Are venous catheters safe in terms of blood tream infection? What should I know?

DIAGNOSIS, PREVENTION AND TREATMENT OF HAEMODIALYSIS CATHETER-RELATED BLOOD STREAM INFECTIONS (CRBSI): A POSITION STATEMENT OF EUROPEAN RENAL BEST PRACTICE (ERBP) for patients and caregivers.

Introduction.

Haemodialysis is only possible if blood can be removed from, and returned to, the body at 200 ml/min or more. The 'gold standard' for gaining access to the blood in haemodialysis is the 'arterio-venous' fistula (AVF). This is a vein that has been surgically joined to an artery. If the vein cannot be directly joined to the artery, an 'artificial' graft, often made of Teflon, may be used. This is referred to as an AVG (Arterio-Venous Graft). Following the connection, the high pressure in the artery expands the vein so that it becomes easy to insert the needles required for dialysis.

Alternatively a catheter can be used for haemodialysis. It can be inserted directly through the skin into a large central vein. This type of catheter is generally used in patients who are not expected to need dialysis for more than a few weeks. If the patient is expected to require long-term dialysis, a tunnel will be made to allow the catheter to pass from the vein, under the skin and out of the body. Tunnelling the catheter under the skin provides a barrier to infection.

In patients on long term maintenance haemodialysis, permanent tunneled central vein catheters are generally considered as the last resort for vascular access. One of the major reasons for discouraging the use of tunneled as well as non-tunneled catheters as an access for haemodialysis, is the risk of infection. They are a source of morbidity (illness) and mortality, by inducing malnutrition, inflammation, cardio-vascular damage, septic complications and metastatic infectious disease. Metastatic infectious disease means that the infection has spread to distant parts of the body from its originating source via the blood stream and settled in these distant sites. Non-tunnelled temporary catheters should be avoided as much as possible, since the risk of infection as compared to tunnelled catheters is even higher. Although the use of permanent catheters in long term dialysis is generally discouraged, the proportion of patients treated with them continues to grow as they are a life saving option in a substantial number of people who have run out of 'native vascular access' (and AVF) possibilities. The presumption is that their high prevalence, especially in the Western World, is due to the increased frequency of dialysis in patients of older age with cardio-vascular disease and/or with diabetes mellitus, in whom the creation or repair of a native fistula is technically challenging, risky or impossible.

When and where should a Central Venous Catheter be placed?

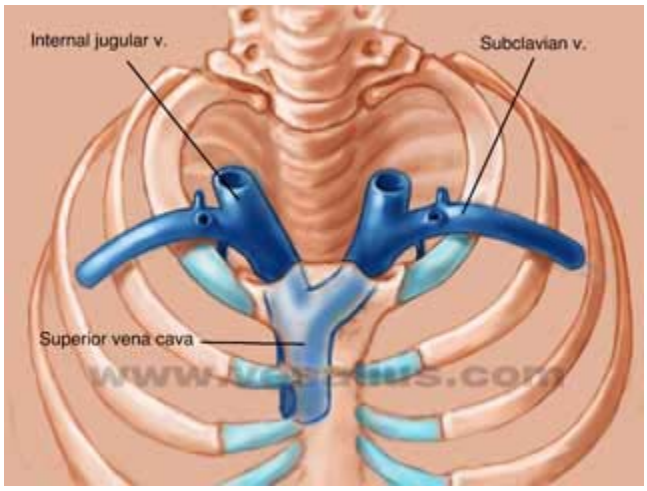
Haemodialysis catheters are required either due to need for urgent dialysis or because patients refuse to have an AVF created. If catheter related complications occur, the

options for alternative access, such as an AVF or peritoneal dialysis should be re-evaluated.

ERBP recommends the following:

Catheter insertion should be performed under strict aseptic circumstances.

