Vascular access handbook for people with kidney disease

(Shortened edition)

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DEDICATION

In loving memory of **María Teresa González Álvarez MD** (1948-2020), whose commitment and dedication contributed greatly to the birth of GEMAV as a society as well as to the development of this handbook.

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PREFACE

The Spanish Multidisciplinary Vascular Access Group (GEMAV) is a transversal scientific society involving all professionals whose degree and professional dedication is performed in areas of health sciences related to vascular access for hemodialysis. The proof of the multidisciplinary profile of GEMAV is the current composition of its board with representation of nephrology, vascular surgery, interventional radiology and nephrological nursing.

The main objective of GEMAV is to promote and to inform about the adequate management of the vascular access for hemodialysis to optimize the care of the person with kidney disease. To the GEMAV board it is very clear that the attention shouldn't focus on *the vascular access in itself* but on *the person with kidney disease who has a vascular access*. In this regard, there is a specific person in charge in the GEMAV board with the heading of "Member responsible for institutional relationships with others cientific societies and with associations of people with kidney disease".

The GEMAV was born in October 2014, initially only as a working group, to elaborate the "Spanish Clinical Guidelines on Vascular Access for Hemodialysis" which was published in 2017.

The unprecedented success of these Guidelines encouraged the GEMAV to move forward and, as a result, it became a scientific society in 2019.The original idea of adapting the most important aspects of the Spanish Clinical Guidelines to the reality of people with kidney disease in the form of a handbook came from Mr. Antonio Tombas, president of the Association of Renal Patients of Catalonia (ADER) along with Mr. Daniel Gallego, president of the National Federation of Associations for the Fight Against Kidney Diseases (ALCER), who immediately joined this Project. On behalf of GEMAV, we must thank them both for the unconditional support to get this VASCULAR ACCESS HANDBOOK FOR PEOPLE WITH KIDNEY DISEASE accomplished. Of course, we are also very grateful to the Iñigo Alvarez de Toledo Renal Foundation (FRIAT) for having been in charge of the design and development of the digital format of this handbook, both the entire and the shortened version. Finally, but it is without a doubt the most important thing, we would like to thank the GEMAV professionals for their efforts to the contribution of the content of the handbook since, without them, it would have never come into being.

We have tried to develop a really useful and practical handbook for people with kidney disease. It is about transmitting information in a simple and clear way to these people so that they can resolve any doubts they may have regarding vascular access for hemodialysis. For this reason, a minimum of textwritten in colloquial language has been included, we avoided technical words whenever It was possible and we also included a profusion of unpublished illustrations (as someone said: “an image is worth a thousand words”). Regarding the handbook structure, it consists of 6 Sections and, at the end of each Section, the “most frequent questions asked by the person with kidney disease regarding the vascular access” have been added (in total, 77 FAQs), 9 highly illustrative short videos linked to the text and a glossary with 61 items. This shortened version tries to summarize the most important aspects of the handbook.

This Handbook, performed by GEMAV with the invaluable collaboration of ADER and ALCER, aims to help people with kidney diseases so that they can find the answers to some aspects of vascular access for hemodialysis once and for all. We hope we have achieved it.

The vascular access for hemodialysis

To carry out this haemodialysis treatment, you need to have what is called a "vascular access for hemodialysis".

This vascular access allows the blood to be forced out of the body into the hemodialysis machine and return unhindered to the body.

There are three types of vascular access:

- Native arteriovenous fistula
- Prosthetic arteriovenous fistula (arteriovenous graft)
- Central venous catheter

Without none of these vascular access types, you CANNOT have hemodialysis treatment.



