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QUESTION: DISCUSS THE DISEASES OF THE RENAL SYSTEM

**Renal system disease**

They are any of the diseases or disorders that affect the human urinary system. They include [benign](https://www.merriam-webster.com/dictionary/benign) and malignant tumors, infections and inflammations, and obstruction by calculi.

Diseases can have an impact on the elimination of wastes and on the conservation of an appropriate amount and quality of body fluid. Many of the [manifestations](https://www.merriam-webster.com/dictionary/manifestations) of renal [disease](https://www.britannica.com/science/disease) can be accounted for in terms of disturbance of these two functions, and the alleviation of symptoms in those renal diseases that cannot be cured depends on knowledge of how these two functions are affected.

The eliminatory process does not, of course, end with the formation of [urine](https://www.britannica.com/science/urine); the urine has to pass down the ureters to the bladder, be stored there, and voided, usually under voluntary control. The whole mechanism can be deranged by structural changes in the lower urinary tract, by infection, or by neurological disorders that lead to abnormal emptying of the bladder. Disturbance of the lower urinary tract is an important cause of pain and distress, notably during pregnancy and in the elderly; and it can lead to serious and progressive damage to the kidneys, either by interfering with the drainage of urine or by allowing bacterial infection to have access to the [kidney](https://www.britannica.com/science/kidney).

[](https://cdn.britannica.com/02/76302-050-EF6404C1/Bacteria-Pseudomonas-aeruginosa-infections-urethra-bladder-women.jpg)

Bacteria such as *Pseudomonas aeruginosa* can cause infections of the urethra and bladder. These infections occur more often in women than in men and are typically associated with significant pain and distress.

**Effects of abnormal renal function on body fluid**

Renal disease in its [diverse](https://www.merriam-webster.com/dictionary/diverse) forms can lead to bodily deficits or excesses of water, sodium, potassium, and magnesium, and also to [protein](https://www.britannica.com/science/protein) deficits occasioned by great losses of protein in the urine. Inability of the kidney to function normally may lead to retention in the blood of the waste products of protein metabolism, such as [urea](https://www.britannica.com/science/urea) and [uric acid](https://www.britannica.com/science/uric-acid), and of other nitrogenous [compounds](https://www.merriam-webster.com/dictionary/compounds) such as creatinine. There may be abnormally high levels of [phosphates](https://www.britannica.com/science/phosphate) in the blood, which in turn can lead (for reasons about which there is still some disagreement) to low blood levels of [calcium](https://www.britannica.com/science/calcium). The [calcium deficiency](https://www.britannica.com/science/calcium-deficiency) can cause [tetany](https://www.britannica.com/science/tetany), a condition marked by muscular spasms and pain, and calcium may be lost from the bones in the process of restoring normal calcium levels in the blood and tissue fluid. For descriptive purposes, changes in volume, changes in [composition](https://www.merriam-webster.com/dictionary/composition), and protein depletion of renal origin will be discussed separately, but these disturbances can and often do coexist.

Though body fluid is most readily apparent in the bloodstream, it is present, and in larger amounts, in the tissues, both between the cells (interstitial fluid) and within them (intracellular fluid). [Extracellular fluids](https://www.britannica.com/science/extracellular-fluid), which include interstitial fluid and [blood plasma](https://www.britannica.com/science/plasma-biology), amount to 25 percent of body weight and contain [sodium](https://www.britannica.com/science/sodium) as their predominant cation (positive ion; metals and hydrogen in solution are cations). [Intracellular fluids](https://www.britannica.com/science/intracellular-fluid), amounting to 33 percent of body weight, have [potassium](https://www.britannica.com/science/potassium) as their predominant cation. These various “compartments” of body fluid are in osmotic [equilibrium](https://www.merriam-webster.com/dictionary/equilibrium), so that if solute (*e.g.,* sodium chloride) is added to the extracellular compartment so as to increase the concentration of the extracellular solution, water will join it to reduce the concentration, and that compartment will increase. An increase in [extracellular fluid](https://www.britannica.com/science/extracellular-fluid), if it is considerable, may be clinically apparent as [edema](https://www.britannica.com/science/edema), a swelling of the tissues by fluid, which can usually be displaced by firm pressure. Edema is present in [acute](https://www.merriam-webster.com/dictionary/acute) [inflammation](https://www.britannica.com/science/inflammation) of the kidney (nephritis), in protein deficiency of renal origin, and in chronic [nephritis](https://www.britannica.com/science/Bright-disease) complicated by [heart failure](https://www.britannica.com/science/heart-failure) associated with abnormally high blood pressure; a factor common to all these states is failure of the kidneys to excrete sodium and water in adequate amounts.

