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Dialysis Access Types: A Guide for Patients and Caregivers

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Introduction

A diagnosis of end-stage renal disease (ESRD) can be scary. It indicates that your kidneys can no longer adequately remove excess fluid and toxins from your body. You will have many questions and may not be sure where to turn for answers.

ESRD is when you will need to start dialysis if you're not able to receive a kidney transplant. Your body will require an alternative method to remove excess fluid and toxins from your body - and dialysis is that life sustaining treatment. But how exactly is dialysis performed? First, you will need an ***'access'***.

Choosing the right access ***for you*** begins with taking into consideration your personal preferences on how and where you would like to receive dialysis.
By playing an active role in your dialysis journey, you gain the upper hand on fear and begin to take the best steps toward your future health.

Feeling Your Best Starts with Choosing the Best Access for You and Timing it Right

The rate of decline in a person's kidney function can vary by patient and circumstances. Some patients see a long, slow deterioration in their kidney function and know that eventually they will require dialysis. For now, time is on their side and they can choose an access that may require time to develop properly. Other patients, however, suffer an acute, quick decline in their kidney function and the organs fail without warning. We refer to this type of patient as one who 'crashed' into dialysis, meaning they did not see the kidney failure coming and require immediate medical intervention to begin dialysis.

There are two types of dialysis: hemodialysis and peritoneal dialysis. Hemodialysis is a treatment for kidney failure that uses a machine to send your blood through a dialyzer (artificial kidney) to remove excess waste and fluid from the body. Once the blood is cleansed of toxins, it is returned to the body. Peritoneal dialysis is a treatment that uses the lining of your abdomen and a dialysate solution to absorb waste and excess fluid from your body. Regardless of which dialysis method your nephrologist suggests, you will need an access created before starting dialysis.

As you begin to build an understanding of the four dialysis access options available, remember too, that your particular dialysis access can change over time due to unforeseen complications. Be patient. Be informed. Finding the best dialysis access for you will eventually be accomplished.

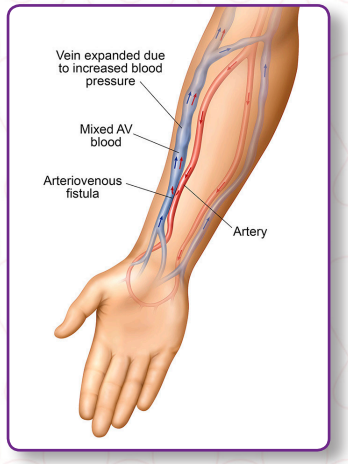
Hemodialysis Access Types

As you follow along on this decision-making process to determine the "best access" for you, keep in mind that some accesses may be used immediately while others require time to mature. Every patient in need of a dialysis access should be evaluated on a case-by-case basis because not every access type will be suitable in your situation. That is why you should thoroughly weigh all your options with your healthcare provider, sooner rather than later.

Let's review the 3 hemodialysis access types and the pros and cons for each:

- **ARTERIOVENOUS FISTULA (AVF)**
- **ARTERIOVENOUS GRAFT (AVG)**
- **CENTRAL VENOUS CATHETER (CVC)**

ARTERIOVENOUS (AV) FISTULA



The arteriovenous venous fistula (AVF) is considered by many healthcare professionals to be the access of choice for hemodialysis patients. There is an ongoing initiative to encourage all hemodialysis patients and physicians to consider "fistula first" because, as it's created using your native vein, this access is the least prone to infection and provides the best outcomes. Once someone's glomerular filtration rate (GFR – the rate at which your kidneys are capable of removing fluid and waste products from your blood) drops to below 20, the likelihood of dialysis is forthcoming. Ideally, fistula creation should occur far enough in advance of the anticipated start of hemodialysis. This will allow time for adequate development of the fistula. If you need to start dialysis immediately, you might need a catheter temporarily while you wait for your fistula to be created and mature.

An AV fistula is created by making a surgical connection between an artery (high flow, high pressure vessel) and a vein (low flow, low pressure vessel). The increased flow from the artery into the venous portion of the fistula causes the vein to enlarge which makes it easier to place dialysis needles. This type of access is created during a minor surgical procedure and takes time to mature for use - approximately 6 weeks to 4 months on average. Once fully ready for dialysis treatment, two needles will be placed in the fistula. Needle placement is referred to as cannulation. Once the fistula is cannulated, blood flows through the tubing into the dialyzer (the artificial kidney), and then back to the body.

