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Glomerulonephritis

Glomerulonephritis is the name given to a range of conditions that can affect the kidney, specifically the glomeruli of the kidney. The glomeruli become damaged, commonly because of a problem with the body's immune system. Many people with glomerulonephritis may not notice any symptoms initially.

However, salt and excess fluid can build up in the body if the glomeruli and kidneys are not working normally. This can lead to complications such as high blood pressure and, in some cases, chronic kidney disease, which may lead to end-stage kidney disease. Treatment will depend on the underlying cause as well as the severity of symptoms.

What is glomerulonephritis?

Glomerulonephritis is the name given to a range of conditions that can affect the glomeruli of the kidney. The kidney consists of small units (nephrons) which produce urine. The glomeruli are clusters of blood vessels within each nephron.

'Glomerulo' refers to the glomeruli and 'nephritis' means inflammation of the kidney. But, strictly speaking, there is not always inflammation present in some types of glomerulonephritis.

In glomerulonephritis there is damage to the glomeruli. This damage interferes with the function of the glomeruli and it can interfere with the function of the kidneys as a whole. Salt and excess fluid can build up in the body if the kidneys are not working normally. This can lead to complications such as high blood pressure and, in some cases, kidney failure can occur.

How severe is glomerulonephritis?

Glomerulonephritis can vary in severity. It can be acute. That is, it can come on suddenly and last for a short period, requiring minimal treatment. Or it can be chronic. That is, it can last for a longer time and it can lead to irreversible damage to the glomeruli and kidneys, interfering with kidney function and leading to chronic kidney disease.

Types of glomerulonephritis

As well as glomerulonephritis being either sudden-onset (acute) or long-term (chronic), there are various ways to classify the different types of glomerulonephritis that can occur. Broadly speaking, glomerulonephritis can be:

- **Primary** – glomerulonephritis develops on its own and is not related to another pre-existing disease or condition in the body.
- **Secondary** – glomerulonephritis develops because of another pre-existing disease or condition in the body. Examples of diseases that can lead to glomerulonephritis in some people are systemic lupus erythematosus (SLE) and polyarteritis nodosa. [See the separate leaflet called Lupus \(Systemic Lupus Erythematosus\) for more details.](#)

Glomerulonephritis classifications

When a sample of tissue is taken from a kidney affected by glomerulonephritis (when a [kidney biopsy](#) is taken), the glomerulonephritis can be classified according to the changes that can be seen when the tissue sample is examined under a microscope. For example, glomerulonephritis can be:

- Focal and segmental glomerulosclerosis – the glomeruli are sclerosed or scarred. Focal means that only some of the glomeruli are affected and segmental means that only parts of a glomerulus (and not the whole glomerulus) may be affected.
- IgA glomerulonephritis – IgA is one of the antibodies produced by the immune system to fight infection. In IgA glomerulonephritis, IgA settles (becomes deposited) in the kidneys, leading to inflammation, scarring and damage.
- IgM glomerulonephritis – the glomeruli become damaged by IgM antibody settling in them.

- Membranoproliferative glomerulonephritis – a glomerulus is made up of a membrane (the tiny blood vessels that filter the blood) and the mesangium which provides support to the glomerulus structure. In membranoproliferative glomerulonephritis, the membrane and the mesangium are both affected and damaged.
- Membranous glomerulonephritis – just the membrane of the glomerulus is damaged and the mesangium is not affected in this type of glomerulonephritis.
- Minimal change nephropathy – if a sample of kidney tissue (a biopsy) is examined under the microscope in this type of glomerulonephritis, it looks essentially normal – there is minimal change. However, symptoms of glomerulonephritis can still be present. This is a common type of glomerulonephritis in children.

Glomerulonephritis symptoms

In many people, glomerulonephritis does not cause any symptoms. It may be diagnosed after blood or urine tests are carried out for some other reason. However, in others, glomerulonephritis can cause symptoms that you may notice. These symptoms can develop slowly, or more quickly in acute glomerulonephritis.

Glomerulonephritis can lead to two main clinical syndromes (sets of symptoms and signs that occur together). These are nephrotic syndrome and nephritic syndrome. The type of glomerulonephritis that is seen when a sample of kidney tissue is examined under a microscope can often have little bearing on the symptoms of glomerulonephritis that can develop.

Nephrotic syndrome

Nephrotic syndrome is when the kidneys leak protein into the urine, due to glomerular damage. Urine with protein in it may appear frothy, and a low protein level in the blood may lead to the legs, or other parts of the body, appearing to be swollen.

