Every minute, blood flows through the kidneys. The kidneys remove waste, balance water and minerals, help control blood pressure, support red blood cell production, and activate vitamin D for bone health. Most of this happens without us feeling it.

Dialysis becomes necessary when the kidneys can no longer keep the blood and body chemistry within safe limits. It is not simply a machine that “makes someone urinate.” Dialysis removes certain wastes and excess water directly from the blood, but it cannot perform every kidney function perfectly.

To understand dialysis, we first need to understand why kidney failure becomes dangerous. Our cells constantly use nutrients and produce waste. Proteins create nitrogen-containing wastes such as urea. Muscles produce creatinine. These substances enter the blood and must be removed.

The kidneys also control how much sodium, potassium, acid, and water remain in the body. This balance must remain within a narrow range. Too much water can cause swelling, high blood pressure, or fluid in the lungs. Excess acid can disturb normal cell function. Extremely high potassium can interfere with the heart’s electrical system and cause a deadly rhythm.

Kidneys are built from microscopic filtering units called nephrons. Each kidney contains roughly a million nephrons. Blood enters a cluster of tiny vessels called a glomerulus, where water and small substances move into a filtering tube. The nephron then decides what the body should keep and what should leave as urine.

Useful substances such as needed water, glucose, and minerals are returned to the blood. Waste and unnecessary water remain in the developing urine. The final urine travels through the ureters to the bladder.

Kidney disease often damages nephrons slowly. The surviving nephrons work harder to compensate, so someone may lose a large amount of kidney function without obvious symptoms. Blood and urine tests can reveal damage before the person feels seriously ill.

Creatinine is one of the wastes measured in blood tests. As kidney filtration worsens, creatinine usually rises. Doctors use creatinine along with age and sex to estimate the glomerular filtration rate, usually called eGFR. The eGFR estimates how much filtering work the kidneys are performing.

Kidney failure is not diagnosed from one number alone. Doctors consider eGFR, symptoms, potassium, acid levels, fluid buildup, nutritional condition, urine output, and the cause of kidney damage. Some people need dialysis at a higher eGFR because dangerous problems have developed. Others remain medically stable at a lower number.

The most common causes of long-term kidney failure are diabetes and high blood pressure. Diabetes can damage the kidneys’ small blood vessels. High blood pressure can injure those vessels, while damaged kidneys can make blood pressure even harder to control. The two problems can feed each other.

Kidney failure may also result from autoimmune disease, inherited disorders, repeated infections, urinary blockage, certain medications, toxins, or severe injury. Chronic kidney disease develops over months or years. Acute kidney injury develops more suddenly, sometimes because of dehydration, infection, shock, medication, obstruction, or reduced blood flow.

Dialysis after acute kidney injury may be temporary if the kidneys recover. Dialysis for permanent kidney failure usually continues for life unless the person receives a successful kidney transplant.

Someone with advanced kidney failure may experience exhaustion, nausea, itching, poor appetite, swelling, difficulty breathing, confusion, muscle cramps, sleep problems, or a metallic taste. These symptoms are not unique to kidney disease, and some people feel surprisingly normal despite dangerously poor laboratory results.

Dialysis uses a basic physical process: substances move from an area of higher concentration toward an area of lower concentration across a thin barrier. This is called diffusion. Water can also be pulled across the barrier. In dialysis, the barrier allows water and small wastes to cross while keeping blood cells and most large proteins in the bloodstream.

There are two main types of dialysis. Hemodialysis cleans the blood through a filter outside the body. Peritoneal dialysis uses the lining inside the abdomen as the filter. They accomplish similar goals through completely different routes.

During hemodialysis, blood leaves the body through tubing and enters a machine. The machine pumps it into a dialyzer, sometimes called an artificial kidney. Inside the dialyzer are thousands of extremely thin hollow fibers.

Blood travels through the fibers while dialysis fluid flows around them in the opposite direction. The fiber walls form the semipermeable membrane. Waste and excess minerals move out of the blood and into the dialysis fluid. The machine also removes excess water. The cleaned blood then returns to the body.

The dialysis fluid is carefully designed. It does not simply wash the blood with plain water. Its concentration helps pull out particular wastes while preventing the body from losing everything small enough to cross the membrane. The water used to prepare it must be highly purified because ordinary tap water contains substances that should never enter this process.

Only a portion of the blood is outside the body at one time. The blood continually circulates through the machine and returns. Nurses and technicians monitor blood pressure, blood flow, machine pressures, temperature, and other safety measurements throughout treatment.

