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Review Article

Extending the End of the Line for 'Last Chance' Central Venous Access in Haemodialysis: What Are the Options for Exotic Line Insertion?

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Abstract

Patients are living longer than ever on renal replacement therapy, whilst venous access options regularly go down, leaving a growing number of patients without any conventional access routes. This review seeks to summarise and analyse the outcomes associated with 'last chance' venous access routes (translumbar, transhepatic, transrenal, sharp recanalisation and limb entry) in order to describe catheter survival, infection rates, and identify specific risks with each of these techniques. We hope this discussion will help clinicians to rationalise the options for patients in this difficult situation.

INTRODUCTION

Patients are living longer on renal replacement therapy than ever before [1]. Recent UK figures show that a new patient starting dialysis at age 50 can expect to survive for over ten years [1], whilst the majority of central venous catheters (CVCs) will not survive their first year Therefore, those who are unsuitable for transplantation or peritoneal dialysis are confronted with an ever narrowing range of venous access options, as traditional routes succumb to infection, thrombosis and stenosis over time. Eventually, the patient is without any traditional access options at all. Notwithstanding attempts to transition all dialysis patients to a surgical access solution (i.e. autogenous or prosthetic angio-access), it remains the case that a group of patients will be unable or unwilling to transition to one of these, or may have not any surgical options remaining following repeated failed attempts.

Once traditional venous access routes have been exhausted, clinicians must consider which of the 'last chance' access options to use (e.g. translumbar, transhepatic, transrenal, limb or sharp recanalisation). The conventional hierarchy is well established - the right internal jugular vein provides an attractive target which offers low dysfunction and infection rates relative to left-sided insertion, subclavian and femoral routes. In contrast, although multiple so called 'last chance' access routes have been described, it remains unclear which of these is superior. This review will attempt to compare outcomes for these techniques.

TRANSLUMBAR

The translumbar approach to percutaneous cannulation of the inferior vena cava (IVC) was first described in the context of long term parenteral nutrition in 1985 [2], but Lund was the first to apply this technique to haemodialysis patients [3]. The technique for translumbar catheter insertion begins with computed tomography pre-intervention planning to establish minimum needle length [4]. The surface landmark for entry is a point 5 cm above the right iliac crest, and the needle is inserted toward the proximal margin of L3. The IVC is identified by feeding a guidewire through the femoral vein, or by injecting contrast into proximal tributaries. Once confident of entry, contrast is injected to confirm placement and a wire is advanced along the tract proximally, until the tip resides in the superior vena cava (SVC). An appropriately sized peel-away sheath is inserted, and the catheter tip should lie in the right atrium.

Survival estimates for translumbar catheters are mixed. In one retrospective study of 84 catheters placed in 28 patients over a period of 6 years at the Cleveland clinic (USA) [5], mean catheter patency was 381 days, whilst 12-month primary catheter patency was only 7% (n=2/28), suggesting that a small number of extremely long-lived catheters skewed the mean, a pattern also seen in other studies [6-8]. In contrast, British researchers reported a 12-month primary catheter patency of 73% [9]. In that study, the authors were comparing outcomes for translumbar catheterisation (whose recipients are *in extremis*); with a contemporary cohort of patients receiving conventional tunneled lines. Catheter patency at 1-year was not significantly worse in the translumbar group. However, these results may not generalize well as the team used an aggressive catheter-sparing strategy, treating infection and thrombosis medically rather than exchanging lines. In addition, all catheters were inserted by a single highly experienced operator.

The leading cause of catheter removals, representing 40% of cases are due to dysfunction and the next most common cause is following infection [10]. Catheter dysfunction is generally recognized by poor blood flow (e.g. <200mlmin^{-1}) and tends to be secondary to thrombus, fibrin sheath formation or catheter migration. Translumbar catheter dysfunction is primarily thrombotic, and a response to thrombolytic therapy is seen in approximately 71-80% of cases [5]. Due to the anatomy of translumbar catheters, migration is an additional problem, with 13% of incident translumbar catheters eroding into the surrounding subcutaneous tissues, retroperitoneal spaces and even the internal iliac vein [11]. Retroperitoneal haemorrhage has been reported in two separate studies following translumbar catheter insertion [10,11]. These reports include a total of three patients, and in all cases the events were self-limiting. Some have argued that to militate against this risk, heparin should be avoided during the first dialysis circuit. Although estimates vary, the infection rate for a modern conventional CVC is between 1-2/1000 catheter days [10]. Infectious complications for translumbar catheters have been reported to be in line with this, one study reported a risk of 2.84/1000 catheter days. Most of these were exit site infections, and the bacteraemia rate in this study was only 0.82/1000 catheter days [9], alternatively Aitken et al report a risk of 0.66/1000 catheter days in their cohort.