Excess protein in the urine can only be detected when the urine is tested using a urine testing strip dipped into the urine or by measuring the exact amount of protein in the urine in the laboratory.

As protein is lost in the urine, this leads to low levels of protein in the blood. Protein and other chemicals in the blood exert an osmotic pressure which tends to pull fluid into the blood vessels. If the concentration of protein in the blood reduces, the osmotic pressure reduces and fluid leaks out from the blood vessels into the tissues. This leads to fluid retention (oedema) which is the main symptom of nephrotic syndrome.

When fluid leaks out of blood vessels into the body tissues, this causes swelling and puffiness of the affected tissues. The face, especially around the eyes, usually becomes puffy first. The ankles can also become puffy and swollen and as oedema becomes worse, the calves, then the thighs, may become swollen.

In severe cases, fluid (ascites) can accumulate in the tummy (abdominal) cavity or in the chest between the lungs and the chest wall (pleural effusion). Ascites can cause abdominal pain and discomfort due to bloating (distension). [Pleural effusions](#) may cause chest pain and breathlessness.

Other symptoms that may develop include:

- [Tiredness](#) and lack of energy (lethargy).
- A poor appetite.
- [Diarrhoea](#) and/or being sick ([vomiting](#)), especially in children.
- [High blood pressure](#).

Nephritic syndrome

Symptoms of nephritic syndrome can include:

- Blood in the urine (haematuria) – damage to the glomeruli can cause blood to pass into the urine. The blood may be obvious to the naked eye. However, in some people, there may only be very small amounts of blood present that can only be detected when the urine is examined under a microscope, or when a urine testing strip is dipped into the urine to detect blood.

- Protein in the urine ([proteinuria](#)) – damage to the glomeruli can also cause protein to leak into the urine. High levels of protein in the urine can make it frothy. However, most of the time, protein in the urine is only detected when the urine is tested using a urine testing strip dipped into the urine. (There will, however, be less protein than in nephrotic syndrome.)
- Passing less urine than usual. Urine may also be darker in colour.
- [Oedema](#) – puffy eyes and puffy face; puffy ankles and legs.
- High blood pressure.

Glomerulonephritis causes

Glomerulonephritis is commonly due to a problem with the body's immune system. Usually, the immune system works to protect the body against things like infections by attacking and killing the germs causing them. However, sometimes the body's immune system can go wrong.

Many cases of glomerulonephritis are caused by the body mistakenly attacking itself, causing damage to the glomeruli of the kidney. It is not always clear why this happens but, in some cases, a trigger can be identified, such as an infection. The infection triggers the problem with the immune system and the damage to the glomeruli.

Infection with certain types of streptococcal germs (bacteria) is the most common infection that can trigger glomerulonephritis. This can happen after an [upper respiratory tract infection](#) or a skin infection that was caused by those bacteria.

Symptoms of glomerulonephritis typically develop between one and three weeks after the initial infection. Other bacteria, viruses, parasites or fungi can also trigger glomerulonephritis. Glomerulonephritis that is triggered by an infection may occur at any age but it most commonly develops in children aged between 5 and 15 years.

Glomerulonephritis can also be triggered after taking certain medicines, including [non-steroidal anti-inflammatory drugs \(NSAIDs\)](#). In some people, it may be difficult to find a trigger for, or the exact cause of, glomerulonephritis.

How is glomerulonephritis diagnosed?

Various investigations may be suggested if glomerulonephritis is suspected. These may include:

- [Testing the urine for blood and protein](#) – this can be done using a dipstick in the clinic. You may also be asked to collect all of the urine that you produce over a 24-hour period to measure the exact amount of protein present.
- A blood test to measure creatinine level – creatinine is a waste product produced by the muscles that is usually passed out in urine. Levels of creatinine in the blood rise if the kidneys are not working properly. The creatinine result can also be used to [calculate the estimated glomerular filtration rate \(eGFR\)](#). This gives a good measure of how well the kidneys are working.
- A blood test to measure [urea and electrolytes](#) – these are usually measured at the same time as creatinine. Urea is another waste product, the levels of which rise in the blood if the kidneys are not working normally. Electrolytes include salts in the blood, such as sodium and potassium, the levels of which can be affected by kidney damage.
- Levels of protein and albumin (a type of protein) can also be measured with blood tests. Blood protein levels will be low in nephrotic syndrome.
- A blood test to check for anaemia.
- Tests to look for the cause of glomerulonephritis – for example:
 - Tests to look for streptococcal infection (sometimes called strep throat), which may include a throat swab, a skin swab or a blood test to look for signs of the infection in the blood.
 - Tests to look for SLE, which may include a blood test to look for signs of this.
- [Chest X-ray](#) – this may be suggested if you have any breathing problems.