Placement Process

Ultrasound vessel mapping should be performed prior to having an AV access (AVF or AVG) created. Vessel mapping is a test performed by your interventionalist or vascular surgeon to identify and evaluate the size and depth of arteries and veins to determine if they can be used for the creation of an arteriovenous access.[i]

For fistula access creation, a form of sedation/analgesia will be provided, and then an incision will be made in your arm to access your blood vessels. The vein will be accessed and isolated in preparation of joining it to the artery. Arteries lie deeper under the skin than veins, so the vein is accessed first. A small incision will be made in both vessels and then they will be stitched together.

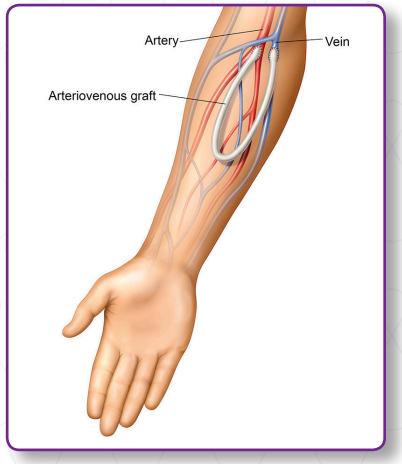
This internal connection can be created at the wrist or in the upper arm. Generally, the first attempt at fistula creation will be in the forearm of your non-dominant arm. This is to preserve the potential for an upper arm fistula if the initial fistula fails. Eventually, as your fistula matures, the vein that was joined to the artery will receive a greater volume of the blood flowing through it causing it to grow in diameter. Some patients may be surprised at how large the vein grows after it has had some time to mature. This is a good sign! It indicates that your veins were strong enough to create this vital vein/artery connection.

PROS	• **Fistulas are the preferred access for long term dialysis because they last longer.** • **Less prone to infections and clotting.** • **Provide better blood flow and can be relied upon for predictable performance.**
CONS	• **An older patient may have weak, fragile or small veins which are not suitable for use.** • **Patients with vascular disease or pacemakers may not be good candidates.** • **Once the fistula matures and grows, it may be visible under the skin.**

New technology - Percutaneous Fistula Creation

Exciting new advances in AV fistula creation continue. Minimally invasive alternatives to surgical fistula creation are now available. Vascular specialists are now being trained to create fistulas using image-guided minimally invasive techniques. This percutaneous/endovascular approach creates fistulas with minimal trauma to the vessel because it's done via needle punctures through the skin (i.e. percutaneously) rather than using an open surgical approach. The percutaneous method to create a fistula involves using a device whereby thermal or magnetic energy is emitted to create the connection between an upper forearm artery and an adjacent vein rather than stitching them together. Initial experiences with these types of devices have resulted in favorable outcomes.

ARTERIOVENOUS (AV) GRAFT



An AV graft is considered the second-best access option for hemodialysis. In 2016, 15% of people receiving hemodialysis at the end of their first year of dialysis had an AV graft.

This access is a soft, biocompatible plastic tube implanted under the skin to connect an artery and a vein. AV grafts have some drawbacks because they are more prone to infections and clotting than an AV fistula. The AV graft is typically used in patients with smaller or inadequate veins. In most cases, AV grafts will be ready for hemodialysis use quicker than a fistula. In the recent past, the use of early cannulation AV grafts has shown a reduced rate of infection as compared to a CVC, as well as a lower mortality in patients requiring urgent access for hemodialysis. In some cases, early cannulation grafts can be used as early as one to three days post placement.

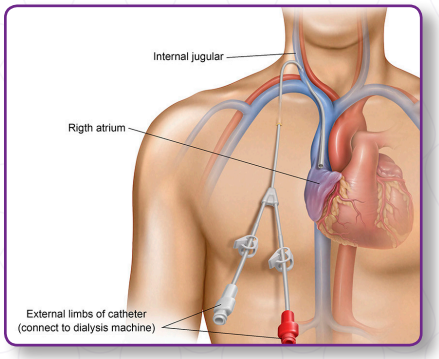
Placement Process

Just like an AV fistula, an AV graft is created surgically. But instead of connecting an artery directly to a vein, your vascular specialist will connect one end of the graft to one of your veins and the other end to one of your arteries, forming a connection between the two.

If you and your doctor decide an AV graft is your best option, the first step should be vessel mapping.

