ORIGINAL ARTICLE

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Haemodialysis tunnelled catheters in the external jugular vein. A single-centre experience of an alternative approach

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ABSTRACT

The percentage of patients with limited venous access options is increasing as the dialysis population grows and patients with chronic kidney disease live longer. Internal jugular vein occlusion often makes the use of alternate anatomic locations for access necessary. Central vein cannulation via the external jugular vein is a recognised technique that must be pursued when the traditional access sites are limited. The purpose of this study is to describe the experience of a nephrology department in the insertion of tunnelled haemodialysis catheters via external jugular vein using a nonsurgical technique.

A prospective cohort study with haemodialysis patients in whom tunnelled catheters were placed via the external jugular vein was conducted. The indications for placement of catheters through the external jugular vein were bilateral or unilateral occlusion of the internal jugular vein with an arteriovenous fistula or graft in maturation in the contralateral upper extremity. Internal jugular vein occlusion was diagnosed on sonography in all patients.

During a 48-month period, 20 tunnelled haemodialysis catheters in 16 patients were inserted in the external jugular vein (18 in the right and 2 in the left vein). The mean age of all patients was 70.8±9.7 years. The initial flow rate was above 300 mL/min in 95% of the catheters. The mean catheter dwell time was 8 months (range 1-50). Beyond difficulty in passing the guide-wire in one patient and local haematoma in another case, there were no procedural complications in the present study. The overall infection rate was 0.087 episodes per 100 catheter-days. Thirty percent of the catheters (n=6) were removed or exchanged because of mechanical, thrombotic or infectious complications. Eight catheters were removed after adequate maturation of definitive vascular access and four patients still have the catheters in use for dialysis treatment. Two patients died with their catheters in place.

These results suggest that insertion of tunnelled haemodialysis catheters in the external jugular vein is a simple and safe procedure. It should be considered in patients with adequate external jugular veins and unilateral or bilateral occlusion of the internal jugular veins.

Key-Words:
External jugular vein; haemodialysis; tunnelled catheters.

INTRODUCTION

The percentage of patients with limited venous access options is increasing as the dialysis population grows and patients with end-stage renal disease live longer[1].

Use of catheters presents a conundrum because of the need for immediate access versus the risk for complications from prolonged catheter use. Long-term or tunnelled catheters have the ability to provide access during a period of months, permitting arteriovenous (AV) access maturation in patients who require haemodialysis (HD) and should not be placed on the same side as a maturing AV access. They can also be used in patients with documented inadequate vascular access anatomy or limited life expectancy[2].

The preferred insertion site for tunnelled cuffed venous dialysis catheters is the internal jugular vein (IJV)[2]. When the IJV is not available for central venous access, the second site remains variable. External jugular vein (EJV) has been described as an alternative vein for placement of central venous catheters (CVC) by several studies and the results of this procedure is compatible with standard methods[3-7]. Some authors believe that the second venous access after the right IJV should be the EJV[8].

The purpose of this study is to describe the experience of a nephrology department in the insertion of tunnelled haemodialysis catheters via EJV using a nonsurgical technique. The procedure of insertion through the EJV is described in detail.

PATIENTS AND METHODS

We performed a prospective cohort study which included 16 haemodialysis patients (11 male and 5 female) that were referred to our nephrology unit for long-term haemodialysis catheter placement from February 2006 to February 2010.

Before the procedure, both sides of the neck were evaluated and IJV patency was assessed with real time ultrasound guidance (GE Logiq 200 Pro Series®). Prior informed written consent was obtained from each patient. The indications for placement of external jugular tunnelled haemodialysis catheters were bilateral occlusion of the IJV (n=4) or to allow maturation of an arteriovenous fistula or graft in the contralateral upper extremity when a unilateral IJV occlusion was present (n=16). The patients' characteristics are set out in Table I.

We used the same type of catheter in all the procedures: silicone, dual lumen haemodialysis with separated tips, 28 cm length (Pourchez Xpresso SafeTrac®, Spire biomedical). In addition to the catheter, the insertion kit also included an 18 gauge introducer needle, two J/straight 0.038 inch guide-wires, three different size dilators (12 Fr,14 Fr and 16 Fr), one 6 Fr sheath, two 5 Fr intracatheter dilators, one #11 scalpel, a tunneling stylet and two injection sealing caps (Fig. 1).

