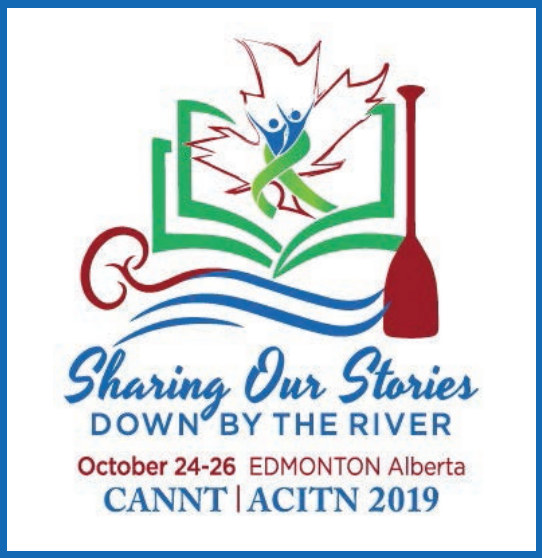
CANNT|ACITN
Canadian Association of Nephrology Nurses and Technologists
l'Association canadienne des infirmières et infirmiers et des technologues de néphrologie

CANNT JOURNAL
JOURNAL ACITN

Volume 29, Issue 1 January–March 2019



IN THIS ISSUE:

CANNT|ACITN
Canadian Association of Nephrology Nurses and Technologists
l'Association canadienne des infirmières et infirmiers et des technologues de néphrologie

JANUARY–MARCH 2019 • VOLUME TWENTY-NINE • ISSUE ONE

CANNT JOURNAL
JOURNAL ACITN

CONTENTS

IN EACH ISSUE:

The CANNT Journal is printed on recycled paper.

Transhepatic central venous hemodialysis catheter insertion: A creative approach for managing challenging vascular accesses

By Patty Quinan, Abdurrahman Eddeb, and Harold Borenstein

ABSTRACT

Establishing and maintaining functional vascular access (VA) for patients on hemodialysis can be challenging. Alternative options must be considered when conventional options are not possible or preservation of a single remaining venous access site to achieve permanent VA is required (Lorenz et al., 2010; Rajan, Croteau, Sturza, Harvill, & Mehall, 1998; Smith, Ryan, & Reddan, 2004). This case report describes a 55-year-old male with multiple failed vascular access procedures, bilateral occlusion of internal and external jugular, subclavian, and innominate veins, and frequent episodes of catheter-related bacteremia (CRB) resulting in hospitalization. A unique plan of care involved the use of a bridging transhepatic catheter pending the insertion of a definitive arteriovenous (AV) graft. The success of this intervention was dependent on collaboration between nephrology, interventional radiology, and vascular surgery team members.

Key words: transhepatic, vascular access, central venous catheter, arteriovenous

INTRODUCTION

Conventional vascular access (VA) options for patients requiring hemodialysis include arteriovenous (AV) fistula, AV graft and central venous catheter (CVC) (i.e., dual-lumen hemodialysis catheter). Long-term use of CVC is associated with high morbidity and hospitalization rates, increased treatment costs, and poor survival (Lok & Mokrzycki, 2011; Maki, Kluger, & Crnich, 2006; Mermel et al., 2009). As such, CVC use is indicated as a bridge to AV access creation, peritoneal dialysis, or renal transplantation within six months. Further, it should be restricted to patients requiring acute or emergency dialysis, and to patients who are otherwise deemed medically or surgically unsuitable for AV access creation (Battistella, Bhola, & Lok, 2011; Jindal et al., 2006; NKF-KDOQI, 2006; Quinan et al., 2011).

AUTHOR NOTE

Patty Quinan, MN, RN, CNeph(C), Clinical Nurse Specialist, Vascular Access Coordinator; Abdurrahman Eddeb, MD, FRCPC, Interventional Radiologist; Harold Borenstein, MD, FRCPC, Nephrologist, Humber River Hospital, Toronto, ON

Address for correspondence: Patty Quinan, Humber River Hospital, 1235 Wilson Avenue, Toronto, ON M3M 0B2.