Blood naturally clots when it touches unfamiliar surfaces. A medication such as heparin may be used during hemodialysis to keep blood from clotting inside the tubing and dialyzer. The amount must be managed carefully because too much anticoagulation can increase bleeding.

The machine needs reliable access to a large amount of blood. An ordinary intravenous line is usually too small and cannot support the repeated high blood flow needed for long-term hemodialysis. A special vascular access must be created.

An arteriovenous fistula is made by surgically connecting an artery directly to a nearby vein, usually in the arm. The stronger arterial blood flow causes the vein to enlarge and develop thicker walls. After it matures, two needles can be placed in it during dialysis. One carries blood to the machine, and the other returns it.

A fistula is generally preferred for long-term hemodialysis because it can last for years and has a lower infection risk than a catheter. It takes time to mature, however, and not everyone has blood vessels suitable for one.

An arteriovenous graft uses a synthetic tube to connect an artery and vein. The graft can often be used sooner than a fistula but tends to have more problems with clotting and infection.

A central venous catheter is a flexible tube placed into a large vein, usually in the neck or upper chest. The two external openings connect directly to the dialysis tubing. A catheter can be used immediately, making it valuable when dialysis must begin urgently.

The major problem is infection. A catheter provides bacteria with a path into a large blood vessel. Catheters also clot or malfunction more often than fistulas. They are sometimes unavoidable, but they generally carry the highest bloodstream-infection risk among hemodialysis access types.

The access must be protected. Blood pressure cuffs, blood draws, tight clothing, and heavy pressure may need to be avoided on a fistula or graft arm. Patients are taught to feel for the thrill, a continuous vibration caused by blood flowing through the access. If the vibration disappears or changes suddenly, the access may be blocked and needs immediate attention.

Redness, warmth, drainage, swelling, fever, or chills can signal infection. Fever or shaking chills during dialysis should never be ignored because bacteria may have entered the bloodstream. A bloodstream infection can progress into sepsis, causing organ failure and death.

Many people receive in-center hemodialysis about three times per week, with each session lasting several hours. The exact schedule depends on medical needs and the treatment plan. Home hemodialysis can be performed more frequently or for longer periods, including overnight in some programs.

Three treatments per week do not mean kidney waste appears only on treatment days. The body produces waste and accumulates fluid continuously. Healthy kidneys work every hour, while standard in-center dialysis performs intense cleaning during scheduled periods. The gap between treatments is one reason diet, fluid limits, and attendance matter.

Missing dialysis allows potassium, acid, waste, and water to accumulate. A person may feel normal at first, but dangerous changes can develop without warning. Missing the longer gap between weekly treatments can be especially risky.

Removing water too quickly can cause low blood pressure, weakness, nausea, cramps, dizziness, headache, or fainting. The machine is not creating those symptoms because it is “taking blood away.” The blood is being returned. The problem is often that fluid is being removed from the bloodstream faster than fluid stored in the tissues can move back into it.

The person’s weight after excess fluid has been removed is often called the target weight or dry weight. If the target is set too high, extra fluid may remain and contribute to swelling or high blood pressure. If it is set too low, treatment may cause repeated low blood pressure and cramps. The target may change with illness, appetite, body-weight changes, or heart function.

Dialysis patients may need to limit fluids because the kidneys can no longer remove enough water between treatments. Fluid does not mean only water in a cup. Ice, soup, gelatin, popsicles, and foods that melt or contain large amounts of liquid also contribute.

Salt increases thirst and causes the body to retain water. Reducing sodium can make fluid control easier. A person who eats heavily salted food may become intensely thirsty, drink more, gain more fluid weight, and then require faster fluid removal at the next treatment.

Potassium requires careful attention because both high and low levels can affect the heart and muscles. High-potassium foods may need to be limited, but the exact plan depends on blood tests and the form of dialysis. A kidney diet is not identical for everyone.

Phosphorus can also accumulate when the kidneys fail. Excess phosphorus may pull calcium from bones, contribute to itching, and help cause harmful calcium deposits in blood vessels and tissues. Foods containing phosphorus may need to be limited, and medications called phosphate binders may be taken with meals to trap phosphorus in the digestive system before it enters the blood.

Kidneys normally release erythropoietin, a hormone that tells bone marrow to produce red blood cells. Damaged kidneys may not produce enough, leading to anemia. Dialysis removes waste but does not restore normal hormone production. Patients may receive iron and an erythropoiesis-stimulating medicine to help the body make red blood cells.

Kidneys also help activate vitamin D and control calcium and phosphorus. Kidney failure can weaken bones and disturb the parathyroid glands. Dialysis patients may therefore need additional medicines even when the filtering treatment is working properly.

