



Patient education: Hemodialysis (Beyond the Basics)

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Literature review current through: **Jun 2026**.

This topic last updated: **Jun 05, 2026**.

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HEMODIALYSIS OVERVIEW

Dialysis is a treatment for severe kidney failure (also called renal failure or end-stage kidney disease). When the kidneys are no longer working effectively, various chemicals, waste products, and fluid build-up in the blood. Dialysis takes over a portion of the function of the failing kidneys to remove these substances. (See "Patient education: Dialysis or kidney transplantation — which is right for me? (Beyond the Basics)".)

Dialysis is typically needed when approximately 90 percent or more of kidney function is lost. Kidney function can be lost rapidly (acute kidney injury) or over months or years (chronic kidney disease). Early in the course of chronic kidney disease, medicine and other treatments can be used to help preserve kidney function and delay the need for dialysis. (See "Patient education: Chronic kidney disease (Beyond the Basics)".)

WHICH TYPE OF DIALYSIS IS BEST?

Once dialysis becomes necessary, you and your kidney treatment team should consider the advantages and disadvantages of the two types of dialysis:

- Hemodialysis (in a dialysis center or at home)
- Peritoneal dialysis (at home) (see "Patient education: Peritoneal dialysis (Beyond the Basics)")

The choice between dialysis options is influenced by a number of factors, such as availability, convenience, underlying medical problems, home situation, and age. Some people may choose not to do dialysis at all because of other health conditions, age, or just personal preference. These choices are best made by discussing the risks and benefits with your kidney specialist (nephrologist), other members of your health care team, and your caregivers. Patients with chronic kidney disease also should discuss the possibility of getting a kidney transplant with their nephrologist. (See "Patient education: Dialysis or kidney transplantation — which is right for me? (Beyond the Basics)".)

WHEN TO START DIALYSIS

Your nephrologist will help you make the decision about when to start dialysis. Your kidney function (as measured by blood and sometimes urine tests), overall health, nutritional status, symptoms, quality of life, personal preferences, and other factors impact the decision regarding the timing of initiation of dialysis. Dialysis should begin well before kidney disease has advanced to the point where life-threatening complications can occur.

The amount of kidney function you have is generally estimated by using the results of a common blood test called the serum creatinine to calculate an estimated glomerular filtration rate (eGFR) level. A newer blood test called cystatin-C also can be used for this calculation. The higher the creatinine level in the blood, the lower your amount of kidney function or GFR. It is generally possible to be put on a kidney transplant waiting list when kidney function is approximately 20 percent of normal. Many patients will need to start dialysis when their kidney function is approximately 6 to 10 percent of normal, although this is variable. Most patients will have some symptoms at this low level of kidney function; starting dialysis will often improve these symptoms. Most patients do not really need to start dialysis until they have some symptoms, and there is not a definite level of kidney function at which it is absolutely necessary to start dialysis in the absence of symptoms, although some nephrologists recommend dialysis, even in the absence of symptoms, once the eGFR level falls below approximately 10 mL/min/1.73 m² (which is how labs report this number). Patients with chronic kidney disease and some with acute kidney injury make a normal amount of urine, but the urine does not get rid of the body's waste products.

If blood tests indicate that the kidneys are working very poorly or not at all; if there are dangerous blood chemistry values, such as a very high blood potassium concentration; or if there are symptoms such as confusion or bleeding that is related to kidney disease, dialysis should be started promptly provided that a decision has been made to do chronic dialysis.

PREPARING FOR HEMODIALYSIS

For patients with chronic kidney disease, preparations for hemodialysis should be made at least several months before it will be needed. In particular, you will need to have a procedure to create an "access" (described below) several weeks to months before hemodialysis begins.

Vascular access — An access creates a way for blood to be removed from the body, circulate through the dialysis machine, and then return to the body at a rate that is higher than can be achieved through a normal vein. There are three major types of access: primary arteriovenous (AV) fistula, synthetic AV bridge graft, and central venous catheter. Other names for an access include a fistula or shunt.

If not a central venous catheter, the access needs to be created weeks to months before hemodialysis begins so it can heal and fully develop, or "mature," before use. Discussions about the access should begin even earlier since you will need to avoid injuring blood vessels that will eventually be used for the access. Having an intravenous (IV) line or frequent blood draws in the arm that will be used for access can damage the veins, which could prevent them from being used for a hemodialysis access. The access is usually created in the nondominant arm; for a right-handed person this would be the left arm.

