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GENERAL INFORMATION

Nutrition strategies in the exhausted vein syndrome

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KEYWORDS
Exhausted vein syndrome;
Venous access;
Vascular access sites

Abstract
Accesses to peripheral and central veins have changed the outcome of many surgical and non-surgical problems. With a central venous access, haemodynamics can be monitored and parenteral nutrition and/or medications can be applied; it is safe access for the administration of chemotherapy and allows constant blood sampling. At the time of placement of central venous access, one must make several considerations such as the objective of venous access, the duration for which it will be used, the available pathways and whether there are complications and contraindications in its use. Complications have resulted in the use of different vascular access sites in the same patient resulting in less accessible sites. This situation is called exhausted vein syndrome.

The exhausted vein syndrome is a lack or absence of veins or arteries to allow vascular access. Among the most used routes are the subclavian, internal jugular, external jugular vein, cephalic vein, basilica vein and the femoral vein. There are other alternative venous access sites that can be used when the most frequent sites are not available. These sites are the common facial vein, axillary vein, inferior epigastric vein, translumbar vein, percutaneous transhepatic vein, azygos vein, the renal vein and the right atrium.

PALABRAS CLAVE
Síndrome de desgaste de venas;
Accesos venosos;
Sitios de acceso vascular

Estrategias en nutrición en el síndrome de desgaste de vena

Resumen
El acceso a las venas periféricas y centrales ha modificado el resultado de muchos problemas quirúrgicos y no quirúrgicos. Con un acceso venoso central puede vigilarse la hemodinamia y la aplicación de nutrición parenteral y/o de medicamentos, es un acceso seguro para la administración de quimioterapia y permite tomar muestras de sangre constantemente. Al momento de la colocación de un acceso venoso central se deben hacer varias consideraciones, algunas son:

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qué objetivo tiene el acceso venoso, el tiempo que se utilizará, las vías de acceso disponibles y si existen complicaciones y contraindicaciones para su uso. Las complicaciones tienen como consecuencia el uso de diferentes sitios de accesos venosos en un mismo paciente, lo que da como resultado que se tengan menos sitios de acceso; a este fenómeno se le llama desgaste de vasos.

El síndrome de desgaste de vasos es una falta o inexistencia de venas o arterias para lograr un acceso vascular. Entre las vías más usadas están: la vena subclavia, la vena yugular interna, la vena yugular externa, la vena cefálica, la basílica y la femoral. Existen además otros sitios alternos de acceso venoso que se pueden usar cuando los sitios más frecuentes no se encuentran disponibles, independientemente de la causa; estos sitios son: la vena facial común, la vena axilar, la epigástrica inferior, la vena translumbar, la vena transhepática percutánea, la vena ácigos, la vena renal y, como última instancia, la aurícula derecha.

Background

Vascular access sites are essential for the management of all outpatient or hospitalised and seriously or chronically ill patients because they offer a direct and rapid entry into the patient's cardiovascular system facilitating the management of various substances (medication, parenteral nutrition, chemotherapy, etc.) more effectively than by other routes and can be used for haemodynamic monitoring. Central venous access is acommonly performed procedure in hospitals. Of all the procedures performed on hospitalised patients, central venous catheter accounts for 8%. More than 5 million central venous catheters are inserted in the United States every year[1].

Vascular access procedures are performed when patients need[3] haemodynamic monitoring, nutrition, chemotherapy, dialysis, administration of medication and multiple blood samples taken.

History of vascular accesses

Vascular access, especially central venous access, historically originated from work performed by Dudrick and Williams who, by administering infusions of amino acids and dextrose through the vein, demonstrated the feasibility of obtaining proper growth and development.

Filler et al. introduced the use of central venous catheter for the administration of total parenteral nutrition initially using polyethylene catheters that were prone to developing clusters of fibrin, which subsequently led to the vein thrombosis used.

In 1967, Stanley Dudrick and Jonathan Rhoads published what they called "intravenous overnutrition", a study conducted with dogs showing that it is possible to feed a living subject for long periods, using only intravenous feeding (studies and experiments conducted since 1962). The first patient who underwent the technique described was a girl with bowel atresia who was fed this way for a period of 22 months, marking the beginning of modern artificial nutrition. In 1973, Broviack et al. described a modified silicone catheter 1-mm in diameter with a teflon retaining sleeve that formed a fibrous tissue around the catheter to block the infection's progress and promote fixation. This catheter is placed through the subclavian vein with the tip in the superior vena cava. In 1979, Broviack's catheter was modified by his haematologist colleague Hickman who increased the internal diameter of the catheter to 1.6 mm so that the infusion of fluid and collecting blood samples was easier. Later, in 1986, modifications were made to create double and triple lumen catheters, so that two or three solutions could be administered simultaneously. Following that, catheters with two-way valves emerged, eliminating the need to irrigate with heparin and prevent air embolism in the case of accidental disconnection from the catheter[4].

