscopic treatment is indicated in severe VUR or when antibiotics are not successful.

Endoscopic treatment is a second effective treatment modality for severe form of VUR. The benefits of endoscopic technique are that it can be performed in outpatient setting, takes just 15 minutes, has fewer risks and does not require any incision. Endoscopic treatment is done under general anesthesia. In this method with the help of endoscope (lighted tube) a special bulking material (e.g. Dextranomer/hyaluronic acid copolymer - Deflux) is injected into the area where the ureter enters the bladder. Injection of the bulking material increases the resistance at the entry of the ureter and prevents urine from flowing back into the ureter. The success rate for resolution of reflux with this method is about 85 to 90%. Endoscopic treatment is a convenient treatment option in earlier stage of VUR as it avoids long term use of antibiotics and the stress of living with VUR for years.

Follow-up: All children with VUR should be monitored life-long with measurement of height, weight, blood pressure, urine analysis and other tests as per recommendation.

When should a the doctor be contacted ?

For children with urinary tract infection the doctor should immediately be contacted in case of:

- Persistent fever, chills, pain or burning during urination, foul-smelling urine or blood in the urine.
- Nausea or vomiting which prevents intake of fluid and medication.
- Dehydration due to poor fluid intake or vomiting.
- Pain in the lower back or abdomen.
- Irritability, poor appetite, failure to thrive or child is unwell.

Regular follow up is advised in VUR to assess blood pressure, growth, recurrence of UTI and damage to kidney.

Chapter 24

Bedwetting

Bedwetting or involuntary passing of urine during sleep is quite common in children. Bedwetting, "Nocturnal Enuresis", is the result of neither kidney ailment nor laziness or naughtiness of children. In most cases it stops on its own without any treatment as children grow up. However it is it a matter of worry for the children and their families because it causes inconvenience and embarrassment.

What percentage of children suffers from bedwetting and at what age does it normally stop?

Bedwetting is common especially under the age of 6 years. At the age of 5 years, bedwetting occurs in about 15 to 20 % of children. With age there is proportionate decrease in bedwetting: at 10 years about 5%; at 15 years just 2% and less than 1% in adults.

Which children are more likely to suffer from bedwetting ?

- Children whose parents have had the same problem in childhood.
- Those who have had delayed in the normal neurological development which reduces the child's ability to recognize a full bladder.
- Children with deep sleep.
- It is more common in boys than girls.
- The problem either starts or increases with psychological or physical stress.
- In a very small percentage of children (2%-3%), medical problems

Bedwetting at night is a common problem in young children, but it is not a disease.

such as urinary tract infection, diabetes, kidney failure, pin worms, constipation, small bladder, abnormalities in the spinal cord or defect in the urethral valves in boys, are responsible.

When and which investigations are performed for bedwetting children?

Investigations are performed only in selected children when medical or structural problems are suspected for bedwetting. Most frequently performed tests are urine tests, blood glucose, X-rays of spine and ultrasound examination or other imaging tests of the kidneys or bladder.

Treatment

Bedwetting is completely involuntary, not done intentionally, so do not scold, punish, shout at beat the child. Rather than blaming, reassure thechild that bedwetting would stop or be cured with time.

Initial treatment for bedwetting includes education, motivational therapy and change in habits of fluid intake and voiding. If bedwetting does not improve with these measures bedwetting alarms or medication may be tried.

1. Education and Motivational Therapy

- The child must be thoroughly educated about bed wetting.
- Bedwetting is not the fault of the children so do not be angry or admonish them. It will worsen the situation.
- Take care that no one teases the child for bed wetting.
- It is important to reduce the stress the child suffers due to bedwetting, and the best way to help the child overcome that is by making him

With increasing age, a sympathetic approach and motivation will cure the problem of bedwetting.

feel that the family is with him and reassuring him that the problem is temporary and it is sure to be corrected.

- Use training pants instead of diapers.
- Make proper arrangement of night lamps to ensure easy access to the toilet at night.
- Keep an extra pair of pajamas, bed sheet and a towel handy, so the child can change bed linens and soiled clothing conveniently if he wakes up due to bedwetting.
- Cover the mattress with plastic to avoid damage to the mattress.
- Place a large towel underneath the bed sheet for extra absorption.
- Encourage daily bath in the morning so that there is no urine smell.
- Praise and reward your child for a dry night. Even a small gift is an encouragement for a child.
- Constipation must not be neglected, it should be treated.

2. Limit Fluid Intake

- Limit the amount of fluid child drinks two to three hours before bedtime. But ensure adequate fluid intake during the day.
- Avoid caffeine (tea, coffee), carbonated drinks (cola) and chocolate in the evening. They can increase the need to urinate and aggravate bedwetting.

3. Advice on Voiding Habits

- Encourage double voiding before bed. First voiding at routine bedtime and second voiding just before falling asleep.
- Make it a habit to use the toilet at regular intervals throughout the day.

Limiting the fluid intake before bedtime and discipline in voiding habits are the most important measures.

- Wake the child up about three hours after he falls asleep every night to void urine. If necessary, use alarm.
- By determining the most likely time of bedwetting, the waking time can be adjusted.

4. Bedwetting Alarms

- Bedwetting or moisture alarms are the most effective method for controlling bedwetting and are generally reserved for children older than 7 years of age.
- In this alarm a sensor is attached to the child's underwear. When child voids in bed, the device senses the first drops of urine, the alarm rings and wakes up the child. The woken up child can control his urine till he reaches the toilet.
- The alarm helps in training the child to wake up just in time before the bedwetting problem.

5. Bladder Training Exercises

- Many children with bedwetting problem have small bladder. The goal of bladder training is to increase the capacity of the bladder.
- During day time children are asked to drink a large quantity of water and told to hold back urine in spite of the urge to pass urine.
- With practice, a child can hold urine for longer time. This will strengthen the bladder muscle and will increase bladder capacity.

6. Drug Therapy

Medications are used as a last resort to stop bedwetting and are generally used only in children over seven years. They are effective, but do not

Bedwetting alarms and drug therapy are generally adopted for children older than 7 years of age.

"cure" bedwetting. They provide a stopgap measure and are best used on a temporary basis. Bedwetting usually recurs when the medication is stopped. Permanent cure is more likely with bedwetting alarms than with medications.

A. Desmopressin Acetate (DDAVP): Desmopressin tablet are available in market and prescribed when other methods are unsuccessful.

