What Your Kidneys Do and What Happens When They Fail

You have two kidneys found under the bottom part of your rib cage in back. The kidneys make urine to cleanse your blood of wastes and extra fluids.

Urine is stored in the bladder and excreted from the body. End-stage kidney failure occurs when the kidneys are working less than 10% of normal.

There are many causes of kidney failure. These include diabetes, high blood pressure, and other diseases. When kidneys fail, fluids and waste products remain in your body. This retention of fluids and wastes is called uremia.

Uremia has many different symptoms. These symptoms affect all of your body systems.

Tell your doctor about your symptoms so treatments to lessen them can be prescribed.

Objectives:
1. Understand basic kidney functions.
2. Understand symptoms of uremia and some treatments used for it.
3. Know the common causes of kidney failure.
What Your Kidneys Do

Where the Kidneys Are

You are born with two kidneys, which are found in the lower middle of the back above the waist, one on each side of the spine. The kidneys are slightly larger than a closed fist. The word “renal” means kidney. Each kidney is attached to the blood system on one side and to the bladder on the other. The connection to the blood system is through “renal arteries” and “renal veins” and to the bladder through ureters. (See Figure 1, below.) Urine is made in the kidneys and stored in the bladder.

Figure 1: Where the kidneys are and how they work
Functions of the Kidneys

The kidneys perform the important work of cleaning the blood of wastes and controlling salt and water balance to avoid build-up of extra fluid. They also help in the control of blood pressure and in the production of red blood cells.

How the Kidneys Work

Blood enters the kidneys through the renal arteries. Inside the kidney, blood is cleaned by passing through tiny filters. Waste products and excess fluid are filtered out of the blood inside the kidneys. (See Figure 1 on page 2.) The clean blood is returned to the body’s central bloodstream through your 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

Nephrons are the one million little filters inside the kidneys that clean the blood. A nephron is made up of a filter of tiny blood vessels called a glomerulus, which is attached to a tubule. (See Figure 2.) When the glomerulus filters your blood, it removes wastes and fluid.

The job of the tubules is to balance the fluids and chemicals in your body. They do this by returning what is needed by the body to the blood and excreting what is not needed. The things that the body doesn’t need are discarded in the urine. Examples of chemicals the kidneys balance are salt, potassium, and calcium.
What is kidney failure?

Kidney failure occurs when the kidneys stop working or the level of work is less than 10 to 15% of normal. The result of kidney failure is a build-up of fluids and chemical wastes in the body. This condition is called uremia and is life-threatening unless treated by dialysis or kidney transplantation.

Two types of kidney failure are acute kidney failure and chronic kidney failure. Acute kidney failure occurs when the kidneys suddenly stop working. Often this condition is temporary. The cause may be disease, injury, major surgery, or toxic agents. Dialysis treatment supports the person while the kidneys recover.

Chronic kidney failure happens when the kidneys are slowly destroyed by disease. This is permanent and the kidney function does not return. Dialysis or kidney transplant is needed to replace the main job of the kidneys. Dialysis does not cure the kidney disease.

Causes of Kidney Failure

There are many causes of kidney failure. Some common causes are listed below.

- **Diabetes** may damage the small blood vessels in the kidneys, decreasing the kidneys’ ability to receive and filter blood. Diabetes may develop in childhood (Type 1) or as a result of obesity or other causes in later life (Type 2). About one-third of children born in the United States in year 2000 will become diabetic.

- **Hypertension** or high blood pressure (over 120/70) causes damage to the small blood vessels of the kidneys. *Nephrosclerosis* is a kind of kidney damage caused by high blood pressure. This 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 treated.

- **Inflammation** in the kidneys means there is swelling of the small blood vessel units (glomerulus). *Glomerulonephritis* is an inflammation of the glomeruli (the filtering unit of the kidney). *Collagen diseases* such as lupus also damage the kidneys by harming the filters of the kidneys.
• **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 structural birth defects.

• **Hereditary conditions** are passed on through families. *Polycystic kidney disease* is a hereditary disease that causes the kidneys to develop cysts which, over time, can lead to kidney failure. Some types of *glomerulonephritis* are also inherited.

• **Nephrotoxins** are chemicals or substances that can cause kidney failure. These include poisons, some medications (especially pain medications), and radiation contrast/dye.

Some of the causes of kidney failure you can’t control. However, steps can be taken to slow down kidney damage. Ways to preserve kidney function will be covered in Chapter 7 of this notebook.

**Chronic Kidney Disease**

**What happens when kidneys fail (reach 10 to 15% of normal function)?**

The main role of the kidney is to keep the inside of the body in balance. Kidneys do many things to reach this goal. When kidneys fail, they cannot do these things. The body’s internal environment gets out of balance and that makes you feel sick. Some of the main effects of kidney failure are discussed below.