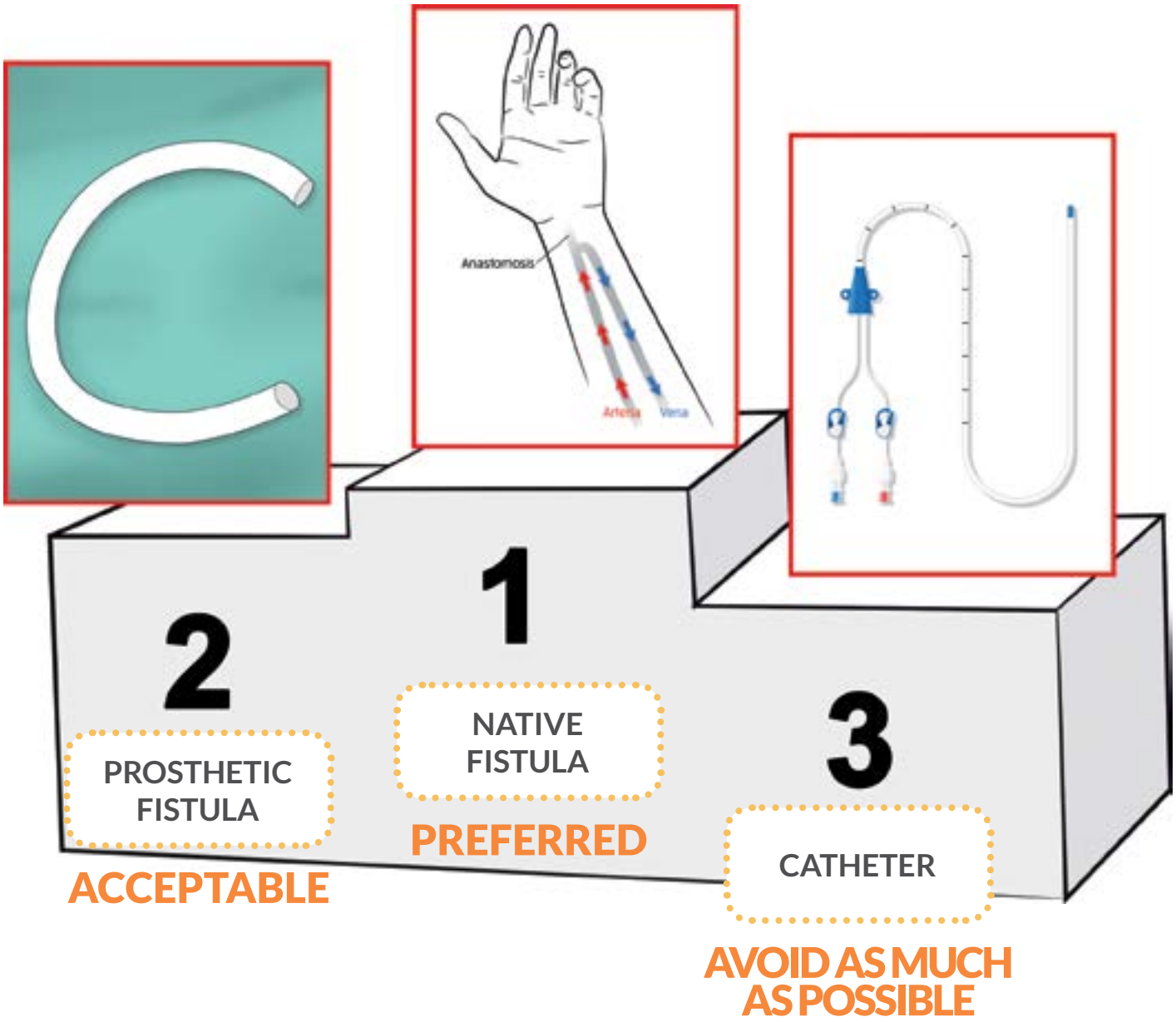
HEMODIALYSIS MACHINE + **Lack of vascular access** = NO HEMODIALYSIS



HEMODIALYSIS MACHINE + **Presence of vascular access** = YES HEMODIALYSIS

Vascular access on the podium

ORDER OF PREFERENCE FOR THE THREE TYPES OF VASCULAR ACCESS



Selection of the best vascular access

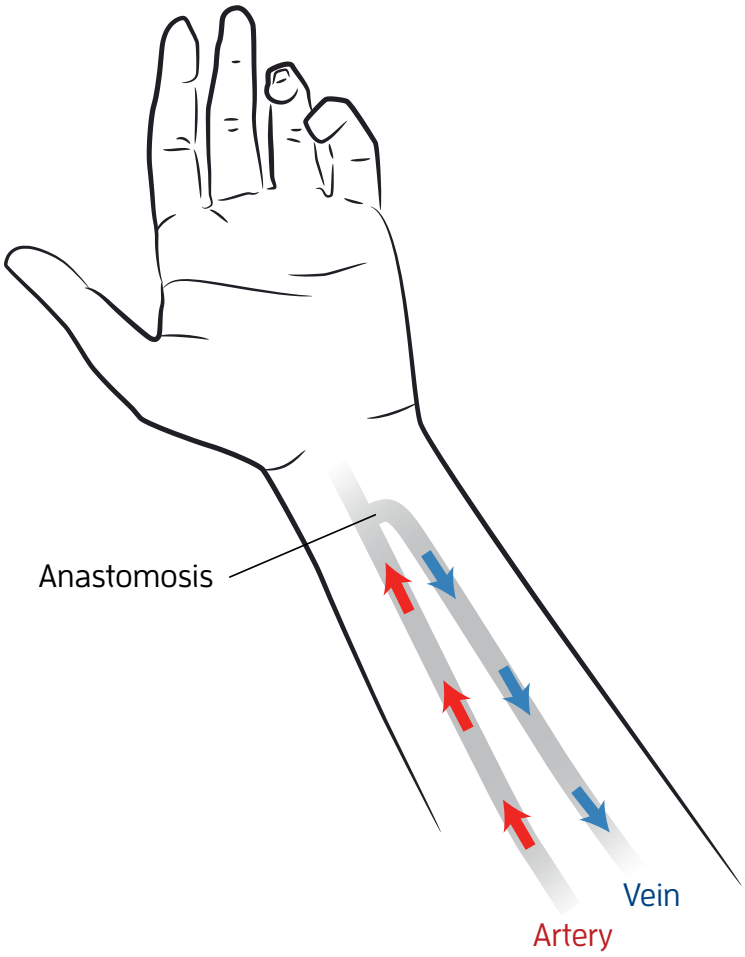
As each person with kidney disease has its own characteristics that may be different from other people, the best type of vascular access to start the hemodialysis program must be personalized on a case-by-case basis. The final decision on the type and location of the best vascular access in a specific person must lie in the hands of the health professionals who look after you and also the same person. This is known as the multidisciplinary team, as represented below this paragraph, from left to right: dialysis nursing staff, nephrologist, kidney disease person, vascular surgeon and interventional radiologist.