TRANSHEPATIC

Transhepatic cannulation of the inferior vena cava has been described by multiple authors, but results are mixed. Po described the insertion of a PermCath™ for haemodialysis in 1994, and whilst the procedure was technically successful, the catheter required replacement after only five days because of poor blood flow [12]. Pre-intervention CT scanning is required in order to assess the patency of the hepatic veins, confirm normal or variant anatomy, and to establish the length of catheter to be inserted [4]. The 8th/9th intercostal space in the right midaxillary line is the surface landmark. The needle is inserted towards the liver in the direction of T12. Then, the needle is withdrawn with contrast injected concurrently, allowing for the identification of the target (right or middle hepatic vein) by fluoroscopy or CT. This may require multiple attempts. A guidewire is inserted to the right atrium and exchanged for a coaxial transitional sheath. Once the tract is established, a subcutaneous tunnel is created, oriented parallel to the needle approach. A gentle angle is ideal to avoid dislodgement with respiration. Finally, a peel away sheath and catheter are then inserted in the standard way.

Estimates of transhepatic catheter survival are mixed, although many reports describe that a significant proportion of transhepatic catheters require removal in the first 30 days [12-14]. One case series of transhepatic catheters found a mean survival of 87.7 days [15], however unfortunately this cohort of 22 patients required 105 exchanges and 127 catheter placements over five years. The median number of changes for an individual patient in this series was five (range 1-18). Other groups have had similar difficulty maintaining access via this route [7]. In one case series, 36 catheters were placed in 12 patients with a mean survival of only 24.3 days [14]. The dysfunction rate for transhepatic catheters explains the need for frequent exchanges to maintain access. On reviewing the records of 22 patients from 2003-2008, Younes et al found the risk of dysfunction due to thrombosis was 1.8/1000 catheter days [15]. However, when dysfunction due to non-thrombotic causes were also included, migration added 3.9/1000 catheter days to the overall dysfunction rate. One group recorded a rate of transhepatic catheter dysfunction of 24.2/1000 catheter days, ten-fold higher than would be expected for a conventional catheter [14]. These high rates of dysfunction are probably secondary to the effect respiration has on catheter migration. In one transhepatic series, 5/16 catheters became dislodged and migration was the most frequent reason for removal [13]. Proper estimation of the specific transhepatic catheter infection risk is difficult due to infrequent reporting. There is no evidence that transhepatic catheters more likely to become infected than any other site, Younes et al did report a 'sepsis risk' of 2.2/1000 catheter days [15].

One aspect of the transhepatic route that causes concern is the frequency of major complications. In one study of 10 patients, one patient died as a result of their access; suffering from massive intraperitoneal haemorrhage on day one [13]. The catheter must traverse and then reside within the liver, frequently causing bleeding or thrombosis. Thrombosis of the hepatic vein can cause an acute Budd-Chiari syndrome and this has been described in a paediatric patient [16]. Finally, the anatomical location of the catheter means that removing transhepatic catheters also represents a risk to the patient, who may subsequently require catheter tract embolisation to close a venous-biliary-peritoneal fistula [17].

