

## **What Your Kidneys Do**

*And what happens with kidney disease*

### **Class Goals**

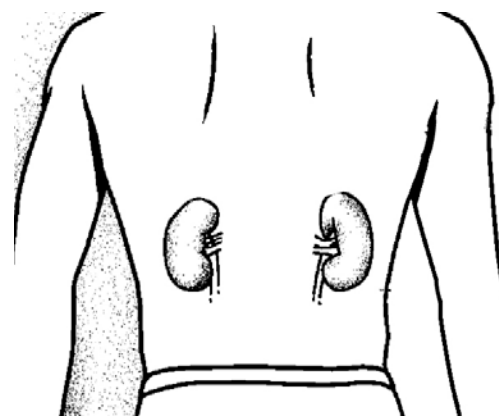
- 1. Understand what kidneys do.**
- 2. Understand symptoms of uremia.**
- 3. Know the common causes of kidney disease and some ways to treat it.**

### **Overview**

- The human body usually has 2 kidneys. They are under the bottom part of your rib cage in back.
- The kidneys make urine to clean wastes and extra fluid from your blood.
- The bladder is connected to the kidneys. It stores urine before it leaves the body. End-stage kidney disease (ESRD) occurs when the kidneys are working less than 15% of normal.
- There are many causes of kidney disease. They include diabetes, high blood pressure, and other diseases. When kidneys fail, fluids and waste products stay in your body. This is called *uremia*.
- Uremia has many different symptoms. These symptoms affect all of your body systems. Tell your doctor about your symptoms so that treatments to lessen them can be prescribed.

### **About Your Kidneys**

- Your kidneys are in the lower middle of your back above your waist, 1 on each side of your spine. (See Figure 1.) Each kidney is a little larger than a closed fist.
- Each kidney connects to the blood system on one side and to the bladder on the other.



**Figure 1: Where the kidneys are**

- The connection to the blood system is through renal arteries and renal veins and to the bladder through ureters. The word *renal* means kidney. (See Figure 2.)
- The kidneys make urine to remove wastes and extra fluids from your blood. Urine is stored in the bladder before it leaves the body.

## Functions of the Kidneys

Kidneys clean wastes from the blood. They also control your body's salt and water balance so that extra fluid does not build up in the tissues. Kidneys also help control blood pressure, help your body produce red blood cells, and help keep bones healthy.