PROS	• **The AV graft is usually ready for dialysis access in about 3-4 weeks after being placed, and from 1-3 days if an early cannulation graft is placed.** • **The AV graft has a lower infection rate than a central venous catheter (CVC).** • **Once the incision site heals, you can resume showering.** • **The graft location is generally in your arm, but a vascular specialist will also consider placement in your chest or leg, if necessary.**
CONS	• **Just like the fistula, needles are required to access the graft for dialysis and over time if the needles are always placed in the same location of the graft significant holes can occur leaving the patient potentially prone to the formation of aneurysms and blood loss.** • **Grafts are more prone to clotting than fistulas.** • **Narrowing of the vein, also referred to as stenosis, is common at the site where the graft connects to your native vessels. This can, in turn, result in lower volume of blood flow to the dialysis system.**

CENTRAL VENOUS CATHETER (CVC)



A central venous catheter (CVC) is intended for short term, immediate use. The United States Renal Data System's 2018 report stated that 80% of ESRD patients who were faced with sudden and unpredicted kidney failure began dialysis with a central venous catheter.

A CVC is a long Y shaped, plastic tube that is inserted through one of the central veins in your neck or groin. The tip of the catheter rests in your heart. The two ends of the Y remain external through your skin. This access type is considered a temporary solution to dialysis access and people with it are often urged by their healthcare provider to pursue an alternative access as soon as possible.

For a patient who suddenly experiences renal failure or 'crashes' into dialysis, the CVC is the first step a vascular specialist may take to begin treating your kidney failure until a more permanent access can be established. A CVC is not recommended for most people as a permanent dialysis access due to the significant catheter-related complications that can arise—such as clotting and infection. However, for those needing immediate access, a CVC may be the best option – even if it's a temporary solution. While a central venous catheter access may be necessary initially, studies have shown that mortality is reduced when a dialysis patient converts from a CVC to an AV fistula or an AV graft within the first year of dialysis. Moreover, patients who receive dialysis via a CVC spend 35 more days in a hospital annually compared to only 7.7 days annually for patients with a fistula.[ii]

Placement Process

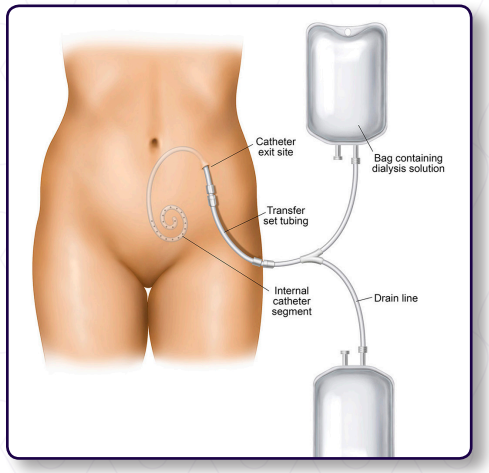
A CVC can be inserted in an outpatient setting. Central venous catheter placement begins with your vascular specialist administering a local anesthetic to numb the selected area for catheter insertion. Ultrasound may be used for guidance to determine the exact site on your body where the catheter will be placed. Fluoroscopy, a type of x-ray, may be used to further guide the catheter through the skin, and into your central vein. The catheter is advanced into one of your central veins until the tip of the CVC reaches the right atrium (upper chamber) inside your heart. There are small cuffs on the catheter that lay just under the skin that aid in keeping the catheter properly placed and minimize the risk of infection.

After the CVC is placed, there may be some pain and swelling around the insertion site. If you need dialysis treatment immediately, your CVC is ready for use. If you do not have to start dialysis immediately and have had the catheter placed in an outpatient setting, you will be able to go home at the end of the procedure.

PROS	• **Dialysis can be performed immediately.** • **Catheters can be inserted during an outpatient procedure.** • **This method for dialysis access avoids needle sticks like those associated with the AV fistula and AV graft methods.**
CONS	• **Not ideal for use as a permanent access.** • **Swimming and bathing are not recommended.** • **Highest rate of infection compared to all other all dialysis access options.** • **It can be difficult to obtain suitable blood flow during dialysis for adequate toxin removal.** • **May cause narrowed veins and thus limit future access site use.**

Patients who dialyze with CVC are 7 times more likely to acquire a vascular access related bloodstream infection compared to those using a fistula. [iii]

PERITONEAL DIALYSIS (PD)



Peritoneal dialysis is a treatment that uses the lining of your abdomen and a dialysate solution to absorb waste and excess fluid from your body as opposed to hemodialysis which directly accesses your blood circulatory system for dialysis.

Peritoneal dialysis is a type of dialysis for those who prefer to undergo dialysis treatment at home. PD uses the peritoneal membrane - the inside lining of your abdomen - and a dialysate solution to remove the waste and excess fluid from your body. With this dialysis method, needles are not used.

