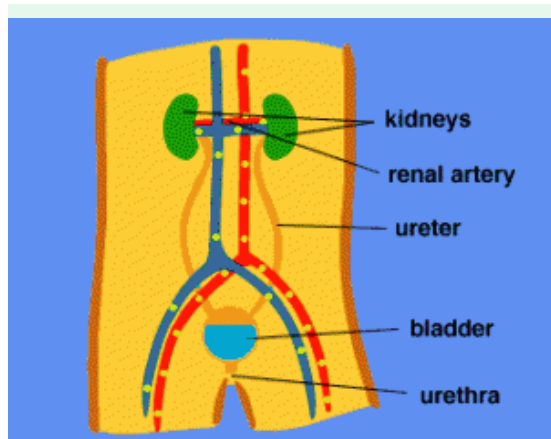


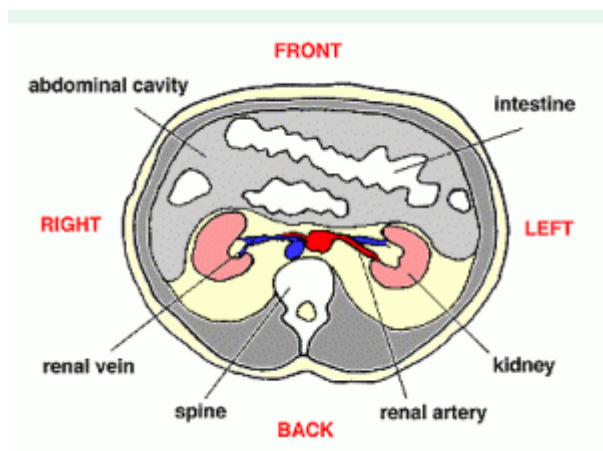
Normal kidneys

Where are the kidneys?

Most people have two **kidneys**, which sit at the back of the abdomen (behind the liver and intestines) in the small of the back on either side of the spine. Each is 11-14 cm (5-6 inches) long and is bean-shaped. It is very difficult to examine a normal kidney because they are far back when examined from the front, and behind a lot of muscles when examined from the back. From the kidneys, the **collecting systems** funnel the urine into tubes (**ureters**) which go down to the **bladder**. The connection to the outside is along the **urethra**.



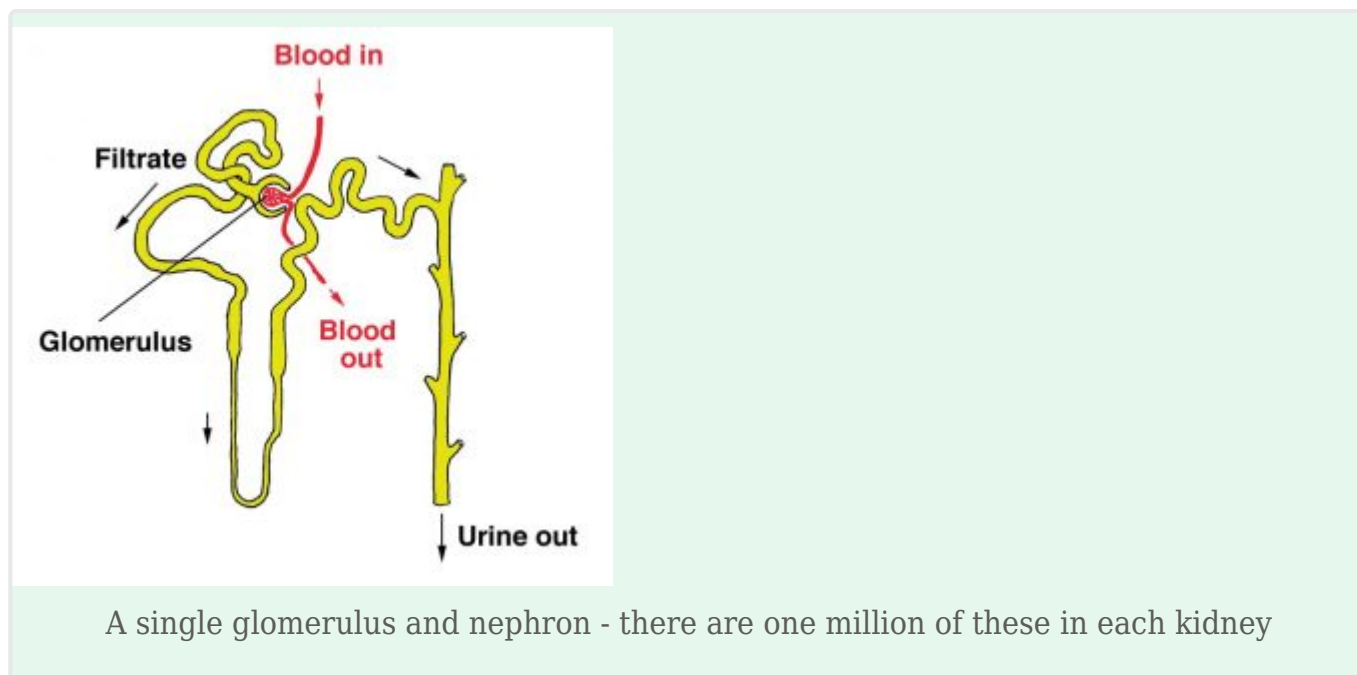
Arteries, veins, ureters and bladder. This image is one from the excellent animation described below