THE MULTIDISCIPLINARY TEAM

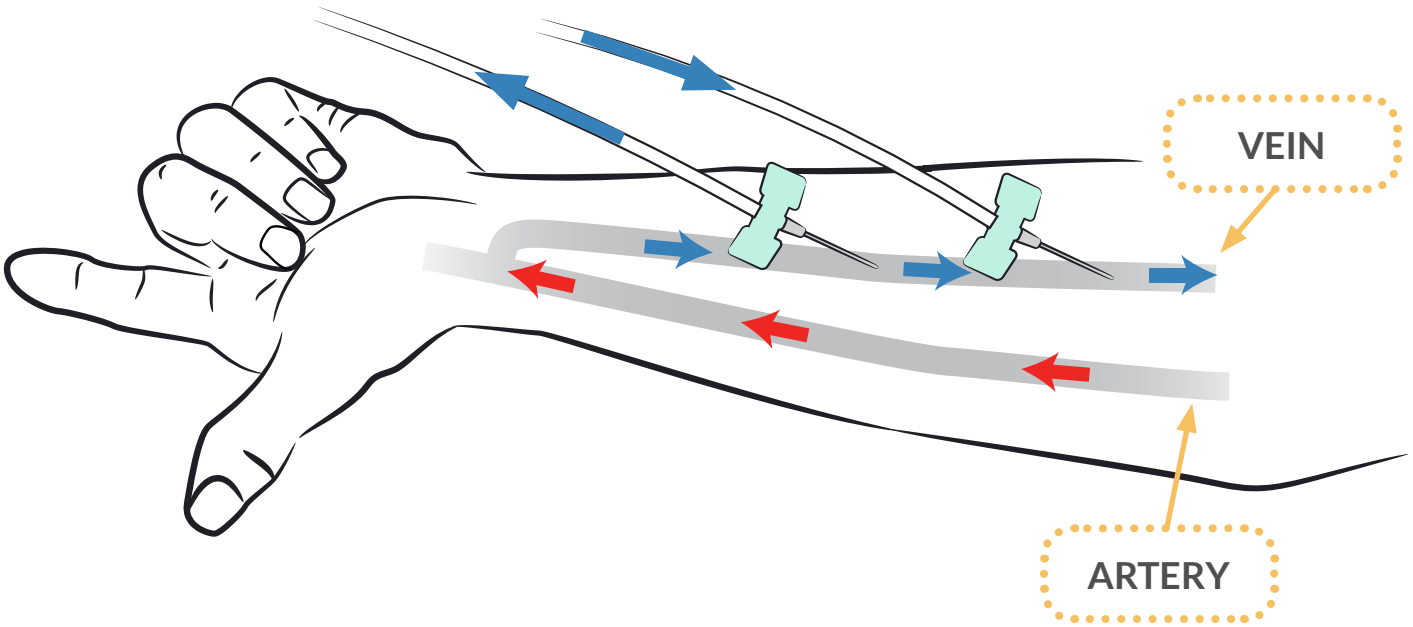
Native fistula

This is the vascular access recommended for most people with chronic kidney disease because it lasts longer than the others and has fewer complications. It consists of surgically creating a union under the skin between an artery and a vein in the upper limb, called an anastomosis (indicated in the picture on the right) (VideoEN 1.1). Once the union has been made, part of the blood circulating in the artery towards the hand is redirected to the vein through the anastomosis. The red and blue arrows in the picture on the right indicate the direction of the blood circulating inside the artery and the vein, respectively.



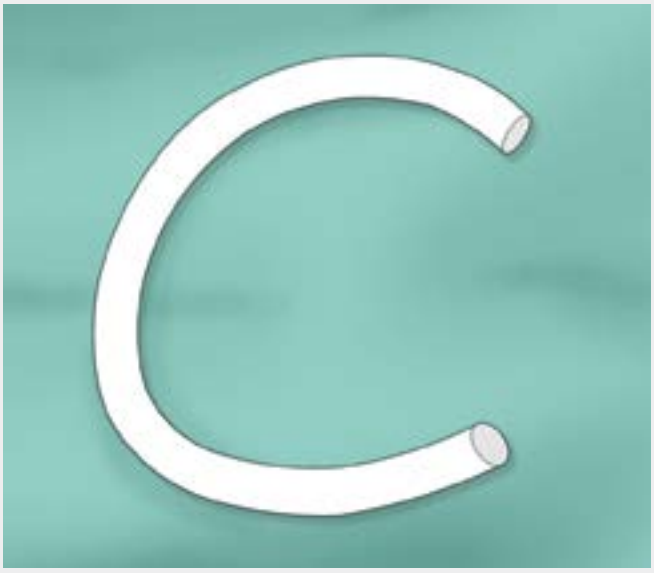
The result of the constant flow of blood from the artery to the vein through the anastomosis is that, after several weeks, this vein gets bigger and more resistant. In this way, after a certain period of time, this modified vein will be ready to needle in order to supply the dialysis machine with the required amount of blood to carry out the hemodialysis sessions. This is known as the maturation process of the fistula (VideoEN 1.1)