Phone: (416) 242-1000 ext 22150; email: ***pquinan@hrh.ca***

Functional VA is essential to patient survival. However, establishing and maintaining functional vascular access for some patients can be challenging and often requires non-conventional and creative approaches (Lorenz et al., 2010). In patients with chronic central vein occlusion who are not candidates for conventional approaches, alternative hemodialysis (HD) access sites include recanalization of occluded neck and chest veins, and femoral veins, catheterization of enlarged collateral vessels, translumbar puncture of the inferior vena cava (IVC), and transhepatic catheter placement (Biswal, Nosher, Siegel, & Bodner, 2003; Kinney, 2003; Lund, Trerotola, & Scheel, 1995; Rajan et al., 1998; Weeks, 2002). Lorenz et al. (2010) suggest that occlusion of the infrarenal IVC may result in technical failure of the translumbar approach and further limit options to transhepatic or direct right atrial catheterization. The following case report describes a unique approach to the management of a challenging vascular access.

CASE REPORT

Mr. E. is a 55-year-old male who started on conventional in-centre hemodialysis in 2006 with a right internal jugular catheter. Past medical history includes hypertension, diabetes, hyperlypidemia, myocardial infarction, chronic cerebral vascular disease, and dementia. In addition, the patient had severe and frequent infectious complications including methicillin-resistant *Staphylococcus aureus* (MRSA) bacteremia, extended-spectrum beta-lactamase (ESBL) urinary tract infection, *Staphylococcus aureus* diskitis at L4-S1, and osteomyelitis.

Vascular access history includes failed left and right arm AV fistulas and AV grafts, and bilateral central vein occlusion (Figure 1). The patient previously had five femoral dialysis catheter-related bacteremias (CRB) within a three-month interval, resulting in catheter exchanges, removals, and line holidays (i.e., line removal and reinsertion after 24–48 hours), and was subsequently being dialyzed with a right tunneled femoral CVC.

After multiple failed VA procedures, a plan to establish alternative, non-conventional vascular access options became necessary for the patient's survival. Peritoneal dialysis was considered; however, due to his history of numerous catheter procedures and episodes of dialysis CRB, he was deemed unsuitable (Figure 1).

An episode of CRB and pulmonary emboli (confirmed by Computer Tomography [CT] scan) led to hospitalization. Treatment included systemic anticoagulation and treatment for CRB from a right tunneled femoral

