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USING A CATHETER FOR HEMODIALYSIS PLACED IN THE INFERIOR VENA CAVA FOR THE FIRST TIME IN N. MACEDONIA - TRANSLUMBAR APPROACH

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ABSTRACT

Maintenance of vascular access for hemodialysis remains a challenge for every doctor. Exhausted conventional vascular access is the cause for the placement of the central venous catheter in unconventional sites such as enlarged collateral vessels, hepatic veins, hemiazygos, azygos, renal veins, and the inferior vena cava. The percutaneous translumbar catheter for hemodialysis in the inferior vena cava was described over 20 years ago. In this article, we report on the procedure and complications arising from the percutaneous translumbar approach of a hemodialysis catheter. This was done for the first time in N. Macedonia. This approach is a potential option in adults and children when conventional approaches are limited.

Keywords: translumbar approach; vena cava inferior; hemodialysis; central venous catheters

INTRODUCTION

End-stage kidney disease (ESKD) is an international health problem, and around three million patients are currently receiving renal replacement therapy (RRT). This number is expected to increase from 5 to 10 million by 2030 [1-3].

As a result of improvement in the life expectancy of hemodialysis patients and the shortage of available kidney donors, maintenance of vascular access (VA) for hemodialysis (HD) remains a challenge. An arteriovenous fistula (AVF) is the first and the best choice of VA due to the low risk of infection and longer duration [4]. Central venous catheters (CVCs) use internal jugular, subclavian and common femoral veins as alternative approaches for HD. Thromboses and stenoses of the VA are the most common complications that lead to reduced blood flow during HD treatment and increased morbidity and mortality of patients. The lack of adequate VA is the main reason for patients' withdrawal from HD in 5% of cases [5]. Some of these patients had exhausted conventional VA due to multiple previous CVCs placed through the usual sites. Extensive surgical intervention for patients presenting obstruction of the superior vena cava (SVC) and tributaries, a bypass with prosthetic graft in AVF stenosis is a potential option but this is associated with significant complications. On the other hand, when the standard approaches are not possible, it is better to place CVCs in unconventional sites such as enlarged collateral vessels, hepatic veins, hemiazygos, azygos, renal veins, and the inferior vena cava (IVC) [6–8].

The percutaneous translumbar catheter for hemodialysis (PTCH) in IVC was described for the first time over 20 years ago [9]. The placement of PTCH in IVC is a useful and relatively safe method of providing VA. It may be considered a potential option in adults and children when conventional approaches are limited [10].

CASE PRESENTATION

We present a 55-year old Caucasian woman, with a medical history of ESKD, who has been on chronic hemodialysis treatment since 2012. She also presented with high blood pressure, diabetes mellitus type 2, and obesity. Her maintenance hemodialysis care was complicated due to recurrent thromboses and stenoses of the VA.

She started on HD via the temporary central venous catheter (CVC) in the right femoral vein. Then, she had multiple arteriovenous fistulae (AVFs) failures due to thromboses, and frequently CVCs changes in both femoral veins. AV-grafts were also created, failing as a result of the small diameters of the feeding artery and a low level of blood pressure. In this situation, a **Tesio**® permanent catheter was placed in the left subclavian vein in 2012. The first problem with CVC was detected in 2017 due to low blood flow during HD treatment. It was the cause for the placement of the new temporary CVC in the right internal jugular vein and removing the permanent CVC from the left subclavian vein. The CVC in the right internal jugular vein was changed many times due to malfunction in the period from 2017 to 2019. Multiple stenoses and thromboses of the bilateral subclavian veins, internal jugular veins, brachiocephalic veins, and SVC were demonstrated by computed tomography angiography (CTA). This was the main reason to start treatment with long-term anticoagulant therapy with vitamin K antagonist, but the result was inadequate. The patient was thus transferred to peritoneal dialysis (PD) in 2021. But she discontinued PD treatment due to recurrent peritonitis for a short time. With no HD vascular access available, a femoral artery catheter was placed as urgent access and motivated the decision to try an unconventional permanent VA. The risk of additional cardio surgery intervention and exhausting VA were decisive for using unconventional VA for HD. After receiving the patient's informed consent, PTCH was placed in IVC for the first time in N. Macedonia.