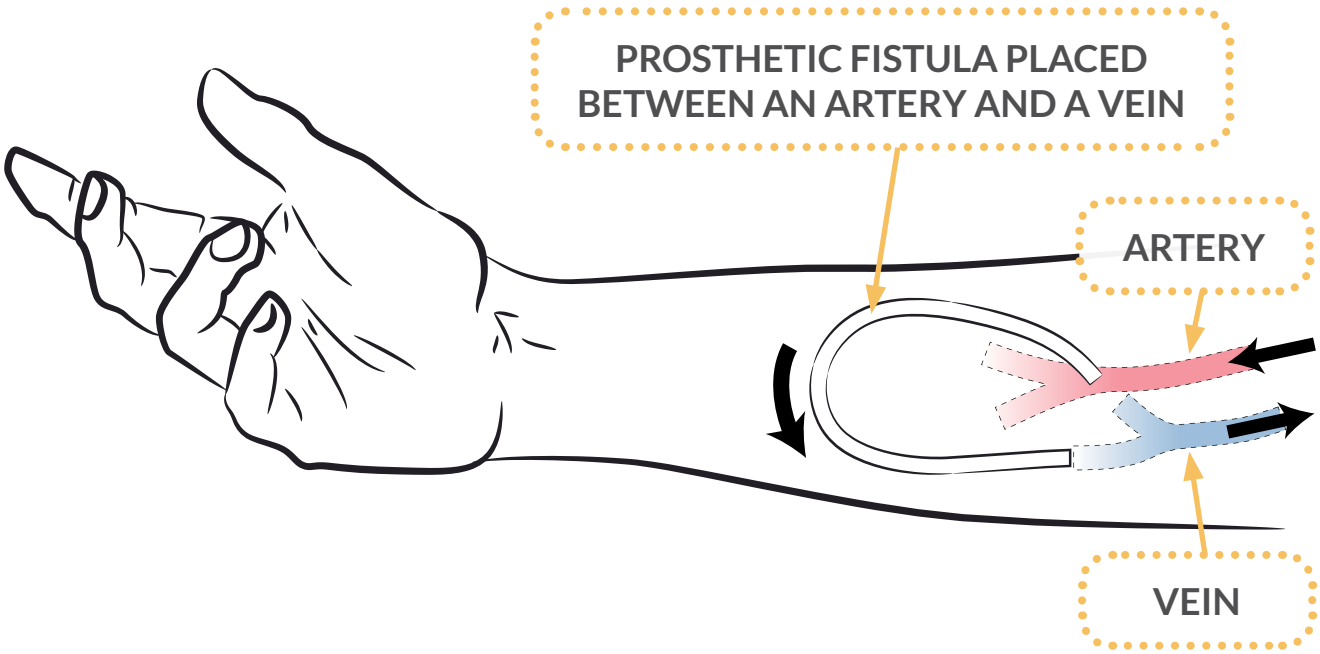
When the vein has matured, 2 needles are usually inserted for performing the haemodialysis treatment, as shown in the following picture. Through the first needle, the blood is sent from the body to the dialysis machine and, once cleansed, it returns to the body through the second needle. The arrows in the picture indicate the direction of the blood (VideosEN 3.1, 3.2 and 3.3).



Prosthetic fistula (arteriovenous graft)

This consists of surgically placing a tube of synthetic material (see the picture on the right) as a bridge between an artery and a vein under the skin, usually in the upper limb (see the following picture). The 2 needles required to perform the hemodialysis session are inserted in this tube.
The black arrows in the picture below indicate the direction of the blood.





Looking after the veins

The veins used to create a fistula in the arm are the same as those used when you have a blood test or when the nursing staff places an intravenous line. When this is done, there is always a risk of damaging these veins and if they are, they cannot be used to create a fistula. So it is very important to avoid needling in the veins of the arm where the fistula will be created and whenever possible, the veins in the hand must be used.



Fistula care just after the operation

When you arrive home after the creation of the fistula, you must check the dressing that was put over the surgical wound. If you see that the dressing gets covered in more and more blood (bleeding), as in the following picture, you must immediately apply constant compression with the fingers of the other hand and go to the Emergency Department of your hospital. At the same time, if you experience both intense pain in the hand and it also becomes cold and pale after having the fistula created, there may be insufficient blood reaching the hand, so you must go to the Emergency Department as well.



Fistula care during the maturation period

It is recommended that you perform exercises before and after fistula creation, for example by compressing a rubber ball with your hand, as shown in the picture on the right (VideoEN 1.1.). The aim of this exercise is to accelerate the fistula maturation process.

Once the surgical stitches have been removed and the professionals in charge of you give their approval, it is very important that you do these exercises. Bear in mind that the more time you spend doing them each day, the better the fistula maturation process will be.



Care during the period of use of the fistula

Once you have a working fistula, it is important to know that you must not take your blood pressure in the fistula-bearing arm, have an intravenous line or take blood for a blood test through one of the veins in this arm or directly through the fistula. Bear in mind that, from now on, the veins in this upper limb “must not be touched” and that the fistula must only be used to do the hemodialysis treatment.



No compression must be placed on the fistula-bearing limb as it can obstruct normal blood flow and cause the fistula to stop working (thrombosis) so that it can no longer be used for hemodialysis. Therefore, it is important not to wear tight-fitting clothes, watches, bracelets and occlusive bandages. It is advisable not to lift heavy weights with the fistula-bearing arm or do brusque exercises and impact sports with it, either. You must not lie on the fistula-bearing arm to sleep. You must avoid sharp changes in temperature (saunas).





Infections can get into the body when the fistula is needled. Thus, cleaning or asepsis measures of the fistula to eliminate microbes and avoid this must be stepped up.