Catheter features

The ideal material for a device that provides central vascular access should be as described by Stewart and Samislow, a material inert to tissue, i.e., the catheter should be as biocompatible as possible to avoid complications and should be ductile so that if they undergo any external force they not break. They should be flexible, tough, durable and easily inserted.

Regarding the number of lumens, they can be mono-, bi- and triluminal. The use of multiluminal catheters is associated with an increase in the percentage of infectious complications. Prospective studies in adults found that a greater number of triluminal catheters were removed from infectious complications when compared with monoluminal catheters. These infectious complications can be minimised by strictly following established protocols, wherein each of the catheter lumens is treated individually as if it were a monoluminal. When these multiluminal catheters are no longer required, they should be replaced with a monoluminal catheter. The central venous access has proven to be the most important factor for acquiring an infection and causing death in patients on hemodialysis for chronic renal failure as an independent risk. The relative risk of bacteremia is seven times higher in patients who have central venous access compared with fistula patients[4,5].

Because of the catheter's characteristics, they can be totally or temporarily implantable. Temporarily implantable catheters can be divided into those that are highly thrombogenic and those that are not. Among those that are highly thrombogenic, polyethylene, polypropylene, polyvinylchloride and nylon are available, which are also not very flexible. These are not recommended for placement in a central vein for intermediate or long periods. Among the low thrombogenicity catheters are those of fluorocarbons such as teflon (tetrafluoroethylene-hexafluoropropylene), which are hemocompatible polymers. Polyurethanes have been modified to obtain thermoplastic polyurethanes. These have been associated with serious complications in newborns such as cardiac perforation; therefore, its use in this age group is not recommended. Siliconised rubber remains the best material tolerated by the body and is one of the most recommended for use in long-term central venous access. Using silicone or polyurethane catheters coated with heparin integrated into its walls, offering a lower rate of thrombogenicity, is advised.

Totally implantable devices are ideal for long-term use as they theoretically prevent entry of contaminating germs into the skin, possibly decreasing the percentage of infectious complications. In addition, they require minimal maintenance, are aesthetically superior and allow more physical activity. Recently, dual lumen chambers have been designed for dual lumen catheters and chambers that are smaller and allow insertion into sites such as the forearm[6].

Considerations

When choosing the type of catheter to be used, the following considerations should be taken into account: determine the target for placement of a vascular access, determine how long the vascular access will be used, determine catheters that are available in our workplace, determkine what pathways are available in the patient and determkine the contraindications in placing a vascular access.

Indications for a central venous access

Indications for administration of total parenteral nutrition in patients who require it are as follows: no possibility of enteral feeding for periods >5 days, administration of chemotherapy in cancer patients withpoor peripheral venous access, patients undergoing prolonged antibiotic treatment, taking blood samples, patients who have a device that provides a central venous access, and patients receiving bone marrow transplants, hemodialysis and plasmapheresis.

Complications of central venous access

There are a number of complications ranging from those so innocuous that they do not affect patient morbidity to lethal ones. The important thing is to try to avoid complications but if they do present, early diagnosis and treatment is essential. The most common complications are phlebitis, infiltration, limitation of movement, coagulopathy, haematoma and thrombosis. Coagulopathy is a contraindication relative to central venous access, although significant bleeding is rare. Safety of the large calibre tunnelled central catheter placement has been documented in patients with mild to moderate coagulation disorders. Thrombocytopenia poses a greater risk compared with prolonged clotting time[7]. In general, non-tunnelled catheters placed on sites are preferred to more easily control bleeding in patients with coagulopathy. A general subclavian pathway should be avoided in patients at risk of bleeding due to an inability to effectively control or compress the venipuncture site. The main causes of thrombosis are varied, from haematological disorders, use of large catheters in small veins, allergies, use of hyperosmolar solutions, use of teflon in catheters, obesity and contraceptive use. Complications have resulted in the use of different venous access sites in the same patient, resulting in fewer access sites being available; this phenomenon is called “exhausted vein syndrome”. Exhausted vein syndrome is a lack or absence of veins or arteries to allow vascular access. The use of vascular access in nephropathy patients undergoing hemodialysis treatment or in patients receiving chemotherapy is common.