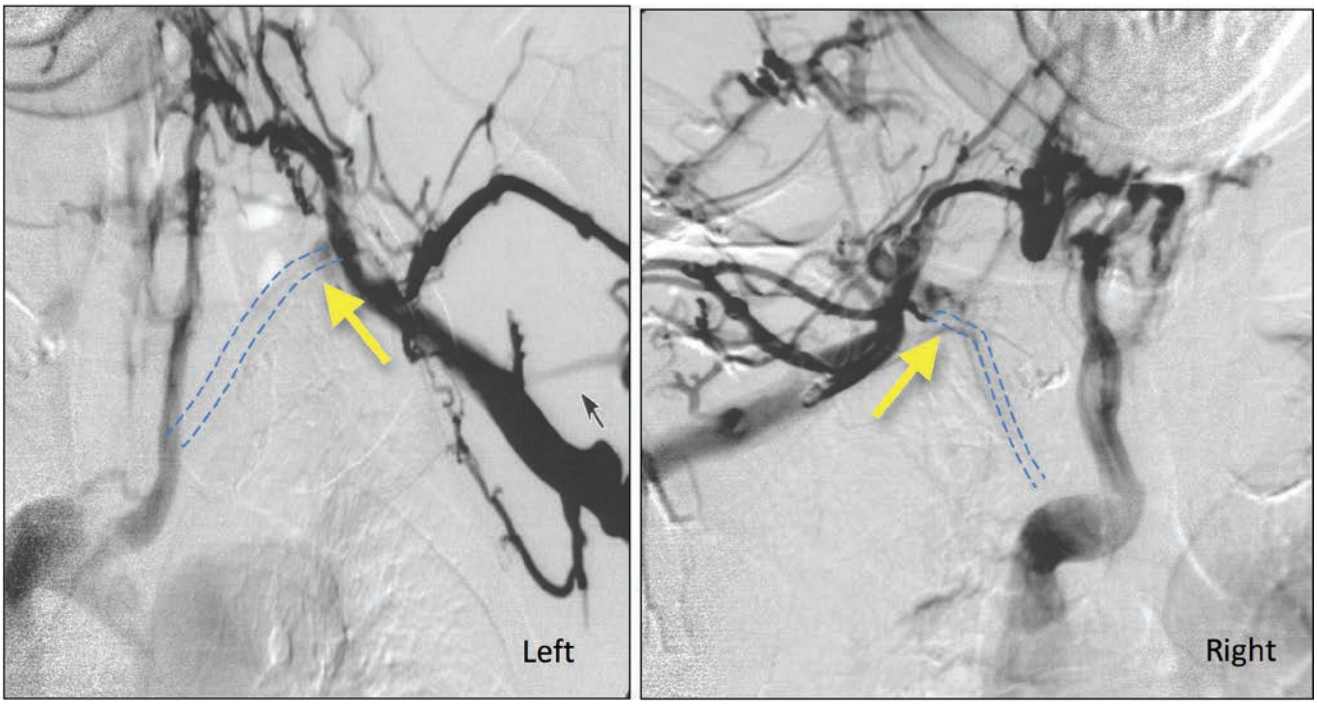


Figure 1. Superior vena cavogram shows chronic occlusion of the left and right innominate veins.

dialysis catheter with broad antibiotic coverage against *Pseudomonas aeruginosa* growth in blood cultures. Due to the complexity of the patient's case, the vascular access coordinator (VAC) presented the case at monthly dialysis access rounds to the vascular surgeons, interventional radiologists, and nephrologists for review. Discussions included establishing a short-term alternative central venous VA, removing the tunneled femoral CVC, and placing a polytetrafluroethylene (PTFE) synthetic graft in the left upper thigh as the definitive VA. The rationale for removing the right femoral catheter prior to placement of the leg graft was to optimize graft function and longevity, and reduce the risk of infection. Since conventional central venous access was not an option, non-conventional short-term options such as translumbar and transhepatic CVC procedures were discussed.

The vascular surgeon reviewed bilateral duplex ultrasounds of leg arteries and veins, and deemed that the patient was suitable for placement of an AV leg graft. The plan was to perform surgery once blood cultures were negative; however, episodes of CRB persisted. Pre-operative instructions from the vascular surgeon prior to placement of an AV leg graft included daily Chlorhexidine scrubs to both groins to minimize the risks of post-operative infection.

The interventional radiologist considered both translumbar and transhepatic catheter options, and decided to proceed with a transhepatic catheter procedure. A translumbar approach was avoided due to the possibility of thrombosis of the inferior vena cava (IVC) in the setting of a plan for placement of an AV leg graft. Therefore, the interventional radiologist planned to insert a transhepatic CVC and remove the infected tunneled femoral CVC.

ANGIOGRAPHIC PROCEDURAL DETAILS: TRANSHEPATIC CVC INSERTION AND REMOVAL OF TUNNELED FEMORAL CVC

The patient's pre-existing right femoral CVC was successfully removed over a guidewire and replaced by a vascular sheath into the proximal portion of the IVC. The diagnostic catheter was then advanced into the right hepatic vein, and a venogram was carried out.

A 22-gauge Chiba needle was advanced into the liver parenchyma from a right-sided intercostal approach into the peripheral portion of the opacified right hepatic vein (Figure 2). A 0.18 guidewire was then advanced through

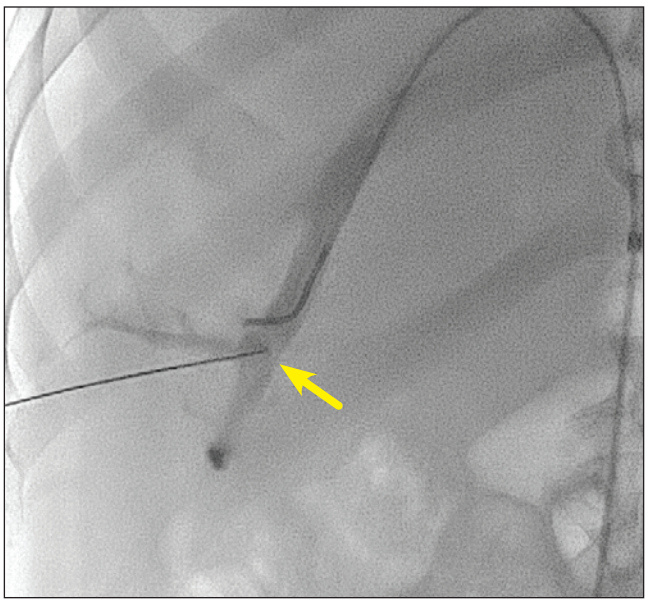


Figure 2. Needle advanced into the right hepatic vein via a right-sided intercostal approach

the needle and eventually into the right atrium (Figure 3). The tract within the liver parenchyma was dilated using a 14-French peel-away sheath. Eventually, a 24-cm (Cardiomed®) CVC was tunnelled through the skin on the right side and advanced through the sheath where its tip was placed into the right atrium (Figure 4).