Peritoneal dialysis cleans the blood without continuously removing it from the body. The peritoneum, a thin membrane lining the abdominal cavity and covering the abdominal organs, contains many small blood vessels. This natural membrane becomes the filter.

A surgeon places a soft catheter into the abdomen. Sterile dialysis solution flows through the catheter and fills the empty space around the abdominal organs. The solution does not enter the stomach or mix with food. It remains inside the peritoneal cavity.

Waste and excess water move from the blood vessels in the peritoneum into the dialysis solution. After a set period called the dwell time, the used solution is drained out and replaced with fresh solution. One drain-and-fill process is called an exchange.

Peritoneal dialysis fluid often contains glucose. The glucose creates an osmotic pull that draws water from the bloodstream into the dialysis solution. Stronger glucose concentrations can remove more water, but repeated glucose exposure may affect blood sugar and contribute calories.

Continuous ambulatory peritoneal dialysis, or CAPD, uses manual exchanges during the day. The solution dwells in the abdomen while the person moves through ordinary activities. The patient drains and replaces it several times daily.

Automated peritoneal dialysis uses a machine called a cycler to perform exchanges, usually while the person sleeps. The patient connects to the machine at night, and the cycler fills and drains the abdomen according to its program.

Peritoneal dialysis provides more continuous cleaning than standard three-times-weekly hemodialysis. Some people prefer the independence of treating at home and avoiding repeated needles. Others find the daily responsibility, storage of supplies, body-image changes, or risk of infection difficult.

Clean technique is essential. The catheter creates a route into the abdomen, so contamination can cause peritonitis, an infection of the peritoneal cavity. Warning signs include cloudy drained fluid, abdominal pain, fever, nausea, or feeling severely unwell.

Cloudy drainage should be treated as an urgent warning, not watched for several days. Peritonitis can damage the membrane, spread infection, interrupt treatment, and become life-threatening.

Peritoneal dialysis may become less effective over time if the membrane changes. Abdominal surgery, hernias, limited home support, or other medical conditions may affect whether it is appropriate. Hemodialysis and peritoneal dialysis each have advantages and risks; one is not automatically better for every person.

Dialysis keeps people alive, but it is not a complete replacement for healthy kidneys. It cannot continuously make moment-by-moment adjustments with the precision of living organs. It also cannot fully replace kidney hormone production.

Some kidney function may remain after dialysis begins. Continuing to make urine does not prove the kidneys are filtering blood adequately. Urine may contain mostly water while dangerous wastes remain in the bloodstream. Remaining kidney function is valuable and may make fluid control easier, but the medical team must determine whether it is sufficient.

Dialysis may be started urgently when potassium becomes dangerously high, acid builds up, fluid fills the lungs, toxins cause confusion or inflammation around the heart, or severe symptoms cannot be controlled another way. In chronic disease, planning before the emergency allows time to choose a treatment and create permanent access.

A kidney transplant places a functioning kidney from a living or deceased donor into the recipient. The person’s original kidneys usually remain unless they are causing a specific problem. A successful transplant can provide more continuous kidney function and greater dietary freedom than dialysis.

A transplant is treatment, not a simple cure. Anti-rejection medicines must be taken consistently, usually for as long as the transplanted kidney works. These medicines suppress the immune system and increase the risk of infection, certain cancers, diabetes, and other complications. Donor organs are also limited, and not every patient qualifies.

Life on dialysis involves more than sitting beside a machine. Treatment schedules affect employment, travel, meals, sleep, relationships, and energy. Some patients feel exhausted after hemodialysis. Others continue working, exercising, parenting, traveling, and living actively with careful planning.

A patient’s condition is judged through more than whether they completed the session. The team follows weight, blood pressure, potassium, phosphorus, calcium, hemoglobin, nutrition, access function, and whether enough waste is being removed. Dialysis must be adjusted as the body changes.

The simplest way to hold everything together is to remember what dialysis can and cannot do. It can remove certain wastes, correct dangerous mineral and acid imbalances, and pull off excess water. It can prevent kidney failure from becoming immediately fatal. It cannot completely reproduce healthy kidneys, repair all damage caused by years of kidney disease, or make diet, medication, access care, and attendance unimportant.

Dialysis is controlled filtering performed because the body's natural filters are no longer enough. Hemodialysis sends blood to an artificial filter outside the body. Peritoneal dialysis brings special fluid to a natural membrane inside the body. Both create a substitute route for wastes and water to leave, keeping the internal environment stable enough for the heart, brain, lungs, muscles, and other organs to continue working.