

UNCONVENTIONAL HEMODIALYSIS ACCESS: PERCUTANEOUS TRANSHEPATIC VENOUS ACCESS AS A LIFESAVING OPTION - A SINGLE-CENTER EXPERIENCE AND LITERATURE REVIEW

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Abstract

Introduction Hemodialysis catheters and arteriovenous fistulas are currently considered the gold standard of dialysis vascular access. Primary venous accesses are the internal jugular, subclavian, and femoral veins. Due to the nature of chronic kidney disease itself and its impact on the vascular system, frequent thrombotic occlusions of the vascular access occur, rendering it dysfunctional and sometimes leading to the lack of any possible conventional venous access for renal replacement therapy. Published data showed the noninferiority of nonconventional (transhepatic, translumbar) routes compared with the conventional ones regarding infectious complications. However, the long-term viability of these accesses remains questionable, while there is a high incidence of postprocedural access dysfunction.

Case reports We present two cases from June 2023, of patients in need of nonconventional vascular access for hemodialysis as a vital indication, in which a catheter was placed via the transhepatic route into the inferior caval vein with the tip positioned in the right atrium. Conventional venous access routes were ruled out in both patients after a detailed radiologic workup showed inadequate flow and severe occlusions. The skin was punctured in the anterior axillary line and a Hickman-type (double luminal) catheter was inserted in the right hepatic vein with ultrasound guidance using the Seldinger technique. It was passed through the inferior caval vein with the tip positioned in the right atrium. After that, a tunnel was created on the anterior abdominal wall. The placed catheters provided sufficient flow for hemodialysis procedures in both patients.

The first presented case provided the patient with adequate renal replacement therapy sessions until his death that ensued after postprocedural complications of cardiac surgery. In the second case, the access was a successful salvage bridging method after previous catheter dysfunction until the patient was conditioned for long-term automated peritoneal dialysis.

Conclusion The two presented cases show successful transhepatic dialysis catheter insertion as a method of vascular access in vital indications.

Keywords: hemodialysis, renal replacement therapy, transhepatic venous access, tunneled dialysis catheter, vascular access

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INTRODUCTION

Hemodialysis catheters (HDC) along with arteriovenous (AV) fistulas represent the cornerstone of modern hemodialysis vascular access. However, these access points are sometimes just a temporary solution due to frequent development of an AV fistula or HDC dysfunction upon the vascular burden of end-stage renal disease (ESRD) itself, or vascular complications of long-term use (1, 2).

Lifesaving HDC insertion routes, after jugular, femoral, and subclavian vein failure include the inferior caval vein (ICV) via translumbar or transhepatic approach (2–5).

First studies about the outcomes of transhepatic catheter placement published in the 1990s reported a total of 51 patients across 3 different studies, proclaiming the access not as suitable as imagined due to high complication rates (2–4, 6).

A more recent study by Şanal et al. reporting outcomes of 38 patients with transhepatic hemodialysis catheterization proved that the transhepatic route provided a relatively reliable lifesaving approach to those patients (7).

Here we report on two cases from June 2023 which represent the start of transhepatic catheterization as a salvage approach at the Clinical Hospital Merkur in Zagreb, Croatia. To our knowledge, these were the first transhepatic HDC cases in our country as well.

Patient selection

The two patients we present in this study were selected exclusively after no other viable vascular approach was available due to thrombosis of the main vascular access points.

Procedure

The patients' hematologic and coagulation parameters were confirmed to be within normal ranges before each intervention, per previously established inclusion criteria for all patients undergoing tunneled HDC placement. The patients were informed about the procedure and informed consent was obtained. The procedures

were performed while the patients were conscious and a local anesthetic (solution of 20 mg/mL lidocaine) was administered. Both procedures were performed by the same two operators with great experience in intravenous HDC placement.

Surgical skin cleansing was performed on the right thoracoabdominal area by standard antiseptic procedure. Imaging guidance was provided by ultrasound (US) with a sterile coated probe.