Venous access sites

Choosing the most appropriate site for central venous cannulation is based on the experience and skill of the operator, the patient’s anatomy, the risks associated with placement (e.g., coagulopathy, pulmonary disease) and the access that is needed[8-10]. Although using the same approach is tempting, knowledge of a variety of techniques to access multiple vascular entry sites is important to satisfy patients’ diverse needs[11]. Higher success rates and lower rates of mechanical complications are clearly related to the operator’s experience[12-14]. Central venous access can be achieved by direct puncture of a central vein, dissection or puncture of a peripheral vein. Until recently, dissection of the cephalic vein or its tributaries was the site of choice for the placement of a central venous access for both adults and children. Catheters placed through a peripheral vein have some advantages, which are listed below.

Fewer complications at insertion

These are easily accessible; however, the peripheral route is not useful when it is required for multiple purposes. In addition,there is a higher rate of complications such as infection, phlebitis, poor flow, infiltration of solutions, accidental catheter removal, as well as not being able to be inserted because of a lack of available veins.

Placement of a central venous access should preferably be performed in the operating room where lighting, low environmental contamination and the availability of materials required, making it the ideal location to do this. However, it has been shown that central venous access can also be performed in the intensive care, neonatal and paediatric care units without increasing the risk of infectious complications. Ideally it should be done with the patient under general anaesthesia or sedation. Another important factor for proper central venous access is the use of X-ray, ideally fluoroscopy, at the time of catheter insertion. In this way the position of the catheter tip can be more accurately confirmed, which should be, in general terms, at the junction of the superior vena cava and right atrium.

The order of selection for a central venous access path for prolonged use varies according to the surgeon’s experience, personal preferences and available paths. The most commonly used routes include the subclavian vein, inter-

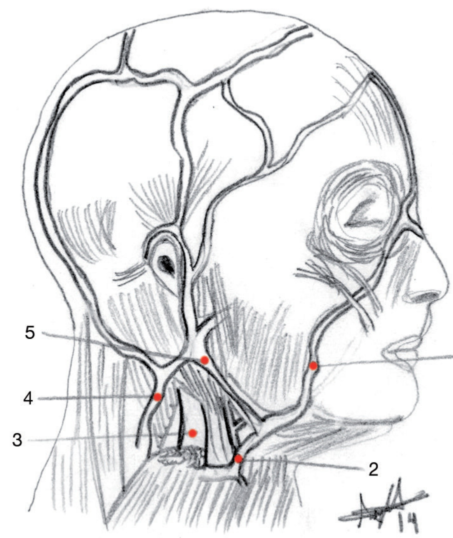

Figure 1 Common facial vein access. 1: facial vein; 2: common facial vein; 3: internal jugular vein; 4: external jugular vein; 5: retromandibular vein.

nal jugular, external jugular, cephalic, basilica and the femoral veins. In addition, there are other alternative sites for venous access that can be used when the most frequent sites are not available. These sites are the common facial, axillary, inferior epigastric, translumbar, percutaneous transhepatic, renal azygos and, ultimately, the right atrium veins.

Common facial vein access. The facial vein comes from the inner corner of the eye, the union of the frontal vein with the supraorbital vein. It follows a path behind the facial and descending artery. Along its path it receives tributaries such as the deep facial vein. It passes below and in front of the inferior mandible angle. The anastomose with the temporomandibular trunk is called the common facial vein. It crosses both carotid arteries to finish in the internal jugular vein between the angle of the mandible and head of the clavicle.

For its catheterisation, a dissection with a transverse incision at the midpoint of a line that runs from the inferior mandible angle to the hyoid bone should be performed. The incision depth is the common facial vein. If the dissection continues, its identity may be confirmed at the end, in the internal jugular vein (Fig. 1)[15].

Axillary vein access. The axillary vein begins at the lower edge of the teres major (round muscle) and is the continuation of the humeral vein. It follows the inner side of the axillary artery separated by the anteromedial trunk of the brachial plexus. Its largest tributary is the internal mammary vein. It becomes a subclavian vein at the outer edge of the first rib. Axillary vein catheterisation can be performed by percutaneous direct puncture with the patient placed in Trendelenburg position with their arm abducted between 100 and 130°. Having determined the artery by palpation, the vein is punctured parallel and below the artery or by dissection, in which case a subcutaneous tunnel is built on the anterior chest wall. Guidance by ultrasound is especially useful in these patients because of the possible depth it can be found at or because they may be overweight or obese (Fig. 2)[15].