Table I

Patient characteristics at baseline

Characteristics	n=16
Male gender (%)	68.8 (n=11)
Age (years)	70.8 ± 9.7 (41-88)
Diabetes Mellitus (%)	25
Previous catheters per patient	5.1 (2-7)
Initial flow rate› 300mL/min (%)	100
Catheter dwell time (months)	8.2 ± 11.5 (1-50)

The placement technique under local anaesthetic was performed by two nephrologists for each patient and is described as follows:

1. The patient is monitored (blood pressure, heart rate, respiratory frequency, pulse oximetry and electrocardiographic monitoring).

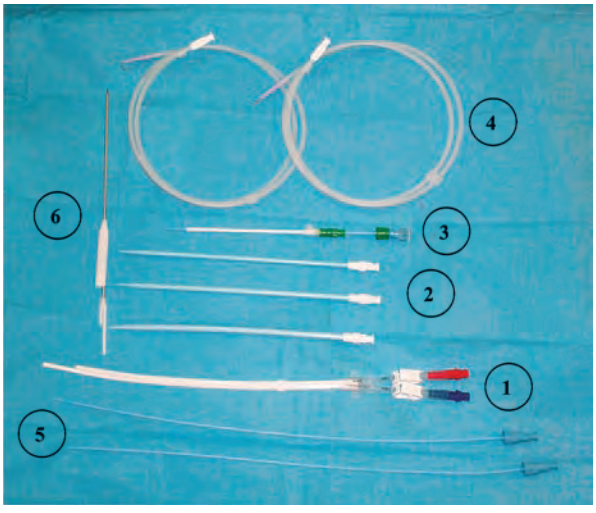


Figure 1

Material used in the procedure and contained in the insertion kit. **1.** Silicone dual lumen haemodialysis catheter. **2.** Different size dilators (12 Fr, 14 Fr and 16 Fr). **3.** 6 Fr sheath (contains one internal sheath). **4.** Two J straight 0.038 inch guide-wires. **5.** 5 Fr intracatheter dilators. **6.** Tunneling stylet.

2. The patient is placed in a Trendelenburg position and we perform neck vessels exploration and identification of the veins using ultrasound guidance.
3. The head is turned to the contralateral side and the site of the neck and upper chest chosen is then prepared using sterile technique.
4. The EJV is identified by visual inspection and palpation (±3 cm cephalad to the clavicle).
5. Local anaesthesia with 1-2 cc of lidocaine 2% is performed and the vein is punctured using Seldinger's technique. This is a very important and delicate step because too much local anaesthetic could collapse the vein and hinder the punction.
6. The guide-wire is passed through the lumen of the 18 gauge introducer needle into the vein. This is followed by the 6 Fr sheath that is inserted through the wire aiming along the axis of the vein toward the clavicle.
7. The internal sheath is removed through the wire; after the second guide-wire is inserted, the external sheath is removed.
8. The smallest dilator is placed through one of the wires to stop the bleed and we then perform a small incision lateral to the venotomy site after local anaesthesia. This incision must be lateral to avoid laceration of the vein.
9. Careful local unbridle (±1 cm in depth) of the venotomy site.
10. The location of the exit site is marked by laying the catheter on the patient's chest in the approximate position in which it will be inserted and the location of the exit site is marked; additional local anaesthesia is performed and a small incision (±0.5 cm) on the exit site is made.
11. After anaesthetising, a subcutaneous tunnel of ± 6 cm is performed, by using the tunnelling stylet, previously connected to the catheter.
12. The two blue intracatheter dilators are passed through the branches of the catheter to provide stiffness to the silicone catheter.
13. Sequential dilatation of the venotomy site is performed using the three different diameter dilators.
14. The two guide-wires are introduced through each of the catheter branches.
15. The catheter is advanced through the vein and the two guide-wires are pulled at the same time in order to avoid catheter kinking; complete with the removal of the two intracatheter dilators and wires.
16. The catheter flow and permeability is then tested.
17. The catheter is flushed with saline solution and prophylactic parenteral antibioterapy (Cefazolin sodium 1 g) is administered.
18. Flush with diluted heparin (1:2) to fill the catheter branches.
19. Suture the venotomy and the exit site (Fig. 2) and finally perform nonocclusive dressing of the catheter.
20. An anteroposterior and lateral chest radiograph is performed to ensure accurate positioning of catheter tip in the caval atrial junction or proximal