To ensure this:

1. You must wash the fistula-bearing limb with soap and water before going into the dialysis room as shown in the picture on the right.
2. The nursing staff must disinfect the needling area using an antiseptic liquid that will be applied just before the needle's insertion.

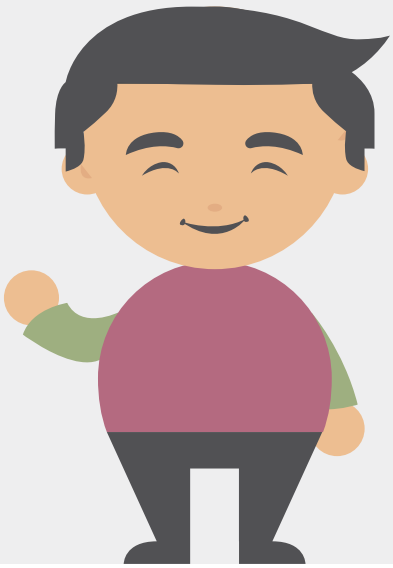


THERE ARE THREE DIFFERENT FISTULA NEEDLING TECHNIQUES

1. **Rope-ladder needling technique (VideoEN 3.1).**
2. **Area needling technique (VideoEN 3.2).**
3. **Buttonhole needling technique or constant needling in the same place (VideoEN 3.3).**

The fistula must be routinely needled by specialized nursing staff working in the hemodialysis units (never by a nursing staff with no knowledge or specific skill). However, whenever there is an easily fistula for needling, all highly motivated people being treated in a hemodialysis unit or at home can choose to needle themselves after a period of training (self-needling).





Once the needles have been inserted, they are securely fixed on the limb, as shown in the following picture, to prevent them from accidentally coming out during the dialysis session. This complication can be serious as it can cause an important bleeding.



Once the hemodialysis session has finished, the needles must be removed and, to avoid bleeding from the holes, a compression must be made immediately with the fingers of the hand. During initial dialysis sessions, the nursing staff can carry out this compression but, later, the same person can do it with the other hand. Clamps must never be placed on the prosthetic fistula in order to compress it, and it is not advisable to use them in the native fistula. The compressive effect of the clamp may cause the fistula to stop working (thrombosis) and it may no longer be of use for hemodialysis.







Fistula surveillance

In order to preserve the fistula for as long as possible to use it for haemodialysis, it is necessary to remain alert and keep an eye on it. Many people with kidney disease preserve their fistula in good conditions for years and do not need any other operation nor a catheter to be placed.

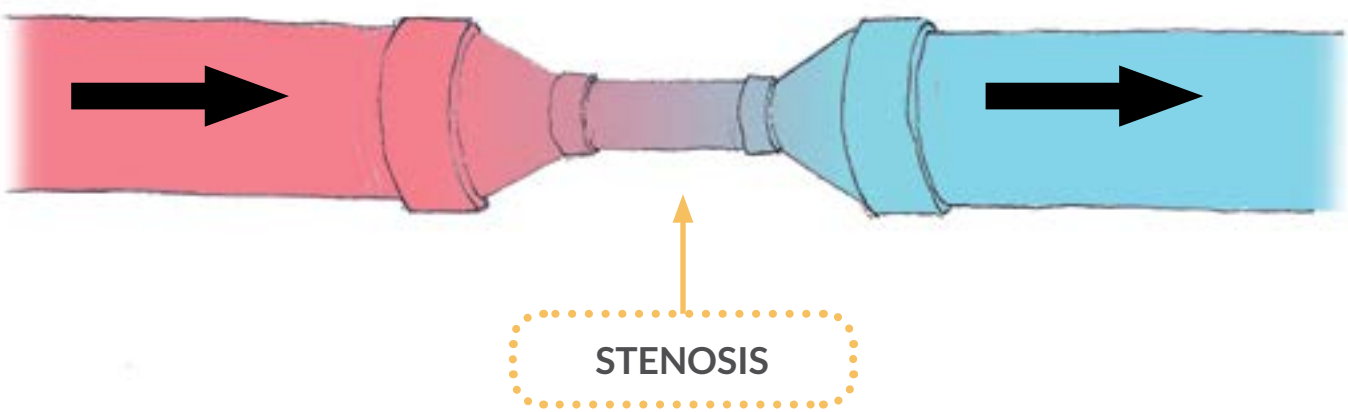


Fistula thrombosis and stenosis



The main objective of fistula surveillance is to avoid its most frequent complication: thrombosis, which occurs when we say that "the fistula has stopped" and the blood can no longer flow. The most common cause of thrombosis is a narrowing (stenosis) in the vein of your fistula that gradually closes until the blood cannot flow and clots (stopped fistula)

This is the same as occurs when there is a narrowing in a tubing indicated by a yellow arrow in the following picture. Due to the presence of this stenosis, the liquid inside the tubing flows much slower than usual inside the tubing segment just before the narrow section (red color). As a result, there is a high risk that the tubing will get jam and the liquid will not be able to get through. The black arrows indicate the direction in which the liquid flows inside the tubing.



Physical examination of the fistula

The exploration or physical examination is very important to detect stenosis in the fistula. It is based on three basic aspects: inspection, palpation and auscultation (VideosEN 4.1, 4.2 and 4.3).