TRANSRENAL

The transrenal approach has been subject to a small number of reports in the literature, which limits estimation of the attendant risks. Transrenal catheterisation requires demonstration (by ultrasound) that kidneys are atrophic, the renal veins are patent and there is a safe window for the needle and catheter to be passed. The mid/inferior parenchyma is identified and a 22-gauge Chiba needle inserted under ultrasound guidance. The course is similar in trajectory to insertion of a nephrostomy tube, with the needle angled superiorly and towards the midline. As with transhepatic cannulation, the needle is pulled back whilst contrast is injected to identify a renal vein tributary. This may require multiple attempts. Direct cannulation of the central vein is typically avoided, and once contrast injection confirms the correct position, a guidewire is inserted followed by a coaxial transitional sheath and the distance to the right atrium is established. A peel-away sheath is inserted, and a catheter introduced once the tract has been dilated. Finally, a subcutaneous tunnel is created and secured.

Three reports of transrenal catheters inserted for haemodialysis were found, of these, all were reported to survive for at least four months without intervention [18-20]. The shortest-lived catheter was lost when the patient died, the second was lost to follow up and the longest surviving catheter was followed to over two years before it was exchanged over a guidewire [18] because of poor blood flow due to fibrin sheath disruption [18]. Data one infection rates have not been reported and so estimation of specific risks is not possible.

Authors highlight the theoretical risk of arterial puncture and emphasise that operators are prepared to perform arterial embolization on the table if necessary (Table 1). Postintervention pseudoaneurysm is another theoretical consideration, given the techniques similarity to percutaneous renal biopsy.

SHARP RECANALIZATION

'Needle' or 'Sharp' recanalization is a method of forced entry into a chronically thrombosed segment of vein. It was used in the 1960s, but lost favour with the introduction and success of angioplasty. The aim is not to re-establish blood flow in central veins, but rather to dilate the vein to the extent it accepts the dialysis catheter. One benefit of this procedure is that it is flexible and can be used for collaterals in the limbs, chest or thorax. Similar techniques have been used for placement of transmediastinal and transvertebral catheters targeting the brachiocephalic vein, persistent left sided SVC and azygos veins. Reports of the technique in haemodialysis patients involve small numbers of patients, with short follow up.

Emergency equipment should be available whenever this technique is employed [4]. At the start of the procedure, venography is initiated at two sites, one distal to and one proximal to the stenosed central segment. This is to establish the shortest, straightest route across the vein. Proper 3D alignment is essential, and the planned recanalization path must not cross vital structures. A balloon is advanced from the central access point and inserted until it reaches the stenosed segment - this will act as the target. At the peripheral site, a 22-gauge chiba needle is inserted along the identified pathway towards the balloon until it is punctured. A guide wire is then placed, snared and pulled through. The tract is dilated, and an appropriately sized catheter inserted. In some cases, the vein is stented.

One series investigating this technique reported on 25 procedures in 22 patients [21]. One might expect poor survival given the quality of the underlying vein. Primary patency was

Table 1: Arterial Embolization Location.

Author (Year), Location	Access type	Study type	Duration	Participant type	Number of patients	Key outcome(s)	Key Conclusion(s)
Liu (2016), USA	Translumbar (TL)	Retrospective case series	2006-2013	Exhausted access options SVC Syndrome 96%	28 patients 84 catheters	40% Dysfunction rate, of these reversed by alteplase in 80% 21% had catheter at EOFU Total access days ranged 4-1948 (Mean patency 381) Primary catheter patency at 3,6,12 months was 43%, 25%, 7% Catheter related BSI 35% (Staph)	TLDC were placed successfully and functioned well. Most common complication was poor blood flow, but leading cause of catheter removal was catheter related bacteremia. TLDC is an acceptable alternative in, with occluded SVC and limited peripheral veins for dialysis catheters. However, these catheters cannot be expected to last more than 2 months without replacement.
Power (2010), UK	Translumbar	Retrospective case series	1999-2008	100% bilateral brachiocephalic occlusions. 8/26 SVC syndrome	26 patients 39 catheters	Cumulative *assisted catheter patency at 6 months and 1 year, 81% and 73% Infection risk 2.84/1000 catheter days One self-limiting retroperitoneal haemorrhage Admission risk for dysfunction 0.88/1000 Patients on HD for 5.9+/-3.2years before TLC	TL inferior vena caval CVCs can offer safe and effective long-term haemodialysis access in patients with no other options
Aitken (2014), UK	Translumbar Tunnelled Femoral Thigh Graft Peritoneal Dialysis Transplantation	Retrospective cohort	2009-2012	Bilateral central vein stenosis	25 TL patients	TL catheter survival at 3,6,12 months was 88%, 65%, 50% TL catheter infection risk was 0.6/1000 catheter days (TLC)	Patients with bilateral central vein stenosis often require more than one vascular access modality to achieve a "personal access solution." Expedited renal transplantation with priority local allocation of DCD organs to patients with precarious vascular access provides a potential solution to this difficult problem.