The transhepatic intervention was done through the right hepatic lobe in the front axillary line in both patients. The access to the hepatic vein was created through the peripheral branches draining to the right hepatic vein. Both cases required the use of 32-cm double luminal tunneled catheters (Medcomp SST OTW) of the Hickman type. The entrance site incision was widened after placing the guidewire. The catheter was inserted after widening the entrance site with a dilator system using the standard Seldinger technique. Following an incision made approximately 4 cm anteroinferior to the skin access site for the tunnel, the catheter was tunneled subcutaneously with the help of a tunneling device. The incision was closed with subcuticular suturing. The catheters were flushed with heparinized solution and the position of the catheter was confirmed using conventional X-ray imaging. The tip of the catheter was positioned in the right atrium in both patients.

Case 1

A 72-year-old male patient was transferred to our Department in June 2023 after HDC failure during a hemodialysis session. His disease burden included two cerebrovascular incidents, one transient ischemic attack, paroxysmal atrial fibrillation, and coronavirus disease 2019 (COVID-19). The patient started undergoing renal replacement therapy in 2016 and had experienced previous HDC-related complications. In December 2021 he had also been admitted to our Department due to *Providencia stuartii* extended spectrum beta-lactamase (ESBL) and OXA-48 catheter-related sepsis, and was treated with ceftazidime avibactam. During the same hospital stay the catheter had been replaced in the same location with surgical help, as the first catheter was placed in the right exterior iliac vein by open surgery (per laparotomy). As the postoperative course was complicated with development of collections surrounding the placed HDC, the surgical decision was to



Figure 1 – Anteroposterior x-ray view of the placed hemodialysis catheter via transhepatic access through the right hepatic vein, inferior vena cava, with the tip positioned in the right atrium



Figure 2 – View of the tunneled dialysis catheter placed via the transhepatic access

insert a percutaneous drain rather than a new surgical solution. The drainage was dysfunctional and thus removed. The team considered other dialysis options such as peritoneal dialysis, which was not suitable for the patient due to his poor eyesight, but after a detailed consultation with the patient's wife, automated peritoneal dialysis (APD) was an option after resolving the inflammatory condition surrounding the previously placed catheter. The pretransplant workup discovered multiple occlusions due to thrombosis in the right subclavian vein, both brachiocephalic veins, proximal

superior caval vein, and both exterior iliac veins, as well as partial thrombosis of the IVC. The transplant team decided against a renal transplantation option due to the lack of a favorable vascular attachment point. The patient had a total of five hospitalizations after the operative catheter placement due to multiple episodes of sepsis, one with methicillin-resistant *Staphylococcus aureus* (MRSA) isolate.

In April 2023 he was admitted to a local hospital due to sepsis with accompanying acute heart failure caused by infective endocarditis affecting primarily the aortic valve with severe aortic valve insufficiency, along with moderate stenosis, but with no microbiological isolate. Also, multiple infectious vegetations related to the HDC tip were noticed and thought to contribute to the aortic insufficiency. A computed tomography (CT) scan was done after extensive antibiotic treatment, visualizing a lamellar collection encapsulating the whole length of the placed catheter without any significant abscess formations, and requiring removal with placement of a new HDC.

After the transfer to our Department, the patient was continuously monitored and treated with broad antibiotic therapy without development of fever. Blood cultures were drawn twice, with no bacteremia detected. Due to the insufficient blood flow rate with the current HDC, the team decided on a transhepatic approach after CT angiography showed a partial thrombosis of the IVC between the iliac inlets and the hepatic vein inlet, as well as a complete right subclavian thrombosis and unclear finding of opacity of the left subclavian vein. A 32-cm Medcomp SST OTW catheter was placed under US guidance through a peripheral branch of the right hepatic vein in the VI liver segment, via IVC with the tip positioned in the right atrium (Figures 1 and 2). There were no immediate postprocedural complications, and the flow rate during hemodialysis was > 350 mL/min, enabling adequate hemodialysis sessions, as well as improving the patient's overall clinical condition. Vancomycin was added to the treatment regimen, and the previously surgically placed catheter was removed from the right external iliac vein several days thereafter. The patient was transferred back to his local hospital for further follow-up and chronic dialysis procedures.