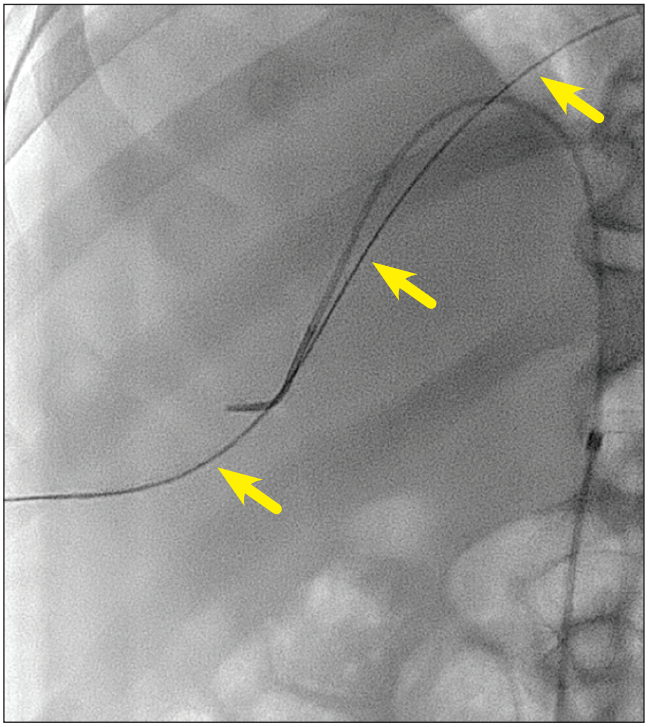


Figure 3. Guidewire is advanced through the needle.

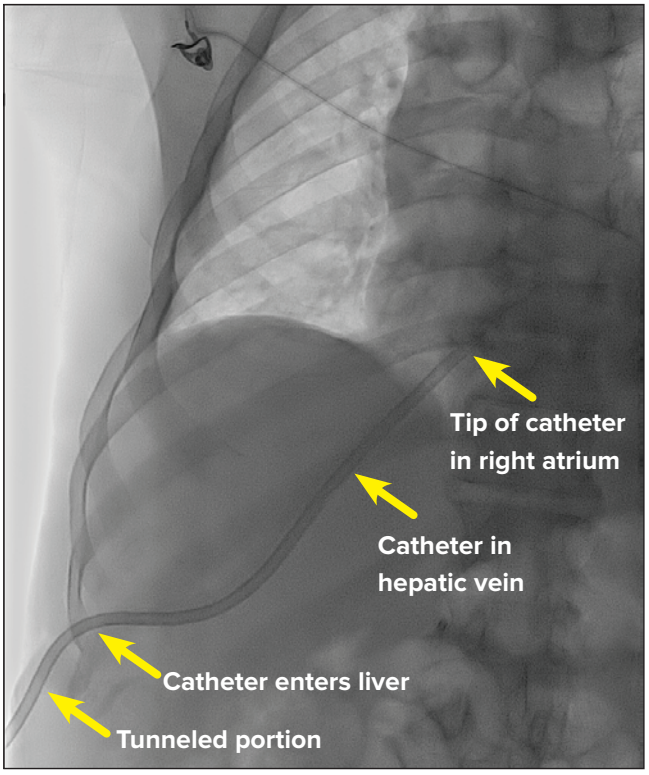


Figure 4. A 24-cm CVC is tunneled and advanced with tip in right atrium.

After the skin tunnel was created and the HD catheter was sutured in place, satisfactory flow was demonstrated through both ports of the right tunneled transhepatic CVC. The vascular sheath and catheter from the right femoral vein was removed without complications.

NURSING IMPLICATIONS FOR CARE OF TRANSHEPATIC CVC

Mr. E. remained in hospital throughout the entire time that the transhepatic catheter was in place. The nursing staff on the in-patient unit, the transportation staff, and the nurses in dialysis were instructed to exercise extreme caution when providing direct patient care and during patient transfers to avoid tugging or pulling on the HD catheter. Nurses were instructed to monitor the catheter site frequently for bleeding or catheter dislodgement, and to ensure that the dressing material remained intact. The transhepatic dialysis catheter was secured in place with a transparent dressing material and changed at least every seven days, in accordance with the Centres for Disease Control and Prevention (CDC) (2011) guidelines (O'Grady et al., 2011). An order was obtained from the nephrologist not to remove the exit site sutures while the catheter was in situ in an effort to reduce the likelihood of migration or accidental dislodgement of the catheter, bleeding, and access loss. It is noteworthy that Mr. E. experienced only one episode of CRB while the transhepatic catheter was in place.