A cross-section of the body taken along the red dotted line shown in the diagram above. (Imagine that the body has been cut across, and you are looking up from below.) The kidneys are to the back, and quite far in and difficult to feel from the surface

Each kidney is joined to the largest artery in the body, the **aorta**, by a short **renal artery**. The kidneys have a huge blood supply - one fifth (20%) of normal blood

flow leaving the heart.



Inside each kidney, blood is channelled to 1 million tiny filters, each one called a **glomerulus** (the plural is glomeruli). Glomeruli are each joined onto small tubes (tubules) to make **nephrons**, and each day 150 litres (40 US gallons) of filtrate passes into the nephrons - 100 times the average daily amount of urine. As the fluid passes along these tubes, most of it is taken back into the blood stream (reabsorbed), leaving only those things that are to be sent out in the urine. Control mechanisms can vary the amount of water, salt, and other substances that are left in the urine when it finally goes into the ureter and down to the bladder.

ANIMATION

[Click here](#) to see an animation of where the kidneys are, and a bit about how they work, from the [Kidney Patient Guide](#) (Wrexham Maelor Hospital, Wales). You need Flash Player on your PC (or Mac) to see it work (links to get this free are provided).

What do the kidneys do?

- remove toxic waste products
- remove excess water and salts
- play a part in controlling your blood pressure
- produce erythropoietin (**epo** for short) which stimulates red cell production from the bone marrow - you get anaemic without this
- help to keep calcium and phosphate in balance for healthy bones

- maintain the blood in a neutral (non-acid) state

Signs that the kidneys are not working properly

Urine tests may show blood or protein that should not normally be there. More information on [haematuria](#) (blood in the urine) and [proteinuria](#) (protein in the urine) is given on other pages.

Blood pressure may be high. Most people with high blood pressure do not have serious kidney disease, but high blood pressure can be a sign of kidney disease. It is more likely to be connected to kidney disease in people who are young, or have severe high blood pressure.

Trouble passing urine is rarely caused by kidney trouble - unless the kidneys are very severely damaged. It is more commonly caused by problems in the bladder, or in the nerves supplying the bladder, or by infection in the urine.

Pain around the kidneys is an uncommon symptom in kidney disease except with [kidney stones](#), and usually has alternative explanations. It is very common with kidney stones, and sometimes occurs with urine infections. Patients with large cysts in the kidney may get pain from them. Sometimes blockage of the artery to the kidney causes pain. Otherwise pain is unusual in kidney disease.

Other symptoms come from loss of kidney function. In the early stages of many kidney diseases, there are no symptoms at all. Kidney function needs to be quite badly damaged before any symptoms become noticeable. At first these are usually very vague and non-specific, and easily confused with many other conditions. A general slowing down and tiredness are common. Later symptoms may include loss of appetite, itch, poor sleep, and many others. Some of these are described on our pages on [chronic renal failure and its progression](#).