This drug reduces the amount of urine produced at night in children. So this drug is useful only in those children who produce a large amount of urine. While the child is on this medication, remember to reduce evening fluid intake to avoid water intoxication. This drug is usually given before bedtime. Avoid this drug at night when the child has, for any reason drunk a lot of fluid.

Although this drug is very effective and has few side effects, because of its prohibitive cost many parents cannot afford it.

B. Imipramin: Imipramin (tricyclic antidepressants) has a relaxing effect on the bladder and tightens the sphincter and thereby increases the capacity of the bladder to hold urine. This drug is usually used for about 3-6 months. Because of rapid effect, the drug is taken one hour before bedtime. This drug is highly effective, but because of frequent side effects it is used selectively.

C. Oxybutynin: Oxybutynin (anticholinergic drugs) is useful in daytime bedwetting. This drug reduces bladder contractions and increases bladder capacity. Side effects may include dry mouth, facial flushing and constipation.

For bedwetting, drug therapy is an effective stopgap measure for short term benefit but it is not curative.

When should one contact the doctor for children with bedwetting problem?

The family of a child with bedwetting should immediately contact a doctor if the child:

- Has day time bedwetting problem.
- Continues bedwetting after the age of seven or eight years.
- Starts bedwetting again after at least six months of dry period.
- Has lost of control in passing stool.
- Has fever, pain, burning and frequent urination, unusual thirst, and swelling of the face and feet.
- Has poor stream of urine and difficulty or straining when passing urine.

Bedwetting needs consultation of doctor in case of day time bedwetting, fever, burning in urination or bowel difficulties.

Chapter 25

Diet in Chronic Kidney Disease

The major role of kidneys is to remove waste products and purify blood. Besides this, the kidney plays an important role in removing extra water, minerals and chemicals; and regulates water and minerals like sodium, potassium, calcium, phosphorus and bicarbonate in the body.

In patients suffering from chronic kidney disease, (CKD) regulation of fluid and electrolytes may be deranged. Because of this reason even normal intake of water, common salt or potassium can cause serious disturbances in fluid and electrolytes balance.

To reduce the burden on the kidney with impaired function and to avoid disturbances in fluid and electrolytes balance, patients with chronic kidney disease should modify their diet as per the guidance of the doctor and the dietician. There is no fixed diet for CKD patients. Each patient is given different dietary advice depending on clinical status, the stage of kidney failure and other medical problems. Dietary advice needs alteration even for the same patient at different times.

The goals of dietary therapy in CKD patients are:

1. To slow down the progression of chronic kidney disease and to postpone the need of dialysis.
2. To reduce toxic effects of excess urea in the blood.
3. To maintain optimal nutritional status and prevent the loss of lean body mass.
4. To reduce the risk of fluid and electrolytes disturbances.
5. To reduce the risk of cardio vascular disease.

General principles of dietary therapy in CKD patients are

- Restrict protein intake to 0.8 gm/kg of body weight/day.
- Supply adequate carbohydrate to provide energy.
- Supply moderate amount of fats. Cutt down intake of butter, ghee and oil.
- Limit the intake of fluid and water in case of swelling.
- Restrict the amount of sodium, potassium and phosphorus in diet.
- Supply vitamins and trace elements in adequate amount. High fiber diet recommended.

Details of selection and modification in diet of patients with CKD are as follows:

1. High Calorie Intake

The body needs calories for daily activities and to maintain temperature, growth and adequate body weight. Calories are supplied chiefly by carbohydrates and fats. Usual requirement of calories in CKD patients is 35 - 40 kcals/kg body weight per day. If caloric intake is inadequate, protein is used to provide calories. This break down of protein can lead to harmful effects such as malnutrition and greater production of waste products. So it is very essential to provide adequate amount of calories to CKD patients. It's important to calculate the calories requirement to patient's ideal body weight and not current weight. The weight may be either low or high especially so in patient's pre-existing malnutrition or in diabetics with CKD

Carbohydrates

Carbohydrates are the primary source of calories for the body. Carbohydrates are found in wheat, cereals, rice, potatoes, fruits and vegetables, sugar, honey, cookies, cakes, sweets and drinks. Diabetics and obese patients need to limit the amount of carbohydrates. It's best

to use complete carbohydrates from cereals like whole wheat, unpolished rise and millets like johar, bajra, ragi, nachni which would also give fibres. These should form large part of carbohydrates or all other simple sugar containing substances should form not more 20% of carbohydrate.

Fats

Fats are important source of calories for the body and provide two times more calories than carbohydrates or proteins. Unsaturated or "good" fats like olive oil, peanut oil, canola oil, safflower oil, sunflower oil, fish and nuts are better than saturated or "bad" fats such as red meat, poultry, whole milk, butter, ghee, cheese, coconut and lard. Reduce intake of saturated fats and cholesterol as they can cause heart disease and kidney damage.

Among the unsaturated fats it is important to pay attention to proportion of monounsaturated and polyunsaturated fats. Excessive amounts of omega-6 polyunsaturated fatty acids (PUFA) and a very high omega-6/omega-3 ratio is harmful while low omega-6/omega-3 ratio exerts beneficial effects. Mixtures of vegetable oil rather than single oil usage will achieve the purpose. Trans fats containing substances like Vanaspati/ Dalda Ghee, potato crisps, doughnuts, commercially prepared cookies and cakes are potentially harmful and should be avoided.

2. Restrict Protein Intake

Protein is essential for the repair and maintenance of body tissues. It also helps in healing of wounds and fighting against infection.
Protein restriction reduces the rate of decline in kidney function and thus delays the need for dialysis and kidney transplantation. But avoid undue protein restriction. Poor appetite is common in CKD patients. Poor appetite and strict protein restriction together can lead to poor nutrition, weight loss, lack of energy and reduction in body resistance; which increases the risk of death.

In India, people consume mostly vegetable diet. Even those who eat non-vegetarian food don't do so on regular daily basis. The diet consume most of times both in socio-economic or better of family still fall short of protein intake advocated Indian Council of Medical Research (ICMR) which is 1gm per kg body weight. Hence, thought restriction of protein to 0.8 gm/kg is advocated for advancing stages of CKD, it is only the marginally. The emphasis should be improving the quality of protein consumed. Attention must be paid to eating protein of high biological value (0.4 to 0.6 gms/kg) containing milk products curd, paneer, refined soyabeen powder, soya granule, soya chunks, egg white etc. and for non-vegetarian egg white on daily basis and small quality of fat fish.