**Lost Control of Salt and Water Balance**

Kidneys control the amount of salt and water in the body by increasing or decreasing the amount of salt and water in the urine. If we eat too much salt and drink too much water, normal kidneys will excrete the extra salt and water in the urine. When kidneys fail, this balancing ability is lost and most of what we eat and drink stays in the body.

When this extra salt water builds up, ankles and other body parts can swell, breathing can be difficult, and blood pressure goes up. Since high blood pressure is one of the most dangerous complications of kidney failure, the control of the amount of salt and water in your body is very important. You can control this by eating less salt. When you eat less salt, you don’t get as thirsty so you don’t drink as much.
Anemia

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

Red blood cells (RBCs) contain 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.

When there is not enough EPO, your red blood cell levels are low. This is called anemia. Anemia can be detected by blood tests that measure the percentage of RBCs in your blood, or hematocrit, and hemoglobin levels. The normal range for hematocrit is 36 to 44%. The normal range for hemoglobin is 12 to 18 g/dl. If your blood test results are below normal, you are anemic.

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 with exercise. In people with kidney disease, a low hematocrit is most often due to the low production of EPO in the kidneys. When your doctor finds a below normal hematocrit or hemoglobin, a blood test will be ordered to check your blood levels of iron, because iron is needed to make red blood cells.

If your iron levels are low, you may be started on iron supplements and told to eat a diet 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. 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. It is given 1 to 3 times a week for people on dialysis. For people who do not need dialysis, a new form of EPO can be given weekly to monthly. It can take from 2 to 6 weeks for you to see a change in your symptoms. 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.

EPO is a costly drug, but is covered in most cases by Medicare, Medicaid, and some private insurance companies. You may have to get your shots at a clinic near your home to meet insurance company requirements, or you may be able to learn to do it yourself at home.
Some companies provide patients with a help line for funding questions. These services provide information on insurance and Medicare to assist getting reimbursement for the drug. You may call 1-800-553-3851 if you are using Procrit, or call 1-800-272-9376 if you are using Aranesp.

The insurance companies can:

- Verify insurance coverage.
- Connect qualified patients to reimbursement options.
- Give patients the ability to enroll themselves in the patient financial assistance program.

In review, when your kidneys fail, the production of a hormone called EPO decreases, which results in a lower number of red blood cells and hemoglobin to carry oxygen to the cells of your body. This is called anemia and can be treated with the drug erythropoietin.

The goal of keeping your hematocrit/hemoglobin level in the normal range is so you can have the energy to keep up an active lifestyle.

**Bone Disease**

The kidneys also produce the active form of vitamin D. The active form of vitamin D is needed to absorb calcium from your gut. It also helps bone strength. When kidneys are not working well, bones can get weak and break easily.

Phosphorous is found in the food we eat. When kidneys fail, the amount of phosphorous in your blood builds up. High blood phosphorous is hard on bones and makes them weak and fragile. It can also cause itching. The best way to lower blood phosphorous is to limit the amount of phosphorous you eat. You should also take special medication, phosphate binders, that will reduce the amount of phosphorous you absorb.

**Heart Disease**

Kidney failure affects the heart long-term. Newer studies have shown that calcium and phosphate imbalance can cause hardening of the heart and blood vessels.

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

There are many nutritional problems that can be caused by kidney failure. These are covered in Chapter 8. However, good eating habits are very important.

Waste Product Build-up

Your body is always making wastes, which are removed from the body by your kidneys. Kidney failure leads to a build-up of these waste products. This condition is called “uremia.” The collection of these waste products causes loss of appetite (particularly for meat), loss of energy, and tiredness. Dialysis or transplantation reduces these wastes and improves symptoms.

Symptoms of uremia include:

- Loss of appetite
- Swelling (edema)
- Drowsiness or confusion
- Shortness of breath
- Feeling sick to your stomach
- High blood pressure
- Puffiness around the eyes
- Decreased sexual interest
- Trouble concentrating
- Feeling tired
- Feeling cold
- Thirst
- Itching
- Headache
- Decrease or increase in frequency of urination

These are some of the major effects on the body when kidneys fail. One important thing to remember is that these effects are usually seen when kidney failure is severe. With a little kidney failure, these problems are either not significant or not felt.
Not all people experience 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.

**Psychological Changes**

As kidney failure gets more severe, depression and other emotional troubles are sometimes seen. This can be because of a sense of loss, change of lifestyle, and being unsure about the future. Common symptoms include poor self-image, feeling hopeless, feeling chronically depressed, sleep disturbance, change in appetite, dry mouth, and constipation. These symptoms could also be the result of a medication or due to a blood chemistry imbalance. Talking with your doctor about what is going on with you, both emotionally and physically, is very important.

**Sexual Dysfunction**

With advanced kidney disease, sexual problems are very common. Sexual difficulties happen because of depression, or hormonal or chemical imbalance. 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. Frequency of sexual intercourse often decreases as kidney disease becomes more severe. Talking openly with your partner and with your health care team is the best way to address these issues. Treatment may be available.
Questions?

Call your doctor’s office.

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

Notes

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