- [Ultrasound scan of the kidneys](#) – this can give information about the size of your kidneys, any blockages, etc.
- [A kidney biopsy](#) – during a kidney biopsy, a small sample of tissue is taken from a kidney. The tissue can be examined under a microscope in the laboratory to give information about the cause of glomerulonephritis. Local anaesthetic is used to numb the area first and an ultrasound scan is used for guidance. A small needle is then passed through the skin to take the sample of tissue.

Glomerulonephritis treatment

The treatment will depend on the underlying cause as well as the symptoms that you have and how severe these symptoms are. In mild cases, no treatment may be needed, just regular and careful monitoring of your condition. In more severe cases, treatment may be suggested.

If you have glomerulonephritis, you will usually be treated and followed up by a specialist in kidney disease, a renal physician. They will be able to advise about treatment for your case. Treatment may include:

- Treatment of any underlying cause of glomerulonephritis – for example, treatment for an infection that may have triggered glomerulonephritis or for an underlying condition such as SLE.
- Changes to your diet and fluid intake – you may be advised to restrict the amount of fluids that you drink as well as the amount of salt and protein in your diet. If this is the case, you will usually be referred to a dietician for advice, and regular blood tests will usually be carried out to monitor your condition.
- Medicines to suppress your immune system. Many cases of glomerulonephritis are thought to be caused by a problem with the immune system, so steroid medicines, or sometimes more powerful medicines, may be advised to help suppress your immune system.
- [Angiotensin-converting enzyme \(ACE\) inhibitor medicines](#) – these may be advised to help reduce the amount of protein in your urine. These medicines can also help to lower blood pressure if this is high.
- Strict [control of your blood pressure](#), using medicines.
- [Medicines to help control high cholesterol levels](#).

- Treatment of anaemia if present.
- Strict treatment of any other conditions that you may have such as [diabetes](#).
- Plasma exchange - this is a treatment similar to dialysis, which can be used to help suppress the immune system. Plasma is the fluid part of the blood containing antibodies. In plasma exchange, plasma is removed and replaced, either with other fluids or with plasma donated from other people that does not contain antibodies. Removing the antibodies may help to reduce the damage to the kidney tissues.
- [Kidney dialysis](#) and kidney transplant may be needed in severe cases.

Complications of glomerulonephritis

Complications of glomerulonephritis can include:

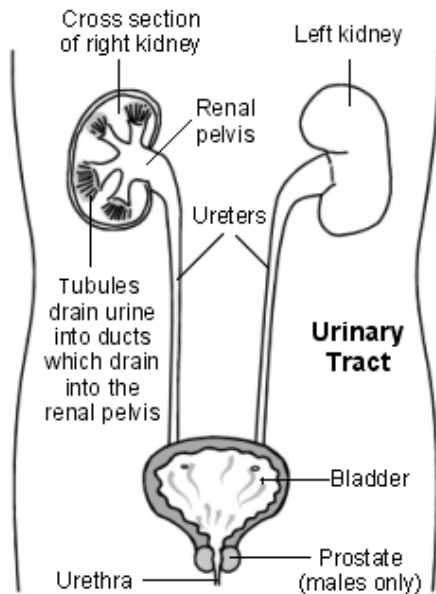
- High blood pressure (hypertension) - the kidneys usually help to control blood pressure. Kidney damage due to glomerulonephritis can interfere with blood pressure control. High blood pressure, if not treated, leads to an increased risk of heart disease and stroke. It can also make kidney damage worse. [See the separate leaflet called High Blood Pressure \(Hypertension\) for more details.](#)
- Chronic kidney disease - may develop due to damage to the glomeruli. This can cause various symptoms and, in some cases, can progress to end-stage kidney disease. [See the separate leaflet called Chronic Kidney Disease \(CKD\) for more details.](#)

Outlook (prognosis)

In many cases, glomerulonephritis can be a temporary problem that can completely get better (resolve). For example, in glomerulonephritis triggered by a streptococcal infection, the long-term outlook (prognosis) is generally very good: more than 98% of people have no symptoms at all five years afterwards.

However, in other cases, glomerulonephritis can become gradually worse over time, cause permanent damage to the glomeruli and lead to chronic kidney disease. In some cases, this can progress to end-stage kidney disease. A kidney biopsy can help your doctors to predict the likely outcome in your individual case.