Peritoneal Catheter

PD is performed by instilling a sterile dialysate solution into the peritoneal cavity. When performing PD, you will instill the dialysate through your PD catheter and let it remain in your abdomen for a prescribed length of time. This is called 'dwell time.' When the dwell time is over, you will drain the used dialysate from your abdomen through the PD catheter and refill your abdomen with fresh dialysate. This process of filling, dwelling and draining your abdomen is called an 'exchange.' Each fill takes approximately 30 to 40 minutes. The dwell time, typically 4 hours, is prescribed by your nephrologist. Depending on the type of PD you choose, you may do these exchanges manually or with the help of a machine.

Placement Process

Catheter placement is a quick procedure that typically takes 15-30 minutes to complete. You may be asked to fast the night before your procedure. The day of, you will be given a local anesthetic and a sedative if necessary. The vascular specialist will insert a soft, flexible plastic tube into the abdomen using a needle and guidewire and direct the tube into place and secure it to the muscle wall. X-ray imaging technology called fluoroscopy allows the practitioner to see inside your body for the procedure. Most of the catheter and the two cuffs remain under the skin while the tip is advanced through the peritoneal membrane into the peritoneal space. The cuffs help to keep the catheter from shifting and act as a barrier to any infectious organisms.

PROS	• **PD catheter placement is a minimally invasive procedure that can be performed in an outpatient setting and does not require general anesthesia.** • **Peritoneal dialysis can be performed in the comfort of your home.** • **Needles are not required for dialysis like used for hemodialysis.** • **The catheter is ready for use in about two to four weeks after placement.** • **PD catheter placement may be an option for patients wishing to avoid the hemodialysis central venous catheter access type.**
CONS	• **For as long as you have a PD catheter, you will not be able to take a bath or go swimming.** • **More than 84 percent of PD catheter complications are caused by an infection.[iv]** • **Potential serious infections such as peritonitis (an infection of the lining of the abdomen), and at the external catheter site can occur.** • **Not everyone is a good candidate for a PD catheter. You may not be able to receive PD if you have:** - **abdominal hernia** - **inflammatory bowel disease** - **recurring diverticulitis** - **large surgical scars on your belly**

Inpatient vs Outpatient

Inpatient care, or medical care administered in a hospital setting, often requires an overnight stay or longer and presents many disadvantages to patients including lengthy patient wait times, higher costs for procedures and no guarantee that you will be cared for by a physician of your choosing. In today's ever evolving healthcare marketplace, patients now have alternatives. Those in need of dialysis accesses maintenance procedures can have them performed at an ambulatory surgery center, (ASC). These outpatient facilities allow patients to have their access management procedures performed in a comfortable, personalized setting. A vascular center's medical team can also ensure ease of appointment scheduling for follow up and access to educational materials to keep the patient informed about how to care for their access for long term use.

Make Access Management a Priority

Management and care of your dialysis access should be your highest priority. A fully functioning vascular access ensures that dialysis procedures occur on a timely and efficient basis. Difficulties can and do occur in dialysis access ranging from stenosis, the development of an aneurysm, to thrombosis or clotting that can lead to less than ideal blood flow during dialysis. Azura Vascular Care is a nationwide network of outpatient ambulatory surgical and vascular care centers that specialize in providing solutions to access difficulties quickly and professionally by a team recognized for its excellence in patient outcomes.

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Glossary

A

Anastomosis: The site where an artery and vein are connected. In an arteriovenous fistula (AVF), the point where the vein and artery are connected. In arteriovenous graft (AVG), the location where the graft is connected to the patient's vein and artery via a biocompatible tube. AVF has one anastomosis, AVG has two.

Aneurysm: A ballooning of a blood vessel, usually an artery; the result of plaque weakening the wall of an artery, then blood pressure causing the artery to balloon out and the artery wall to become dangerously thin.[v]

Angioplasty: A procedure to widen the vessel narrowed by stenosis or occlusions by passing a balloon-tipped catheter through an artery and then inflating to compress plaque against the artery wall.

Arteriogram: An X-ray image of the arteries taken by using a catheter to inject contrast dye into the vessels to visualize the flow of blood and vascular disease.

Arteriovenous (AV): Relating to an artery and a vein.

Artery: Blood vessels that carry blood away from the heart.

AV Fistula (AVF): A surgically created vascular access where a vein and an artery are connected to each other creating a conduit for blood to flow from an artery directly into a vein. Ideally, AV fistula creation is done several months before hemodialysis is needed, because it requires time to develop, or mature.