Inferior epigastric vein access. Flows into the external iliac vein and continues into the femoral vein. Drains the lower portion of the abdominal wall. It anastomoses upwards with the superior epigastric vein. The epigastric vein can be catheterised through dissection in the inguinal region. It is performed at the upper inguinoabdominal fold penetrating the fascia of the external oblique, the internal oblique, the transversalis fascia and the fascia of the external oblique. In the same way as the axillary vein, ultrasound-guided puncture can be an alternative for channelling (Fig. 3)[15].

Translumbar access. The inferior vena cava is accessed, which receives venous drainage of the iliac veins, abdominal viscera tributaries or from the wall. Its path is upwards on the last lumbar vertebrae and the right psoas, on the right side of the aorta until it reaches the right crus of the diaphragm. Its chest portion is mainly intrapericardial. To catheterize, the patient is placed in the supine position and a guide is inserted through the femoral vein up to the inferior vena cava. With the patient in prone position a percutaneous puncture is made on the right side of the column at L4-L5 and, with fluoroscopic control, the signal guide is reached with a puncture needle (Fig. 4)[15].

Percutaneous transhepatic access. For a percutaneous hepatic access to the inferior vena cava the patient must be placed in the supine position, and with the help of a real-time ultrasound, the inferior vena cava is located while avoiding arterial and ductal structures. After puncturing the vein with a #21 needle, the catheter is advanced until the tip reaches the superior vena cava and innominate vein. This procedure can be done also by reaching the hepatic

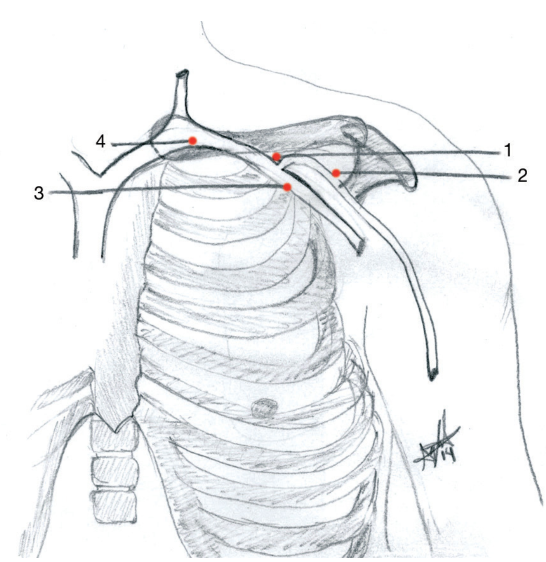

Figure 2 Axillary vein access. 1: axillary vein; 2: basilica vein; 3: cephalic vein; 4: subclavian vein.

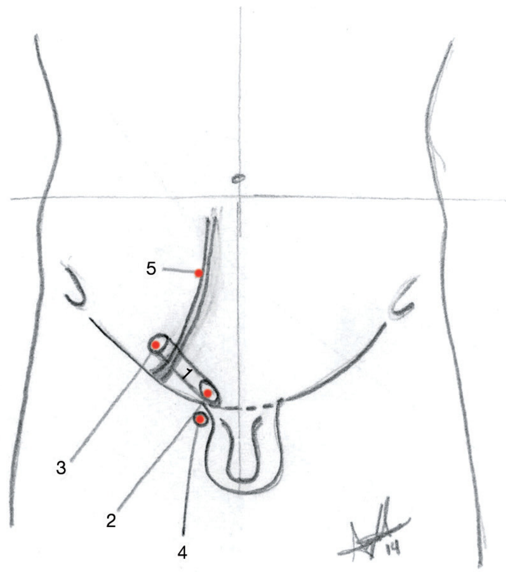

Figure 3 Inferior epigastric vein access. 1: inguinal canal; 2: subcutaneous inguinal ring; 3: abdominal inguinal ring; 4: femoral ring; 5: inferior epigastric artery and vein.

vein and then the inferior suprahepatic vena cava. In both cases, the catheter is tunnelled toward the anterior abdominal wall. The potential risks of using these central venous accesses are thrombosis of the inferior vena cava, renal or hepatic veins, and pulmonary embolism. In these cases, the presence of an interventional radiologist is very important and helpful for the success of this channelling method, regardless of the high degree of complications that may occur (Fig. 5)[15].