Procedure details: The combined technique of computed tomography (CT) and fluoroscopy were used [9, 11, 12].

The first step included the placement of PTCH, performed under CT guidance. The patient was placed in the prone position on the angiography table, undergoing moderate sedation and a local anesthetic (10 ml **Xylocaine**® 2%). The puncture site was above the right iliac crest on the lateral of the spine between T12 (thoracic vertebra) to L3 (lumbar vertebra). We used an 18 Gauge (G) needle, 20 cm in length. The blood aspiration from the needle was a sign that we punctured the IVC successfully. Then through the needle, a **Super Amplatz® Super Stiff** guidewire was inserted into the IVC, and its position was confirmed by CT images. A 7F (French size) dilatator was inserted over the wire and exchanged by **Medcomp**® 11F and 24 cm in length temporary catheter (figure 1). Blood was aspirated from both lumens of the catheter to confirm good flow and then was heparin locked.

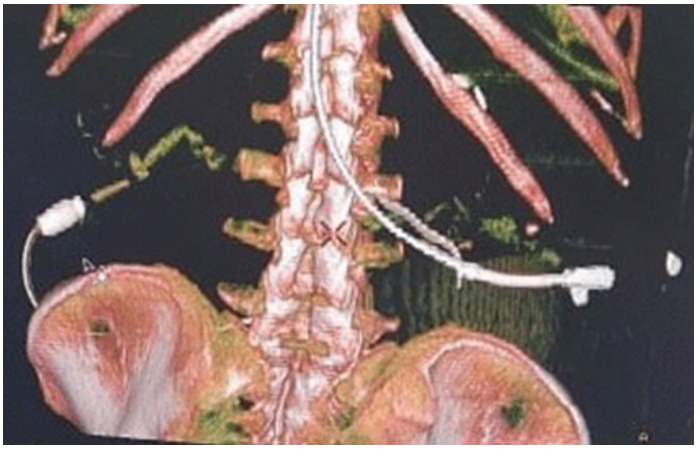


Figure. 1



Figure. 2

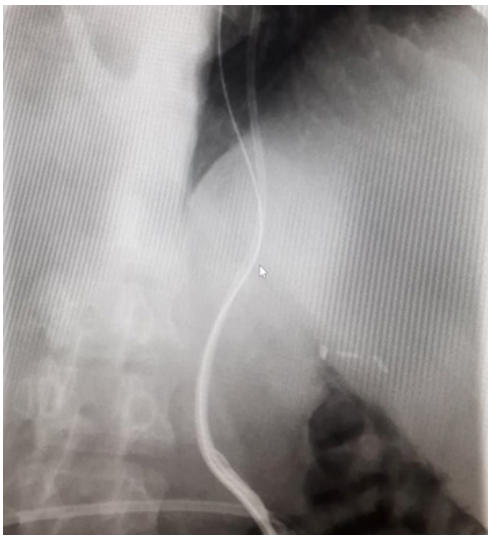


Figure. 3

In the second step, occurring one month later, the temporary catheter was exchanged via the wire by **Tesio®** 10F x (27cm and 30cm) two-lumens permanent catheter by fluoroscopy guidance and tunneled to the right flank. The temporary catheter was removed after the successfully inserted **Super Amplatz® Super Stiff** guidewire (figure 2). Then over the Ampaltz wire, the tip of the 14.5 F peel-away sheath was advanced into the IVC. The **Tesio®** catheters were pulled through the two subcutaneous tunnels from the right flank (approximately 5-8 cm) from the previous catheter site and inserted into the IVC via the sheath (figure 3). The functionality of the permanent catheter was done via blood aspiration from each lumen of the catheter. Correct placement in the IVC and adequate flow were confirmed with contrast injection (iodinate 15 mL). The catheter was heparin locked and secured with the appropriate dressing. The next day, after the intervention, the patient was started on HD treatment through the catheter in a supine position (Photo 1).

