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CASE REPORT

Translumbar Tunnelled Placement of a Haemodialysis Catheter in a Patient with Transposition of the Inferior Vena Cava: A Case Report

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INTRODUCTION

Inferior vena cava (IVC) transposition is a well-known anatomic variant[1] with a reported prevalence of 0.2% to 0.5%.[2] Due to the complexity of IVC embryogenesis, many anatomical forms and variations are encountered. Anomalies of the IVC can be misdiagnosed and overlooked but are usually visualised by cross-sectional non-invasive imaging methods including computed tomography (CT) and magnetic resonance imaging.[2,3] In most patients these variations are asymptomatic, but they can be a potential cause of complications during surgical or interventional radiological procedures.

CASE REPORT

A 59-year-old man with femoral haemodialysis catheter failure due to iliac vein thrombosis was admitted for placement of a translumbar tunnelled haemodialysis catheter (TLC). His medical history included myocardial infarction, hypertension, hyperlipidaemia, diabetes, chronic kidney disease, and renal failure consequent to diabetic nephropathy. He had been receiving dialysis for 8 years, during which time he had required repeated catheter exchanges and been treated for repeated catheter-related sepsis, and bilateral brachiocephalic and superior vena cava occlusions. Bilateral femoral veins had been previously catheterised with thrombotic complications and catheter malfunction.

Informed consent was obtained and coagulation tests were performed prior to the procedure. Catheter insertion was performed in two steps. Under local anaesthesia and mild conscious sedation with the patient in a prone position, the access route was planned under CT guidance. The left IVC was visualised so the puncture needle track was switched from the right to the left side (Figure 1). Navigation was performed by repeated CT spiral scans with gradual advancement of the needle from above the left iliac crest toward the infrarenal segment of the IVC (Figure 2). After IVC puncture, a 6F 33-cm dilator was inserted over the wire (Figure 3). In the second step, the patient was transferred to the angiography suite. Under fluoroscopic guidance and in the right lateral decubitus position, subcutaneous tunnel length and catheter trajectory were planned. A dedicated

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Ethics Approval: This case report was approved by the local ethics committee of the University Hospital Ostrava in April 2020. Informed consent was obtained from the patient.

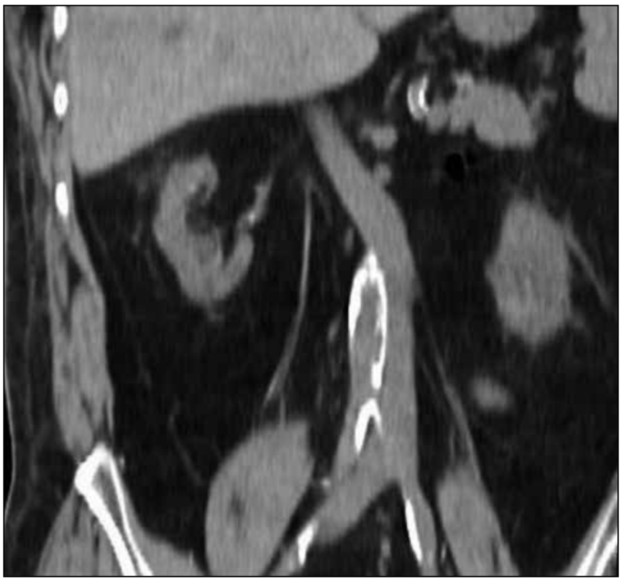

Figure 1. Computed tomography coronal reformatted image of the left inferior vena cava, multiplanar reconstruction.

