

## KIDNEY DISEASES

The kidneys help eliminate waste from your blood before sending it back up to your heart. Kidneys filter about ½ cup of blood per minute by removing waste and extra water, which is then eliminated from the body through urine. Kidneys are located in the upper abdominal in both the left and right side, right below your rib cage. If there is a problem with your kidneys, your blood is not filtered properly, which can cause problems for your body. When some minerals are not filtered out, they can become hard crystals, also known as, kidney stones. Chronic kidney disease is a long-term disease of the kidneys in which they gradually lose their function.

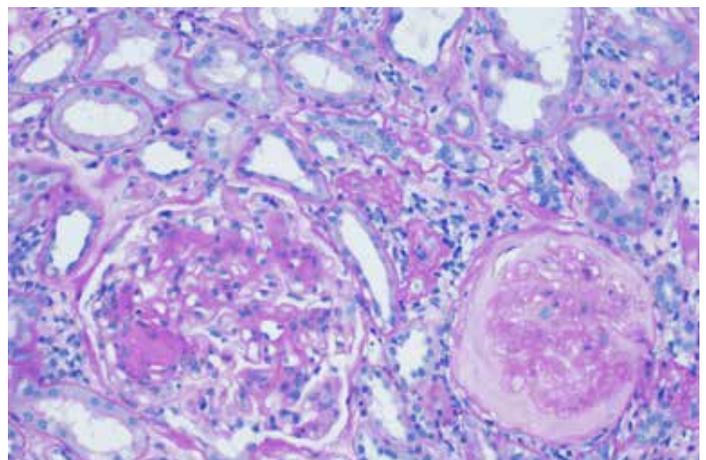
To learn more go to [www.ascp.org/patients](http://www.ascp.org/patients).

If your kidneys are failing or not functioning properly, you might be put on dialysis. Dialysis is the process of removing these toxins from the blood through a dialysis machine, used to replace or support your kidneys. Kidney replacement therapy in the form of dialysis and kidney transplantation has greatly improved the outlook for patients with kidney disease. Dialysis can be used in the setting of both acute kidney injury and in chronic kidney disease. Kidney transplantation typically replaces kidney function in the context of chronic kidney disease.

Diseases of the kidney are common: up to one in three adults in the US are at risk for developing kidney disease. Conditions such as diabetes and hypertension are particularly common causes of kidney failure, but there are many other diseases that affect kidney function. This includes diseases that affect the kidney primarily as well as diseases elsewhere in the body that also affect the kidney.

### UNDER THE MICROSCOPE

This biopsy shows two glomeruli. The left glomerulus shows findings of diabetic kidney disease, but is likely still filtering the blood. The right glomerulus shows marked chronic damage, with complete sclerosis. It can no longer filter the blood. The more of this type of glomerulus that are present in the kidney, the greater the degree of chronic kidney disease.



## LABORATORY TESTS RELATED TO KIDNEY DISEASES

There are numerous possible laboratory tests used every day in patients with kidney disease. Some assess basic aspects of kidney function, and help determine that there is acute or chronic kidney failure. Others are used to help identify the cause of the kidney disease. In all cases, however, both the decision about which tests to order and how to interpret the results must take place in the context of the clinical history and physical examination of the patient. Often the kidney doctor will examine the urine in the office using the microscope (urinalysis) and by means of dipstick testing. The results can also determine the need for additional testing, for example if there is blood or protein in the urine. Some of the most common lab tests are described here, but there are many other tests that are not covered. *\*Please note that reference ranges are set by individual laboratories for their specific populations so reference ranges might differ slightly.*

**Glomerular Filtration Rate (GFR):** This test detects how well kidneys are working by measuring the flow of filtered blood through the kidneys. A typical reference range for adults is between 90-120 mL/min/1.73m<sup>2</sup>.

**Urinalysis:** This test measures a number of substances in the urine, including infections. This test is important because the results can indicate a problem with the kidney or the prostate. This test looks at the number of red blood cells, white blood cells, bacteria, blood, crystals (which can become kidney stones), acidity, protein, glucose and bilirubin levels, which is a waste product created from breaking down old red blood cells.

**Urine Protein:** This test measures the amount of protein in the urine, which, if excessive, is termed proteinuria. This test is important because too much protein can indicate issues with the kidneys. Typical protein excretion is <150 mg/day.