Catheter outcome

The PTCH insertion was successful with good blood flow during the first session of dialysis (>250 mL/min) and no peri-procedural complications (major bleeding or clotting) were noted. The first catheter-related bloodstream infection (CRBSI) was registered 10 months later and was successfully treated with systemic antimicrobial therapy. Also, we noticed a small dislocation of the catheter from the initial position, but this was not associated with PTCH functionality. The pain was also observed and was treated symptomatically.

DISCUSSION

The number of patients on HD is increasing all over the world, having reached nearly 1600 in N. Macedonia by the end of 2020 [1].3 The creation of AVF is the first choice as a permanent

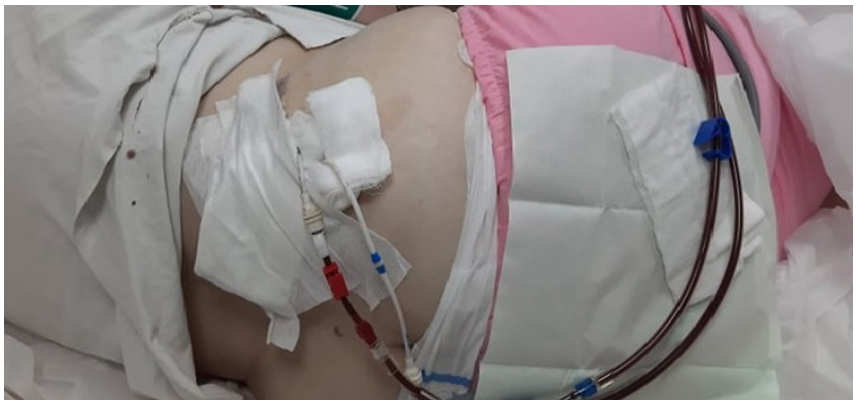


Photo 1

VA for HD in our hospital, but the number of patients using CVCs is constantly increasing [14]. The problem posed by difficult VA in patients dependent on CVCs is likely to increase. There is a small number of studies to date that report on translumbar catheters for HD [11, 15]. The PTCH in IVC is an acceptable approach in patients who require long-term HD, with occluded SVC and limited conventional veins for catheters [16].

PTCH function well in many patients, but one expects to have a higher complication rate compared with conventional CVCs.17 The functionality of PTCH at 12 months is presented in a range from 17% to 73.2% [10].

Patients who require PTCH have a long hemodialysis vintage with numerous comorbidities including cardiovascular disease and obesity. This also applies to our patient. The PTCH in IVC as permanent VA for HD was placed for the first time in N. Macedonia. We used the combined technique of CT and fluoroscopy [9,11, 12] These techniques have been individually described in the literature. Because we were placing translumbar catheter for the first time, and in order to maintain more safety for the patient, we used both techniques for the placement of the catheter.

Power et. al presented 39 patients for whom a PTCH was placed. These catheters performed well with a mean blood flow rate of 300 mL/min, and a mean spKt/v value exceeding the expected urea reduction larger than 61%.15 Lund et. al9 reported a flow rate from 200 to 300 mL/min and Rajan et. al11 reported minimum blood flow rates between 200 to 250 mL/min but reaching 350-400 mL/min. In our patient the achieved blood flow rate was from 250 to 300 mL/min and spKT/v=1.6.

Infection, thrombosis, mechanical obstruction, and hematoma are the most common complications of the PTCH [10]. The high rate of infection is associated with the anatomical position of the catheter, since the patient lies on the exit site which causes additional mechanical stress. Liu et. al in their study showed that the most common overall complications were poor blood flow (40.2%) followed by CRBSI (36%). They presented that main clinical presentations of catheter related infection were fever without purulent discharge or hypotension (52.8%), fever with hypotension (11.1%), fever with purulent discharge (13.9%) and purulent discharge alone from the catheter exit site (11.1%).10 The CRBSI in our patient was without purulent discharge or hypotension and was treated successfully with systemic antimicrobial therapy [12, 18]. After the treatment, the patient was feeling better, with a low level of c-reactive protein (CRP) and a low count of white blood cells (WBC). The catheter was not removed and exchanged because it was the first CRBSI with a good response to the antimicrobial therapy.

