Iliac cuffed tunnelled catheters for chronic haemodialysis vascular access

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Introduction

Obtaining and maintaining vascular access is of pivotal importance in the care of chronic haemodialysis patients. According to the Dialysis Outcomes Quality Initiative (DOQI) guidelines, peripheral arteriovenous (AV) fistulas or grafts are the preferred type of access [1]. The use of central venous catheters for chronic haemodialysis is discouraged [1]. Compared with AV fistulas, central catheters carry a substantially increased risk of infection and bacteraemia [2]. However, in approximately a quarter of the patients, peripheral venous access has been exhausted or is not feasible in the first place [3,4]. In these cases, cuffed tunnelled right atrial catheters inserted into the jugular or subclavian veins permit adequate blood flow for dialysis. The femoral veins may be used in situations where the jugular or subclavian veins are not available. Femoral catheters are prone to exit-site infections and bacteraemia, and have an unacceptable risk of thrombosis and life-threatening embolism in ambulatory patients.

In the current case report, we describe an alternative approach to haemodialysis vascular access. We successfully placed cuffed tunnelled catheters in the iliac veins of six patients, A–F, from our own chronic haemodialysis programme and an affiliated dialysis centre (Table 1). Each of the patients had a history of repeated creation and loss of peripheral vascular access except for one, in whom vascular surgeons ruled out peripheral access in the first place [3,4]. All six patients had documented thrombosis of the jugular and/or subclavian veins (Table 1). Patient D had a history of chronic anticoagulation due to repeated catheter-related thrombosis (Figure 1).

Description of procedure and clinical outcome

Prior to the placement of the catheter, all patients were informed about benefits and risks of the procedure, and their written consent was taken. The intervention was carried out by an experienced nephrologist (Figure 2). A prophylactic single shot of imipenem (500 mg) was administered intravenously. The patients were placed supine, and patency of the femoral and iliac veins as well as their relation to the peritoneal sac was visualized by duplex Doppler ultrasound. Under sterile conditions, 20 ml of 2% mepivacaine were applied subcutaneously, and the iliac vein was punctured at an angle of ~45°. Using the Seldinger technique, a 55 cm, 15 French single-lumen DEMERS® catheter (Bionic GmbH, Friedrichsdorf, Germany) was introduced into the iliac vein. In the vicinity of the catheter, a subcutaneous pouch was then formed by blunt dissection. An incision was made lateral to the umbilicus, and a subcutaneous tunnel was created from the incision to the pouch by blunt preparation. The cuff was imbued in gentamycin, and the catheter was carefully advanced through the tunnel to the exit-site. Ease of blood flow was checked by repeated and rapid filling and voiding of a 10 ml syringe. The pouch was closed with 2–3 sutures, and the catheter was diligently covered with sterile dressing. At the end of the intervention, the catheter was visualized by ultrasound. Radiographical visualization was not needed.

Typical maximal arterial/venous flow rates of the single-lumen catheters were around 350/450 to 550/600 ml/min, respectively. Urea reduction rate was calculated in four patients, ranging from 64 to 83%.

Two of the six patients, A and D, experienced catheter malfunction which was resolved with mechanical declotting by high-pressure injection or guidewire manipulation. The catheter of patient D was instilled with urokinase a total of six times; when anticoagulant therapy was changed from phenprocoumon to danaparoid, no further episodes of catheter malfunction occurred. The catheters of patients B, C, E and F have not malfunctioned to date. Consequently, catheter exchange or removal has not been necessary.

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in any of the six patients so far. However, in patient C, the catheter was removed following the successful creation of a peripheral arteriovenous fistula. Patient B refused further dialysis after a non-fatal myocardial infarction and subsequently deceased.

The first patient who underwent the procedure was not initially treated with anticoagulation, but received such therapy following the occurrence of a pelvic deep-vein thrombosis. Notably, this patient was coincidentally found to have renal cell carcinoma. The following five patients, including two with circulating lupus anticoagulant, were started on systemic anticoagulation with low molecular weight heparins, vitamin K antagonist or danaparoid. Patient F (Figure 3) was in compliant with her parenteral anticoagulation and

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**Table 1. Patient characteristics**

<table>
<thead>
<tr>
<th>Patient</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td>Female</td>
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<td>Male</td>
<td>Female</td>
<td>Female</td>
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<tr>
<td>Age (years)</td>
<td>70</td>
<td>78</td>
<td>52</td>
<td>79</td>
<td>79</td>
<td>66</td>
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<tr>
<td>Weight (kg)</td>
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<td>72</td>
<td>48</td>
<td>52</td>
<td>93</td>
<td>56</td>
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<tr>
<td>Diagnosis</td>
<td>Type 2 diabetes mellitus</td>
<td>Interstitial nephritis</td>
<td>IgA-type glomerulonephritis</td>
<td>Type 2 diabetes mellitus</td>
<td>Rheumatoid arthritis</td>
<td>Interstitial nephritis</td>
</tr>
<tr>
<td>Months on dialysis</td>
<td>85</td>
<td>43</td>
<td>97</td>
<td>45</td>
<td>15</td>
<td>209</td>
</tr>
<tr>
<td>Vascular history</td>
<td>Jugular veins occluded, left subclavia occluded, lymph oedema in left arm</td>
<td>Occlusion of the anonymous vein, inverse flow of the left jugular vein</td>
<td>Jugular veins occluded</td>
<td>Jugular veins and superior vena cava occluded</td>
<td>Jugular veins and left subclavian vein occluded</td>
<td>Jugular and subclavian veins occluded, aneurysm of the right subclavian artery</td>
</tr>
<tr>
<td>No. of lost peripheral fistulas or catheters</td>
<td>8</td>
<td>7</td>
<td>4&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2</td>
<td>13</td>
</tr>
<tr>
<td>Previous catheters</td>
<td>Cuffed tunnelled in left subclavian vein</td>
<td>Cuffed tunnelled in right subclavian vein</td>
<td>Cuffed tunnelled in right jugular vein</td>
<td>Cuffed tunnelled in left jugular vein</td>
<td>Lupus anticoagulant, HIT</td>
<td>Lupus anticoagulant</td>
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<tr>
<td>Additional information</td>
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<td></td>
<td></td>
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</table>