The kidneys in such edematous states need not themselves be diseased; for example, normal kidneys, in a patient with heart failure, may retain sodium when handicapped in their function by poor circulation and by abnormal amounts of sodium-retaining hormones, such as aldosterone. Increase in extracellular fluids is the only volume change that is both common and easily discernible in renal disease, but the opposite condition, sodium depletion or clinical [dehydration](https://www.britannica.com/science/dehydration-physiology), is more commonly the result of vomiting and [diarrhea](https://www.britannica.com/science/diarrhea) when they are complications of terminal renal disease. Sodium and water depletion can be recognized by a lack of elasticity in the superficial tissues and by poor filling of the blood vessels, as well as by signs of impaired circulation, including a fall in [blood pressure](https://www.britannica.com/science/blood-pressure) and an increase in pulse rate. Though changes in intracellular fluid volume occur in some diseases, especially when the potassium content of the body is affected, there is no easy way of detecting them.

**Diseases and disorders of the Kidney**

**Acute renal failure**

Acute renal failure occurs when renal function suddenly declines to very low levels, so that little or no urine is formed, and the substances, including even water, that the kidney normally eliminates are retained in the body. There are two main mechanisms that can produce acute renal failure. When the [cardiac](https://www.britannica.com/science/cardiovascular-disease) output—the amount of blood pumped into the general circulation by the heart—is lowered by hemorrhage or by medical or surgical shock, the renal circulation is depressed to an even greater extent. This leads directly to inefficient excretion, but, more importantly still, the kidney tissue cannot withstand prolonged impairment of its blood supply and undergoes either patchy or massive [necrosis](https://www.britannica.com/science/necrosis) (tissue death). Given time, the kidney tissue may regenerate, and it is on this hope that the treatment of acute renal failure is based. The form of acute renal failure that is due to a poor supply of blood ([ischemia](https://www.britannica.com/science/ischemia)) has many causes, the most common and most important being multiple injuries, [septicemia](https://www.britannica.com/science/septicemia) (infections invading the bloodstream), abortion with abnormal or excessive bleeding from the female genital tract, internal or external hemorrhage, loss of fluid from the body as in severe [diarrhea](https://www.britannica.com/science/diarrhea) or burns, transfusion reactions, and severe heart attacks; a special case is the transplanted kidney, which commonly goes through a phase of acute renal failure that is independent of possible rejection.

The second common mechanism of acute renal failure is toxic. Many [poisons](https://www.britannica.com/science/poison-biochemistry) are excreted by the kidney, and in the process, like other urinary [constituents](https://www.merriam-webster.com/dictionary/constituents), they become concentrated and thus reach levels in the tubular fluid that damage the lining cells of the tubules. Though the tubular cells die and are shed in the urine, regeneration can take place and the patient survive, if he can be maintained during the period of depressed renal function and is not killed by other effects of the poison. Poisons that can affect the kidney in this way are numerous, but the main groups are heavy metals (mercury, arsenic, uranium); organic solvents (carbon tetrachloride, propylene glycol, methanol); other organic substances (aniline, phenindione, insecticides); and antibacterial agents (sulfonamides, aminoglycosides, amphotericin), and some fungi (*e.g.,* *Amanita phalloides*). In addition to the ischemic and toxic causes of acute renal failure, mention must be made of fulminating varieties of acute renal illnesses that are generally mild (*e.g.,* acute glomerulonephritis—see below) and of the acute form of immunologic rejection that can destroy a kidney irrevocably within minutes of transplantation. Another mechanism of acute renal failure is characterized by acute obstruction of the flow of urine from the kidneys; this condition is easily treated by restoring adequate urinary drainage from at least one kidney.

[**Glomerulonephritis**](https://www.britannica.com/science/Bright-disease)