After the access is placed, it is important to monitor and care for it over time. (See 'Caring for the access' below.)

Primary arteriovenous fistula — A primary AV fistula is the preferred type of vascular access for many patients. It requires a surgical procedure that creates a direct connection between an artery and a vein (figure 1). This is often done in the lower portion of the nondominant arm but can be done in the upper arm as well. Sometimes, a vein that would not normally be useful for creating an AV fistula can be moved so that it is more accessible; this is often done in the upper arm.

Regardless of its location or how it is created, the access is located under the skin. During dialysis, two needles are inserted into the access. Blood flows out of the body through one needle, circulates through the dialysis machine, and flows back into the access through the other needle.

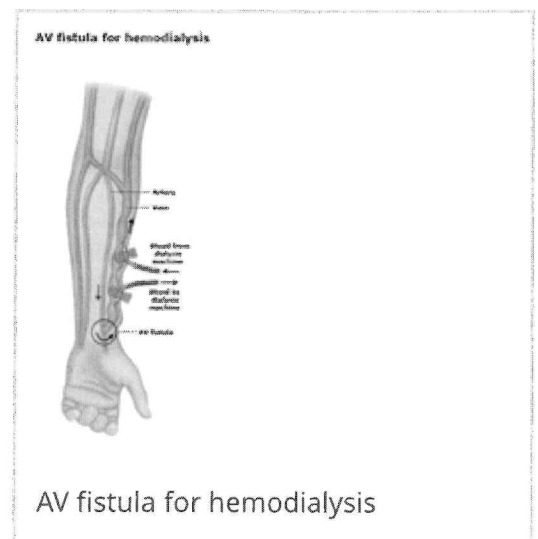


Figure 1 - larger image below

A primary AV fistula is usually created two to four months before it will be used for dialysis. During this time, the area can heal and fully develop or "mature."

Synthetic bridge graft — Sometimes, a patient's arm veins are not suitable for creating a fistula. In these cases, a flexible, rubber-like tube can be used to create a path between an artery and vein (figure 2). This is called a synthetic bridge graft. The graft sits under the skin and is used in much the same way as the fistula, except that the needles used for hemodialysis are placed into the graft material rather than the patient's own vein.

Grafts heal more quickly than fistulas and can often be used approximately two to three weeks after they are created. However, complications such as narrowing of the blood vessels and infection are more common with grafts than with AV fistulas.

Central venous catheter — A central venous catheter uses a thin, flexible tube that is placed into a large vein (usually in the neck) (figure 3). It may be recommended if dialysis must be started immediately and the patient does not have a functioning AV fistula or graft. A central venous catheter can be placed as a temporary access while a fistula or graft is maturing, but it can also be used as a long-term access for some patients.

Catheters have the highest risk of infection and often do not work as well as other access types.

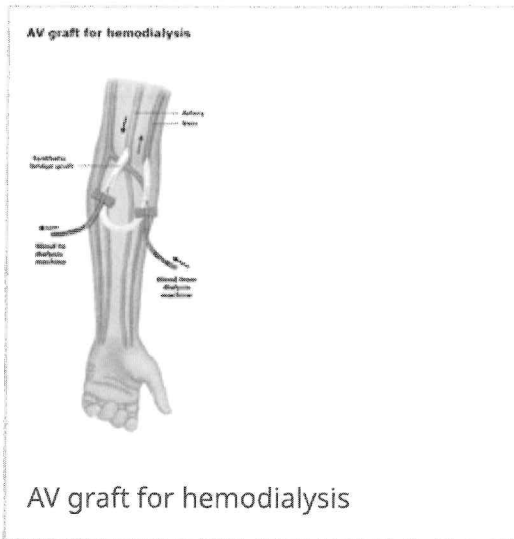


Figure 2 - larger image below

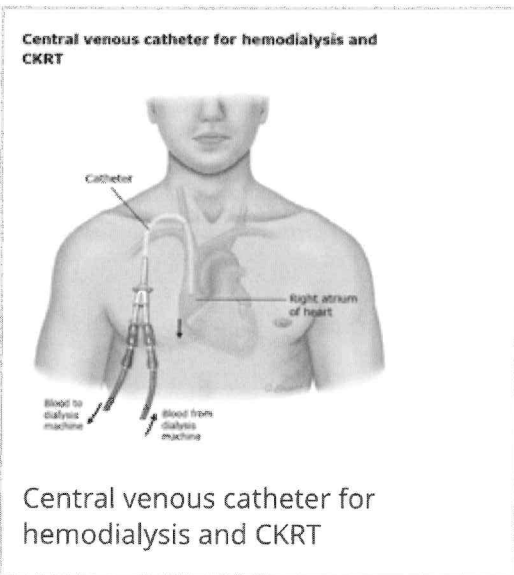


Figure 3 - larger image below

Dietary changes — Some patients, especially those who receive hemodialysis in a center, will need to make changes in their diet before and during hemodialysis treatment. These changes ensure that you do not become overloaded with fluid and that you consume the right balance of protein, calories, vitamins, and minerals.