SURGICAL PLACEMENT OF LEFT ARTERIOVENOUS LEG GRAFT

One-week post-transhepatic catheter insertion, Mr. E. was scheduled for vascular surgery for placement of a left AV thigh polytetraflouroethylene (PTFE) graft. However, two days before surgery, the patient developed rigors while on HD, and IV antibiotics were administered. After discussion with the vascular surgeon and the nephrologist, the decision was made to proceed with surgery. Blood cultures grew *E. coli*, and the patient was treated with ceftazidime, ertapenem, and cefazolin intravenously, and oral ciprofloxacin.

Placement of the left AV thigh graft occurred five days after insertion of the right transhepatic CVC. The surgical procedure was tolerated well, and a strong bruit was noted throughout the leg graft during the immediate post-operative period. On assessment, the bruit and thrill were strong, and three weeks post-operatively, the AV graft was deemed ready for cannulation. A duplex ultrasound confirmed an access flow volume of 1,000 mL/min with no evidence of stenosis. A plan was made to remove the transhepatic catheter once cannulation was successful for three consecutive dialysis treatments.

Twenty-five days after placement of the left leg AV graft, cannulation was initiated using two 16-gauge needles. At a blood flow rate of 300 mL/min, the venous and arterial pressure readings of 150 mmHg and –150 mmHg were recorded, respectively. Hemostasis after needle removal was achieved after 10 minutes for each site. After discussions with the nephrologist, vascular surgeon, and interventional radiologist, the transhepatic catheter was removed without incident 38 days post AV graft insertion. The transhepatic catheter was in situ for a total of 43 days (6 weeks).

ANGIOGRAPHIC PROCEDURE: REMOVAL OF TRANSHEPATIC CVC AND EMBOLIZATION OF THE LIVER PARENCHYMA TRACT

Under sterile conditions and fluoroscopic control, the patient's pre-existing right transhepatic catheter was withdrawn over a guidewire (Figure 5). The extrahepatic venous location of the tip of the catheter was confirmed with contrast injection (Figure 6). The transhepatic catheter was then removed without complications. The tract within the liver parenchyma was then embolized using a 12 mm Amplatzer Vascular Plug II (Figure 7). The Amplatzer plug was successfully deployed in the tract. Mild oozing from the site disappeared following the deployment of the plug (Figure 8).