**Urine Culture:** This test measures the presence of bacteria in the urine. This test is important because urine in the bladder is normally sterile, and presence of bacteria can indicate a urinary tract infection (UTI), which men can suffer from as well as women. Normal urine is free from bacteria in the bladder.

**Blood Urea Nitrogen (BUN):** This test measures the amount of nitrogen in your blood. This test is important because higher level can indicate kidney issues. A typical reference range for adults is between 7-20 mg/dL, through the ranges can vary based on your age.

**Serum Creatinine:** This test measures the level of creatine in your blood. Normally, kidneys filter our creatine, which is a waste product created through metabolism of both the muscle and of certain foods. This test is important because higher levels of creatine can indicate an issue with your kidneys. A typical reference range for adults is between 0.84 and 1.21 mg/dL. *Please note that the reference range for creatinine depends on a person's age, sex, body and muscle mass etc.*

**Creatinine Clearance:** This test measures how much creatinine your kidneys filtered. Through this test, creatine levels from your blood and your urine are compared. This test is important because it indicates how well the kidneys are functioning.

**Phosphorus:** This test measures the amount of phosphorus in your blood. Phosphorus is a mineral needed to build strong bones. This test is important because abnormal levels can indicate kidney disease. A typical reference range for adults is between 2.5 and 4.5 mg/dL.

**Calcium:** This test measures the amount of calcium in your blood. Calcium is important for strong bones, and for your muscles, nerves, and heart. This test is important because abnormal levels can indicate kidney disease. A typical reference range for adults is between 8.5 and 10.2 mg/dL.

**Microalbumin:** This test measures the presence of small amounts (hence, "micro") of albumin in the urine, which is a protein found in blood serum. Albumin is the main protein of blood plasma and it helps bind other minerals and hormones. When kidneys start to fail, a small amount of albumin begins to leak through which this test can detect. A typical reference range for adults is less than 30 mg. The ratio of this protein to creatinine in urine is used by your doctor to understand kidney function.

**Blood Glucose:** This test measures the amount of glucose in your blood. This test is important, because higher levels of glucose indicates diabetes. A typical fasting reference range for adults is less than 100 mg/dL.

**Uric Acid:** This test measures the uric acid in your blood or urine. Uric Acid is present in everyone's blood but higher levels can indicate kidney stones or other kidney-related diseases. A typical reference range for adults is around 1.9-8 mg/dL.

**Erythropoietin:** This test measures the volume of the erythropoietin hormone, which is mainly produced by the kidneys and helps create red blood cells. This test is important because erythropoietin controls red blood cell production. A typical reference range for adults from 3.7 to 36 IU/L.

## ADDITIONAL LABORATORY TESTS RELATED TO CHRONIC KIDNEY DISEASE

**(Urine) Albumin/Creatinine Ratio ((U)ACR):** This test measures the presence of albumin in urine by dividing your albumin concentration by your creatinine concentration. This test is important because high levels of albumin can indicate kidney disease. A typical reference range for adults is less than 30mg/g.

**Urine Protein to Creatinine Ratio (UP/CR):** This test measures the protein being released in the urine through a test that divides your protein concentration by your creatinine concentration. Typical protein elimination is less than 0.2g/day. This test is important because abnormal levels can indicate kidney damage.

**Parathyroid Hormone (PTH):** This test measures the level of parathyroid hormone in the blood, a hormone produced by your four parathyroid glands. This test is important because helps find the cause of abnormal levels of calcium in the blood, which can lead to chronic kidney disease. A typical reference range for adults is between 10-65 pg/mL.

## LAB RESULTS INDICATIVE TO CHRONIC KIDNEY DISEASE

**Glomerular Filtration Rate (GFR):** A score less than 60 for 3 consecutive months indicates kidney disease.

**Creatinine:** lab values persistently above the typical reference range for creatinine or a significant increase in creatinine

**Urine Albumin to Creatinine Ratio (UACR):** more than 30 mg/g

## LAB RESULTS ASSOCIATED WITH CHRONIC KIDNEY DISEASE

For some kidney diseases, a biopsy is essential for diagnosis. Kidney biopsy may be performed to determine the causes of acute or chronic kidney disease, as well as in patients who have blood or protein in the urine. The tissue is typically processed in three different ways, and examined with the light microscope, with the electron microscope at much higher power, and with a fluorescent light microscope after staining for immune deposits. Immune deposits are often the cause of disease of the glomeruli, and their assessment is often essential for the correct diagnosis.