A diet that is low in sodium, potassium, and phosphorus may be recommended, and the amount of fluids (in drinks and foods) may be limited. A dietitian can help you to choose foods that are

compatible with hemodialysis treatment. (See "Patient education: Low-sodium diet (Beyond the Basics)" and "Patient education: Low-potassium diet (Beyond the Basics)".)

LOCATION OF HEMODIALYSIS TREATMENT

Hemodialysis can be done at a dialysis center or at home.

Home treatment — Home treatment requires that you and your family have training and ongoing support from health care providers who are experienced in treating patients with home hemodialysis. This usually includes a nephrologist (kidney specialist) and specially trained nurses.

Patients treated with home hemodialysis can often lead more independent lives and may have better life expectancy compared with those treated in a dialysis center. This is due, in part, to home hemodialysis patients often having more frequent or longer dialysis treatments than those treated in a dialysis center.

Home hemodialysis can be done during the day or at night:

- When done during the daytime, it typically involves treatments on four to seven days each week.
- When done at night (called nocturnal hemodialysis), it typically involves three to seven treatments each week, which are done while you are sleeping. Additional time is needed to prepare and clean up.

Home dialysis can be done at a time that is convenient for you. You are typically encouraged to have someone else (a family member, friend, or technician) available to assist you before, during, and after dialysis, but this is not absolutely necessary. A health care provider must be available by telephone in case questions or problems arise; some machines allow you to be monitored remotely via the telephone or internet.

A daily (or nightly) dialysis schedule provides substantial benefits compared with in-center, three times weekly hemodialysis. More frequent dialysis results in a significant improvement in your well-being, reduces symptoms during and between dialyses, and improves quality of life. Home hemodialysis can improve your quality of life because it allows you to assume more responsibility for your own care and allows you to remain in the comfort of your home during treatment. In addition, patients who use home hemodialysis are often able to continue working.

Equipment — Home hemodialysis requires that you have a dialysis machine in your home. Depending upon the machine, additional supplies may be needed, including water treatment tanks, dialyzers, dialysate (a solution used to clean your blood), bleach and disinfectant, syringes, needles, medications, blood tubes, and water test kits. Some machines require electrical and plumbing modifications in the area of the home where dialysis will be done.

Newer home hemodialysis systems are portable and can be used while traveling, although many patients who use home hemodialysis and wish to travel make arrangements for in-center dialysis at the location where they will be traveling. (See 'Travel options' below.)

Dialysis center treatment — Dialysis may be done in a hospital, a clinic associated with a hospital, or a freestanding clinic. Centers are staffed with nurses and patient-care technicians, all of whom participate in your care along with a nephrologist and often an advanced practice provider. In general, in-center hemodialysis takes between three and five hours (the average is three-and-a-half to four hours) and is done three times a week. You will be able to read or sleep during treatment, and you may have access to a television. Eating, drinking, and visitors are often restricted in a dialysis center.

Hemodialysis can also be done at night (called nocturnal hemodialysis) in a dialysis center, typically three times weekly while you are sleeping in the center. Nocturnal hemodialysis may provide substantial benefits compared with conventional in-center, three times weekly hemodialysis treatments that are three to four hours in duration. The longer nocturnal dialysis treatments can result in a significant improvement in your well-being, reduce symptoms during and between dialyses, and improve quality of life.

Travel options — Dialysis centers are located throughout the United States and in many locations around the world. Patients who require dialysis but wish to travel can make an appointment at a dialysis center in the location where they will be traveling (called a transient center). Many dialysis centers have a staff member, either a nurse or social worker, who can help arrange the appointment; planning should begin six to eight weeks in advance to ensure that space is available.

The dialysis center where you normally have dialysis treatments will need to provide information to the transient center about your medical history, including recent test results and treatment records, a list of medications, insurance information, and any special requirements.