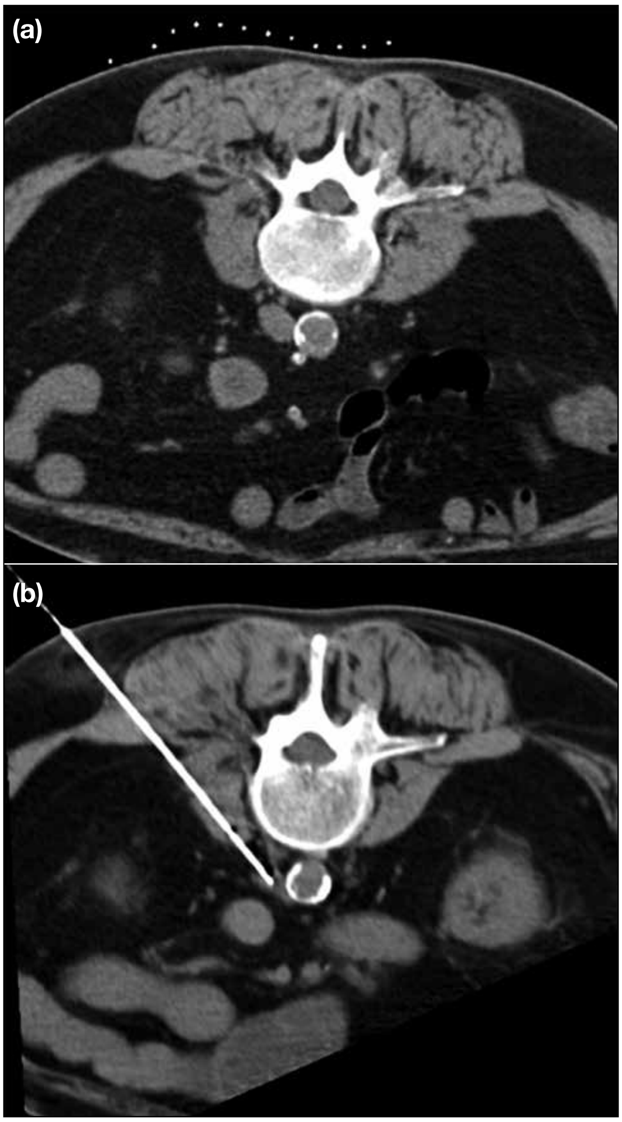

Figure 2. (a) Computed tomography transverse image of the left inferior vena cava (IVC). Patient in prone position. (b) Computed tomography–navigated left IVC puncture. Patient in prone position.

double lumen catheter for a translumbar approach (Split-Cath® III; MedComp, Harleysville [PA], United States) was tunnelled and inserted. Correct positioning of the catheter tip in the right atrium and potential complications were evaluated again on site with fluoroscopy (Figure 4). After aspiration and flushing, 4% citrate lock Intralock® Fresenius was administered. Antibiotic prophylaxis was administered for 5 days. The procedure was uneventful and haemodialysis was performed to test the function of the catheter prior to discharge of the patient.

DISCUSSION

Venous anomalies and variations of the IVC are observed quite frequently but there is no consensus on their classification. The most frequently encountered and published anomalies include the retroaortic left renal vein, left IVC, double IVC, circumaortic left renal vein, interruption of the IVC with azygos and hemiazygos continuation, absence of the infrarenal IVC and circumcaval ureter.[1,3]

The left-sided IVC results from regression of the right supracardinal vein with persistence of the left supracardinal vein. The IVC is then created by the iliac veins junction and continues to the left renal vein that crosses anterior to the aorta in the normal fashion, connecting with the right renal vein to form a normal right-sided suprarenal IVC. The major clinical significance of this anomaly is the potential for misdiagnosis as left-sided para-aortic adenopathy. Spontaneous rupture of an abdominal aortic aneurysm into a left IVC has also been reported.[3]

The presence of venous variations and anomalies can have a substantial influence on surgical and interventional procedures. For instance, in cardiothoracic surgery, renal transplant surgery, transfemoral cardiac or superior vena cava procedures or internal jugular vein or subclavian vein catheter placement, they can contribute to life threatening complications. Transjugular access to the infrarenal IVC for filter placement may be difficult and filter efficiency in cases of the double IVC may be diminished.

The number of patients requiring haemodialysis is increasing on an annual basis. According to international guidelines, an arteriovenous fistula or graft should be the preferred means of vascular access for haemodialysis.[4]

Figure 3. Computed tomography coronal reformatted, multiplanar reconstruction. Dilator and wire position after inferior vena cava cannulation.

They have good long-term patency and a low rate of infectious and thrombotic complications. Despite the recommendations, the number of haemodialysis patients using central venous catheters as their principal access is growing worldwide. In 2016 in the United States, approximately 80% such patients were starting dialysis with the catheter and 19% were on long-term dialysis.[5] Analysis of the subgroup of patients aged >75 years revealed that 48% were on long-term haemodialysis via a catheter.[6] However, prolonged use of catheter access is associated with catheter-specific complications that can ultimately lead to venous damage and exhaustion of routine venous access via the jugular or subclavian veins. Femoral access is associated with more frequent infectious and thrombotic complications and alternative venous access is then required. With the number of patients with a central venous haemodialysis catheter growing, the problem posed by difficult vascular access is likely to increase.

Although a translumbar direct approach to the IVC was first described in 1971, the rarity of this procedure dictates that only relatively small cohorts of patients have been described.[7,8] The technique has now been standardised and most centres perform IVC cannulation under fluoroscopic control. Puncture is performed from above the right iliac crest and centred towards the L2 vertebral body, not crossing the midline. Some centres use a catheter or wire inserted into the IVC beforehand from the groin puncture to mark the IVC course. However, in patients with bilateral iliac vein thrombosis