Glomerulonephritis is the disorder commonly known as nephritis, or Bright’s [disease](https://www.britannica.com/science/disease). The primary impact of the disease is on the vessels of the [glomerular](https://www.britannica.com/science/glomerulus) tuft. The suffix “-itis” suggests an inflammatory lesion, and glomerulonephritis is indeed associated with infection, in the limited sense that it may begin soon after a streptococcal infection and may be aggravated in its later course by infections of various kinds. Nevertheless, there is convincing evidence that glomerulonephritis does not represent a direct attack on the kidney by an infective agent; it appears to be, rather, an immunologic disorder, in the sense of the formation of [antibodies](https://www.britannica.com/science/antibody) in response to the presence of a foreign protein (antigen) elsewhere in the body; these form antigen–antibody complexes that lodge in the glomerular tuft or, in a small number of cases, themselves become deposited on the capillary glomerular walls. In each case the antibody or the antigen–antibody complex reaches the kidney via the circulation, and the mechanism is usually referred to as circulating complex disease. Glomerular damage is a consequence of the reaction that follows within the glomeruli. These deposits of foreign protein and complexes react with other protein components of blood (see the article [complement](https://www.britannica.com/science/complement-immune-system-component)) and attract to the site white blood cells and platelets, which also are circulating in the blood; these in turn release protease enzymes and other chemical mediators of tissue injury.

This view of glomerulonephritis is based partly on [analogy](https://www.merriam-webster.com/dictionary/analogy) with the renal damage that can be induced in animals by allergic mechanisms and partly on finding that a protein component of the allergic reaction is deposited in the diseased glomerulus. Within the general concept of an immunologic disorder, there is ample room for a variety of primary stimuli and of later immunologic disease-causing mechanisms. These include the possibility of primary glomerular damage, causing the glomerulus itself to become antigenic and so to provide a secondary antibody response, and also the participation of (or lack of participation of) T lymphocytes. Such a [diversity](https://www.merriam-webster.com/dictionary/diversity) is strongly suggested not only by the variations in the glomerular tissues observed both with the ordinary and with the [electron microscope](https://www.britannica.com/technology/electron-microscope) but also by the varying [manifestations](https://www.merriam-webster.com/dictionary/manifestations) of the disease observed in the affected person.

Typically, glomerulonephritis appears as an [acute](https://www.merriam-webster.com/dictionary/acute) illness one to two weeks after a [sore throat](https://www.britannica.com/science/sore-throat), or less commonly, after a persistent streptococcal infection of the skin. Other infective agents may be responsible, however, including some viruses and protozoans. A small number of drugs that act as foreign macromolecules can also do so.

[**Vascular disease**](https://www.britannica.com/science/cardiovascular-disease)

In the discussion of chronic [renal failure](https://www.britannica.com/science/kidney-failure), attention was drawn to the cycle in which high blood pressure secondary to renal disease can produce further damage to the kidneys. Clearly, primary vascular disease, disease affecting the [blood vessels](https://www.britannica.com/science/blood-vessel) could equally well be a cause of renal damage.

The most dramatic instance of this is the condition known as [malignant hypertension](https://www.britannica.com/science/malignant-hypertension), or accelerated hypertension, which arises when the [blood pressure](https://www.britannica.com/science/blood-pressure) attains extremely high levels, the diastolic figure (the blood pressure between heart contractions) being 140 millimeters of mercury or higher (the normal being around 80). Sustained levels of this magnitude cause serious damage to the arterioles, the smallest of the arteries; this damage is widespread, but as it affects the kidneys it produces rapid destruction of renal substance, with a scarred kidney. Unless the blood pressure is controlled, malignant hypertension can cause death in a few months; since treatment at an early stage is notably effective, the condition represents an important medical emergency. Since the retinas are damaged as rapidly as the kidneys, the affected person may first notice blurring or loss of vision and will typically have a severe [headache](https://www.britannica.com/science/headache). Prompt treatment is necessary to avoid [stroke](https://www.britannica.com/science/stroke-disease), as well as damage to other organs.

More modest, but still elevated, levels of blood pressure can cause more gradual renal damage in elderly people or in those made prematurely aged by widespread [arteriosclerosis](https://www.britannica.com/science/arteriosclerosis) (“hardening of the arteries”). In this condition the damage is in the larger arteries rather than in the arterioles, and the condition is one of slowly progressive scarring. Renal damage can also arise, by various mechanisms, in a large number of diseases that impair the proper functioning of the blood vessels, such as [diabetes mellitus](https://www.britannica.com/science/diabetes-mellitus), the collagen disorders, bacterial [inflammation](https://www.britannica.com/science/inflammation) of the heart lining, and many more.

A specific endovascular cause of high blood pressure that, although uncommon, is important from the point of view of the control of blood pressure in healthy individuals involves the [juxtaglomerular apparatus](https://www.britannica.com/science/juxtaglomerular-cell) (JGA) and the secretion of [renin](https://www.britannica.com/science/renin). Occasionally, following trauma or arising spontaneously as a result of vascular disease, one or the other of the main renal arteries becomes constricted (renal artery stenosis). The fall in blood pressure beyond the constriction leads to increased secretion of renin from the JGA with the formation of the vasoactive angiotensin II. As a result, the blood pressure rises. Removal of the affected kidney, surgical repair of the constriction, or percutaneous transluminal angioplasty (a balloon catheter inserted through the skin and inflated in the artery to flatten plaque build-up) usually restores the blood pressure and the blood renin level to normal.