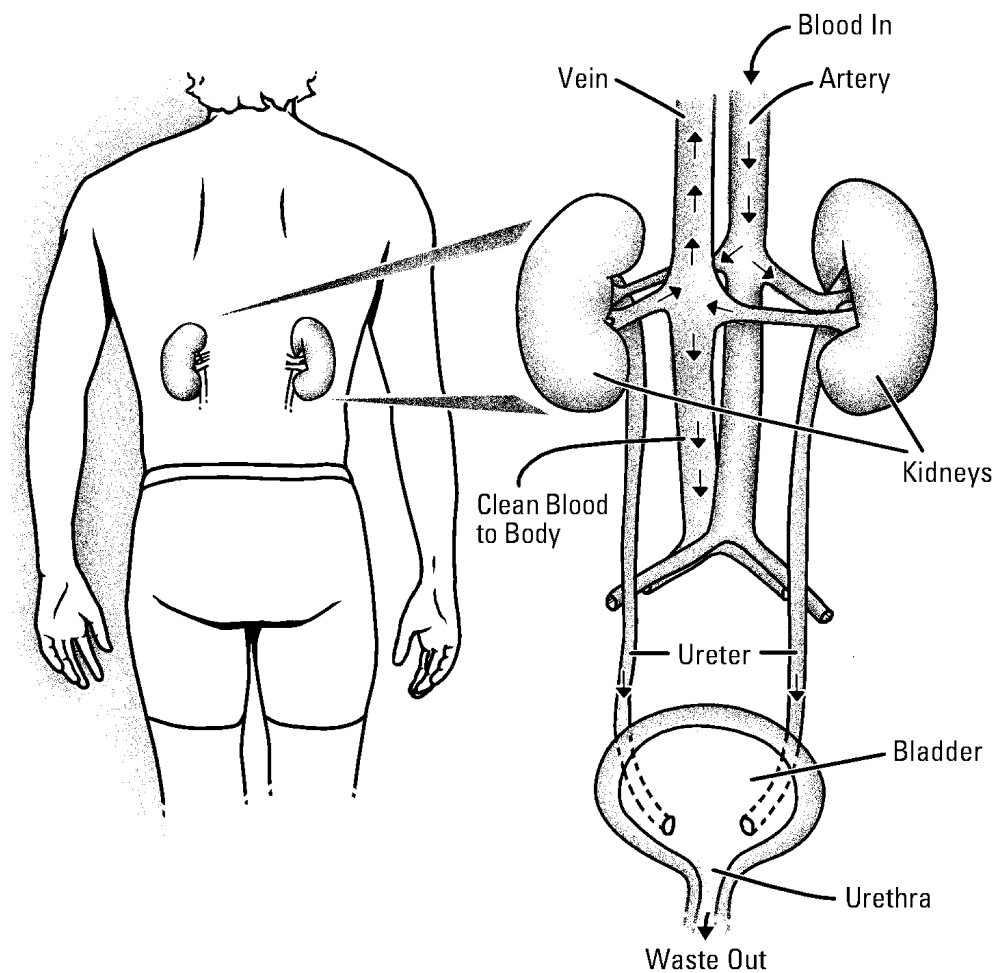


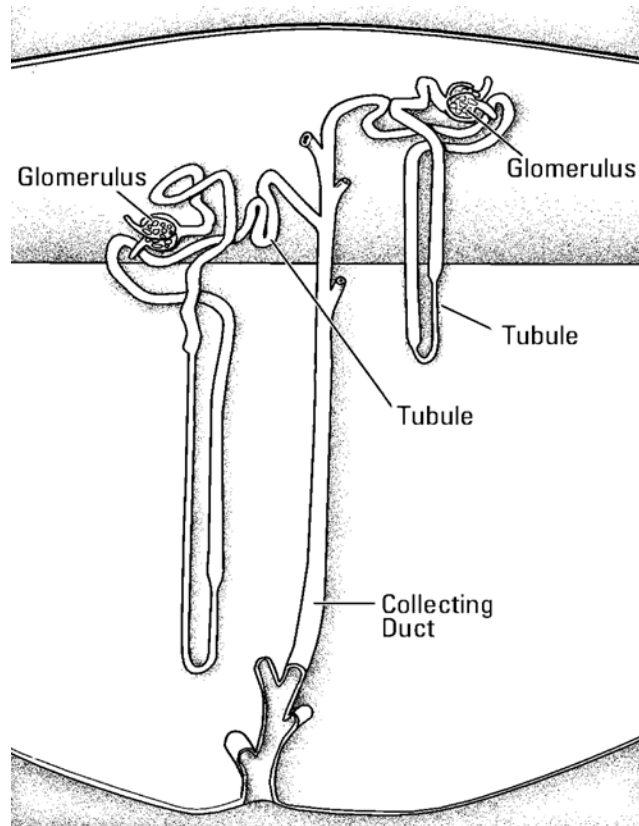
Figure 2: How the kidneys work

## How the Kidneys Work

- Blood enters the kidneys through the renal arteries.
- Inside the kidney, blood passes through tiny filters called *nephrons*. Waste products and excess fluid are removed.
- The clean blood is returned to the body's central bloodstream through the renal veins.
- Wastes and excess fluid leave the kidneys through the *ureters* and are stored in the bladder as urine.
- When the bladder is full, urine is passed out of the body through a tube called the *urethra*.

## What Nephrons Do

- There are 1 million nephrons (filters) inside the kidneys. A nephron is made up of tiny blood vessels called a *glomerulus*, which is attached to a *tubule*. (See Figure 3.) When blood passes through the glomerulus, wastes and fluid are removed.
- Tubules help keep the right balance of fluids and chemicals (such as salt, potassium, and calcium) in your body. They do this by returning what your body needs back to your body. The rest leaves the body as urine.



**Figure 3: Glomeruli and tubules inside a nephron**

## Kidney Failure

Kidney failure occurs when the kidneys stop working, or they are working less than 15% of normal. There are many causes of kidney failure. They include diabetes, high blood pressure, and other diseases.

When kidneys fail, there is a buildup of fluids and chemical wastes in the body. This condition is called uremia. It is life-threatening unless it is treated by dialysis or kidney transplantation.

Uremia has many different symptoms. These symptoms can affect all of your body systems. Tell your doctor what your symptoms are so that together you can talk about treatments to lessen them.

There are 2 types of kidney disease: acute and chronic.

### Acute Kidney Injury

*Acute kidney injury* occurs when the kidneys suddenly stop working. Often this condition is short-term. The cause may be disease, injury, major surgery, or poisons. If needed, dialysis treatment supports the person while the kidneys recover.

### Chronic Kidney Disease

*Chronic kidney disease* occurs when the kidneys are slowly destroyed. In chronic kidney disease, the kidneys do not recover. Dialysis or a kidney transplant is needed to do the main job of the kidneys. Dialysis and kidney transplant are treatments for kidney disease, but not a cure.

Chronic kidney disease is divided into stages using the glomerular filtration rate (GFR). GFR measures how well your kidneys filter blood. This table shows stages of kidney disease based on the GFR.