## KIDNEY TRANSPLANTS

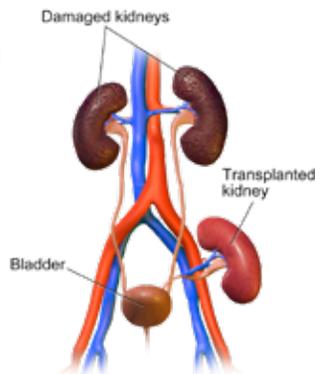
When a compatible donor for a kidney is available, a person needing a new kidney can undergo kidney transplantation. When possible, doctors try to leave the two native kidneys when conducting a kidney transplant. The reason for this is because the kidneys are located in a place that is difficult to reach and doctors want to avoid avoid further surgery.. Instead, the new kidney is added in the pelvic area as shown in the image below. It is important to note that this can only be done if the two native kidneys do not have a disease that can spread or damage other organs.

## LAB TESTS INVOLVED IN KIDNEY TRANSPLANTS

**Cross-Matching:** This is a test performed before transplantation to help assess whether the donor organ will be compatible with the recipient.

### Human Leukocyte Antigen (HLA):

HLA testing assesses the genes and antigens people have inherited. Testing is also done for anti-HLA antibodies that could case the transplant to fail. The purpose of this test is to align a donor up with the recipient to make sure that they have matching antigens to increase the chance of a successful transplant.



**Donor specific antibody (DSA) levels:** Elevated DSA levels may indicate that a form of rejection is occurring involving the patient's antibodies against the donor kidney. Additional support for a diagnosis of rejection can be obtained from examination of a kidney transplant biopsy.

**Testing for BK/polyoma virus:** Infection by BK/polyoma virus is very common, but in a patient who is immunosuppressed (such as a transplant patient), infection can cause significant damage to the transplanted kidney. Testing for the virus can be carried out in the blood or the urine, and if there is concern for infection, additional support for this diagnosis can be obtained from examination of a kidney transplant biopsy.

**Kidney transplant biopsy:** Biopsy of the transplant kidney is necessary to definitively diagnose rejection of the kidney, and to separate this from an infection or from other forms of kidney disease that cause kidney failure in the transplant.

## BLOOD TYPE COMPATIBILITY:

		Donor's Blood Type							
		O-	O+	B-	B+	A-	A+	AB-	AB+
Patient's Blood Type	AB+	ü	ü	ü	ü	ü	ü	ü	ü
	AB-	ü		ü		ü		ü	
	A+	ü	ü			ü	ü		
	A-	ü				ü			
	B+	ü	ü	ü	ü				
	B-	ü		ü					
	O+	ü	ü						
	O-	ü							

For more information and to get involved:  
[www.ascp.org/patients](http://www.ascp.org/patients)

 [Champions@ascp.org](mailto:Champions@ascp.org)

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# MEET ANTHONY



Anthony was diagnosed with end-stage renal disease at 22 years old. He went on emergency dialysis and was added to the kidney transplant list. Four years later, Anthony received a kidney from a friend, who happened to be a perfect match. Anthony received his new kidney two weeks before his son was born. Not only did he feel he was given a second chance, but he also started his new life as a father.

*“Without the pathologists or lab professionals my life would be very different today. They may not see patients face-to-face all the time but they are making a difference. Without that lab work, I would just be a memory”.*

To learn more and to watch a video about Anthony, go to [www.ascp.org/patients](http://www.ascp.org/patients).

## ASK YOUR DOCTOR

- Should I have a yearly kidney test?
- Am I at high risk for kidney disease? If so, which tests should I pay attention to?
- What test indicates the severity of damage to my kidneys?
- Should I drink a lot of water? How do I determine how much water I should drink?
- What is the course of action based on my lab results?
- What are the follow up tests and what are we looking for?
- What qualifies me for a kidney transplant?

For more information and to get involved:  
[www.ascp.org/patients](http://www.ascp.org/patients)

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