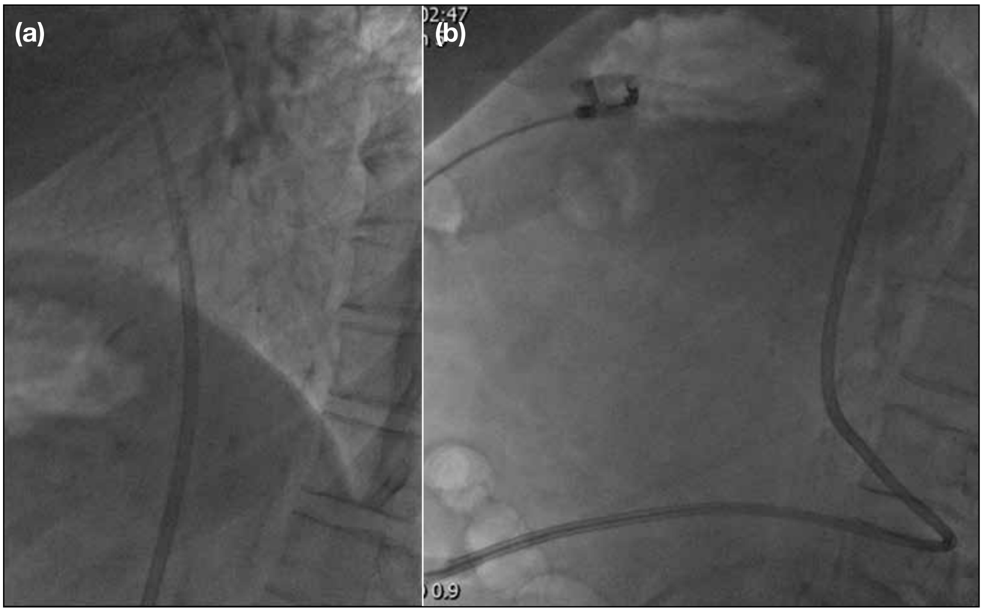

Figure 4. (a) Fluoroscopic image. Translumbar catheter distal tip within the right atrium. (b) Fluoroscopic image. Catheter course in the left lumbar region.

it is not possible to insert the wire or catheter into the IVC. In addition, because of the lack of accessible veins, good-quality IVC imaging usually cannot be performed. Because venous variations can influence the translumbar catheter insertion substantially, the need for thorough preprocedural cross-sectional imaging cannot be overemphasised. The IVC puncture is performed with the patient in a prone position, so the patient should also be in a prone position for the preprocedural CT or magnetic resonance imaging examination. This avoids the risk of variations in anatomy caused by organ movement when the patient is scanned in a traditionally supine position. Venous phase with good opacification of the venous system should be obtained whenever possible.

Data on CT and cone-beam CT navigated procedures instead of fluoroscopy have been recently published.[9,10] In general, and in patients with limited access, these two methods allow for exact pathway planning and direct puncture needle visualisation. The drawback of CT navigation is the need for a two-step hybrid procedure and transfer of the patient between two examination rooms. This problem can be solved by C-arm navigation performed in the same CT examination room. The cone-beam CT provides three-dimensional data acquired by detector rotation in the angiography suite. Dedicated software for needle navigation can also be used. In this way the procedure can be performed in one location, combining the advantages of cross-sectional and fluoroscopic imaging. In our institution we routinely use CT-navigated IVC cannulation that limits the potential for complications. Upon successful IVC puncture the patient is transferred next door to the angiography suite for TLC placement. It should be noted though that three-dimensional navigation procedures increase the radiation dose considerably relative to fluoroscopy.

Without a thorough knowledge of venous anatomy, TLC insertion can be complicated at several stages. During IVC cannulation, there may be inadvertent puncture of the aorta, bowel, kidney, ureter, duodenum or spleen. One must keep in mind that the puncture track is later dilated to accommodate a 16F peel away sheath and this may cause substantial damage to nearby structures. Insertion of the sheath and catheter into the left IVC is more risky because of the angulations between the left IVC, left renal vein and normally positioned right-sided suprarenal segment of IVC, all of which can be injured more easily during wire, dilator, sheath and catheter manipulations. Catheter malposition or kinking may lead to insufficient function or even vessel wall perforation. In the long-term, indwelling catheters with more curves can induce fibrosis and vein thrombosis more often than in the normal straight course of the right-sided IVC. With other types of venous variations, an interventional radiologist can face similar problems due to the small diameter of the veins, changes in diameter and irregular course of the veins compared with normal anatomy.

Our patient was transferred to our institution for TLC placement. No previous cross-sectional examination or medical history of IVC variation was available at the time of admission. Early recognition of the left IVC during CT navigation allowed for change of the puncture site, safe puncture, and subsequent tunnelled catheter placement. No early complications were noted, and the catheter functioned well for 29 months until the patient died of myocardial infarction. To the best of our knowledge this is the first publication of TLC insertion into the left IVC.

It is crucial to diagnose and describe IVC anomalies and variations to enable proper planning of surgical and interventional procedures. Lack of awareness of these anomalies may lead to severe and potentially deadly complications.

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