Technical Report

A method to insert a haemodialysis catheter by parasternal access

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Introduction

In 1944 Kolff [1] developed the procedure of haemodialysis as a treatment for patients with renal failure. Haemodialysis relies on devices installed permanently, and used for repeated and easy access to the circulation. The establishment of these accesses has become a regular activity of vascular surgeons and nowadays such accesses are also used to deliver anticancer medication [2] and for total parenteral nutrition.

Sometimes, peritoneal dialysis is not possible because of frozen abdomen, the veins which surgeons usually use may become obliterated, or central (subclavian and jugular) veins may become occluded or narrowed. These make central access impossible and result in the exacerbation of the uraemic syndrome. Under these circumstances the need to create a new route of access becomes urgent. This paper describes an alternative and last-resort solution which entails installing a Hickman catheter [3] via a right parasternal access and an extrapleural technique.

Technique

After preoperative preparation, and under usual conditions for general anaesthesia, the patient is positioned in 15° semi-Fowler. We perform a 7-cm right parasternal vertical incision, beginning 3 cm below the inferior border of the clavicle ending at the superior border of the 3rd rib cartilage. After dissection of the subcutaneous tissue, the aponeurosis and pectoralis major muscle are incised along the same line (Figure 1). Next we expose about 2 cm from the second right rib cartilage and resect it with a ‘Gluck’ costotome. Beneath this exposed area we make a longitudinal incision 1 cm from the right sternal border into the intercostal muscles to expose, ligate and cut the right internal thoracic artery and vein. The mediastinal pleura and the phrenic nerve are displaced laterally by blunt dissection. The ascending aorta must be identified medially by palpation. By extending the dissection the superior vena cava is reached, identified and exposed in its extrapericardial course—hereafter the vessel is encircled with ‘Lower’ (dull angled) forceps and fixed with a 1-gauge silk loop. The patency of the vessel is verified by aspirating blood from it with a 21-gauge needle.

At this time we recommend making a subcutaneous tunnel for the catheter in the anterior thoracic wall. We make an incision about 7 cm lateral to the skin incision and make a semicircular tunnel convex cephalad, to avoid infections (Figure 2). The silk loop is then firmly pulled upwards; the Hickman Kit Needle has been previously curved slightly at its tip to make the insertion maneuver into the proximal vein easier. The guide wire (Safe-T-J wire, Hickman® Peel-Apart Introducer Kit, Bard Access Systems, Salt Lake City, Utah, USA) is then passed through it by rotating it in its longitudinal axis during its introduction, after which the needle is removed. Subsequent to this we slide the kit dilatator covered with the disposable sheath over the guide inside the superior vena cava until it reaches the right atrium. The end of the catheter is introduced and positioned into the inferior vena cava outlet. The disposable material ‘Peel Apart® dilator’ and the silk thread loops are then removed. Adequacy of flow is verified in both channels of the catheter. Next we reconstruct the incision planes after testing the integrity of the mediastinal pleura (Figure 2), and close both skin incisions without leaving drainage tubes.

Important aspects of the technique are summarized as follows.

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(i) We have better illumination of the procedure with a headlamp.
(ii) We preserve pleural integrity.
(iii) We identify the ascending aorta medially, right phrenic nerve on the pleura laterally and the superior vena cava as the deepest structure.
(iv) We control the superior vena cava in its extrapericardial course with a silk loop.
(v) We do a radiological examination at the end of the operation.

Clinical case

The patient is a 71-year-old woman with end-stage chronic renal failure, non-insulin dependent diabetes mellitus and systemic arterial hypertension.

She had initially been treated with ambulatory peritoneal dialysis for several years, preserving an active family life. Later, because of frozen abdomen, the treatment had to be changed to chronic haemodialysis which was carried out via high-flow central catheters of the Mahurkar and Hickman type. She had a history of multiple surgical approaches in the neck vessels and the right iliac vein, and she had suffered bilateral thrombosis of the neck vessels and of the inferior vena cava—all confirmed by Doppler Duplex.

On her admission to hospital she had no haemodialysis catheter nor any way to place a conventional high-flow central catheter, consequently she developed a uraemic syndrome, anasarca and congestive cardiac failure.

As the last hope to save her life, we decided to place the catheter at the junction of the superior vena cava and the right atrium. She was admitted and taken to the operating room as a very high-risk patient for general anaesthesia.

The procedure followed the technique we have described above. There were no surgical complications and the patient went directly to the haemodialysis unit to resume her treatment. The postoperative course was uneventful.

A thoracic X-ray confirmed the proper placement of the catheter, which has functioned satisfactorily for 12 months before this report, allowing flows of 200–350 ml/min. The patient was able to resume her family life.

Discussion

Over time different ways of performing haemodialysis have been described [4]. With technological advances high-efficiency dialysis membranes have made venous-venous dialysis possible so that central venous catheters have become another option to be offered to the chronically ill patient. The prototype of these catheters is Hickman’s—it has a felt ring that causes fibrosis and forms a tissue ‘seal’ which decreases the possibility of an ascending infection. This double-lumen catheter is normally placed in the subclavian or jugular vein with the end placed near the right atrium. If these catheters are placed in the lower limb vessels they have less blood flow and a higher risk of thrombosis [5], oedema and pulmonary emboli.

Fig. 1. (1) Incision of the superficial planes, exposure and curettage of the 1st right rib cartilage (c). (2) With the resected cartilage and longitudinally sectioned intercostal muscles, the internal thoracic vessels (it) are ligated and sectioned. Pleura (p) and right phrenic nerve (pn) are displaced laterally, ascending aorta (AA) medially, the superior vena cava (svc) is found deeper down. (3) The high-flow catheter (h) inserted in the superior vena cava and its end at the level of the right atrium (ra).

Fig. 2. Final position of the double lumen catheter in the subcutaneous chest tunnel. The vertical line represents the incision of the already sutured skin. The end of the tube at right atrium (ra) level insinuated in the inferior vena cava (ivc).
Since conventional approaches are sometimes obliterated and the route to the superior vena cava narrowed, the surgeon is asked to create a new access. Many alternative approaches including transluminal dilatation by retrograde catheterization [6], the placement of a Hickman catheter by a transfemoral access [7], saphenous vein, gonadal vein, intercostal veins [8], azygos vein [9] and even a direct access to right atrium by thoractomy [10] have been described.

The approach discussed here has not been previously reported and we consider it a good choice that is safe and useful in these cases with none of the inconveniences of a pleurotomy with a temporary collapse of the lung and nor the need to install a pleural water seal.

To date we have treated three more patients with this technique, and they are doing well.

References


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