The catheter in our report has maintained its function 12 months after placement. The literature suggests that IVC presents a smaller chance of thrombosis than other conventional VA for HD. [19, 20] The prophylaxis against thrombosis was not recommended by other reports because of the high flow within IVC [15]. Also, double-lumen catheters perform better than two single-lumen catheters [15]. Because of the location, retroperitoneal hemorrhage and fibrosis complications are more frequent, when compared to traditional access [21]. Retroperitoneal hemorrhage or fibrosis has not been noted in our patient.

Mechanical obstruction is another problem of implantable catheters, and this was presented in a range of 0.08/100 to 0.19/100 catheter day.15,22 Catheter dislodgment is noted to be the leading cause of catheter failure for translumbar catheters, as excess adipose tissue is concentrated in the tunnel area. Also, obesity and the position of catheter insertion are the cause of mechanical complication [23]. A small dislocation of the catheter from the initial position was presented in our patient, which was attributed to obesity. Fortunately, mechanical obstruction was not associated with PTCH functionality.

From a technical standpoint, successful placement of PTCH requires a multidisciplinary approach between an interventional nephrologist and an interventional radiologist. Yet there are common complications such as hematoma, catheter thromboses, infection, migration of catheter tap, and fibrin sheath formation which limit the success. Despite the risk of complications, doctors are faced with a decision that has limited success in order to ensure the survival of patients. The literature reports only on small studies and case reports associated with the successful placement and complications of PTCH [9, 15, 23]. It is the option for doctors that in cases where no other VA alternatives are available, PTCH must be attempted as a routine alternative.

In summary, we presented, in detail, the combined techniques of CT and fluoroscopy of

the placement PTCH for the first time in our country. It was the first pioneer step for further investigation in the field of vascular access in N. Macedonia.

ABBREVIATIONS

VA- Vascular access

PTCH - Percutaneous translumbar catheter for hemodialysis

ESKD - End-stage kidney disease

RRT - Renal replacement therapy

HD - Hemodialysis

AVF- Arteriovenous fistula

AVFs – Arteriovenous fistulae

CVC - Central venous catheter

CVCs - Central venous catheters

IVC - Inferior vena cava

SCV - Superior vena cava

CTA - Computed tomography angiography

PD - Peritoneal dialysis

CT - Computed tomography

F - French size

G- Gauge

CRBSI - Catheter-related bloodstream infection

CRP - C-reactive protein

WBC - White blood cells

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Резиме

КАТЕТЕР ЗА ХЕМОДИЈАЛИЗА ВО ДОЛНАТА ШУПЛИВА ВЕНА (VENA CAVA INFERIOR) ЗА ПРВПАТ ВО С МАКЕДОНИЈА - ТРАНСЛУМБАЛЕН ПРИСТАП

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Одржувањето функционален васкуларен пристап за хемодијализа преставуваа предизвик за сите специјалисти вклучени во процесот на нивното креирање. Истрошените конвенционални васкуларни пристапи се причина за поставување централен венски катетер (ЦВК) за хемодијализа на неконвенционални места, какви што се: издолжените колатерални вени, хепатичните вени, азигосот, хемиазигосот, реналните вени и долната шуплива вена (vena cava inferior). Транслумбалниот пристап на поткожно поставување на ЦВК за хемодијализа во vena cava inferior е првпат опишан пред дваесетина години. Во продолжение на текстот детално ја прикажуваме процедурата и можните компликации од првото транслумбално поставување на ЦВК за хемодијализа во vena cava inferior во РС Македонија.

Процедурата е релативно безбедна и треба да се користи како алтернативна метода за поставување ЦВК за хемодијализа кај возрасни и кај деца, кога другите традиционални пристапи се истрошени.

Клучни зборови: транслумбален пристап, долна шуплива вена, хемодијализа, централно венски катетер