Herscu (2013), USA	Translumbar Transhepatic (TH)	Retrospective case series	2000-2011	Exhausted access	3 TL patients 4 TH patients	A mean of 14 (range: 11–18) dialysis access procedures prior to transhepatic/translumbar attempts. Primary catheter patency ranged from 15 to 658 days, with a mean of 295 days and a median of 245 days. Overall catheter patency ranged from 15 to 790 days, with a mean of 380 days and a median of 245 days.	TL and TH venous access are viable long-term alternative routes for catheter-based hemodialysis access in patients who have exhausted conventional options.
Rajan (1998), USA	Translumbar	Case series	1994-1997	Last chance access	42 patients 58 catheters	Complications included sepsis. fibrin sheath and thrombosis. IVC stenosis, 1 IVC occlusion after 40 months. Catheter migration into SC soft tissues, retroperitoneum and iliac veins. Retroperitoneal haematoma secondary to catheter migration out of the IVC following HD, and spontaneous retroperitoneal haemorrhage, n=2. Good flow rates of 300-400ml/min	TL route is an effective last resort. Advise 1st dialysis session should occur without heparin to allow tract to heal sufficiently
De Keulenaer (2005), Australia	Translumbar	Case report		Exhausted access	1 patient	Discharged day 95, with catheter still functioning. Occlusion of the inferior vena cava PICC line occurred on day 21 which was resolved with urokinase injection. Klebsiella sepsis with septic shock requiring a 24-hour readmission to intensive care for supportive treatment occurred 31 days after TL catheter insertion. Resolved with removal of the line and antibiotic treatment.	TL inserted into a critically ill 30-year old chronic haemodialysis patient with a history of intravenous substance abuse whose intravenous access sites had become exhausted. This approach could be an alternative where the standard access routes have become non-viable
Biswal (2000)	Translumbar	Case series		Exhausted access	10 patients	Catheters were in place for a total of 2252 catheter days. The average duration of catheter placement was 250 days (range 30-580 days). All catheters were functioning up to the time the study was completed One patient died. The most common complication was partial dislodgment of the catheter in 3 of 23 catheters (13%), all occurring in obese patients. One episode of retroperitoneal hemorrhage was noted in a patient having the single-access technique. There were no episodes of infection or IVC thrombosis.	Placement was successful in all cases and resulted in few complications. Catheters placed from a transcaval approach may be less prone to fibrin sheath formation. Therefore, placement of hemodialysis catheters using direct puncture of the IVC should become part of the procedural armamentarium of the interventional radiologist.

Smith (2004), USA	Transhe-patic	Retro-spective cohort		Last chance access	16 patients 21 catheters	Technical success was achieved in all patients. The mean total access site service interval was 138 catheter days (range, 0-599 days), and there was no significant difference according to patient sex (P =.869). Of the 16 catheters placed initially, five became dislodged and required an additional access procedure to be performed. These 21 catheters required 30 exchanges in 10 patients (48%) (range, 1-6 exchanges per patient). The most common reason for catheter exchange was device failure. There were six complications among 21 catheters placed (29%), including one death from massive intraperitoneal hemorrhage on the day after catheter placement.	Transhepatic hemodialysis catheters offer a viable option to patients with limited options; however, there are maintenance issues and complications
Po (1994), USA	Transhe-patic	Case re-port		Exhausted access	1 patient	There were no bleeding or thrombotic complications. The catheter was replaced once through the same track due to poor blood flow and reinserted once after 5 days due to infection. The patient has been doing well and receiving adequate dialytic therapy for over 1 year with this form of vascular access.	First report of haemodialysis catheter via the transhepatic route
Younes (2011), USA	Transhe-patic	Retro-spective review	2003-2008	Exhausted access	22 patients 127 catheters	Technical success was achieved in all cases. There were no hepatic injuries (bleeding or fistula formation). There were 105 exchanges in 14 patients, with a mean of 7.5 exchanges, a median of 5 exchanges (range 1–18 exchanges), and a catheter migration rate of 0.39 per 100 catheter-days. The sepsis rate was 0.22 per 100 catheter-days. The catheter thrombosis rate was 0.18 per 100 catheter-days. The mean cumulative catheter duration in situ was 506.2 days, and the mean time catheter in situ was 87.7 days. The mean total access site interval was 1,046 catheter-days (range of 423–1,413 catheter-days).	Transhepatic hemodialysis catheter placement is associated with low rates of morbidity. In this series, transhepatic catheters provided the possibility of long-term functionality, despite associated high rates of catheter-related maintenance, provides a potentially viable access for patients with exhausted access options.