3. Fluid Intake

Why must patients of CKD take precautions in fluid intake?

Kidneys play a major role in maintaining proper amount of water in the body by removing the excess fluid as urine. In patients with CKD, as the kidney functions worsen, the volume of urine usually decreases.

Reduced urine output leads to retention and excess fluid in the body causing puffiness of the face, swelling of the legs and hands and high blood pressure. Accumulation of fluid in lungs causes shortness of breath. If this is not controlled, it can be life threatening.

What are the clues of excess water in the body?

Excess water in the body is called fluid overload. Swelling, ascites (accumulation of fluid in the abdominal cavity), shortness of breath, and weight gain in a short period are the clues which indicates fluid overload.

What precautions patients of CKD must take to control fluid intake?

To avoid fluid overload or deficit, volume of fluid should be taken as per the recommendation of the doctor. Volume of fluid permitted may

vary for each CKD patient and is calculated on the basis of urine output and fluid status of each patient.

How much fluid is a chronic kidney disease patient advised to take?

- In patients without swelling and with adequate urine output, unrestricted water and fluid intake is permitted. But patients with chronic kidney disease should take large amounts of fluid to protect kidney is a misconception.
- Patients with swelling and reduced urine output are instructed to restrict fluid intake. To reduce swelling, fluid permitted in 24hrs should be less than the volume of urine in a day.
- To avoid fluid overload or deficit, volume of fluid usually permitted in a day = urine volume of previous day plus 500ml. Additional 500ml of fluid approximately makes up for the loss of fluid through perspiration and breathing.

Why must patient of CKD weigh themselves daily and maintain a record?

To monitor fluid volume in the body and to detect fluid gain or loss at the earliest, the patients should weigh themselves daily and record it. The body weight remains constant when the instructions of fluid intake are followed strictly. Sudden weight gain indicates fluid overload due to increase in fluid intake. Weight gain warns the patients about the need of more meticulous fluid restriction. Weight loss usually occurs as a combined effect of restriction of fluid and response to diuretics.

Useful Tips to Reduce Fluid Intake :

To restrict fluid intake is difficult, but these tips will help you:

1. Weigh yourself at a fixed time every day and adjust fluid intake accordingly.

2. The doctor advises you on how much fluid consumption is permitted in a day. Accordingly calculate properly and drink measured volume of fluid every day. Remember fluid intake includes not only water but also tea, coffee, milk, curd, buttermilk, juice, ice-cream, cold drinks, soup, thin dal etc. While calculating fluid intake you must also calculate the hidden fluids in your food. Beware foods such as watermelon, grapes, lettuce, tomatoes, celery, gravy, gelatin, frozen treats like popsicles etc. as they have high water content.
3. Reduce salty, spicy and fried food in your diet as they increase thirst, leading to greater consumption of fluids.
4. Drink only when you are thirsty. Do not drink as a habit or because everyone is drinking.
5. When you are thirsty take a small amount of water or try ice. Take a small ice cube and suck it. Ice stays longer in the mouth than liquid, so it is more satisfying than the same amount of water. Do not forget to account for ice as consumed fluid. For easy calculation, freeze the allotted amount of water into an ice tray.
6. To take care of dryness of mouth, one can gargle with water without drinking it. Dryness of mouth can be reduced by chewing gums, sucking hard candy, lemon wedge or mints and the use of mouthwash to moisten mouth.
7. Always use small size cup and glass for your beverages to limit fluid intake.
8. Take medicines after meals when you are taking water to avoid extra water consumption for medicine.
9. A patient must keep himself busy with work. A patient who has little to occupy himself feels the desire, to drink water more often.
10. High blood sugar in diabetic patients can increase thirst. So a stringent control of blood sugar is essential to reduce thirst.
11. Since hot weather increases one's thirst, any measure taken to live in cooler comfort is desirable and recommended.

How to measure and consume precisely the prescribed amount of fluid per day?

- Fill a container with water. equal to the exact amount of fluid prescribed by the doctor for daily intake.
- The patient must bear in mind that no more than that amount of fluid intake is permitted for the day.
- Each time the patient consumes a certain amount, fluid should be observed. The same amount of water should be removed from the water container and discarded
- When the container has no more water, the patient realizes that his limit of fluid intake for the day has been reached and no more is to be drunk. The patient is advised to distribute total fluid intake evenly throughout the day to avoid the need of additional fluid.
- This control method is to be repeated every day.
- By this simple but very effective method the prescribed volume of fluid can be precisely delivered to the patient and fluid intake can be restricted.

4. Salt (Sodium) Restriction in Diet

Why are CKD patients advised low sodium diet?

Sodium in our diet is important for the body to maintain blood volume and to control blood pressure. Kidneys play an important role in the regulation of sodium. In patients with CKD, kidneys cannot remove excess sodium and fluid from the body so sodium and water build up in the body.

Increased amount of sodium in the body leads to increased thirst, swelling, shortness of breath and increase in blood pressure. To prevent or reduce these problems, the patients of CKD must restrict sodium intake in diet.

What is the difference between sodium and salt?

The words sodium and salt are routinely used as synonyms. Common salt is sodium chloride which contains 40% sodium. Salt is the principle source of sodium in our diet. But salt is not the only source of sodium. There are quite a few other sodium compounds in our food, such as:

- Sodium alginate: Used in ice-cream and chocolate milk.
- Sodium bicarbonate: Used as baking powder and soda.
- Sodium benzoate: Used as a preservative in sauce.
- Sodium citrate: Used to enhance flavor of gelatin, desserts and beverages.
- Sodium nitrate: Used in preserving and coloring processed meat.
- Sodium saccharide: Used as artificial sweetener.
- Sodium sulfite: Used to prevent discoloration of dried fruits.

The above mentioned compounds contain sodium but are not salty in taste. Sodium is "hidden" in these compounds.

How much salt should one take?

Average intake of salt in Indian population is about 6 to 8 grams per day. Patients with CKD should take salt according to the recommendation of the doctor. CKD patients with swelling and high blood pressure are usually advised to take about three grams of salt per day.

Which foods contains high amount of sodium?

Foods high in sodium are:

1. Table salt (common salt), baking powder.
2. Papad, salted pickles, salted chutney, sauce, chat masala and sambharas.
3. Baked food items like biscuits, cakes, pizza and breads.
4. Foods containing cooking soda or baking powder e.g., Indian foods

such as ganthiyas, pakodas, dhoklas, handwa, samosa, ragda patties, dahi vadas etc.