Catheters inserted in the femoral position (in the groin) are prone to a higher risk of infection and bacteraemia than if the internal jugular vein (in the neck) is used and should therefore be avoided as much as possible. Of the remaining positions, the subclavian is discouraged for reasons other than infectious risk (i.e. stenotic complications i.e. narrowing of the vein with consequential partial obstruction to the flow of blood from the dialysis machine). Among the internal jugular positions, the right one is the more convenient.



How should a Central Venous Catheter be managed?

Strict hygienic precautions using sterile and disposable material (drapes, gloves) must be applied by caregivers whenever a central vein catheter is manipulated, connected or disconnected. The patient should at least wear a mask. Two trained staff members (one nurse focusing on the catheter and one helper to manage the dialysis machine and assist the nurse) are needed to enable the connection and disconnection. The most important principle for preventing infection is to adopt a meticulous approach to the handling of catheters in a reliable and sterile fashion, when connection and disconnection are performed or at any other time.

Preventive antimicrobial catheter locks and catheter surface treatment

After dialysis the catheter lumens are filled with a solution which is called the 'lock'. There is increasing evidence that antimicrobial locks are effective in preventing catheter related blood stream infections.

Some locks may have extra antimicrobial or biofilm removing properties (A biofilm is an aggregate of microorganisms that adhere to each other or to a surface). Adding antibiotics, either to heparin or to citrate solutions used for locking catheters, has an extra beneficial effect compared to heparin or citrate alone. However, they should always be used in combination with systemic antibiotic treatment, because of the possibility of creating resistance when they are used alone. Over time, progressively lower concentrations of citrate have been applied (from 46.7 to 4%). Even 4% concentrations achieve significantly better results than heparin.

A Food and Drug warning against citrate locks was issued in 2000 following a fatal accident with the 46.7% solution. The 46.7 and 30% concentration ranges are considered unsafe. For that reason, **the low 4% concentration is the only one recommended. This is supported by the American Society of Diagnostic and Interventional Nephrology (ASDIN)**.

According to ERBP, there is not enough evidence for a clinical benefit from ethanol locks. Ethylene diamine triacetic acid (EDTA) has been proposed as an alternative.

For each type of lock, the corrosive or damaging potential on catheter polymers should be taken into consideration.

The use of antimicrobial locks should not be used as an excuse to be less vigilant in applying strict hygienic precautions.

Exit site dressings

In addition to ensuring skin antisepsis before and during catheter placement, the exit site, where the catheter emerges through the skin, should be inspected and cared for on a daily basis. The exit site should be covered with a dressing as long as the catheter is in place.

With long-term catheters, gauze is the preferred choice. Gauze should be replaced if it is no longer dry or clean. The patient should be instructed to respect strict hygienic measures by preserving the integrity and dryness of the dressing, and should know what to do in case it becomes wet or disintegrates.

Exit site and nasal antibiotic ointments

The use of antibiotic ointment at the insertion site has a beneficial effect in reducing Catheter Related Blood Stream Infections and exit site infections. Application is especially recommended after catheter placement until the insertion site has healed. However the application of mupirocin might be complicated by development of resistance. Prolonging antibiotic ointment application after site healing probably offers

no advantage and has the potential to increase the risk for development of resistance and for *Candida* colonization.

According to ERBP, there is insufficient evidence to routinely use nasal antibiotic ointment in a haemodialysis setting.

Diagnosis of CRBSI:

Cultures of blood may be taken from the intravenous catheter to determine if blood that has been residing in the catheter for some time has become infected.

ERBP considers that, in many cases, it may be impossible to puncture a peripheral vein because of non-availability or because it is deemed desirable to preserve veins for creating future access If a patient is suspected of having a blood stream infection, it is normal practice to take blood samples from a site other than the indwelling catheter. However as many of the fever episodes that necessitate blood culture sampling occur during dialysis, when the blood flows through the catheter are high, it is likely that blood cultures collected through the catheter will offer similar results to peripheral blood which therefore renders peripheral sampling redundant.