INSPECTION
This consists of observing the fistula



PALPATION
This consists of touching the fistula with the fingers



AUSCULTATION
This consists of listening to the fistula using a stethoscope



You must check the fistula every day. You must examine the whole fistula-bearing arm to see if there is anything abnormal (inspection) and touch the fistula to see if it is working (palpation). When you touch the fistula, you will notice a vibration which means blood flowing though the fistula that it is working (VideosEN 4.1 and 4.2).



If you don't notice this flow or vibration, the fistula may be stopped and is not working. In this case, you must phone your Hospital or Dialysis Centre and they will tell you what to do. Bear in mind that if your fistula has recently stopped, it might be possible to salvage it before the next dialysis session. Moreover, the longer the time that passes with a fistula stopped, the fewer the possibilities that exist to salvage it.

Fistula exploration by using ultrasonography

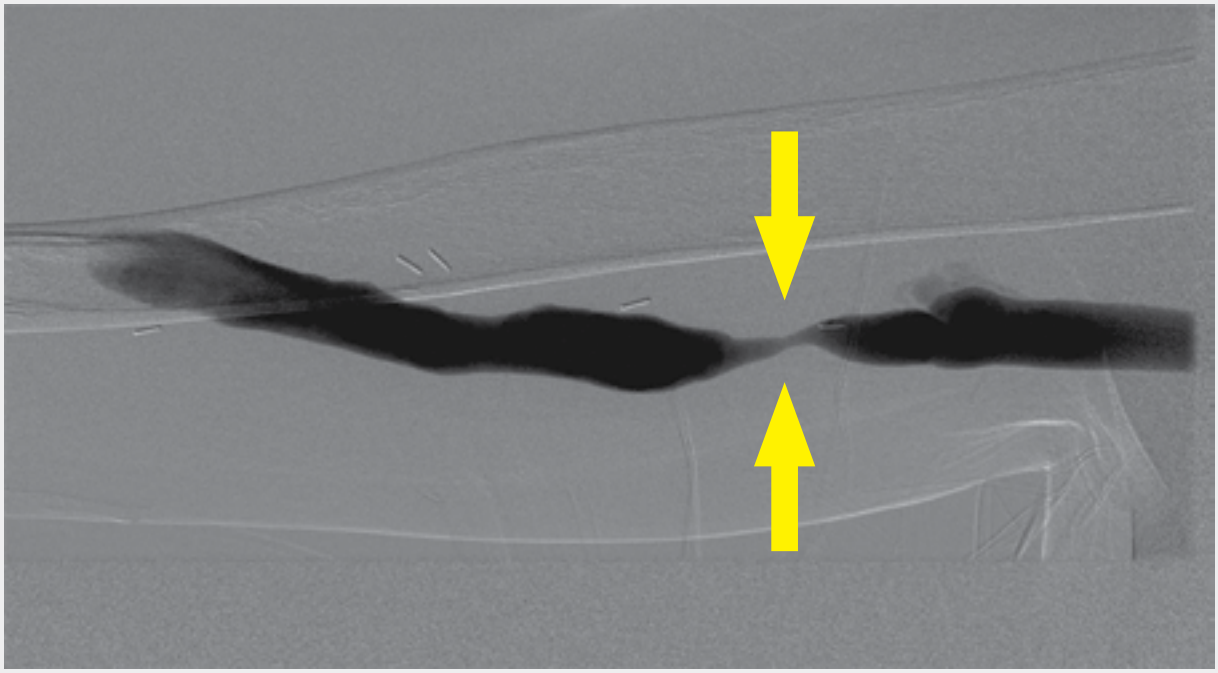
The use of some technological resources such as ultrasonography or the methods that calculate the flow of blood circulating through the fistula are very important for its surveillance.

Ultrasonography is an imaging technique that does not harm the body, is painless and allows periodic fistula surveillance. Among other benefits, ultrasound allows the confirmation of a stenosis previously suspected by using other methods. In the picture on the right, a well-developed radiocephalic fistula is being explored by using the ultrasound probe. Everything captured by this probe can be seen directly, in real time, on the ultrasound screen.



Fistula exploration by using fistulography

In some cases, doubts still remain regarding the stenosis observed by ultrasonography, so a further exploration, called fistulography, will need to be done. This consists of injecting a contrast liquid into the fistula to be able to see the whole trajectory inside (VideoEN 5.1). In the following picture, you can see the contrast liquid that fills the fistula in black and an area of stenosis (or narrowing) indicated by the yellow arrows.



Treatment of fistula thrombosis

Thrombosis is the most frequent complication, both in the native fistula as well as the prosthetic fistula and occurs when a blood clot (thrombus) obstructs the inside of the fistula and the blood cannot flow (stopped fistula). Salvage treatment of the thrombosed fistula can be done in two different ways: through interventional radiology and through surgery.





Interventional radiology:
the vein is needled and a tube is inserted into it which allows the thrombus to be fragmented and aspirated.

Surgery:
A small cut is made in the vein and the blood clot is removed.

Treatment of fistula stenosis

As previously discussed, fistula stenosis is the most frequent cause of thrombosis. This stenosis must be treated before blood clots and thrombosis occur. The corrective treatment of fistula stenosis can be done in two ways, depending on the location and extension of the stenosis: through surgery and through interventional radiology.