5. Wafers, chips, popcorn, salted groundnuts, salted dry fruits like cashew nuts, pistachios, canned foods etc. and also avoid Readymade salted Indian snacks like sev, chivada, chakri, mathri, etc.
6. Commercial salted butter and cheese.
7. Instant foods like noodles, spaghetti, macaroni, cornflakes etc.
8. Vegetables like cabbage, cauliflower, spinach, fenugreek leaves, radish, beetroot, coriander leaves etc.
9. Salted lassi, masala soda, fresh lime and coconut water.
10. Drugs like sodium bicarbonate tablet, antacid, laxatives etc.
11. Non-vegetarian foods like meat, chicken and animal body organs like kidney, liver and brain.
12. Sea food like crab, lobster, oyster and shrimp and oily fish like columbi, kurang, kekda, bangada etc and dried fishe.

Practical Tips to Reduce Sodium in Food

1. Restrict salt intake and avoid extra salt and baking soda in diet. Cook food without salt and add permitted amount salt separately. This is the best option to reduce salt intake and ensure consumption of prescribed amount of salt in everyday diet.
2. Avoid food with high sodium content (as listed above).
3. Do not serve salt and salty seasonings at the table or altogether remove the salt shaker from the dining table. Do not add salt in food like salad, buttermilk, rice, chapatti, bhakhary, parathas etc.
4. Carefully read labels of commercially available packaged and processed foods. Look not only for salt but also for other sodium containing compounds. Carefully check the labels and choose “sodium-free” or “low-sodium” food products.

5. Check sodium content of medicine.
6. Boil vegetables with high sodium content. Throw away the water. This can reduce sodium content in vegetables.
7. To make low salt diet tasty, one can add garlic, onion, lemon juice, amchur, bay leaf, tamarind pulp, vinegar, cinnamon, cardamom, cloves, saffron, green chilies, nutmeg, black pepper, cumin, fennel, poppy seeds etc.
8. Caution! Avoid the use of salt substitutes as they contain high amount of potassium. High potassium content of salt substitute can raise the potassium levels in blood to dangerous levels in CKD patients.
9. Do not drink softened water. In the process of water softening, calcium is replaced by sodium. Water purified by reverse osmosis process is low in all minerals including sodium.
10. While eating at restaurants select food that contains less sodium.

5. Potassium Restriction in Diet

Why are CKD patients advised to restrict potassium in diet?

Potassium is an important mineral in the body. Potassium is needed in the body for the proper functioning of muscles and nerves and to keep heartbeat regular.

Normally, the level of potassium in body is balanced by eating potassium containing foods and removal of excess potassium in the urine. Removal of excess potassium in the urine may be inadequate in a patient with chronic kidney disease which can lead to high level of potassium in the blood (a condition known as hyperkalemia). Between the two kinds of dialysis patients, the risk of hyperkalemia is lesser in peritoneal dialysis compared to that in hemodialysis. The risk differs in both groups because the process of dialysis is continuous in peritoneal dialysis while it is intermittent in hemodialysis.

High potassium levels can cause severe muscle weakness or an irregular heart rhythm which can be dangerous. When potassium is very high,

the heart can stop beating unexpectedly and cause sudden death. High potassium level can be life threatening without noticeable manifestations or symptoms (and therefore it is known as a silent killer).

To avoid serious consequences of high potassium, CKD patients are advised to restrict potassium in diet.

What is normal potassium level in blood? When is it considered high?

- Normal level of potassium in blood is 3.5 mEq/l to 5.0 mEq/l.
- When the level of potassium reaches 5.0 to 6.0 mEq/l, it needs modification in diet.
- When the level of potassium is greater than 6.0 mEq/l, it is dangerous and needs active intervention to reduce it.
- When the level of potassium is greater than 7.0 mEq/l, it can be life threatening and needs urgent treatment.

Classification of eatables according to potassium levels

To maintain proper control of potassium in blood, food intake must be modified as per the doctor's advice. On the basis of potassium contents, foods are classified in three different groups (high, medium, and low potassium containing foods).

High potassium = More than 200 mg/ 100 gms of food
Medium potassium = 100 to 200 mg/ 100 gms of food
Low potassium = Less than 100 mg/ 100 gms of food

Foods - High in Potassium

- **Fruits:** Amla, fresh apricot, ripe banana ripe, cherries, chikoo, fresh coconut, custard apple, grapes, gooseberry, kiwi fruit, lemon, ripe mango, musk melon, mosambi, peach, plum and sapota.
- **Vegetables:** Amaranth, brinjal, broccoli, cluster beans, colocasia, coriander, drumstick, mushroom, raw papaya, potato, spinach, sweet potato and yam (suran).

- **Dry fruits:** Almond, cashew nut, dates, dry figs, raisins and walnut.
- **Cereals:** Bajra, ragi and wheat flour.
- **Pulses:** Black gram dal, bengal gram dal, bengal gram (whole), chana, chana dal, green gram dal, lentil dal, masoor dal, mung, red gram, red split lentils and tur dal.
- **Masala:** Cumin seeds, coriander seeds, dried red chili and fenugreek seeds.
- **Non-vegetarian food:** Fish like anchovy, mackerel, rohu, white pomfret; shell fish like prawns, lobster and crabs and beef.
- **Drinks:** Bournvita, coconut water, coffee, condensed milk, drinking chocolate, fresh fruit juices, rasam (dal), soup, beer, wine and many aerated drinks.
- **Miscellaneous:** Chocolate, cadbury, chocolate cake, chocolate ice cream, Lona salt (salt substitute), potato chips and tomato sauce.

Foods - Medium in Potassium

- **Fruits:** Lichee, sweet lime, pomegranate and water melon.
- **Vegetables:** Beet root, raw banana, bitter gourd, cabbage, carrot, celery, cauliflower, french beans, okra (ladies finger), onion, pumpkin, radish, sweet corn, safflower leaves and tomatoes.
- **Cereals:** Barley, general purpose flour (maida), jowar, noodles made from wheat flour, rice flakes (pressed rice, poha) and wheat vermicelli.
- **Non-vegetarian food:** Cital, hilsa, katla, magur, liver.
- **Drinks:** Cow milk and curd.
- **Miscellaneous:** Black pepper, cloves, cardamom, garam masala (mixture of Indian spices).