Azygos vein access. The azygos vein originates from the union between the subcostal and lumbar veins ascending to the level of the renal veins. It reaches the thorax through the aortic opening of the diaphragm, ascends through the posterior mediastinum behind the oesophagus and up behind the lung pedicle. At the level of the fourth thoracic vertebra there is an anterior arch on the pulmonary pedicle into the superior vena cava. Along its path it receives the upper and lower hemiazygos vein and posterior veins, intercostal except the first one. Central venous access using the azygos vein has been described by channelling the intercostal vein or directly through a thoracotomy. The selected intercostal vein is approached through a transverse incision

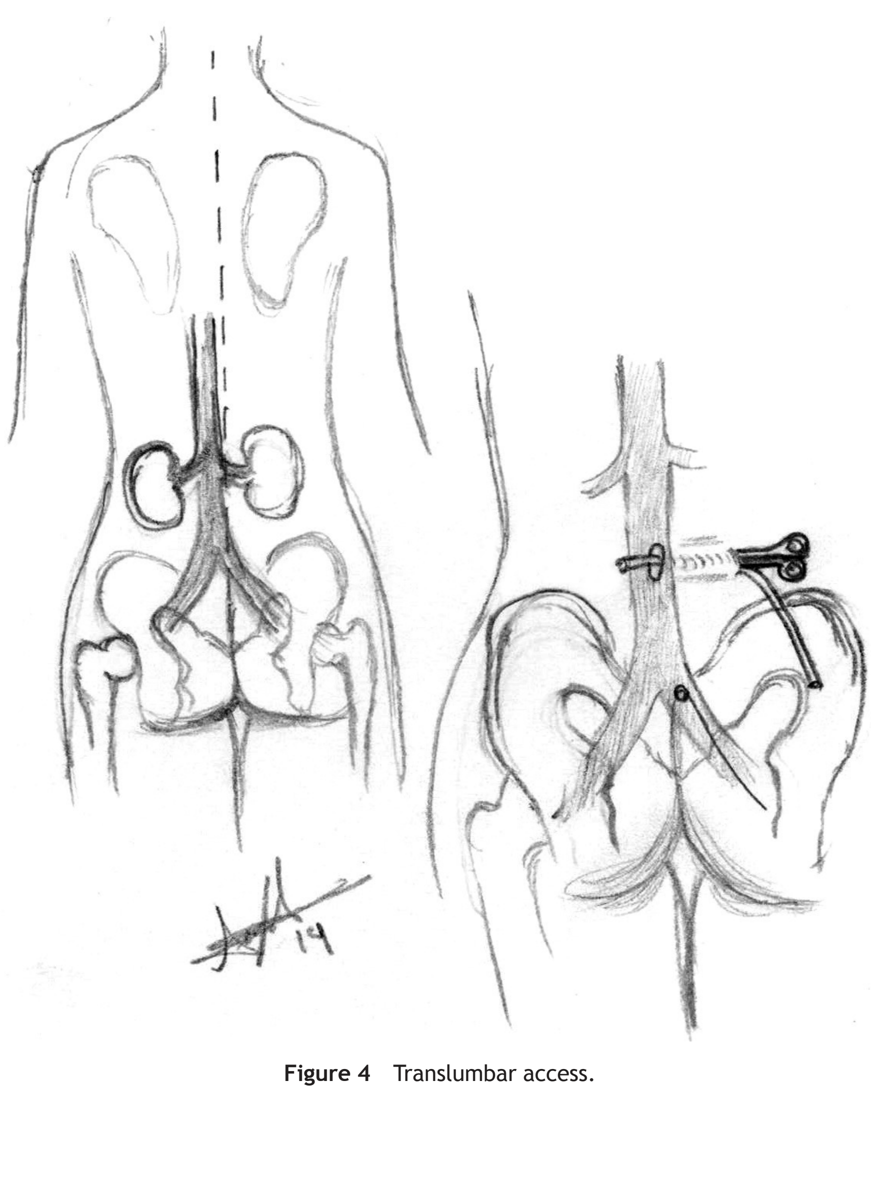

Figure 4 Translumbar access.