The HDC remained functional for a month until the patient's death during a revision procedure which was warranted after development of hemopericardium as a complication of a cardiac surgery performed in July 2023.

Case 2

A 49-year-old male patient was referred to our Department in June 2023 due to insufficient hemodialysis flow rate. The patient was on a chronic renal replacement therapy regimen from July 2020. His chronic kidney disease started after he suffered a stroke at the early age of 34, with consequential aphasia and severe spastic tetraparesis. Shortly thereafter, the patient suffered multiple episodes of chronic pyelonephritis followed by a bilateral pyelotomy in 2017. The course of his chronic kidney disease progressed to the need for renal replacement therapy. His first vascular approach was an AV fistula that soon became dysfunctional with no additional possibilities for AV fistula formation, after which the first non-tunneled HDC was inserted in the left internal jugular vein, to be replaced by a tunneled one soon thereafter. The tunneled catheter remained in function for two years until March 2022, when it was spontaneously dislodged from the tunnel, and a new tunneled HDC was inserted into the right femoral vein. A CT venography scan was done in March 2020 and showed a complete thrombosis of the left subclavian, left brachiocephalic, and right subclavian veins, with thrombosis at the point of the inlet to the caval vein, leaving the aforementioned venous drainage relying completely on the collateral circulation. There were no suitable venous access points in the upper caval vein and its branches.

The existing vascular approach showed an insufficient flow rate and demanded thrombolysis treatment to allow for a satisfactory hemodialysis procedure, after which the patient was urgently referred to our Department. The vascular access was first treated with alteplase, but without a satisfactory response, after which the team decided to place a new vascular access point into the right femoral vein, which also proved dysfunctional in view of the required hemodialysis flow rate. Due to the dysfunction and recirculation of the newly placed catheter, a new CT angiography was performed, which showed ICV thrombosis up to the level of the hepatic vein inlet, with a stationary finding of the superior caval vein branches. Due to the vital indication for a new vascular access, the team opted for a hepatic vein vascular access point. Under US guidance, a 32-cm Medcomp SST OTW double luminal catheter was inserted in the peripheral branch of the right hepatic vein in the VI liver segment, via intercostal access in the front axillary line due to a high colon placement which made the subcostal approach unsuitable. There were no immediate postprocedural complications, and the catheter tip was positioned in the right atrium via the ICV. The catheter blood

flow rate was > 350 mL/min, enabling adequate hemodialysis sessions during the first week post insertion.

Unfortunately, due to the patient's highly respiratory mobile liver, the catheter tip started to migrate peripherally, which resulted in compromised blood flow and eventual loss of function after the first week of hemodialysis. Meanwhile, the patient was conditioned for automated peritoneal dialysis (APD). A peritoneal catheter was surgically placed, and the dysfunctional hepatic vein catheter was removed soon thereafter.

The patient was transferred back to his local hospital for further follow-up and chronic dialysis procedures, and to our knowledge the peritoneal access has been functional to date.

DISCUSSION

These two case reports represent the start of alternative HDC placement options in our Department. The two selected patients carried a heavy disease burden specific to each case, and as such had a vital indication after current HDC failure.

The primary catheter placement choice in concordance with the current guidelines are the internal jugular veins, as they do not compromise possible future catheter placement sites, as well as the upper and lower extremity circulation in view of grafting AV fistulas (8, 9). Secondary approaches, such as the subclavian and femoral veins, carry a higher risk of stenosis or occlusion (9, 10).

Both the translumbar and transhepatic approach were considered in our patients, but based on the current available research and the specific requirements and options in each case, we decided on the transhepatic approach due to the verified ICV thrombosis. The transhepatic route carries a higher risk of immediate complications, as they occur in up to one third of the patients in some studies (3). We found no evidence of hepatic artery injury or perihepatic hematoma using real-time US guidance.

As previously stated by Stavropoulos et al., transhepatic HDC can be placed safely, as the infectious complications are acceptable compared to the other sites. However, the researchers in that study experienced lower primary patency rates in comparison with previously published reports (2, 10–13).