Foods - Low in Potassium

- **Fruits:** Apple, blackberries, cherries, guava, oranges, ripe papaya, pear, pineapple, rose apple (jambu fruit) and strawberries.
- **Vegetables:** Bottle gourd(dudhi), broad beans (papdi), capsicum, ridged gourd (turiya), cucumber, fenugreek leaves (methi), garlic, lettuce, green peas, raw mango and pointed gourd (parvar), tinda (tender).
- **Cereals:** Rice, rava and wheat semolina.
- **Pulses:** Green.peas
- **Non-vegetarian food:** Beef, lamb, pork, chicken and egg.
- **Drinks:** Buffalo milk, coca-cola, fanta, lemonade, lime juice in water, limca, rimzim and soda.
- **Miscellaneous:** Dried ginger, honey, mint leaves, mustard, nutmeg and vinegar.

Practical Tips to Reduce Potassium in Food

1. Take one fruit per day, preferably with low potassium.
2. Take one cup of tea or coffee per day.
3. Vegetables with potassium should be taken after reducing the amount of potassium (as mentioned below).
4. Avoid coconut water, fruit juices and foods with high potassium contents (as listed above).
5. Almost all food contains some potassium, so the key is to choose food with a low potassium level, when possible.
6. Restriction of potassium is necessary not only for predialysis CKD patients, but is also necessary even after initiating dialysis.

How to reduce potassium content in vegetables?

- Peel, and cut vegetables in to small pieces.

- Wash them with lukewarm water and put them in a large pot.
- Fill the pot with hot water (the quantity of water must be four to five times the volume of vegetables) and soak them for at least one hour.
- After soaking the vegetables for 2 - 3 hours, rinse them three times with warm water.
- Subsequently boil the vegetables with extra water. discard the water.
- cook the boiled vegetables as desired.
- In this way you can reduce the amount of potassium in vegetables, but not completely. So it is preferable to avoid high potassium containing vegetables or take them in small quantity.
- As vitamins are lost in cooked vegetables, vitamin supplements should be taken as per the doctor's advice.

Special tips for leaching potassium from potatoes

- Dicing, slicing or grating potatoes into smaller pieces is important. Maximize surface of the potatoes exposed to water by this method.
- The temperature of the water used to either soak or boil the potatoes makes the difference.
- Using large amount of water to soak or boil potatoes is helpful.

6. Phosphorus Restriction in Diet

Why must CKD patient take low phosphorus diet?

- Phosphorus is a mineral essential to keep bones strong and healthy. Usually extra phosphorus present in food is removed in urine and thereby the blood phosphorus levels are maintained.
- Normal value of phosphorus in blood is 4.0 to 5.5 mg/dl.
- In CKD patients the extra phosphorus taken in food is not excreted in urine and so the blood level rises. This increased phosphorus drains out calcium from the bones making them weak.

- Increase in phosphorus level can lead to many problems like itching, weakness of muscles and bones, bone pains, bone stiffness and joint pain. The stiffness of bone results in increased susceptibility to fracture.

consumption of which food with high phosphorus content should be reduced or avoided?

Food containing high phosphorous are:

- Milk and dairy products: butter, cheese, chocolate, condensed milk, icecream, milk shake, paneer.
- Dry fruits: cashew nuts, almonds, pistachios, dry coconut, walnut.
- Cold drinks: dark colas, Fanta, Mazza, Frooti, beer.
- Carrot, colacasia leaves, corn, groundnut, fresh peas, sweet potato.
- Animal protein: meat, chicken, fish and egg.

7. High Vitamin and Fibers Intake

CKD patients suffer from inadequate supply of vitamins during predialysis period due to reduction of food intake, special method of cooking to remove excess potassium and poor appetite. Certain vitamins – especially water soluble vitamins B and C, folic acid etc – are lost during dialysis.

To compensate for inadequate intake or loss of these vitamins CKD patients usually need supplementation of water-soluble vitamins and trace elements. High fiber intake is beneficial in CKD. So patients are advised to take more fresh vegetables and fruits rich in vitamin and fibers.

Designing the Daily Food

For CKD patients daily food intake and water intake is planned and charted out by the dietitian in accordance with the advice of the nephrologist.

Common principles for the diet plan are:

1. **Water and liquid food intake:** Fluid intake restriction must be as per the doctor's advice. Daily weight chart must be maintained. Any improper gain in weight indicates increased fluid intake.

2. **Carbohydrate:** To ensure that the body gets adequate calories along with cereals and pulses, the patient can take sugar or glucose containing food, provided he/she is not diabetic.

3. **Protein:** Milk, cereals, pulses, eggs, chicken are the main source of protein. Those patients of CKD who are yet not on dialysis are advised to curtail protein in diet. They are advised to take 0.8 grams per kilogram of body weight per day. Once dialysis is started, patient needs high-protein diet (especially the patients on peritoneal dialysis).

   Avoid eating animal proteins such as meat, chicken and fish which contain high protein, potassium and phosphorous. All animal protein can be harmful to CKD patients.

4. **Fat:** The amount of fat in food must be reduced but total curtailing of butter; ghee etc from food can be dangerous. Generally soyabean oil, groundnut oil is useful for the body but it is desirable to take these oils in limited quantity.

5. **Salt:** Most patients are advised to take low salt diet. Do not add salt at the table. Do not take food cooked with baking powder; and if you take it see that it is taken in restricted amount. Avoid use of salt substitutes as they contain high amount of potassium.

6. **Cereals:** Rice or rice products like flattened rice (poha), kurmura (puffed rice) can be taken. To avoid monotony of taste one can take various cereals like wheat, rice, poha, sago, semolina, all purpose flour, cornflakes in rotation. Barley, bajra, and corn can be taken but in a small quantity.

7. **Pulses:** Various dals should be taken in right quantities in rotation so that the change in taste can make food palatable. As dal is liquid, the amount of fluid consumed with it must be taken into account. If possible it is preferable to make dal thicker in consistency rather than with more water. The amount of dal must be taken as per the doctor's instructions.

8. To reduce potassium from dals it is essential that after washing, they must be soaked in hot water and the water discarded. Subsequently boil them with water and discard extra water after boiling. The dal, can now be cooked as per your taste. As an alternative to dal and rice, one can take khichadi or dosa.

9. **Vegetable:** Vegetables with low potassium can be liberally taken. But vegetables with high potassium must be processed to remove potassium before consumption. To improve taste lemon juice can be added.