**Fig. 1.** Digital-subtraction angiography visualizing total occlusion of the right subclavian and near-total thrombosis of the anonymous vein in patient D.

**Fig. 2.** Schematic diagram depicting the placement of a cuffed tunnelled catheter in the left external iliac vein. One incision is necessary to facilitate tunnelling of the catheter.

HIT, heparin-induced thrombocytopenia.
Data are current up to March 2006.
<sup>a</sup>Patient C performed peritoneal dialysis prior to catheter insertion.
<sup>b</sup>In patient D, creation of a native fistula was technically not feasible.
<sup>c</sup>Patient F received a renal allograft transplant on 22 January 2006.
developed femoral-vein thrombosis. She was subsequently switched to oral anticoagulation.

After more than 1500 cumulative catheter days, none of the patients have suffered exit-site infections or catheter-related bacteraemias (CRB).

Discussion

Chronic haemodialysis requires repeated and reliable vascular access, preferably arteriovenous fistulas or grafts. In approximately a quarter of the patients, peripheral access cannot be obtained or has been exhausted [3]. Central venous catheters allow for haemodialysis with adequate blood flow, but they are prone to catheter-related infections and may need to be replaced when thrombosis occurs [2]. The subclavian and jugular veins are preferred for placing central catheters, as they are associated with the lowest rates of infection and thrombosis. However, in some patients, even these are occluded or otherwise unsuited for catheter placement. In these desperate cases, other large-bore vessels have to be used to gain access to central circulation.

We devised a novel vascular access using an external iliac vein as an entry point for cuffed tunnelled catheters. We expected iliac catheters inserted from above the inguinal ligament (Figure 2) to be better suited to long-term use than femoral catheters, as the latter are subject to repeated kinking, accompanied by occlusion of the femoral vein when patients flex their hips. This may increase the risk for catheter and/or venous thrombosis. In addition, heparin used to block the catheter may be released into the blood stream by kinking and stretching, which renders the femoral catheter more susceptible to clotting. Consequently, bed rest is advised for patients with femoral catheters. In contrast, our iliac catheter patients were able to ambulate.

All of the iliac catheters described in this report have remained functional over an observation period of more than 1500 days. The catheters of patients A and E required mechanical declotting or urokinase instillation a number of times. Notably, these two patients presented with hypercoagulative states; patient A suffered from renal-cell carcinoma, and patient D had circulating lupus anticoagulant. None of the catheters had to be exchanged due to malfunction. In comparison, the primary patency rate of femoral cuffed tunnelled catheters was 55% after 180 days in one report [5]. In another study, only 50% of femoral cuffed tunnelled catheters were still in use 3 months after placement [6]. Maya and Allon [7] reported a median femoral catheter survival of only 59 days.

We have observed no catheter-related infections or CRBs so far. Interestingly, with femoral catheters, Maya and Allon [7] reported an incidence of CRB of 40% after ~150 days. Others have calculated the overall rate of episodes of cuffed tunnelled CRB to be as high as one in every 200–250 days [8,9]. A higher rate of bacteraemia with femoral catheters might stem from the fact that these catheters are located more closely to the contamination-prone intertriginous folds.

The literature provides a plethora of different solutions for the dialysis patient in dire need of a chronic vascular access, such as parasternal [10], translumbar [11], transrenal [12], transhepatic [13] or even intracardiac catheterization [14]. Some rely on surgical expertise for catheter placement [15]. In contrast, the procedure we propose in the current report can be carried out by an experienced nephrologist, and assistance from surgeons or radiologists is not needed.

There are, however, also some caveats with regard to using the iliac veins for vascular access. For instance, accidental puncturation of the peritoneal sac with ensuing peritonitis must be avoided. Furthermore, it is currently not clear whether the presence of an iliac catheter for a longer period of time renders the vessel unsuitable for potential renal transplantation. Finally, given the fact that patients with a chequered history of dialysis access commonly suffer from clotting disorders, systemic anticoagulation for patients with cuffed tunnelled iliac catheters is advisable.

Conclusion

Cuffed tunnelled catheters placed in the iliac vein may provide vascular access in haemodialysis patients where peripheral or superior vena cava options are
not feasible. The current case report provides initial evidence for the safety and efficacy of this last resort.

Conflict of interest statement. None declared.

References

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