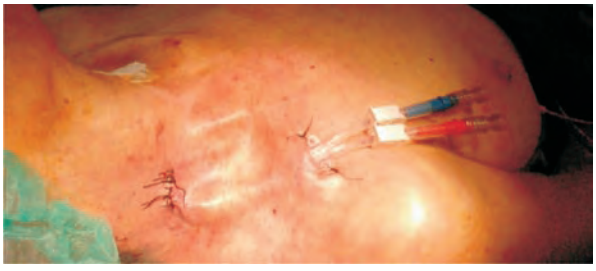


Figure 2

Suturing the skin incision and catheter fixation at the exit site.

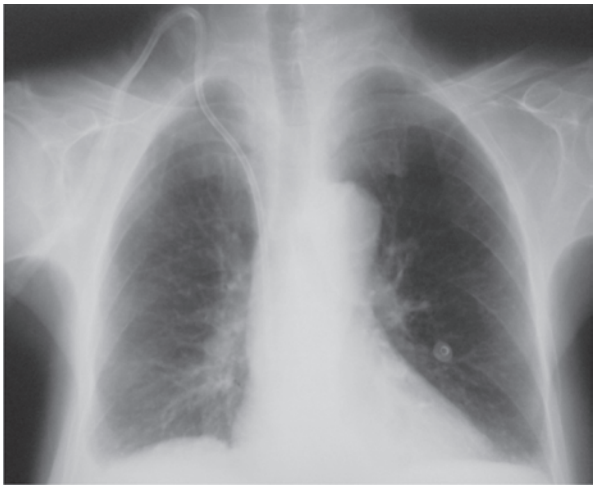


Figure 3

Posteroanterior projection of chest radiography obtained after the procedure shows that the tip of the catheter is located at the caval atrial junction.

to the right atrium (Fig. 3). After the procedure the patient is discharged and referred to the haemodialysis centre.

Follow-up was based on clinical surveillance by nephrologists in dialysis units. The patients were after referred to our department if there was a problem with the catheter (need to exchange or removal, infection, dysfunction). We defined catheter dysfunction as failure to attain and maintain an extracorporeal blood flow of 300 mL/min or greater at a prepump arterial pressure more negative than -250 mmHg, according to Dialysis Quality Initiative Guidelines[2].

Complications were defined as procedural (*i.e.*, occurring at the time of the intervention or within 24 hours) and delayed or late (*i.e.*, occurring beyond that period).

The following items were assessed: development of catheter infection, patency of the catheter, cause of catheter removal and cause of patient's death.

Catheters were followed until their removal, patient's death or until the end of the study.

RESULTS

During a 48-month period, 20 tunnelled haemodialysis catheters in 16 patients were inserted in the EJV (18 in the right and 2 in the left vein). We used the right EJV as the first approach in all patients except in two where we had to use the left EJV because one had an anatomical bifurcation of the right vein in the venotomy site and the other already had a right EJV previously that left a fibrous scar in the venotomy site. There were no technical differences between the placement in the right or left EJV.

The mean age of all patients was 70.8 ± 9.7 years and 69% (n=11) were male.

Immediate Success

The cannulation of the EJV at first attempt was successful in 100% of the cases (n=20). We did not experience any difficulties or complications in performing cannulation in the right or left EJV.

In one case we had to use manipulation of the ipsilateral shoulder to pass the guide-wire through the EJV-SCV (external jugular vein-subclavian vein) junction.

The duration of catheter insertion in the EJV using the method described was 30-45 minutes.

All the catheters allowed a flow rate above 300 mL/min at least in the first three dialysis sessions except in one case of catheter dysfunction that required exchange at six days.

Procedural complications

There was one minor periprocedure complication with local haematoma in a patient with coagulation disturbance associated with hepatic insufficiency that was managed by regional compression.

Late complications

A total of four episodes of catheter-related infections were identified, providing an overall infection rate of 20%. This corresponded to 0.087 infections per 100 catheter-days. One case needed catheter removal after one month due to bacteraemia and positive blood cultures for gram-positive cocci. One patient needed catheter replacement on three occasions, with a different subcutaneous tunnel because of three episodes of subcutaneous tunnel infection with different bacterial pathogens. The mean time between infection episodes in this patient was 10±3.6 months.