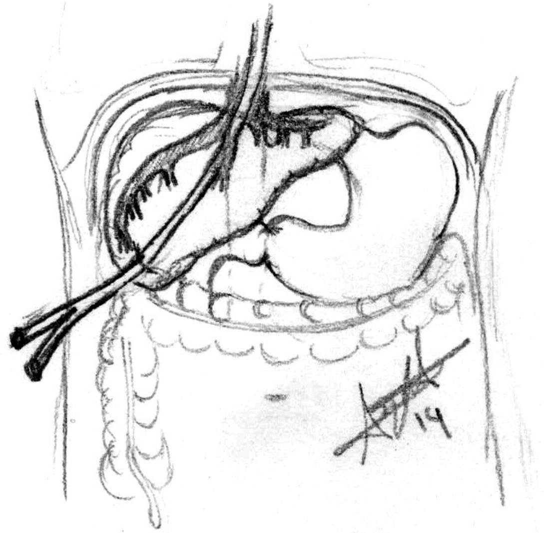

Figure 5 Percutaneous transhepatic access.

on the intercostal space. The location of the catheter tip is confirmed with fluoroscopy. The catheter is tunnelled to the anterior wall of the chest or abdomen (Fig. 6)[15].

Renal vein access. The renal veins originate in the anastomosis of the interlobular veins and communicate with the upper vena cava system through the azygos vein medial roots at

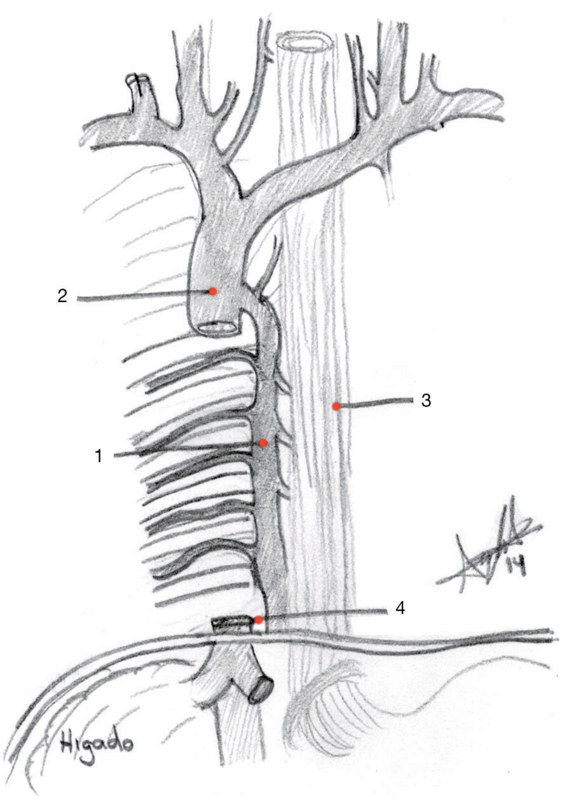

Figure 6 Azygos vein access. 1: azygos vein; 2: superior vena cava; 3: oesophagus; 4: inferior vena cava.

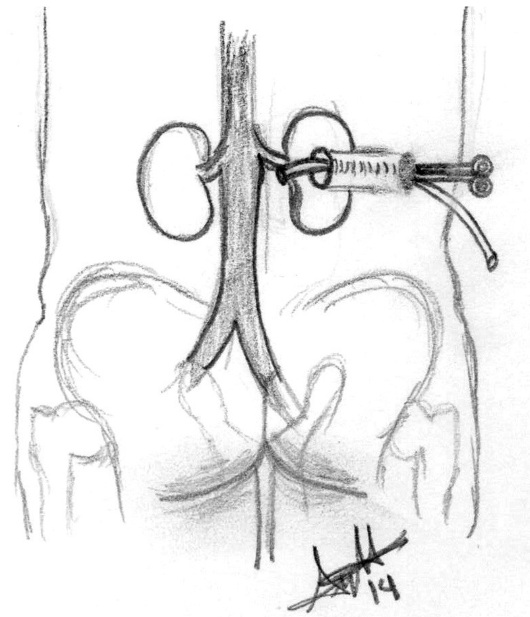

Figure 7 Renal vein access.

the right and the hemiazygos vein at the left. The renal veins empty into the inferior vena cava through a dilation known as renal blister. To catheterise, the patient is placed in a prone position, a percutaneous puncture is made on the right side of the column at a level higher than L2 and is reached with the puncture needle guided by Doppler ultrasound to locate either of the two renal veins; it is also useful to use computed tomography for this procedure (Fig. 7)[15].

Right atrium access. The right atrium forms the right edge of the heart and receives venous blood from the superior vena cava, inferior vena cava and the coronary sinus. Channelling the right atrium through a thoracotomy for an extended central venous access and using thoracoscopy has been suggested. There has been some success in this type of approach and should be used as a last option, especially when other less invasive options that generate less morbidity and mortality have been exhausted[15].

Conflict of interest

The authors declare no conflict of interest.

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