Patients with chronic medical problems, including those who require dialysis, should plan carefully for travel away from home. This may include carrying extra medications and written prescriptions, a medical identification device, and a list of health care provider contact information. (See "Patient education: General travel advice (Beyond the Basics)".)

HEMODIALYSIS MONITORING

Blood testing — Patients who use hemodialysis, either at home or in center, will be monitored with blood tests to ensure that the time and type of dialysis treatments (called dialysis prescription) are optimal. Studies have shown that the correct dialysis prescription improves health, prevents complications, and prolongs survival. Blood testing is done at least once per month, and adjustments to the dialysis prescription may be made based upon the results of testing.

Body weight monitoring — Because kidneys that are failing cannot remove enough fluid from the body, dialysis must perform this task. Accumulation of fluid between hemodialysis treatments can lead to complications. Most patients will be weighed before and after dialysis and will be asked to monitor their weight on a daily basis at home. If your weight increases more than usual between treatments, contact your health care provider.

Caring for the access — It is important to take care of your access to prevent complications. Complications can occur even if you are careful but are much less common if you take a few precautions:

- Wash the access with soap and warm water each day and always before dialysis. Do not scratch the area or try to remove scabs.
- Check the area daily for signs of infection, including warmth and redness.
- Check that there is blood flow in the access daily. There should be a vibration (called a thrill) over the access. If this is absent or changes, notify your health care provider. Sometimes, flow monitoring is done during the dialysis treatment using ultrasound (sound waves). The flow monitoring measures the speed of blood flow during dialysis treatment.
- Take care to avoid traumatizing the arm where the access is located; do not wear tight clothes or jewelry, carry heavy items, or sleep on the arm. Do not allow anyone to take blood or measure blood pressure on this arm.
- Rotate needle sites on the access. Use gentle pressure to stop bleeding when the needle is removed. If bleeding occurs later, apply gentle pressure; call a health care provider if bleeding does not stop within 30 minutes or if bleeding is excessive.

SIDE EFFECTS

Most patients tolerate hemodialysis well. However, side effects of hemodialysis can occur. Low blood pressure is the most common complication and can be accompanied by lightheadedness, shortness of breath, abdominal cramps, muscle cramps, nausea, or vomiting. Some patients feel fatigued or "washed out" for some period of time after a hemodialysis session.

Treatments and preventive measures are available for the discomforts that can occur during dialysis. Many of these side effects are related to excess salt and fluid accumulation between dialysis treatments, which can be minimized by carefully monitoring how much salt and fluid you consume.

WHERE TO GET MORE INFORMATION

Your health care provider is the best source of information for questions and concerns related to your medical problem.

This article will be updated as needed on our website (www.uptodate.com/patients). Related topics for patients, as well as selected articles written for health care professionals, are also available. Some of the most relevant are listed below.

Patient level information — UpToDate offers two types of patient education materials.

The Basics — The Basics patient education pieces answer the four or five key questions a patient might have about a given condition. These articles are best for patients who want a general overview and who prefer short, easy-to-read materials.

Patient education: Hemodialysis (The Basics)

Patient education: Chronic kidney disease (The Basics)

Patient education: Polycystic kidney disease (The Basics)

Patient education: Preparing for hemodialysis (The Basics)

Patient education: Choosing between dialysis and kidney transplant (The Basics)

Patient education: Acute kidney injury (The Basics)

Patient education: Dialysis and diet (The Basics)

Patient education: Kidney transplant (The Basics)

Patient education: Planning for a kidney transplant (The Basics)

Patient education: Glomerular disease (The Basics)

Patient education: Hemodialysis catheter placement (The Basics)

Patient education: How to care for a hemodialysis catheter (The Basics)

Patient education: Arteriovenous vascular access for hemodialysis (The Basics)

Patient education: End-stage kidney disease (kidney failure) (The Basics)

Patient education: 24-hour urine collection (The Basics)

Beyond the Basics — Beyond the Basics patient education pieces are longer, more sophisticated, and more detailed. These articles are best for patients who want in-depth information and are comfortable with some medical jargon.

Patient education: Dialysis or kidney transplantation — which is right for me? (Beyond the Basics)

Patient education: Chronic kidney disease (Beyond the Basics)

Patient education: Peritoneal dialysis (Beyond the Basics)

Patient education: Low-sodium diet (Beyond the Basics)

Patient education: Low-potassium diet (Beyond the Basics)

Patient education: General travel advice (Beyond the Basics)

Professional level information — Professional level articles are designed to keep doctors and other health professionals up-to-date on the latest medical findings. These articles are thorough, long, and complex, and they contain multiple references to the research on which they are based. Professional level articles are best for people who are comfortable with a lot of medical terminology and who want to read the same materials their doctors are reading.