No catheter-related infection episodes were observed in the two cases in which the left EJV was used.

There were four cases of catheter dysfunction, meaning 0.087 episodes per 100 catheter-days. One patient underwent catheter exchange because of malfunction at six days. The chest radiograph showed a kinking of the catheter near the venotomy site. Three catheters required intraluminal thrombolysis because of catheter associated low blood flow. Intraluminal thrombolysis was performed with Alteplase, according to the protocol used in our department, with restoration of catheter patency.

There were no mechanical complications related with the left EJV catheters.

One patient developed progressive facial and neck oedema two months after catheter placement probably in consequence of catheter-mural thrombus. After removal of the catheter, the oedema disappeared and the patient underwent angiography that excluded central vein stenosis.

Follow-up

The mean catheter dwell time was eight months (range 1-50).

Eight catheters were electively removed due to adequate maturation of definitive vascular access and four patients still have the catheter in use for dialysis treatment. These patients had documented inadequate peripheral veins for surgeons to perform a definitive vascular access.

Thirty percent of the catheters (n=6) were removed or exchanged because of complications referred to above.

Two patients died with their catheters in place from noncatheter-related causes.

DISCUSSION

Central venous cannulation via the EJV is a recognised technique[9]. The EJV is easily accessed, given its superficial location on the neck[10]. Thus, sonographic imaging of the jugular veins can significantly improve the safety, speed, and comfort of the procedure by defining the vascular anatomy before puncture, showing complications from prior attempts in these vessels, and providing guidance for needle puncture[11].

The right EJV has a relatively straightforward course and short length, which is very similar to those of right IJV. It is formed just below and behind the angle of the mandible by union of the posterior auricular and retromandibular veins. It lies under the platysma muscle in the neck and obliquely crosses the superficial surface of the esternocleidomastoid muscle. Approximately 2 cm above the middle of the clavicle, it passes through the cervical fascia to enter the SCV[12].

The left jugular vein has a longer length which is associated with a higher incidence of catheter malfunction[13]. However the only malfunction that we had was with a right EJV catheter and it was due to kinking in the subcutaneous tunnel that was corrected after catheter exchange with a wider tunnel.

The results of this study show that the initial success cannulation rate was 100% and there were no immediate technical complications.

It is imperative for the physician to identify previously patients possessing EJV that are too small, too tortuous or not patent and alternative accesses planned[1] in order to minimise cannulation problems.

The use of the Seldinger J-wire increased successful central venous cannulation via the EJV. Much better results are achieved in this study compared to 50% to 79% of success described by Byth *et al.*[9].

One patient presented difficulties in the progression of the guide-wire through the EJV-SCV junction. This problem was easily solved by using manipulation of the homolateral shoulder to facilitate passage of the guide-wire past the clavicle. In a prospective study performed by Sparks and co-workers[14], this technique was used to pass the J-wire through the clavicle during external jugular vein catheterisation with a success rate of 40%. Variations of the termination and angulation of the EJV as it enters the SCV and the distribution and morphology of the valves in the EJV also contribute to this difficulty[15,16].

In this study there was one case of fibrous scar in the venotomy site in a patient with a previous right EJV catheter that compromised future cannulation and led to catheterisation of the contralateral EJV. We are aware that this complication may occur more frequently in the EJV as it is more superficial than the IJV but there are no studies to support this. Further prospective studies are needed to compare and evaluate the consequences of repeated cannulations on central veins.

Our total infection rate was 0.087 episodes per 100 catheter-days; one case needed catheter removal and three underwent catheter exchange with a different subcutaneous tunnel. No catheter-related infection was observed in the two cases in which the left EJV was used.

These results are better than those published by other authors[17,18] who only used the right EJV catheterisation (0.22 episodes per 100 catheter-days) and by Duszak[19] who reported 0.11 infections per 100 catheter-days using noninfection-related over-the-wire catheter exchanges.