Understanding the kidneys and urine production

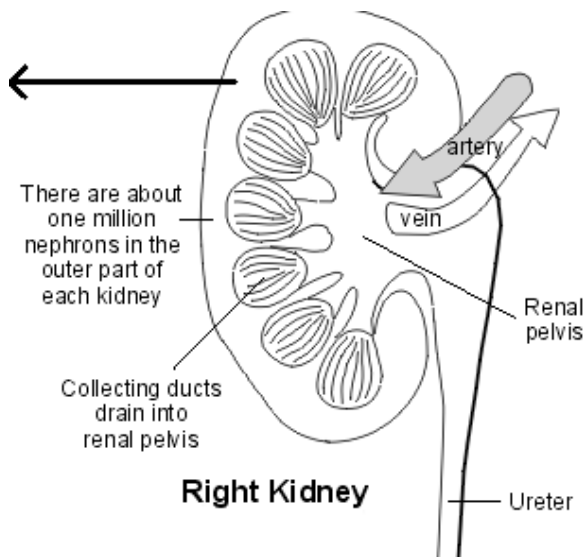
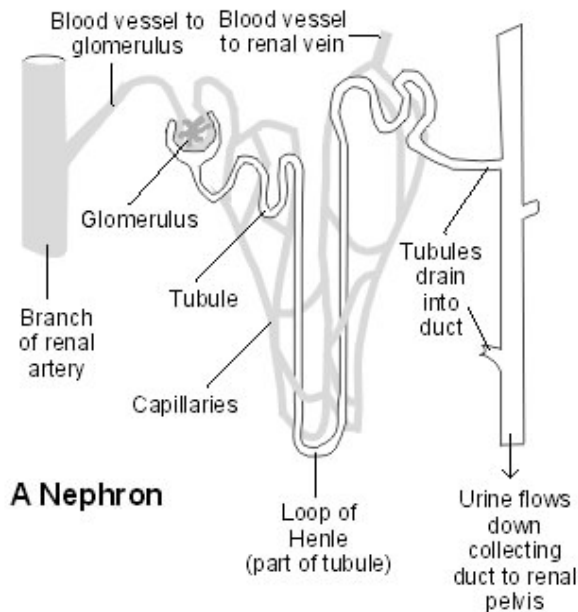


The kidneys clear waste materials from the body and maintain a normal balance of fluids and chemicals in the body.

The two kidneys lie to the sides of the upper tummy (abdomen), behind the intestines and on either side of the spine. The kidneys are higher up in the body than people imagine - from behind they are actually partially protected by the lowest ribs. The kidneys move slightly with a change in body position and with movement of the diaphragm with breathing. The diaphragm is the muscle under your lungs that helps you breathe in.

Each kidney is about the size of a large orange but bean-shaped.

The word 'renal' is a descriptive medical word, meaning related to the kidney. For example, a renal physician is a doctor who looks after people with kidney (renal) diseases.



A large renal artery takes blood to each kidney. The artery divides into many tiny blood vessels (capillaries) throughout the kidney. In the outer part of the kidneys, tiny blood vessels cluster together to form structures called glomeruli.

Each glomerulus (the singular form of glomeruli) is like a filter. The structure of the glomerulus allows waste products and some water and salts to pass from the blood into a tiny channel called a tubule, while keeping blood cells and protein in the bloodstream. Each glomerulus and tubule are called a nephron. There are about one million nephrons in each kidney.

As the waste products, water and salts pass along the tubule there is a complex adjustment of the content. For example, some water and salts may be absorbed back into the bloodstream, depending on the current level of water and salts in your blood. Tiny blood vessels next to each tubule enable this fine-tuning of the transfer of water and salts between the tubules and the blood.

The liquid that remains at the end of each tubule is called urine. This drains into larger channels (collecting ducts) which drain into the inner part of the kidney (the renal pelvis). From the renal pelvis the urine passes down a tube called the ureter which goes from each kidney to the bladder. Urine is stored in the bladder until it is passed out through another tube, called the urethra, when you go to the toilet. The cleaned (filtered) blood from each kidney collects into a large renal vein which takes the blood back towards the heart. The kidneys, ureters, bladder and urethra are, together, called the urinary tract.

Further reading

- [Floege J, Amann K](#); Primary glomerulonephritides. Lancet. 2016 May 14;387(10032):2036-48. doi: 10.1016/S0140-6736(16)00272-5. Epub 2016 Feb 25.
- [Chronic kidney disease: assessment and management](#); NICE guideline (last updated November 2021)
- [Glomerulonephritis](#); National Kidney Foundation, 2022

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