Stavropoulos (2003), USA	Transhepatic	Retrospective review		Exhausted access	12 patients 36 catheters	The mean time of the catheters in situ was 24.3 days. Catheter thrombosis rate of 2.40 per 100 catheter-days. The line sepsis rate was 0.22 per 100 catheter-days.	Poor patency rates were seen because of a high rate of late thrombosis. Transhepatic dialysis catheters should only be used as a last resort unless limitations of catheter thrombosis can be overcome.
Lorenz (2010), USA	Translumbar (transhepatic guidance)	Case report		Exhausted access, failed TL	1 patient		
Law (2015), Hong Kong	Transrenal	Case report	2011-2013	Last chance access	1 patient 2 catheters	After 2 years catheter dysfunction secondary to fibrin sheath dysruption which failed to respond to urokinase administration. Exchange of hemodialysis catheter over the same site was performed.	In conclusion, our experience shows that percutaneous transrenal placement of hemodialysis catheter is feasible and the catheter can function well for a reasonable period of time. In case of complications, such as catheter blockage, revision and replacement are still possible under guidance of fluoroscopy"
Murphy (2002), USA	Transrenal	Case report		Last chance access	1 patient		The authors report a successful case of transrenal access into the renal vein with consequent insertion of a tunneled catheter for hemodialysis in a patient with limited options
Ong (2005), USA	Transrenal	Case report	4 months	Scleroderma	1 patient	Patient died with a functioning catheter at 4 months	Percutaneous placement of a hemodialysis catheter via the transrenal approach is technically feasible in the appropriate clinical setting, in patients who have exhausted their traditional venous access sites. However, the attendant risk of arterial and visceral injuries exists; therefore, further experience with this approach is needed to establish the overall risk versus benefit ratio
Pua (2012), Singapore	Sharp recanalization	Case report	9 months	End stage access	1 patient	Catheter survived to end of follow up at 9 months	Central vein recanalization, although technically challenging, is an attractive option for CDH. The ability to recanalize an occluded central vein conserves remaining venous accesses for future use and averts the need for unconventional and less favorable sites such as translumbar, femoral, or transhepatic access. Furthermore, catheters placed in a recanalized occluded central vein catheter exit the subcutaneous tunnel in a conventional location on the chest, familiar to both the patient and the dialysis personnel.