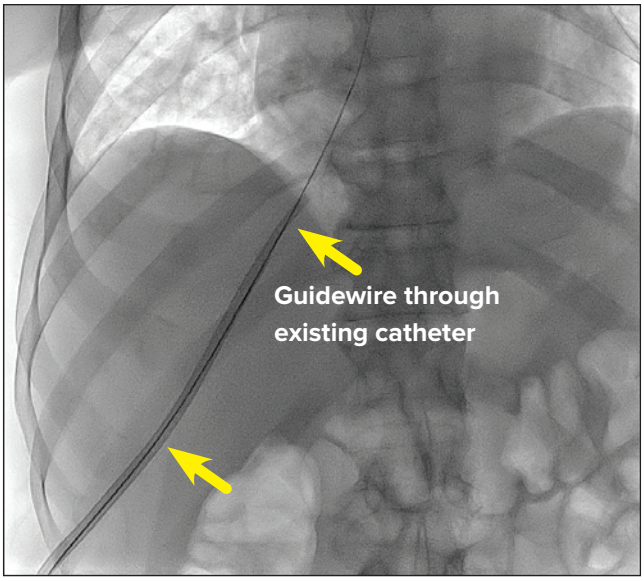


Figure 5. Withdrawal of pre-existing right transhepatic CVC over a guidewire

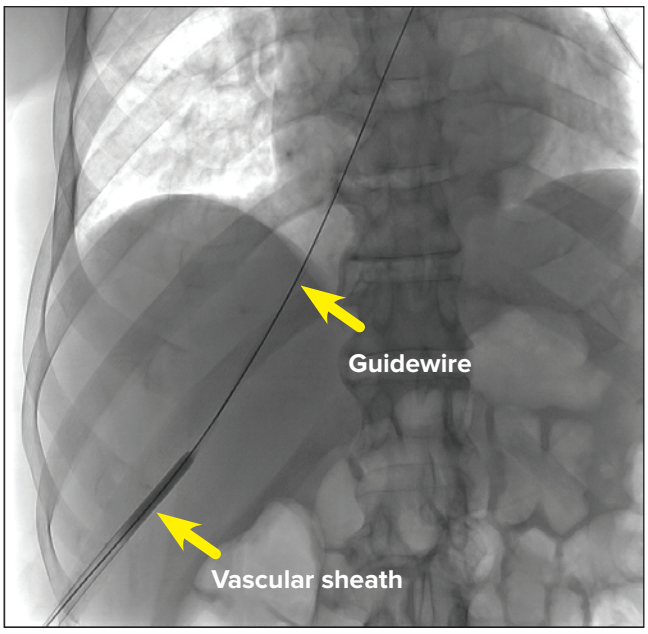


Figure 6. Confirmation of catheter tip extrahepatic venous location with contrast

DISCUSSION

Interventional radiologists, in collaboration with the nephrology team (nephrologists, VAC, and nurses), and vascular surgeons play an integral role in achieving and maintaining functional vascular accesses for all patients on hemodialysis. However, establishing VA for some patients presents a significant challenge and may require non-traditional approaches (Lorenz et al., 2010; Rajan et al., 1998; Weeks, 2002).