An alternative approach that might increase the chances of identifying responsible organisms is to culture blood or (a) blood clot(s) extracted from the catheter before the start of dialysis. However, a large proportion of patients exhibit symptoms related to CRBSI only during haemodialysis, and make pre-dialysis sampling less successful.

When blood is taken via a vein during haemodialysis, it is possible that the origin of the infection may not come from the catheter but from another source. It is therefore important to exclude other sources of infection by careful history taking; a thorough examination; imaging and if possible, culture of any urine that may be produced by the patient.

To guide antibiotic therapy, it is of utmost importance that each haemodialysis centre maintains a database of all suspected and proven CRBSI and episodes of bacteraemia in general including: the causative organisms; their sensitivity pattern to antibiotics; the potential source (catheter related, pneumonia, urinary tract, etc.); and the outcomes after therapeutic intervention. As a consequence, each unit should be aware of its catheter related infections.

Management of catheter infection in patients receiving haemodialysis

When should a catheter be removed?

Removal of the catheter should be considered as additional intervention to systemic antibiotic treatment when any of the following severe complications arise: sepsis; infected clot or fibrin sheath; suppurative thrombophlebitis (inflammation of the vein which produces pus); metastatic infection (where infection breaks away from its point of origin and is carried by the

blood stream to a distant site such as the brain or liver or skin); persistent blood stream infection or persistent clinical signs of infection in spite of 72 hours of appropriate antimicrobial therapy; infection with *S. aureus*, *P. aeruginosa*, or fungi; tunnel infection with fever.

For tunnel infection without fever, topical antibiotic application might be attempted first.

If infection does not resolve, systemic antibiotic treatment should be initiated. If systemic antibiotics fail, the catheter should be removed.

ERBP recommends the insertion of a new tunneled central vein catheter only when the patient remains without fever for ≥ 2 weeks. In the interval, a temporary non-tunneled haemodialysis catheter should be inserted at another site. Using catheters placed purely for a single dialysis session and removed immediately afterwards, might be considered to minimize the risk of colonization of the non-tunneled catheter.

However, in patients on haemodialysis, options for access may be limited. Firstly, removal of a catheter will require another catheter to be inserted, increasing the potential risk of further damage to the central vein. Secondly, access options may already be extremely limited, and additional attempts at central vein cannulation may be impossible or incur a high risk.

If problems are anticipated, an alternative strategy is to exchange the catheter over a guidewire. The optimal time for such replacement is after 72 hours of appropriate and effective antibiotic treatment. However, replacement over a guidewire increases the risk of hardening or narrowing the vein, and is associated with a high treatment failure rate.

Surveillance blood cultures should be obtained one week after completing the antibiotic treatment for the CRBSI if the catheter has not been removed. If these cultures are positive, the catheter should be removed.

In order to preserve future access options, the practice of peripheral blood culture sampling from blood vessels that could potentially could be used for the future for creation of vascular access should be limited or avoided.

In all circumstances, systemic antibiotic therapy should be administered for CRBSI.

Antibiotic locks

If catheter removal is deemed unnecessary, undesirable or impossible, an antibiotic lock is an important therapeutic option. An antibiotic lock should not be used alone, but always in conjunction with systemic antibiotics for the recommended periods. Although dwell times generally should not exceed 48 hrs (or 24 hrs for patients with femoral

catheters), renewal of the haemodialysis lock after every dialysis session is considered sufficient.

Diagnosis of an outbreak of CRBSI

To understand the reasons for recurrent outbreaks of infection the patterns of micro-organisms' antibiotic sensitivity should be evaluated including molecular fingerprinting. Dialysis centres should establish standard care protocols for prevention and treatment as well as a quality improvement program. In case of an outbreak of CRBSI, the root cause analysis should assess compliance with these protocols. If compliance is below expectation, retraining and eventually reorganization of care should be considered. If compliance with the protocol is deemed appropriate, modification of the protocol could be considered, and the process of care re-audited.