Przywara (2012), Poland	Sharp recanalization	Case series	2010-2011	Central venous stenosis	16 patients	No early or late complications related to the procedure occurred. We did not observe any clinically significant aggravation of symptoms of central vein stenosis or occlusion. Complications, not-related to the procedure included one, late skin entry site infection and one, late catheter thrombosis. No complications related to the procedure occurred within the period of last 12 months of observation.	"Our paper presents simple, quick and cost effective method of implantation of permanent catheters in hemodialysed patients with CVOD and exhausted and failed vascular access.
Athreya (2008), UK	Sharp recanalization	Case series		Failed wire recanalization	5 patients 6 catheters	One case was complicated by extravasation of contrast into the upper mediastinum after an initial puncture attempt. Initial catheter survival for 4-months until it was accidentally displaced by the patient. Mean catheter survival of 13 months (range 1-36 months) 2 patients died at 1-month due to medical co-morbidity and chest infection.	This technique can permit successful dialysis catheter placement in patients who have failed with traditional techniques.
Messina (2011), Italy	Sharp recanalization	Case series		Central venous stenosis	5 patients	Hemodialysis (HD) was carried out long term in all patients except one who presented a non-functioning CVC after 4 months. In one case the catheter, still functioning well after 9 months, was removed due to kidney transplantation. The CVC in the left superior vena cava was replaced with a longer one after 12 months, and it is still functioning well 3 months after replacement. The patency of the other two catheters has to date been kept for 9 and 18 months.	The placement of CVC for HD in atypical sites can be considered a viable option in extreme cases; adequate imaging support is paramount in order to facilitate the procedure and to avoid complications.
Mastuura (2010), USA	Mediastinal catheterisation	Case series		End stage access	3 patients	In all three cases, the tunneled dialysis catheters were placed under local anesthesia with no intravenous sedation. No pneumothorax occurred and all three catheters were used for HD within 24 hr. Two catheters were removed at 3 and 4 months for infection. One catheter continues to function well at the end of follow up.	As the lifespan of our dialysis patient population continues to improve, we will see an increasing need to perform complicated access procedures to maintain HD support. These three cases emphasize the value of the transmediastinal technique using basic C-arm fluoroscopy and a limited stock of basic catheters and guidewires

Funaki (2001), USA	Thyrocervical or occluded collateral veins in neck or chest	Retrospective review		End stage access	24 patients 25 catheters	Technical success was achieved in 22 (88%) of 25 procedures There were two procedural complications: a vasovagal episode and an episode of respiratory distress requiring intubation. Catheter malfunction requiring exchange occurred at a rate of 0.67 per 100 catheter days. Infection requiring catheter removal occurred at a rate of 0.06 per 100 catheter days. Primary patency was 90% at 1 month, 71% at 6 months, and 25% at 12 months. Secondary patency was 100% at 6 months and 70% at 12 months.	In patients undergoing hemodialysis in whom conventional venous access sites have been exhausted, interventional radiologic venous recanalization for the placement of permanent catheters is safe and effective. Catheters placed in recanalized veins or small collateral veins have shorter primary patency rates compared with those of conventionally placed catheters, but the former can be maintained for relatively long periods.
Yates (2009), UK	Great saphenous vein	Retrospective case series	6 months	Final, in extremis attempt at access	7 patients	All patients had successful completion of at least one HD session of at least >300ml/min flow. No immediate complications. Mean duration of patency: 76 days, median duration 64 days (range 3 - 163 days). Primary patency rates were 57%, 43% and 29% at 30, 60 and 90 days respectively. Secondary patency rates were 71%, 57% and 29% respectively. 29% mortality - 2 died of unrelated cause - one with functioning catheter.	Authors believe GSV insertion confers a benefit over femoral vein or deep circumflex iliac vein insertion. Insertion performed under direct vision. GSV considered an important site for placement of a CVC when other sites are unavailable.
Skandalos (2012), Greece	Great saphenous vein	Case series		End stage access	12 patients	No intraoperative or immediate post operative complications. During the study period 3 thromboses and an infection were detected (0,95 per 1000 catheter days). The primary catheter patency rates were 92%, 84%, 54% at 30, 90 and 180 days respectively, varying from 28 to 845 days (mean±SD = 294 ± 243,3	The introduction of dialysis catheters in the inferior vena cava through the great saphenous vein is technically simple with rare complications and with higher patency rates compared to the traditional femoral approach.

90% at 1-month but dropped rapidly to 25% at 1 year. The tracts were readily amenable to replacement, and 12-month secondary patency rates were reported to be 70%. Other groups report maintaining access with medical therapy, in one case report, the recanalised catheter was used for 12 months, and during that time thrombolytic therapy was required. Another group was able to use this route for nine months without any intervention [22]. A small study of six patients found that the sharp recanalization procedure provided a mean patency of 13 months [23]. It is difficult to establish an overall estimate of the thrombosis risk as the technique can be used at different sites. In the large mediastinal study above, the overall risk of dysfunction requiring change of catheter was 6.7/1000 catheter days [21]. There are limited data pertaining to infection rates for this technique as well, although one would expect similar rates to the underlying vein used. Funaki et al. used recanalized veins in the chest and they found very low infection risk of 0.6/1000 catheter days [21]. However, their definition of 'infectious complication' required the removal of the catheter, their results may reflect how aggressively they treated rather than replaced infected catheters.