#### Stages of Kidney Disease Based on GFR

| Stage | Description                                 | Glomerular Filtration Rate* |
|-------|---|-----------------------------|
| 1     | Kidney damage with normal or raised GFR     | More than 90 ml per minute  |
| 2     | Kidney damage with mild decrease in GFR     | 60 to 90 ml per minute      |
| 3     | Kidney damage with moderate decrease in GFR | 30 to 59 ml per minute      |
| 4     | Kidney damage with severe decrease in GFR   | 15 to 29 ml per minute      |
| 5     | Kidney failure                              | Less than 15 ml per minute  |

\* *Your GFR number tells your doctor how much kidney function you have. As chronic kidney disease progresses, your GFR number will get smaller.*

## Causes of Kidney Disease

There are many causes of kidney failure. Some common causes are:

### Diabetes

Diabetes may damage the small blood vessels in the kidneys. This affects how well the kidneys take in and filter blood. Diabetes may be type 1, which requires insulin. Or it may be type 2, which can develop from *insulin resistance*, low insulin production, or obesity. About 1 out of every 3 children (about 33% of all children) born in the U.S. in the year 2000 will become diabetic.

### Hypertension

High blood pressure (hypertension) higher than 120/70 damages the small blood vessels of the kidneys. *Nephrosclerosis* is a kind of kidney damage that is caused by high blood pressure. It causes a scarring of the small blood vessels and results in kidney failure. Millions of Americans have high blood pressure, but less than half are being treated. Treatment for high blood pressure also protects the kidneys.

### Inflammation

Inflammation in the kidneys means there is swelling of the small blood vessel units (glomeruli). This swelling affects how well they work.

*Glomerulonephritis* is an inflammation of the glomeruli. Collagen diseases such as *lupus* also damage the kidneys by harming the glomeruli.

### Blockage

A blockage is any condition where the blood cannot flow through the kidney, or urine cannot flow to the bladder. *Obstructive uropathy* is a blockage caused by kidney stones, scarring, pressure, or birth defects. This blockage can damage the kidney tissues.

### Heredity

Some health conditions are *hereditary*, which means they are passed from parents to their children. *Polycystic kidney disease* is a hereditary disease that causes the *cysts* to grow on the kidneys. Over time, these cysts can lead to kidney disease. Some types of glomerulonephritis are also inherited.

### Nephrotoxins

Nephrotoxins are chemicals or other substances that can cause kidney disease. They include poisons, some medicines (especially pain medicines), and *contrast* (X-ray dye) used in some radiology exams.

Some of the causes of kidney disease cannot be reversed. But, steps can be taken to slow down kidney damage. Chapter 7 of this notebook covers ways to help kidneys work longer.

## Chronic Kidney Disease

The main job of kidneys is to keep the body chemistry and fluid levels in balance. Kidneys do many things to make this happen. When they fail (reach less than 15% of normal function), they cannot do these things. The inside of the body gets out of balance, and that makes you feel sick.

Some of the main effects of kidney failure are:

### Salt and Water Out of Balance

Kidneys control the amount of salt and water in the body tissues. They do this by increasing or decreasing the amount of salt and water in the urine. If we eat too much salt and drink too much water, healthy kidneys will excrete the extra salt and water in the urine.

When kidneys fail, this balancing does not happen, and most of the salt we eat and the liquids we drink stay in the body. When this extra salt water builds up:

- Ankles and other body parts can swell
- It can be hard to breathe
- Blood pressure goes up

High blood pressure is one of the most dangerous side effects of kidney disease. That is why it is so important to control the amount of salt and water in your body. You can do this by eating less salt. When you eat less salt, you do not get as thirsty, so you do not drink too much. This helps reduce swelling.

### Anemia

Kidneys produce an important hormone called *erythropoietin* (EPO). This hormone tells the bone marrow to make more red blood cells (RBCs). When kidneys fail, EPO production decreases.

When there is not enough EPO, your RBC levels are low. This is called *anemia*. Your doctor may give you a blood test that measures the RBCs in your blood. This result is called *hematocrit*. The normal range for hematocrit is 36% to 44%. If your hematocrit is below 36%, you have anemia. In people with kidney disease, a low hematocrit is most often due to the low production of EPO in the kidneys.

Another blood test for anemia measures a substance in the RBCs called *hemoglobin*. Hemoglobin delivers oxygen to all the cells inside your body. When your hemoglobin level is low, less oxygen is carried to all your body parts. The normal range for hemoglobin is 12 to 18 g/dl. If your blood test results are below normal, you have anemia.

Anemia can make you feel very tired and run down. It can also cause headaches and make you feel weak, dizzy, and short of breath, especially when you exercise.

If your doctor finds that you have below-normal hematocrit or hemoglobin, a blood test will be done to check your blood levels of iron. This is because iron is needed to make red blood cells.