Surgery:

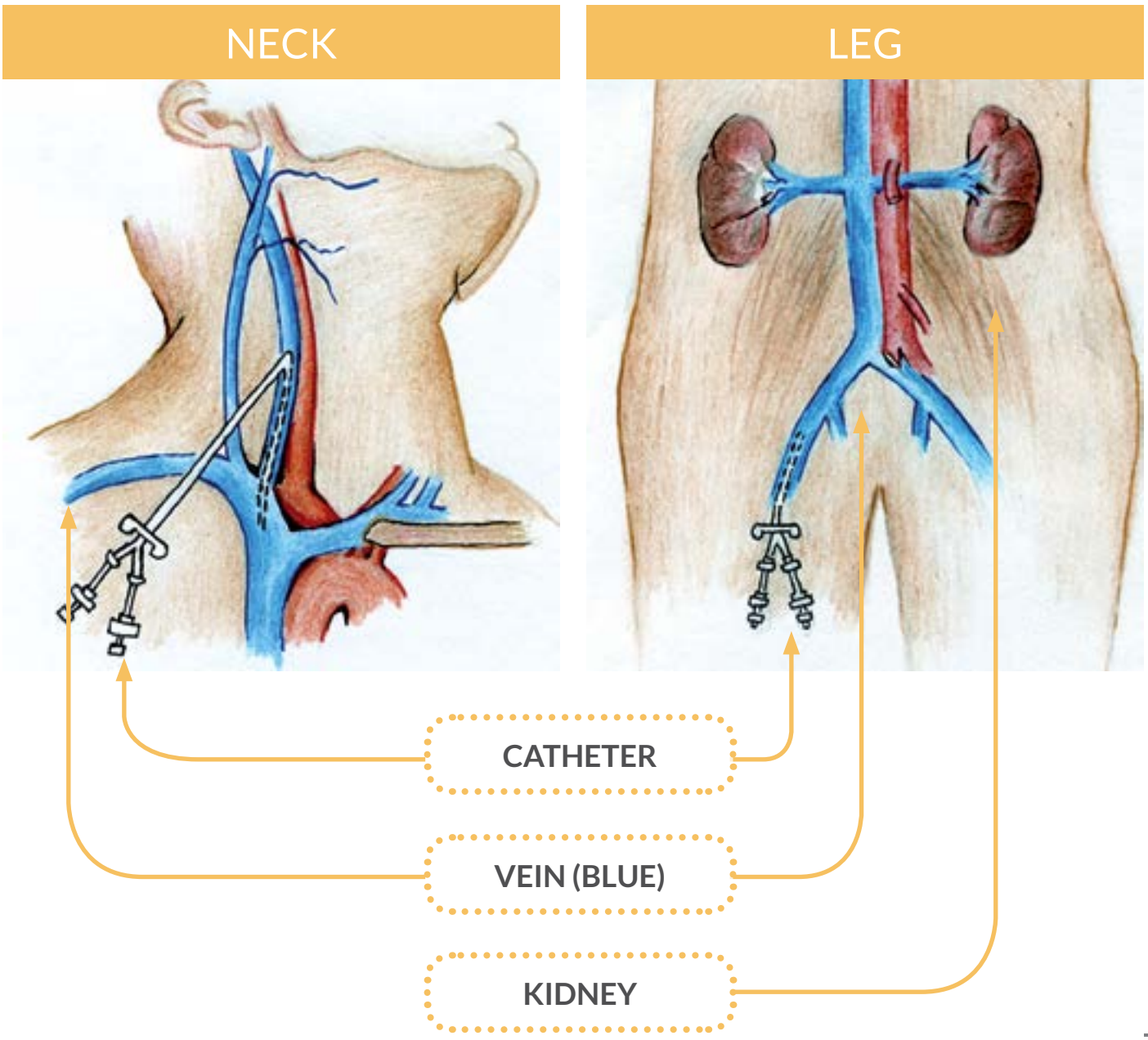
this involves creating a new anastomosis, that is, a new union to join the artery and vein, but further up, just above the problem area, thereby avoiding the stenosis.

Interventional radiology:

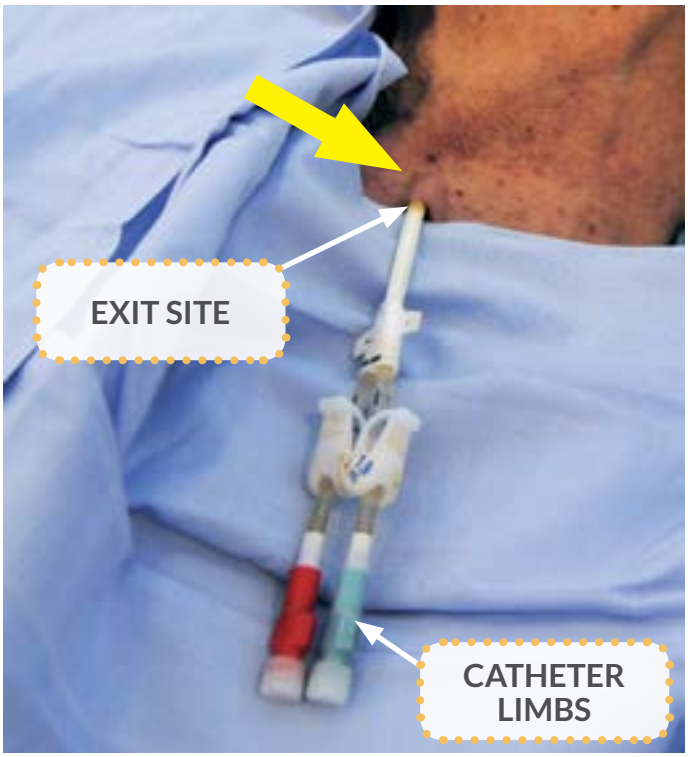
the vein is needled and a ball is inserted into the narrowed area of the vein (VideoEN 5.1). This ball acts like a balloon which is inflated in this area, thereby dilating the vein and thus opening up a new path for the blood to flow normally through the fistula.