Needle recanalization is inherently risky and emergency equipment is necessary whenever it is pursued. Specific complications reported in the literature range from vasovagal syncope to haemopneomothorax causing immediate respiratory distress and intubation [4,24]. Multiple studies have reported instances of fluid leak into the mediastinum, although these cases were treated successfully with stenting.

Limb entry

A final approach is to use nonstandard limb vessels as an entry point. Urgent temporary access can be achieved via the femoral artery [25], but for tunnelled access, veins such as the great saphenous vein are useful and preserve the iliofemoral system for future transplant.

For the open approach to the Great Saphenous vein, it is exposed in the thigh, 5cm from the saphenofemoral junction and a CVC inserted through a longitudinal venotomy [26]. The catheter tip is advanced to lie in the common iliac vein or IVC. The distal segment of GSV may be ligated and the proximal end tied to secure the catheter. The cuff and subcutaneous tissues are closed in the normal fashion.

Two case series with a total of 19 patients report primary patency results which equivalent to the conventional technique of percutaneous femoral vein cannulation. Skandalos et al. demonstrated primary patency of 92, 84 and 54% at 30, 90 and 180 days respectively [27]. No infection risks have been reported in the literature. Dysfunction rates are difficult to estimate. In the Nicholson cohort, one patient's catheter required exchange due to dysfunction, the other patients were either bridged to grafts or died [26].

DISCUSSION & CONCLUSION

This review highlights that there are in fact multiple 'last chance' access options, but that a deeper evidence base of these techniques is needed to support decision making. In particular, concerns remain regarding the rate and extent of complications associated with the transhepatic route. Sharp recanalisation techniques have also been associated with significant patient morbidity, with multiple reports of central vein puncture. The translumbar route appears to be safest, and offers favourable medium-long term catheter survival with a low complication rate. Although very little has been published regarding the transrenal approach, current reports suggest that it may be an attractive avenue for future study. The open approach to Great Saphenous vein cannulation may be a safe, effective alternative to percutaneous femoral vein cannulation, particularly if central vein stenosis is a concern, or future transplantation a possibility. Knowledge of the range of possible outcomes may ensure that the best technique is used for patients requiring last chance dialysis access.

REFERENCES

1. NHSBT. 2014 - The Seventeenth Annual Report - UK Renal Registry 2014, accessed 28 April 2017.

2. Kenney PR, Dorfman GS, Denny DF. Percutaneous inferior vena cava cannulation for long-term parenteral nutrition. Surgery 1985; 97: 602–605.

3. Lund GB, Trerotola SO, Scheel PJ. Percutaneous translumbar inferior vena cava cannulation for hemodialysis. Am J Kidney Dis 1995; 25: 732–737.

4. Rahman S, Kuban JD. Dialysis Catheter Placement in Patients With Exhausted Access. Tech Vasc Interv Radiol 2017; 20: 65–74.

5. Fanna Liu, Stacy Bennett, Susana Arrigain, Jesse Schold, Robert Heyka, Gordon McLennan, et al. Patency and Complications of Translumbar Dialysis Catheters. Semin Dial 2015; 28: E41–E47.

6. Aitken E, Jackson AJ, Kasthuri R, Kingsmore DB. Bilateral central vein stenosis: Options for dialysis access and renal replacement therapy when all upper extremity access possibilities have been lost. J Vasc Access 2014; 15: 466–473.

7. Herscu G, Woo K, Weaver FA, Rowe VL. Use of unconventional dialysis access in patients with No viable alternative. Ann Vasc Surg 2013; 27: 332–336.

8. Rajiv Biswal, John L Nosher, Randall L Siegel, Leonard J. Bodner. Translumbar placement of paired hemodialysis catheters (Tesio Catheters) and follow-up in 10 patients. Cardiovasc Intervent Radiol 2000; 23: 75–78.