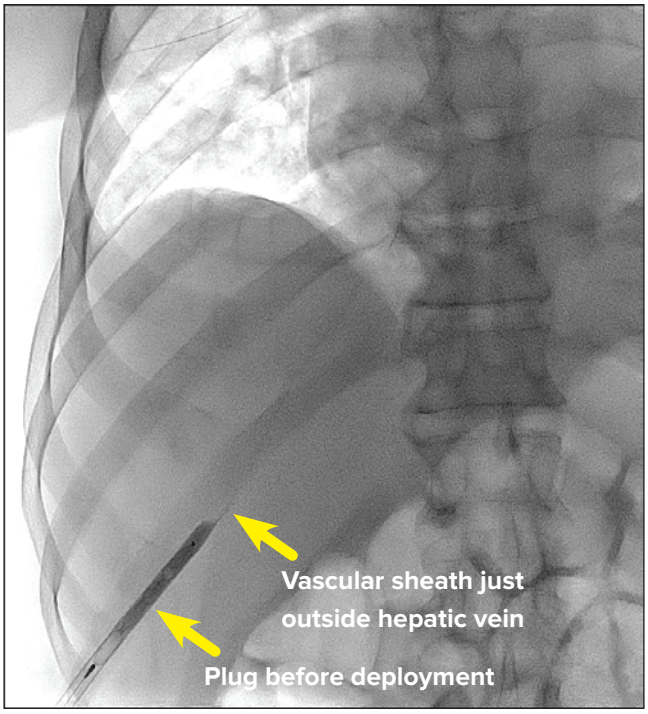


Figure 7. Embolization of liver parenchyma tract with Amplatzer plug

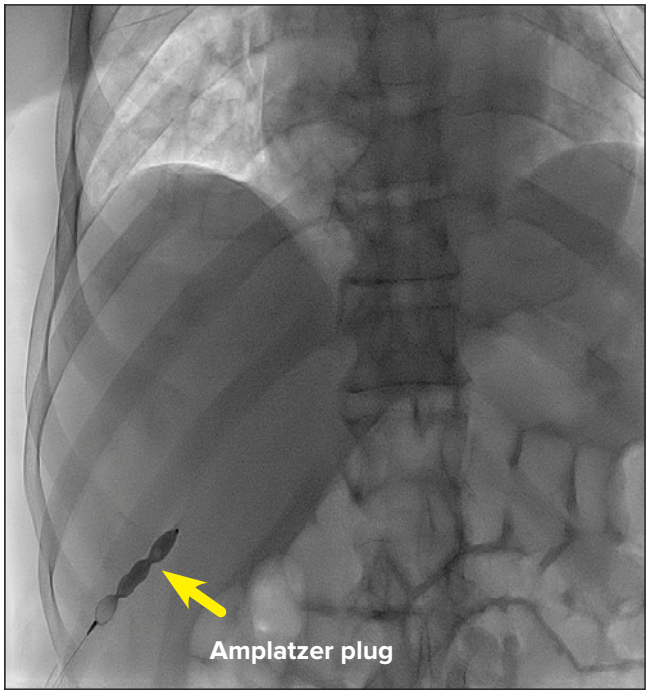


Figure 8. Final deployment of Amplatzer plug

The first report of successful placement of a transhepatic HD catheter was a case report by Po, Koolpe, Allen, Alvez, & Raja (1994), who concluded that the transhepatic route was sufficient for adequate dialysis. Further studies report that transhepatic HD catheters are considered a safe and viable option for patients with limited options; however, they suggest that there are maintenance issues and complications (Ghasemi Esfe et al., 2010; Lorenz et al., 2010; Sanal et al., 2016; Smith et al., 2004; Younes et al., 2011). Ghasemi Esfe et al. (2010) reported a complication rate of 29%, which is significantly higher than jugular access. Complications include: bleeding; biliary tract communication; infection; hepatic dysfunction; migration into the subcutaneous soft tissue, retroperitoneum, or iliac veins; dislodgement; and thrombosis (Kim & Lund, 2002; Rajan et al., 1998; Sanal et al., 2016; Smith et al., 2004; Stavropoulos et al., 2003; Younes et al., 2011). Despite the substantial risks associated with transhepatic catheters, Smith et al. (2004) and Wacker, Lipuma, and Blum (2005) reported patency rates greater than 120 days in more than 50% of patients, and more recently, Sanal et al., (2016) reported patency rates of 50% at 136 days. Transhepatic catheters are considered a feasible option in patients who have exhausted conventional VA approaches and should be used as a last access (Lorenz et al., 2010; Smith et al., 2004; Stavropoulos et al., 2003; Waker, Lipuma & Blum, 2005; Sanal et al., 2016).

CONCLUSION

Transhepatic catheter placement is demonstrated as a bridge to establishing a functional AV access. In this case report, the transhepatic CVC was in place for a total of 38 days with only one episode of catheter occlusion requiring instillation of alteplase (Cathflo®) for restoration of catheter patency. It should be noted that due to sluggish flow from the arterial (red) catheter lumen, the catheter was connected in the reverse position with each dialysis, even immediately after the catheter was inserted. The urea reduction ratio remained consistently above 70%, and pre-dialysis serum potassium levels remained below 5.6 mmol/L. Successful cannulation of the left AV leg graft was achieved 25 days post-operatively and was maintained, thus allowing for the removal of the transhepatic catheter.

Our single patient experience with a transhepatic catheter as a bridge therapy proved to be highly successful, and may be considered for patients who have exhausted conventional vascular access options. Transhepatic catheter placement by the interventional radiologists will be considered at our centre in the future as an option in the management of patients who have exhausted conventional vascular accesses. Younes et al. (2011) and Sanal et al. (2016) evaluated functional outcomes of 22 and 34 catheters, respectively, and concluded that transhepatic catheters provide alternative short-term and long-term access for patients who are dependent on chronic HD and have inaccessible central venous routes. Furthermore, the authors suggest that with effective use of imaging modalities, transhepatic venous catheterization has high technical success and low rates of morbidity and complication rates in experienced hands. Generalizability of this approach to VA may be limited to centres with advanced expertise in interventional radiology and remains to be determined. Further studies would be required to determine its feasibility for longer-term VA in patients on chronic HD.

REFERENCES

Battistella, M., Bhola, C., & Lok, C.E. (2011). Long-term follow-up of the hemodialysis infection prevention with polysporin ointment HIPPO study: A quality improvement report. *American Journal of Kidney Diseases*, *57(3)*, 432–441.

Biswal, R., Nosher, J.L., Siegel, R.L., & Bodner, L.J. (2003). Translumbar placement of paired hemodialysis catheters (Tesio catheters) and follow-up in 10 patients. *CardioVascular Interventional Radiology*, *23(1)*, 75–78.

Ghasemi Esfe, A.R., Vaziri Bozorg, S.M., Ahmadi, F., Eslami, K.H., Ghasemi Esfe, M., & Rokni Yazdi, H. (2010). Percutaneous transhepatic venous access for permanent hemodialysis catheter placement: Procedure and complications. *Iranian Journal of Radiology*, *7(2)*, 67–70.

Jindal, K., Chan, C., Deziel, C., Hirsch, D., Soroka, S., Tonelli, M., & Culleton, B. (2006). Hemodialysis adequacy in adults. *Clinical Journal of the American Society of Nephrology*, *17*(Suppl 1), S24–27.

Kim, H.S., & Lund, G.B. (2002). Exotic catheter access. In R.J. Gray & J.J. Sand (Eds.). *Dialysis access: A multidisciplinary approach* (pp. 270–282). Philadelphia, PA: Williams & Wilkins.

Kinney, T.B. (2003). Translumbar high inferior vena cava access placement in patients with thrombosed inferior vena cava filters. *Journal of Vascular and Interventional Radiology*, *14(2)*, 1563–1568.