Central venous catheter

The catheter is a hollow, flexible, plastic tube that is placed in a large vein in the body, usually in the neck although it can also be placed in the leg, which has two limbs on the outside. The blood goes out from the body through one of the catheter limbs to the dialysis machine and the cleansed blood goes back to the body from the machine via the other limb (see the following pictures and VideoEN 6.1).



Types of catheter





Tunnelled catheter:
this is called as such because the body of the catheter is attached using a cuff in a tunnel located beneath the skin. In this way, the risk both of infection and movement of the catheter is reduced. The yellow arrow in the picture on the right shows the catheter body fixed in a tunnel beneath the skin.

Non-tunnelled catheter:
here is no tunnel and the catheter body goes directly out of the body from the vein needling point (yellow arrow. As a result, the risk of infection is higher than in the tunnelled catheter and it should not be left in place more than two weeks.



Catheter placement

It is recommended the hemodialysis catheter be placed by using ultrasound guidance and by qualified medical staff with experience following strict asepsis measures (without microbes) to prevent infection.



Catheter handling

The haemodialysis catheter must only be used for performing the dialysis treatment and must not be used for other purposes (for example, to administer drugs outside the dialysis session).The catheter should be handled only when strictly necessary to avoid one of its complications, which is infection. The more the catheter is handled, the greater the risk of infection.

The connection and disconnection of the catheter to the dialysis machine in each session must be done exclusively by specialised staff in the dialysis unit. These processes must be carried out following strict asepsis measures (without microbes) to prevent infection that include the professionals who handling the catheter, people around at that moment and the catheter carrier him/herself (VideoEN 6.1).

The ten commandments of the catheter carrier



- I have to maintain good hygiene habits and know how to wash and bathe myself every day.
- I have to keep an eye on the dressing to make sure it is clean and dry and covers the whole catheter.
- Except for the dialysis staff, I must not allow anybody to take off my dressing or handle the catheter.



- I can wear any kind of clothes as long as they do not compress the catheter and I should avoid brusque movements when I get dressed and undressed. I must wear clothes that open at the front when I go to the haemodialysis session.



- I can have a shower as long as the catheter is protected by a waterproof dressing without directing the water jet at the catheter area.
- I cannot have a swim in the sea or in the swimming pool.



- I have to avoid pulls that can move the catheter and avoid sharp, cutting objects around it.
- If I get high fever and shiver, it is a sign of alarm that there may be a catheter infection and I have to go to Emergency at the hospital.



- If I have any problem with the catheter, I must get in touch as soon as possible with the staff at the dialysis unit.
- I must not try to solve any catheter-related problems on my own.

Bibliography

Spanish Clinical Guidelines on Vascular Access for Hemodialysis. J. Ibeas, R. Roca-Tey, J. Vallespín, T. Moreno, G. Moñux, A. Martí-Monrós, et al. by the Spanish Multidisciplinary Vascular Access Group (GEMAV). Nefrología 2017; 37 (Suppl 1): 1-191. Available at www.gemav.org

Videos of the handbook

VideoEN 1.1. The arteriovenous fistula creation
https://www.youtube.com/watch?v=yLyc52aABMI
The surgery to create an arteriovenous fistula is described. The exercises for fistula maturation are showing at the end of the video.

VideoEN 3.1. Rope ladder needling technique
https://www.youtube.com/watch?v=Qk7KHHsAgJ8
Detailed description of the fistula needling process by using the ropeladder technique.

VideoEN 3.2. Area needling technique
https://www.youtube.com/watch?v=2yfK4dMp6D0
Detailed description of the fistula needling process by using the area technique.

VideoEN 3.3. Buttonhole needling technique
https://www.youtube.com/watch?v=hAJnoFrOpUc
Detailed description of the fistula needling process BY using the buttonhole technique.

VideoEN 4.1. Daily self-examination of the fistula: arteriovenous fistula with stenosis
https://www.youtube.com/watch?v=jBNzN_am4sU
The process of exploring a fistula is described step by step, in this case with a narrowing or stenosis, which must be performed daily by the person with kidney disease.

VideoEN 4.2. Daily self-examination of the fistula: arteriovenous fistula without stenosis
https://www.youtube.com/watch?v=0RRpJ5xD6UY
The process of exploring a fistula is described step by step, in this case without any narrowing or stenosis, which must be performed daily by the person with kidney disease.

VideoEN 4.3. Fistula exploration by the nursing staff
https://www.youtube.com/watch?v=tVwyJqTmTrg
Detailed description of the fistula exploration by the nursing staffin the dialysis room just before start to needling.

VideoEN 5.1. What is a fistulography?
https://www.youtube.com/watch?v=hmxTCxJN6Kc
Fistulography description procedure during the fistula stenosis treatment by using interventional radiology.

VideoEN 6.1. Dialysis connection through a catheter
https://www.youtube.com/watch?v=k7456MZUbYw
The process of connecting a catheter to the hemodialysis machine to carry out a dialysis session is described in detail.



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