9. Power A, Singh S, Ashby D, Hamady M, Moser S, Gedroyc W, et al. Translumbar central venous catheters for long-term haemodialysis. Nephrol Dial Transplant 2010; 25: 1588–1595.

10. Shingarev R, Barker-Finkel J, Allon M. Natural History of Tunneled Dialysis Catheters Placed for Hemodialysis Initiation. J Vasc Interv Radiol 2013; 24: 1289–1294.

11. Rajan DK, Croteau DL, Sturza SG, Harvill ML, Mehall CJ. Translumbar placement of inferior vena caval catheters: a solution for challenging hemodialysis access. RadioGraphics 1998; 18: 1155–1167.

12. Po CL, Koolpe HA, Allen S, Alvez LD, Raja RM. Transhepatic PermCath for hemodialysis. Am J Kidney Dis 1994; 24: 590–591.

13. Smith TP, Ryan JM, Reddan DN. Transhepatic Catheter Access for Hemodialysis. Radiology 2004; 232: 246–251.

14. Stavropoulos SW, Pan JJ, Clark TW, Soulen MC, Shlansky-Goldberg RD, Itkin M. Percutaneous transhepatic venous access for hemodialysis. J Vasc Interv Radiol 2003; 14: 1187–1190.

15. Younes HK, Pettigrew CD, Anaya-Ayala JE, Soltes G, Saad WE, Davies MG. Transhepatic Hemodialysis Catheters: Functional Outcome and Comparison Between Early and Late Failure. J Vasc Interv Radiol 2011; 22: 183–191.

16. Pieters PC, Dittrich J, Prasad U, Berman W. Acute Budd-Chiari syndrome caused by percutaneous placement of a transhepatic inferior vena cava catheter. J Vasc Interv Radiol; 8: 587-590.

17. Putnam SG, Ball D, Cohen GS. Transhepatic dialysis catheter tract embolization to close a venous-biliary-peritoneal fistula. J Vasc Interv Radiol; 9: 149–151.

18. Law WP, Cheung CY, Chan HW, Kwok PC, Chak WL, Chau KF. Hemodialysis catheter insertion using transrenal approach. Hemodial Int 2015; 19: E14–E16.

19. Murthy R, Arbabzadeh M, Lund G, Richard H, Levitin A, Stainken B. Percutaneous transrenal hemodialysis catheter insertion. J Vasc Interv Radiol 2002; 13: 1043–1046.

20. Seng HO, and ramon GH. Percutaneous transrenal placement of a tunneled dialysis catheter is feasible in some patients who have exhausted their traditional venous access sites. 2005, accessed 26 October 2017.

21. Funaki B, Zaleski GX, Leef JA, Lorenz JN, Van Ha T, Rosenblum JD. Radiologic Placement of Tunneled Hemodialysis Catheters in Occluded Neck, Chest, or Small Thyrocervical Collateral Veins in Central Venous Occlusion. Radiology 2001; 218: 471–476.

22. Pua U. Dilator venotomy technique for placement of hemodialysis

catheter following recanalization of occluded central vein. Hemodial Int 2013; 17: 122–125.

23. Athreya S, Scott P, Annamalai G, Edwards R, Moss J, Robertson I. Sharp recanalization of central venous occlusions: a useful technique for haemodialysis line insertion. Br J Radiol 2009; 82: 105–108.

24. Lew SQ, Nguyen B-N, Ing TS. Unusual sites for hemodialysis vascular access construction and catheter placement: A review. Int J Artif Organs 2015; 38: 293–303.

25. Frampton AE, Kessaris N, Hossain M, Morsy M, Chemla ES. Use of the femoral artery route for placement of temporary catheters for emergency haemodialysis when all usual central venous access sites are exhausted. Nephrol Dial Transplant 2008; 24: 913–918.

26. Yates PJ, Barlow AD, Johari Y, Doughman T, Nicholson ML. The great saphenous vein for central venous access and haemodialysis. Nephrol Dial Transplant 2008; 24: 208–210.

27. Skandalos LK, Samaras AA, Karakatsanis AI, Ditsias TK, Filippidis AA, Mavromatidis KS. Insertion of permanent hemodialysis catheters through the great saphenous vein. Int J Artif Organs 2012; 35: 520–524.

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