[**Tumors**](https://www.britannica.com/science/tumor)

Tumors in general are covered in the article [Cancer](https://www.britannica.com/science/cancer-disease). In this section, those tumors peculiar to the excretory system, and their local effects, are discussed briefly. In the case of [benign](https://www.merriam-webster.com/dictionary/benign) tumors, these effects include pressure on local structures and obstruction to hollow organs; with malignant tumors, one must add the possibilities of local invasion and of spread by the bloodstream or lymphatics to other organs (metastasis).

[**Carcinoma**](https://www.britannica.com/science/carcinoma)

The most common [tumor](https://www.britannica.com/science/tumor) of the renal substance is a carcinoma, renal cell cancer (formerly called a [hypernephroma](https://www.britannica.com/science/renal-carcinoma)), which is a malignant tumor, arising from epithelial cells (the cells of the bodily coverings and linings). It was formerly thought to arise from adrenal cortical cells lying within the kidney substance. This has since been disproved. One to 2 percent of all tumors are renal carcinomas, and most affected persons are aged from 40 to 60. The tumor may be symptomless or may first be apparent from the occurrence of metastases in the lungs, causing spitting up of blood; or in the bones, causing pathological fracture.

Much more commonly, the first evidence of the tumor is blood in the urine, which may be painless or may cause [colic](https://www.britannica.com/science/colic-equine-disease) of the ureter, if clots are being passed. There may also be a dull pain in the loins, from stretching of the kidney capsule. The tumor may be directly [palpable](https://www.merriam-webster.com/dictionary/palpable), or it may be revealed by X rays or ultrasonography. The silhouette of the kidney may be distorted by a rounded swelling; or the [renal pelvis](https://www.britannica.com/science/renal-pelvis), made visible by the injection of a [contrast medium](https://www.britannica.com/science/contrast-medium), may be displaced or distorted. Less common first indications of renal carcinoma are an obscure fever, or polycythemia (excess of red blood cells in the blood), due to excessive production of erythropoietin. Direct visual examination of the urinary tract with an instrument called a cystoscopy may demonstrate the side that is affected, blood coming from one ureteric opening only. Since this bleeding can equally arise from a tumor of the renal pelvis, examination of the renal pelvis is usually called for. An exploratory operation may sometimes be needed; if carcinoma is found to be present, the kidney must be removed. There is some evidence that the results of surgery may be somewhat improved by [radiation therapy](https://www.britannica.com/science/radiation-therapy). The overall outlook is poor, with a five-year survival rate no better than 50 percent. This is, however, one of the forms of malignant tumor in which arrest or even regression has been described.

has been described.

**(Wilms’ tumor)**

Nephroblastoma is a less common, but nevertheless an important, tumor in childhood, in which other forms of cancer are less common. About half the cases occur at ages two to four, but the tumor may be present even at birth. Early [diagnosis](https://www.merriam-webster.com/dictionary/diagnosis), immediate surgery, and chemotherapy [constitute](https://www.merriam-webster.com/dictionary/constitute) the best possibility for a cure.

**Other tumors**

In addition to tumors of the renal substance, the renal pelvis may be affected by fernlike growths of the epithelium (papilloma’s). Benign tumors of the kidney substance occur, but rarely; on the other hand, [cysts](https://www.britannica.com/science/cyst) (abnormal sacs filled with liquid or semisolid substance) of the kidney are relatively common but are not tumors in any strict sense, being rather malformations brought about by failure of the embryonic tubules to achieve a proper outlet. Several forms of renal cystic disease, most of them fatal, occur in infancy. Various forms of solitary cyst occur, which may need local surgical treatment if they cause symptoms. The form of [polycystic](https://www.britannica.com/science/polycystic-renal-disease) (multiple-cyst) renal disease that allows survival into adult life is a familial condition, in which several members of the family have little trouble until middle life but then are progressively affected by kidney malfunction. Episodes of blood in the urine and urinary infection are common, and the kidneys are large and irregular. Cysts of other organs e.g; the liver may be present. X rays show irregularity of the renal pelvis, through pressure from the cysts. Puncture of the cysts is possible, but the results are not encouraging; the general treatment is that of chronic renal failure, which may now include removal of the kidney and transplantation.