Lok, C.E., & Mokrzycki, M.H. (2011). Prevention and management of catheter-related infection in hemodialysis patients. *Kidney International*, *79(6),* 587–598.

Lorenz, J.M., Regalado, S., Nuvuluri, R., Zangan, S., VanHa, T., & Funaki, B. (2010). Transhepatic guidance of tranlumbar hemodialysis catheter placement in the setting of chronic infrarenal IVC occlusion. *CardioVascular and Interventional Radiology*, *33*, 635–638.

Lund, G.B., Trerotola, S.O., & Scheel, P.J. Jr. (1995). Percutaneous translumbar inferior vena cava cannulation for hemodialysis. *American Journal of Kidney Diseases*, 25(5), 732–737.

Maki, D.G., Kluger, D.M., & Crnich C.J. (2006). The risk of bloodstream infection in adults with different intravascular devices: A systematic review of 200 published prospective studies. *Mayo Clinical Proceedings*, *81*(9), 1159–1171.

Mermel, L.A., Allon, M., Bouza, E., Craven, D.E., Flynn, P., O'Grady, N.P., … Warren, D.K. (2009). Clinical practice guidelines for the diagnosis and management of intravascular catheter-related infection: 2009 update by the Infectious Disease Society of America (IDSA). *Clinical Infectious Diseases, 49(1)*, 1–45.

National Kidney Foundation – Kidney Disease Outcomes Quality Initiative (NKF-KDOQI). *Clinical practice guidelines and clinical*

practice recommendations: 2006 updates. Clinical practice guidelines for vascular access - Guideline 1. Retrieved from http://kidneyfoundation.cachefly.net/professionals/KDOQI/guideline_upHD_PD_VA/va_guide1.htm

O'Grady, N.P., Alexander, M., Burns, L.A., Dellinger, E.P., Garland, J., Heard, S.O., ... Healthcare Infection Control Practices Advisory Committee (HICPAC) (Appendix 1). (2011). Guidelines for the prevention of intravascular catheter-related infections. *Clinical Infectious Diseases*, *52*(9), e162–e193. doi.org/10.1093/cid/cir257

Po, C.L., Koolpe, H.A., Allen, S., Alvez, L.D., & Raja, R.M. (1994). Transhepatic permcath for hemodialysis. *American Journal of Kidney Diseases, 24,* 590–591.

Quinan, P., Beder, A., Berall, M. J., Cuerden, M., Nesrallah, G., & Mendelssohn, D. (2011). A three-step approach to conversion of prevalent catheter-dependent hemodialysis patients to arteriovenous access. *Canadian Association of Nephrology Nurses and Technologists Journal, 21(1),* 22–33.

Rajan, D.K., Croteau, D.L., Sturza, S.G., Harvill, M.L., & Mehall, C.J. (1998). Translumbar placement of inferior vena caval catheters: A solution for challenging hemodialysis access. *Scientific Exhibit 18(5)*, 1155–1167.

Sanal, B., Nas, O.F., Dogan, N., Korkmaz, M., Hacikurt, K., Yildiz, A. ,... Erdogan, C. (2016). Safety and functionality of transhepatic hemodialysis catheters in chronic hemodialysis patients. *Diagnostic and Interventional Radiology*, *22*(6), 560–565.

Smith, T.P., Ryan, J.M., & Reddan, D.N (2004). Transhepatic catheter access for hemodialysis. *Vascular and Interventional Radiology, 232(1)*, 246–251.

Stavropoulos, S.W., Pan, J.J., Clark, T.W., Soulen, M.C., Shlansky-Goldberg, R.D., Itkin, M., & Trerotola, S.O. (2003). Percutaneous transhepatic venous access for hemodialysis. *Journal of Vascular and Interventional Radiology*, *14*(9 Pt 1*)*, 1187–1190.

Wacker, F.K., Lipuma, J., & Blum, A. (2005). Alternative hemodialysis catheterization access in patients with occluded peripheral venous access sites. *Rofo*, *177*(8), 1146–1150.

Weeks, S.M. (2002). Unconventional venous access. *Techniques in Vascular and Interventional Radiology, 5(2)*, 114–120.

Younes, H.K., Pettigrew, C.D., Anaya-Ayala, J.E., Soltes, G., Saad, W.E., Davies, M.G., ... Peden, E.K. (2011). Transhepatic hemodialysis catheter; functional outcome and comparison between early and late failure. *Journal of Vascular and Interventional Radiology*, *22*(2), 183–191.