Acute hemodialysis prescription

Assessment of nutritional status in patients on hemodialysis

Cancer screening in patients on maintenance dialysis

Choosing modality of chronic kidney replacement therapy (KRT)

Indications for initiation of dialysis in chronic kidney disease

Prescribing and assessing adequate hemodialysis

Clinical monitoring and surveillance of the mature hemodialysis arteriovenous fistula

Clinical monitoring and surveillance of hemodialysis arteriovenous grafts to prevent thrombosis

Overview of the hemodialysis apparatus

Hemodialysis arteriovenous graft dysfunction and failure

Patient survival and maintenance dialysis

Reactions to the hemodialysis membrane

Reuse of dialyzers

Overview of hemodialysis arteriovenous graft maintenance and thrombosis prevention

Residual kidney function in kidney failure

Approach to the adult patient needing vascular access for chronic hemodialysis

The following organizations also provide reliable health information.

- National Library of Medicine
(www.nlm.nih.gov/medlineplus/healthtopics.html)
- National Institute of Diabetes and Digestive and Kidney Diseases
(www.niddk.nih.gov)
- National Kidney Foundation
(800) 922-9010
(www.kidney.org)
- Home Dialysis Central
(www.homedialysiscentral.org)
- Kidney School
(www.kidneyschool.org)
- United Network for Organ Sharing (UNOS)
(888) 894-6361
(www.unos.org)

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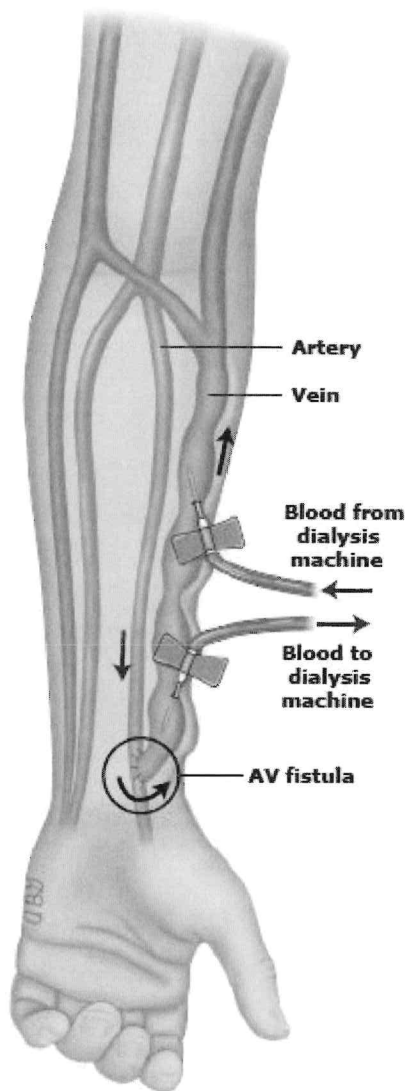
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Topic 4414 Version 29.0