10. **Fruits:** Fruits with low potassium content like apple, papaya, berry can be taken but only once a day. On the day of dialysis patient can take any one fruit. Fruit juice and coconut water must be avoided.

11. **Milk and milk products:** 300 to 350 ml of either milk or milk products like kheer, ice cream, curd, maththa can be taken. Again, to avoid the extra liquid, limit the volume of these products.

12. **Cold drinks:** Pepsi, Fanta, Frooti must be avoided. Do not take fruit juice or coconut water.

13. **Dry fruits:** Dry fruits, groundnut, sesame seeds, fresh or dry coconut must be avoided.

Glossary

Glossary

Acute kidney failure (injury): A condition in which there is sudden or rapid loss of kidney functions. This type of kidney damage is temporary and usually reversible.

Anemia: It is a medical condition in which hemoglobin is reduced in blood. Anemia leads to weakness, fatigue and shortness of breath on exertion. Anemia is common in CKD and occurs due to decreased erythropoietin production by kidney.

Automated peritoneal dialysis (APD): See CCPD.

Arteriovenous fistula (AV Fistula): It means creating connection between artery and vein surgically, usually in the forearm. In AV fistula large amount of blood with high pressure enters into the vein causing dilatation of the vein. The enlarged dilated veins allow easy repeated needle insertion required for hemodialysis. AV fistula is the most common and the best method of vascular access for long term hemodialysis.

Artificial kidney: See dialyzer.

Benign prostatic hypertrophy (BPH): It is common for the prostate gland to become enlarged as a man ages. BPH is a non-cancerous prostatic enlargement in elderly males which compresses the urethra, blocks urine stream and causes problems in urination.

Blood pressure: It is the force exerted by circulating blood on the walls of blood vessels as the heart pumps out blood. Blood pressure is one of the principal vital signs and its measurement consists of two numbers. The first number indicates systolic blood pressure which measures the maximum pressure exerted when heart contracts. The second number indicates diastolic pressure, a measurement taken between beats, when heart is at rest.

Brain death: "Brain Death" is a severe and permanent damage to brain which does not revive with any medical or surgical treatment. In "Brain Death" dead body's respiration and blood circulation are artificially maintained.

Cadaveric kidney transplantation: See deceased kidney transplantation.

Calcium: The most abundant mineral in the body, essential for the development and maintenance of strong bones and teeth. Milk and milk products like yogurt and cheese are rich natural sources of calcium.

Catheter for hemodialysis: It is a long, flexible hollow tube with two lumens. Blood is withdrawn from one lumen, enters the dialysis circuit for purification, and is returned to the body via the other lumen. Insertion of double lumen catheter is the most common and effective method for emergency and temporary hemodialysis.

Continuous ambulatory peritoneal dialysis (CAPD): CAPD is a form of dialysis which can be carried out by a person at home without the use of a machine. In this type of dialysis, fluid is exchanged at regular intervals throughout, i.e. 24-hour a day, seven days a week.

Continuous cycling peritoneal dialysis (CCPD): CCPD or Automated peritoneal dialysis (APD) is a form of continuous peritoneal dialysis carried out at home every day with an automated cycler machine. In CCPD, a machine performs fluid exchanges while the patient is sleeping at night. In this process the machine automatically fills and drains the dialysis solution from the abdomen.

Creatinine and urea: These are breakdown or waste products of protein metabolism. These substances are removed by kidneys. The usual level of serum creatinine is 0.8 to 1.4 mg% and that of urea is 2 to 4 mg%. In kidney failure the level of urea and creatinine in blood rises.

Chronic kidney disease (CKD): Gradual progressive and irreversible loss of kidney function over several months to years is called chronic kidney disease. In this non- curable disease, kidney function reduces slowly and continuously. After a long period it reduces to a stage where the kidney stops working almost completely. This advanced and life threatening stage of the disease is called End Stage Kidney Disease – ESKD.

Cystoscopy: A diagnostic procedure in which the doctor looks inside the bladder and the urethra using a thin, lighted instrument called a cystoscope.

Deceased (cadaveric) kidney transplantation: It is an operation in which a healthy kidney donated by a person with brain death is transplanted in a patient of chronic kidney disease.

Diabetic kidney disease (nephropathy): Long-standing diabetes causes damage to small blood vessels of the kidney. This damage initially causes loss of protein in urine. Subsequently it causes hypertension, swelling and then gradual and progressive damage to the kidney. Finally, progressive deterioration leads to severe kidney failure (End stage kidney disease). This diabetes induced kidney problem is known as diabetic kidney disease. Diabetic kidney disease is the most common cause of chronic kidney disease, accounting for 40-45 percent of new cases of CKD.

Dialysis: It is an artificial process by which waste products and unwanted water is removed from the body in patients with kidney failure.

Dialyzer: An artificial kidney that filters blood and removes wastes and extra water from the body in the process of hemodialysis.

Diuretics: Drug that increases the production of urine and increases excretion of water in the form of urine which helps to "lose water" from body. Diuretics are also called "Water pills".

Dry weight: It is the weight of a person after all excess fluid is removed by dialysis.

Dwell time: During peritoneal dialysis, the period for which PD fluid remains in the abdomen is called the dwell time. During dwell time the process of purification takes place.

eGFR: The eGFR (estimated Glomerular Filtration Rate) is a number which is calculated from blood creatinine level and other information. eGFR measures how well kidneys are working and its normal value is 90 or more. The eGFR test is useful for the diagnosis, grading of stages and monitoring the progression of CKD.

Electrolytes: There are many minerals like sodium, potassium, calcium in the blood stream that regulate important function of the body. These chemicals are called electrolytes. As the kidney keeps the electrolyte concentrations constant in blood, in patients with kidney diseases, blood is tested to check electrolyte levels.

Endstage kidney disease (ESKD): Advanced stage of chronic kidney disease (Stage 5 CKD) is known as endstage kidney disease (ESKD) or end stage renal disease (ESRD). At this stage of CKD there is complete or almost complete failure of the kidneys. ESKD patients need treatment, such as dialysis or transplantation to lead a fairly normal life.

Erythropoietin (EPO): It is a hormone produced by the kidneys that promotes the formation of red blood cells by the bone marrow. If the kidneys are damaged, they are not able to produce enough erythropoietin resulting in decrease in the formation of red blood cells which leads to anemia. Erythropoietin is available as an injectable medication for the treatment of anemia due to kidney failure.