Tests for kidney disease

Blood tests (more info about individual kidney blood tests)	
Urea	a simple test, but the result is affected by food and by dehydration.
Creatinine	a more reliable measure.
Estimating GFR using just blood tests (eGFR, estimated GFR)	

Equations

The **MDRD** and **CKD-EPI** equations use blood tests, age, and race to work out approximately what the GFR is. They are not as good as measuring GFR directly, but they are very useful. [Calculate your MDRD eGFR](#) (from the Renal Association website); or your [CKD-EPI eGFR](#) (Kidney Health Australia) Remember that this is not as accurate as measuring GFR, and in some people eGFR may be quite far from the real GFR. [Explain reduced GFR](#)

More accurate tests to show GFR

GFR means glomerular filtration rate, the most useful measure of kidney function. As the normal value is about 100, it gives an approximate 'score out of 100' for kidney function. However your normal GFR depends on your size and age.

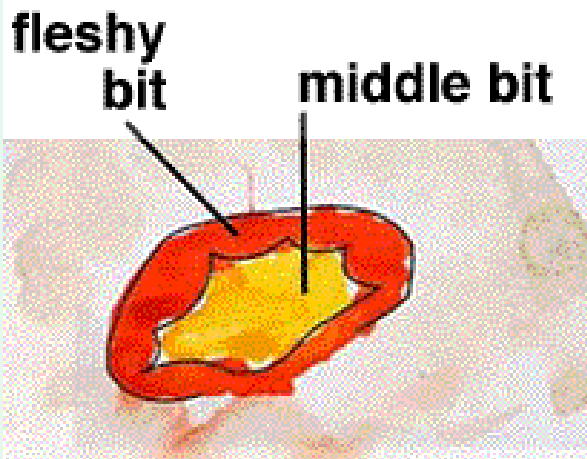
Creatinine clearance

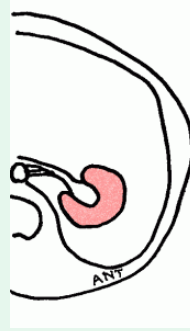
requires collection of all urine over 24h, with a blood test. The Cockcroft-Gault equation used to approximately estimate this before eGFR equation.

Imaging tests (X-rays etc.)

A number of different kinds of test can be used to show the kidneys. These are some common examples.

Ultrasound is the most commonly used technique. It uses sound waves, not X-rays, and seems to be completely safe, even in pregnancy. The pictures look better during the examination than when 'stills' are shown. This image shows a normal kidney by ultrasound (top right), with a diagram below it to show the outline of the kidney.





CT - Computed tomography, the 'CAT scan', is widely used to show organs and structures. The one on the left shows just the left half of the body, with the kidney shown in pink on the diagram beside it (compare with the figure above)

PIC TO BE INSERTED

MRI - Magnetic resonance imaging is another type of cross-sectional imaging like CT. It is sometimes useful for showing particular regions well, and it can sometimes be used to show blood vessels as an alternative to arteriography (see below)



IVU (or IVP) - intravenous urography (or pyelography). In this test an injection of a substance that is eliminated through the kidneys is given. This shows up on X-rays, and it can be followed travelling from the kidney, down the ureters into the bladder. It is useful for showing the ureters and for suspected kidney stones. This image shows the left kidney seen from the front, with dye in the collecting system leading into the top of the ureter.

Arteriography (angiography) This is a way of showing the blood supply to the kidneys. It

usually requires injection of contrast material into the artery that you are trying to see. It is described on another page on [angiography and angioplasty](#). Here is an example showing the blood supply to the left kidney. A thin tube has been passed into the main artery to the lower body (the aorta) from the groin, and an injection of contrast material given. The renal artery on the left (the right side of the picture) is blocked, while that on the right is narrowed.



Kidney biopsy

A kidney biopsy involves taking a small sample of kidney through a needle to look at it under the microscope. More information about this test is given in our page on [renal biopsy](#).

Where can I find further information?

You can [search this site](#), or go to our [EdRen INFO](#) page. Or you can brave the rest of the Internet.

- [History of how the nephron works](#)
- [Kidney tests](#)
- [Kidney biopsy](#)

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