GRAPHICS

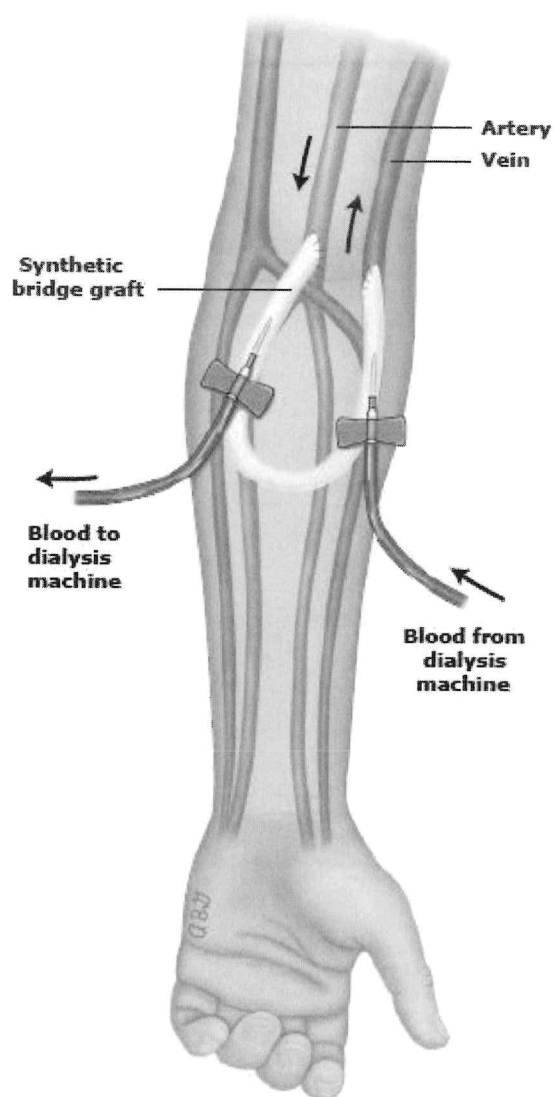
Figure 1: AV fistula for hemodialysis



This drawing shows an AV fistula in a person's arm. An AV fistula is under the skin. A doctor makes an AV fistula by doing surgery to connect an artery directly to a vein. It is usually done in the lower arm, but can be done in the upper arm. During hemodialysis, 2 needles are put into the access to remove and return blood to the body.

AV: arteriovenous (this means involving an artery and a vein).

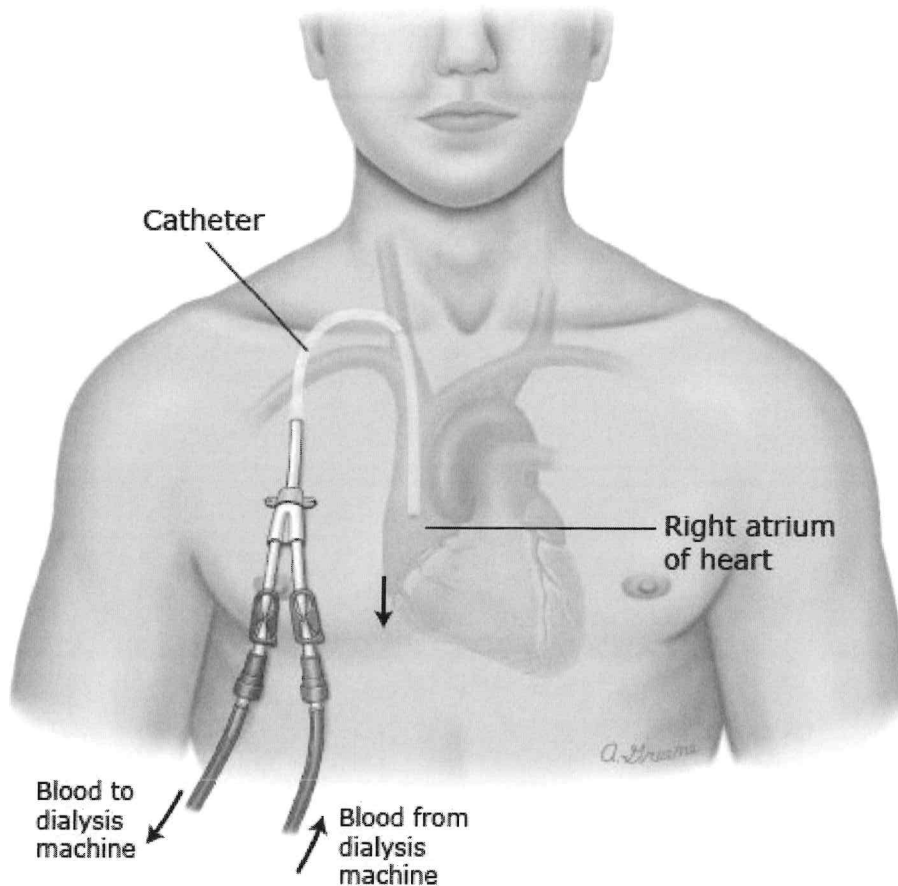
Figure 2: AV graft for hemodialysis



This drawing shows an AV graft in a person's arm. A graft is under the skin. A doctor makes a graft by doing surgery. They use a flexible rubber tube to connect an artery to a vein. During hemodialysis, 2 needles are put into the graft to remove and return blood to the body.

AV: arteriovenous (this means involving an artery and a vein).

Figure 3: Central venous catheter for hemodialysis and CKRT



This drawing shows a central venous catheter, which is a thin, flexible tube. It is put inside the body before a person has certain types of dialysis, such as hemodialysis and continuous kidney replacement therapy ("CKRT").

One end of the catheter is put into a large vein, usually in the neck. The other end stays outside the body. During dialysis, the end outside the body is connected to tubes from the dialysis machine.