As described by CDC guidelines, catheter exchange over a guide-wire in combination with antibiotic therapy might be an alternative as a salvage strategy in patients with limited venous access[20,21]. It is also associated with less discomfort and a significantly lower rate of mechanical complications[22]**.** In this study the patient who needed repeated catheter replacements over a guide-wire had different agents causing subcutaneous tunnel infection and the episodes, which excluded relapsing infection, were many months apart. We created a different subcutaneous tunnel in each replacement. This patient had no other central or peripheral veins suitable for the creation of a vascular access. Capdevila *et al.*[23] reported the possibility of successful treatment of haemodialysis catheter-related sepsis with empirical antibiotic treatment and no need for catheter removal but they had no cases of subcutaneous tunnel infection which poses greater risk of catheter colonisation.

There was one catheter-related thrombotic complication in a patient who had normal catheter function. The facial and neck oedema was probably related to mural thrombus that mimic the symptoms of a central vein stenosis and disappeared after catheter removal. The patient after underwent an angiography that showed no stenosis or residual clot. This finding associated with normal function of the catheter is also described in another study where thrombus formation was detected in patients without signs of catheter malfunction[24].

The overall malfunction rate was 0.087 episodes per 100 catheter-days. The cases of inadequate extracorporeal blood flow were due to intraluminal thrombus, and solved by endoluminal thrombolytic therapy with Alteplase with no evidence of recurrence during the follow-up. These results were similar to those described in other studies[25-28].

As a limitation of this study, we have to mention that catheters were placed without imaging guidance during the procedure which might be useful in detecting such mechanical problems as malpositioned catheter tip. As dictated by the vascular access guidelines of the Dialysis Outcomes Quality Initiative, the position of the tip of any central catheter should be verified radiologically for optimal flow[2]. By using chest X-ray immediately after the procedure, we did not experience any need for catheter removal due to malpositioning. However, the inability to detect previous central vein occlusion and the fact that the EJV forms a tight angle at its insertion into the SCV are also potential pitfalls and can compromise the cannulation so in our opinion the catheterisation of the EJV should be ideally done with fluoroscopic control. We expect to have fluoroscopy in our department in the near future to surpass this limitation.

There are currently no data specifically related to the haemodialysis patient population that recommends routine parenteral antibiotics at the time of insertion of a CVC to prevent colonisation or bloodstream infection[29]. Cefazolin, the prophylactic antibiotic used in all cases after catheter placement, is a first generation cephalosporin that has a broad spectrum gram-positive coverage. It is a recognised antibiotic against methicillin-susceptible Staphylococcus aureus bacteraemia in dialysis patients[30]. According to the protocol created in our department since 2001 and in the absence of beta lactam allergy, we administer 1 g of intravenous Cefazolin after the insertion of any tunnelled catheter. Our opinion is that the risk of colonisation with the placement of tunnelled catheters is high and we do not have any known reported case of Cefazolin resistance.

From this series of 20 cases, it can be concluded that EJV catheterisation might share the advantages (and also the drawbacks) of internal jugular veins. The potential benefits and the long-term outcomes must be evaluated and confirmed by randomised clinical trials using catheterisation of EJV for haemodialysis tunnelled catheters.

Long-term catheters in the EJV offer good long-term outcomes compared to other locations as

femoral and translumbar veins[31,32]. They are much less prone to infection and to mechanical problems that may become impossible to solve without removal. No symptomatic central venous stenosis was observed, although we did not look for asymptomatic stenosis. This is a small series, and the overall complication rates of tunnelled haemodialysis in the EJV need to be determined and compared to other central veins approaches in larger studies.

The ultimate aim of this article is to encourage nephrologists to consider the EJV in their strategy of tunnelled catheter placement and to help to determine the place of the EJV in the currently recommended algorithms for catheter placement. It is clear that IJV remains the central vein of choice. Our positive experience in this field leads us to believe that EJV should be an option, prior to use of less desirable routes (*e.g.* femoral, subclavian, translumbar and transhepatic).

The description of the technical procedure should help standardise nephrology departments to cannulation technique and long-term catheter placement in the external jugular vein as a simple and safe, nonsurgical procedure, when IJV is not usable. EJV catheters have also the advantage of sparing the IJV in the future in patients with a definitive vascular access in maturation and unilateral occlusion of the contralateral IJV.

A lack of local knowledge or expertise in the EJV catheterisation will force nephrologists to maintain it at its current status of marginal alternative.

Conflict of interest statement. None declared.

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