Exchange: It means one complete cycle of peritoneal dialysis, consisting of three stages. The first stage is inflow of dialysis fluid in the abdomen. In the second stage, the fluid remains in the abdomen for several hours allowing excess fluid and toxins to move from the blood to the dialysis fluid (also called dwell). The third stage is outflow of the dialysis fluid.

Extracorporeal shock wave lithotripsy (ESWL): It is a modality in which highly concentrated shock waves produced by lithotriptor machine break up urinary stones. The stones break down into small particles and are easily passed through the urinary tract in urine. ESWL is effective and widely used treatment modality for kidney stones.

Fistula: See arteriovenous fistula.

Graft: A type of access for long term hemodialysis. Graft is a short piece of synthetic soft tube which joins a vein and an artery in the arm. Needles are inserted in this graft during hemodialysis treatment.

Hemodialysis: Most popular modality to treat kidney failure. In hemodialysis blood is purified with the help of dialysis machine and an artificial kidney (dialyzer).

Hemoglobin: It is a protein molecule in red blood cells that carries oxygen from the lungs to the body tissues and returns carbon dioxide from the tissues to the lungs. Hemoglobin is measured by blood test and its reduced value is referred as anemia.

Hyperkalemia: Normal serum potassium levels are between 3.5 and 5.0 mEq/L. Hyperkalemia is a condition characterized by elevated levels of potassium in the blood. Hyperkalemia is common in kidney failure, can be life threatening, and requires urgent medical treatment.

Hypertension: It is the term used to describe high blood pressure.

Immunosuppressant Drug: Medications which suppress (decrease) the body's immune system and prevent the body from rejecting a transplanted organ.

Intravenous urogram (IVU): It is an investigation where series of x-rays of urinary system are taken after injecting an intravenous iodine containing dye. This test gives information about function of kidney and structure of urinary tract.

Kidney biopsy: A procedure to get a small piece of kidney tissue with a needle so that it can be examined under a microscope for the diagnosis of the disease.

Kidney failure: Condition in which deterioration in kidney function leading to inadequate filtration of toxins and waste products from the blood. It is characterized by increase in urea and creatinine levels in blood.

Microalbuminuria: Refers to the appearance of small but abnormal amounts of albumin in urine. Its presence indicates early onset of diabetic kidney disease.

Micturating cystourethrogram: See voiding cystourtehrogram.

Nephron: The functional unit of the kidney responsible for the actual purification and filtration of the blood. Each kidney contains about one million nephrons.

Nephrologist: A physician specialized in kidney diseases.

Nephrotic syndrome: Kidney problem which is seen more frequently in children characterized by loss of protein in urine (more than 3.5 grams per day), low blood protein levels, high cholesterol levels, and swelling.

Paired kidney transplantation: Many patients with endstage kidney disease have healthy and willing potential kidney donors but the problem is blood group or cross match incompatibility. Paired kidney donation is the strategy which allows the exchange of living donor kidneys between two incompatible donor/recipient pairs to create two compatible pairs.

Peritoneal dialysis: It is an effective treatment modality for kidney failure. In this process of purification, dialysis fluid is introduced into the abdominal cavity through a special catheter. This fluid removes waste products and extra water from the blood. Fluid is removed from abdomen after a variable period of time, and discarded.

Peritonitis: It is an infection inside the abdominal cavity. Peritonitis is a common complication of peritoneal dialysis and can be life threatening, if not treated.

Phosphorus: Phosphorus is the second most-abundant mineral found in the body, next only to calcium. It works with calcium to build strong bones and teeth. Meats, nuts, milk, eggs, cereals are phosphorus rich foods.

Polycystic kidney disease (PKD): PKD is the most common genetic disorder of the kidney, characterized by the growth of numerous cysts (fluid sacs) in the kidneys. It is the fourth leading cause of chronic kidney disease.

Potassium: It is a very important mineral in the body needed for proper function of nerves, heart and muscles. Fresh fruit, fruit juices, coconut water and dry fruits are rich source of potassium.

Pre-emptive kidney transplantation: Kidney transplantation is usually carried out after a variable period of dialysis therapy. A kidney transplant done before the initiation of maintenance dialysis is a pre-emptive kidney transplant.

Proteins: They are one of the three main classes of food which build, repair and maintain body tissues. Pulses, milk, eggs and animal foods are rich sources of protein.

Proteinuria: Presence of abnormally high levels of protein in urine.

Rejection: The process in which the body recognizes that a transplanted organ is not its own and tries to destroy it.

Semipermeable membrane : A membrane that selectively allows certain dissolved substances and fluid to pass through, while holding back the others. Membrane is a thin natural tissue or artificial material.

Sodium: A mineral in the body which regulates blood pressure and blood volume. The most common form of sodium in food is sodium chloride, which is table salt.

Trans-urethral Resection of the Prostate (TURP): It is the most common and standard treatment of benign prostatic hyperplasia (BPH) performed by urologists. In this minimally-invasive surgical treatment, an instrument called cystoscope is passed through the urethra and the prostate gland blocking the urine flow is removed.

Ultrasound: It is a painless diagnostic test that uses high frequency sound waves to create an image of the organs or structures inside the body. Ultrasound is a simple, useful and safe test which provides valuable information such as the size of kidney, obstruction to urine flow, and the presence of cyst, stone and tumors.

Urologist: A surgeon specialized in kidney diseases.

Vesicoureteral reflux (VUR): It is a condition with an abnormal backward flow (reflux) of urine from the bladder toward the ureters and possibly up to the kidneys. This is an anatomic and functional disorder which can happen either on one or both sides. VUR is the major cause of urinary tract infection, high blood pressure and kidney failure in children.