In our cases, no issues related to catheter thrombosis or infection were found, primarily due to the very short endpoints in both patients, as one catheter remained functional until the patient's death one month later, and the other became dysfunctional after the first week due to tip migration. This complication was reported in 37 % of the cases in some studies, which is theorized to have been caused by the relatively short intravascular distance between the hepatic veins, the ICV, and the right atrium, accompanied by high organ mobility, as well as the fact that the hepatic veins are relatively short and narrow (4).

The urgency to investigate the possible cause of lower flow rates due to this complication is greater in comparison with the common internal jugular vein approach, as the migration could lead to serious complications. In our case, the catheter had migrated primarily due to the patient's anatomy and neurological condition, therefore making the alternative of APD a more durable option in this case.

This presentation and review of the other published cases shows that the transhepatic access can be reliable in life-saving situations, even as only a bridging method, like in our second case. There is still considerable experience to be gained from implementing this method, thus limiting the current failure rates.

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SAŽETAK

NEKONVENCIONALNI KRVOŽILNI PRISTUP ZA HEMODIJALIZU: PERKUTANI TRANSHEPATIČNI VENSKI PRISTUP KAO OPCIJA SPAŠAVANJA ŽIVOTA, ISKUSTVO JEDNOG SREDIŠTA I PREGLED LITERATURE

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Uvod: Hemodijalizni kateteri (HDK) su uz aterijskovenske fistule zlatni standard u dijaliznim žilnim pristupima današnjice. Primarni žilni putevi postavljanja HDK-a su unutarnje jugularne, potključne i femoralne vene. Zbog same prirode kronične bubrežne bolesti i njenog utjecaja na žilni sustav, često se događaju trombotičke okluzije žilnih puteva koje dovode do disfunkcije dijaliznog puta te ponekad do iscrpljenja svih mogućnosti konvencionalnih žilnih pristupa u svrhu nadomještanja bubrežne funkcije. Objavljena izvješća pokazuju da nekonvencionalni pristupi (transhepatični, translumbarni) nisu inferiorni konvencionalnima u pogledu infektivnih komplikacija. Ipak, ostaje upitna njihova dugoročna korist budući da su praćeni velikom incidencijom disfunkcije pristupa.

Prikazi slučaja: Ovo je prikaz dvaju slučajeva bolesnika iz lipnja 2023. godine koja su kao vitalnu indikaciju zahtijevala postavljanje nekonvencionalnog HDK-a transhepatičnim putem hepatičnim venama u donju šuplju venu do desnog atrija. U oba bolesnika svi konvencionalni pristupi prethodno su bili iskorišteni i bili su bez radiološki prikazanog prikladnog protoka kroz te vene. Pod ultrazvučnim nadzorom u lokalnoj je anesteziji punktirana hepatična vena u razini prednje aksilarne crte i Seldingerovom tehnikom postavljen dvoluminalni Hickmanov kateter duljine 32 cm s vrhom u desnom atriju. Potom je kreiran tunel na prednjoj trbušnoj stijenci. Kateteri su u oba bolesnika omogućili zadovoljavajući protok i korišteni su za hemodijalizu. Prvi prikazani slučaj transhepatičnog pristupa za hemodijalizu omogućio je bolesniku zadovoljavajuće provođenje postupaka nadomještanja bubrežne funkcije do smrti, uzrokovane poslijeoperacijskim kardiokirurškim komplikacijama, dok je u drugog bolesnika uspješno poslužio kao spasonosna metoda provođenja nadomještanja bubrežne funkcije između disfunkcije prethodnog dijaliznog puta i kondicioniranja bolesnika za trajniju opciju nadomještanja bubrežne funkcije automatiziranom peritonejskom dijalizom.

Zaključak: Dva prikazana slučaja predstavljaju uspješno postavljanje HDK-a transhepatičnim putem kao metodom uspostave dijaliznog pristupa u vitalnoj indikaciji.

Ključne riječi: hemodijaliza, krvožilni pristup, nadomještanje bubrežne funkcije, transhepatični krvožilni pristup, tunelirani kateter za dijalizu

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