### **Treatments for Anemia**

- **Iron supplements.** If your iron levels are low, you may be started on iron supplements and told to eat foods that are high in iron. Some of the best food sources of iron are iron-fortified breads and cereals, dark green leafy vegetables, dried fruits, and beans such as red, black, and pinto.
- **EPO injections.** Your doctor may also start you on EPO to help your bone marrow produce more red blood cells. When your body does not produce enough EPO to make red blood cells, you will need to take EPO as a shot to raise your hematocrit levels.

EPO is an injection given under the skin or *intravenously* (into a vein). It is given 1 to 3 times a week for people who are on dialysis. For people who do not need dialysis, a form of EPO can be given once a week to once a month.

EPO is a costly drug, but it is usually covered by Medicare, Medicaid, and some private insurance companies. You may have to get your shots at a clinic near your home to meet your insurance company requirements. Or, you may be able to learn to do it yourself at home.

It can take from 2 to 6 weeks for you to see a change in your symptoms after you start treatment for anemia. Your doctor will watch your hematocrit and hemoglobin levels to decide what dose is right for you. The dose may change depending on your blood test results.

The goal of keeping your hematocrit and hemoglobin levels in the normal range is to give you the energy you need to keep up an active lifestyle.

#### **Paying for Kidney Medicines**

Some drug companies provide a phone number to call if you have questions about paying for their drug. They can give you information on insurance and Medicare that may help you get reimbursed for the drug.

When you call, ask the drug company:

- What insurance covers the drug
- How qualified patients can get reimbursed
- How to enroll in the drug company's financial assistance program

If you are using **Procrit**, call 800.553.3851. If you are using **Aranesp**, call 800.272.9376.

## **Bone Disease**

- **Vitamin D.** The kidneys also produce the active form of vitamin D. This form of vitamin D helps your body absorb the calcium in the foods you eat. It also helps keep bones strong. When kidneys are not working well, bones can get weak and break easily.
- **Phosphorus.** Phosphorus is a mineral found in food. With kidney disease, the amount of phosphorus in your blood builds up. A high blood phosphorus level makes bones weak and fragile. It can also cause itching.

The best way to lower blood phosphorus is to limit the amount of phosphorus you eat. You should also take special medicine, *phosphate binders*, to reduce the amount of phosphorus your body absorbs. (See Chapter 8 for more information about phosphorus and foods.)

## **Heart Disease**

Over time, kidney disease affects the heart. Studies show that when calcium and phosphorus are out of balance, hardening of the heart and blood vessels can occur.

The best way to lower the risk of heart disease is to control your blood pressure, reduce salt and water buildup, and maintain calcium and phosphorus balance. Exercise, good nutrition, and not smoking are also very helpful.

## **Nutrition Problems**

There are many nutritional problems that can be caused by kidney disease. These are covered in Chapter 8. In general, good healthy eating habits are very important.

## **Waste Product Buildup**

Your body is always making waste, which means your kidneys are always hard at work removing waste. Kidney disease leads to a buildup of these waste products. This condition is called *uremia*.

Symptoms of uremia include:

- Loss of appetite
- Swelling (*edema*)
- Drowsiness or confusion
- Feeling short of breath
- Feeling sick to your stomach



- High blood pressure
- Puffiness around the eyes
- Decreased sexual interest
- Trouble concentrating
- Feeling tired
- Feeling cold
- Being thirsty
- Itching
- Headache
- Decrease or increase in how often you need to urinate

These are some of the major effects on the body when kidneys are not working well. Symptoms of advanced kidney disease also include not sleeping well, changes in appetite, and having dry mouth and constipation

One important thing to remember is that these effects usually occur when kidney disease is severe. With early kidney disease, these symptoms are either not a problem or not felt at all.

Not all people have all these symptoms. These symptoms may also be the result of other illnesses. Kidney disease can only be diagnosed through blood, urine, and other tests by your doctor.

### **Emotional Changes**

As kidney disease gets more severe, depression and other emotional problems sometimes occur. This can be because of a sense of loss, change of lifestyle, and being unsure about the future.

Common symptoms of advanced kidney disease include poor self-image, feeling hopeless, and feeling depressed all the time. These symptoms could also be side effects of a medicine you are taking, or your blood chemistry may be out of balance.

It is important to talk with your doctor about what is going on with you, both emotionally and physically.

### **Sexual Problems**

With advanced kidney disease, sexual problems are very common. These happen because of depression, or because hormones or body chemicals are out of balance.

High blood pressure and certain medicines for high blood pressure can also contribute to sexual problems. Impotence in men and decreased orgasms in women are quite common in people with kidney disease.

People often have sexual intercourse less often as their kidney disease becomes more severe.

Talk openly with your partner and with your healthcare team about these issues. There may be treatments that can help.

## Questions?

Your questions are important. Call your doctor or healthcare provider if you have questions or concerns.

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