Voiding cystourethrogram: A procedure used to outline the anatomy of the lower urinary tract (bladder and urethra) by catheterizing a patient and introducing solution (dye) which can be seen on X-ray films. The patient is asked to void urine and X-rays are taken

Abbreviations

ACE : Angiotensin Converting Enzyme

ADPKD : Autosomal Dominant Polycystic Kidney Disease

AGN : Acute Glomerulonephritis

AKI : Acute Kidney Injury

APD : Automated Peritoneal Dialysis

ARB : Angiotensin Receptor Blockers

ARF : Acute Renal Failure

AV Fistula : Arterio Venous Fistula

BP : Blood Pressure

BPH : Benign Prostatic Hypertrophy

BUN : Blood Urea Nitrogen

CAPD : Continuous Ambulatory Peritoneal Dialysis

CCPD : Continuous Cycling Peritoneal Dialysis

CKD : Chronic Kidney Disease

CRF : Chronic Renal Failure

DKD : Diabetic Kidney Disease

DM : Diabetes Mellitus

DMSA : Dimercaptosuccinic Acid

eGFR : Estimated Glomerular Filtration Rate

EPO : Erythropoietin

ESKD : End Stage Kidney Disease

ESRD : End Stage Renal Disease

ESWL : Extracorporeal Shock Wave Lithotripsy

GFR : Glomerular Filtration Rate

HD : Hemodialysis

IDDM : Insulin Dependent Diabetes Mellitus

IJV	**:**	Internal Jugular Vein
IPD	**:**	Intermittent Peritoneal Dialysis
IVU/IVP	**:**	Intravenous Urography/Pyelography
MA	**:**	Microalbuminuria
MCU	**:**	Micturating Cysto Urethrogram
MRI	**:**	Magnetic Resonance Imaging
NIDDM	**:**	Non-Insulin Dependent Diabetes
NSAID	**:**	Non-Steroidal Anti-Inflammatory Drug
PCNL	**:**	Percutanous Nephrolitomy
PD	**:**	Peritoneal Dialysis
PKD	**:**	Polycystic Kidney Disease
PSA	**:**	Prostate Specific Antigen
PUV	**:**	Posterior Urethral Valves
RBC	**:**	Red Blood Cells
RRT	**:**	Renal Replacement Therapy
TB	**:**	Tuberculosis
TIBC	**:**	Total Iron Binding Capacity
TURP	**:**	Trans Urethral Resection of Prostrate
UTI	**:**	Urinary Tract Infection
VCUG	**:**	Voiding Cysto Urethrogram
VUR	**:**	Vesicoureteral Reflux
WBC	**:**	White Blood Cells

Common Blood Tests for Kidney Patients

Commonly used laboratory blood tests for kidney patients and their reference ranges are summarized below.

Test	Conventional units	Conversion factor	SI units
Blood Tests for Kidney Function			
Blood urea nitrogen	8 - 20 mg/dl	0.36	2.9 - 7.1 mmol/L
Creatinine Male Female	0.7 - 1.3 mg/dl 0.6 - 1.2 mg/dl	88.4 88.4	68 - 118 mcmd/L 50 - 100 mcmd/L
eGFR	90 - 120 ml/min	--	--
Blood Tests for Anemia			
Hemoglobin Male Female	13.5 - 17.0 g/dl 12.0 - 15.5 g/dl	10 10	136 - 175 g/L 120 - 155 g/L
Hematocrit Male Female	41 - 53% 36 - 48%	0.01 0.01	0.41 - 0.53 0.36 - 0.48
Iron total	50 - 175 mcg/dl	0.18	9 - 31 mcmol/L
Iron-binding capacity total	240 - 450 mcg/dl	0.18	45 - 82 mcmol/L
Transferrin	190 - 375 mg/dl	0.01	1.9 - 3.75 g/L
Transferrin saturation	20 - 50 %	--	--
Ferritin Male Female	16 - 300 ng/ml 10 - 200 ng/ml	2.25 2.25	36 - 675 pmol/L 22.5 - 450 pmol/L

Test	Conventional units	Conversion factor	SI units
Blood Tests for Electrolytes and Metabolic Bone Diseases			
Sodium (Na)	135 - 145 mEq/L	1.0	135 - 145 mmol/L
Potassium (K)	3.5 - 5.0 mEq/L	1.0	3.5 - 5.0 mmol/L
Chloride (Cl)	101 - 112 mEq/L	1	101- 112 mmol/L
Calcium ionized	4.4 - 5.2 mg/dL	0.25	1.10 - 1.30 mmol/L
Calcium total	8.5 - 10.5 mg/dl	0.25	2.2 - 2.8 mmol/L
Phosphorus inorganic	2.5 - 4.5 mg/dl	0.32	0.8 - 1.45 mmol/L
Magnesium	1.8 - 3 mg/dl	0.41	0.75 - 1.25 mmol/L
Bicarbonate	22 - 28 mEq/L	1	22 - 28 mmol/L
Uric acid Male Female	2.4 - 7.4 mg/dl 1.4 - 5.8 mg/dl	59.48 59.48	140 - 440 mcmol/L 80 - 350 mcmol/L
PTH	11 - 54 pg/ml	0.11	1.2 - 5.7 pmol/L
Blood Tests for General Health			
Protein Total Albumin	6.0 - 8.0 g/dl 3.4 - 4.7 g/dl	10 10	60 - 80 g/L 34 - 47 g/L
Cholesterol total	100 - 220 mg/dl	0.03	3.0 - 6.5 mmol/L
Blood sugar fasting	60 - 110 mg/dl	0.055	3.3 - 6.1 mmol/L
Blood Tests for Liver Function			
Bilirubin Total Direct Indirect	0.1 - 1.2 mg/dl 0.1 - 0.5 mg/dl 0.1 - 0.7 mg/dl	17.1 17.1 17.1	2 - 21 mcmol/L <8 mcmol/L <12 mcmol/L
Alanine transaminase (SGPT)	7 - 56 unit/L	0.02	0.14 - 1.12 mckat/L
Aspartate transaminase (SGOT)	0 - 35 units/L	0.02	0 - 0.58 mckat/L
Alkaline phosphatase	41- 133 units/L	0.02	0.7 - 2.2 mckat/L

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Complete Guide for Kidney Patients

Save Your Kidney

Comprehensive Information about Prevention and Treatment of Kidney Diseases

Dr Sanjay Pandya
M.D. D.N.B. Nephrologist

Priti Sanjay Pandya
B Sc

Do you know ?

- There is an alarming rise in the number of kidney failure patients
- The treatment cost of End Stage Kidney Disease is more than bypass surgery of heart.
- Simple information about kidney disease can help you to prevent kidney diseases.

Highlights of the Book

- Easy to read - aimed to provide up-to-date practical information about kidney diseases.
- Simple guidelines which everyone must know to keep kidneys healthy/ safe.
- Simple tips on how to recognize warning signs of kidney diseases and to make an early diagnosis.
- Practical and detailed treatment advice for a person with chronic kidney diseases which could delay dialysis or even avoid the need for it altogether.
- Detail explanation of dietary selections and restrictions for patient with kidney failure.

Read, Heed and Save Your Kidneys