AV Graft (AVG): A surgically created vascular access using a synthetic material to connect an artery to a vein. AV graft placement is usually done a few weeks prior to use and takes several days to several weeks before it is usable for hemodialysis.

B

Bruit: A buzzing or swooshing sound caused by the high-pressure flow of blood through the patient's AV fistula or AV graft.

C

Central Venous Catheter (CVC): A soft, flexible tube that is inserted into a large vein in the neck, chest, or leg to provide vascular access for hemodialysis.

Chronic kidney disease (CKD): Progressive loss of kidney function over a period of months or years.

D

Dialysis: The process of removing wastes and excess fluid from the blood artificially as a substitute for the normal function of the kidneys.

E

End-stage renal disease (ESRD): The progression of chronic kidney disease to the point where dialysis or transplantation is necessary to sustain life.

Glossary (cont'd)

F

Fistulogram: A special x-ray that uses contrast dye to examine the blood flow in a fistula or graft (dialysis access). Performed by injecting dye through a catheter to check to see if it is blocked or if there is narrowing (stenosis).

G

Graft: In hemodialysis, a biocompatible synthetic tube that is inserted into your arm to connect an artery to a vein.

H

Hemodialysis: The process of artificially removing wastes and excess fluids from the blood via machine (dialyzer) after kidneys have failed.

Hematoma: Excessive bleeding between the access and surrounding tissue—a bruise.

Heparin: Medication used to prevent blood from clotting while outside of the body.

Hyperplasia: Faster growth of tissue than normal.

Hypertension: High blood pressure.

Hypotension: Low blood pressure.

K

Kidney: One of two bean-shaped organs that filter wastes from the blood.

Kidney failure: Loss of kidney function.

O

Occlusion: Blockage. May occur in fistulas or grafts.

P

Percutaneous: A medical procedure or method where access to inner organs or other tissue is done via needle-puncture of the skin, rather than by using an "open" approach where inner organs or tissue are exposed (typically with the use of a scalpel).[vi]

Peritoneal Membrane: A membrane that lines the cavity of the abdomen and consists of an outer layer closely adhering to the walls of the abdomen and an inner layer that folds towards the internal organs.

Peritoneal Dialysis: A dialysis option for patients with chronic kidney disease. PD occurs inside the body using the semipermeable peritoneal membrane as a filter.[vii]

Pseudoaneurysm: Akin to an aneurysm but doesn't involve the entire thickness of the vessel wall. Often occurs from repeated needle sticking of one site.

Glossary (cont'd)

R

Recirculation: Already dialyzed blood returning to the patient through the venous needle mixes with un-dialyzed blood entering the arterial needle.

S

Shunt: The original permanent vascular access for hemodialysis patients, external plastic tubes which were connected to an artery and to a nearby vein; this was called a Scribner Shunt. The tubes extend outside of the body, and when not in use are connected together, externally. This type of access is rarely used in dialysis treatment today due to a high rate of infection and bleeding. Many people continue to refer to arteriovenous grafts and fistulas as "shunts" since blood is shunted through these passageways.

Steal Syndrome: A condition that occurs when the AVF or AVG "steals" blood flow from the lower part of the limb where it is located; the reduced blood flow causes the hand or foot to feel unusually cold.

Stenosis: An abnormal narrowing of a blood vessel.

Stent: A mesh-like device that is placed in a narrowed area of a blood vessel to hold it open.

T

Thrill: The buzz caused by the passage of blood from the high-pressure arterial system to the low-resistance venous system. Can be palpated (felt) with the fingers.

Thrombectomy: The removal of a clot from a graft or fistula.

Thrombosis: The formation of a blood clot in a blood vessel.

V

Vascular access: In hemodialysis, a natural or artificial blood vessel used to transfer blood from the body to the dialyzer and back again.[vii]

Vein: A blood vessel that carries blood toward the heart.

Vessel Mapping: A procedure used to evaluate the size and depth of the arteries and veins to determine if they can be used for the creation of an arteriovenous dialysis access.

About Azura Vascular Care

Azura Vascular Care, a division of Fresenius Medical Care North America, is a national leader in the field of vascular specialty services. Operating and managing outpatient vascular care and ambulatory surgery centers in 25 states and Puerto Rico, Azura's physicians and trained medical specialists perform minimally invasive procedures to treat and manage a wide variety of vascular conditions, including dialysis access management, peripheral artery disease, uterine fibroids, varicoceles, varicose veins and more.

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