Technical Report

Indwelling silicone femoral catheters: experience of three haemodialysis centres

R. Montagnac¹, Cl. Bernard², J. Guillaumie³, P. Hanhart², P. Clavel¹, J. Yazji,³, L. M. Martinez³ and F. Schillinger¹

Departments of Nephrology-Hemodialysis, General Hospitals of ¹Troyes, ²Montbeliard, and ³Dole, France

Abstract The aim of this study is to describe the experience of three haemodialysis centres using indwelling femoral silicone catheter (model SSL 1220M, Medcomp, USA) in 55 patients, three with acute renal failure, one requiring plasmapheresis, and 51 with chronic renal failure but no other available vascular access. Sixty-four catheters were in place for a mean duration of 41.5 ± 30 days. The rate of catheter-related complications, including mechanical problems, thromboses, and infections was low and they were never life-threatening.

The results of the study suggest that femoral cannulation with modern flexible devices can be considered as a reliable temporary access, even for extended periods, with advantages exceeding those for subclavian and jugular routes.

Key words: haemodialysis; temporary vascular access; femoral catheter; silicone elastomer; ambulatory treatment

Introduction

Femoral vein catheterization in haemodialysis was deemed undesirable for long-term vascular access because patients could not move as long as the catheter was in place because of the rigidity of the material, or because frequent reinsertions were necessary [1–8]. Moreover, the risk of local and infectious complications were considered unacceptable. It was therefore virtually impossible to treat patients on an ambulatory basis [8,9].

Modern femoral catheters are made of silastic, which is a more flexible and biocompatible material. Thus they are less traumatic and reduce the risks of infection and vein thrombosis. Therefore they can remain in place for a long time without immobilization and often without hospitalization of the patients, thus decreasing treatment costs.

This study retrospectively analyses the use of such a new catheter in three dialysis centres (Troyes, Montbeliard, and Dole) over 7 months.

Subjects and methods

Catheter

The catheter used was the SSL 1220 M model (Medcomp, Harleyville, USA): 12 French single-lumen catheter, made of silicone elastomer, length 20 cm.

Catheters were percutaneously inserted in 55 patients by a total of 10 nephrologists. Nine catheters had to be replaced (seven on the same side and two on the other) and therefore a total of 64 catheters were studied. None of them was tunnelled.

Patients

Patients were 39 males and 16 females with a mean age of 60 years (range 25–86 years) and mean weight of 64 kg (range 43–93 kg). Central venous access was required in the following situations:

- acute renal failure and plasma exchanges 4
- end stage renal failure 25
- absence of an useable vascular access 1
- transient complications of the usual access 1
- infection 1
- haematoma 13
- thrombosis 7
- recent corrective surgery 4
- refractory access problem due to patient’s history 4

Anticoagulation

Anticoagulation during dialysis sessions was achieved with standard heparin, routinely administered twice to 16 patients, dalteparin sodium administered once or twice to 19 patients, and enoxaparin sodium given once or twice to 20 patients. Mean doses were 100 IU, 91 IU, and 0.61 mg per kg body weight respectively.

© 1997 European Renal Association–European Dialysis and Transplant Association
Between dialysis sessions, standard heparin was instilled into the lumen (mean 7300 IU per catheter = 114 IU/kg) before closing the catheter with a luer lock.

All procedures

were performed with the same aseptic conditions in the three centres. Two nurses wearing surgical attire performed the connection and disconnection. The exit site was protected with a sterile occlusive dressing during and between the dialysis sessions. The catheter was not used for any purpose between two sessions.

Disinfection of the exit site was different in the three centres. The protocol used in one centre included local application of mixed rifampicin and protamine. Another centre used a foaming solution of povidone iodine with application of 70% alcohol, followed by a dermal solution of povidone iodine to cleanse the site when connecting the catheter. The same protocol was used when disconnecting with the exception that alcohol was replaced by physiological saline. The third centre used a sterile aqueous solution of 0.05% chlorhexidine when connecting and disconnecting the catheter.

Study parameters

For each catheter, the duration of cannulation and the number (3 per week for 88% of patients) and duration of dialysis sessions were recorded.

The blood flow rate obtained with double-pump devices was calculated as follows:

\[
\text{blood flow mean value} = \frac{\text{arterial blood flow} + \text{venous blood flow}}{4}
\]

The quality of epuration was evaluated by blood creatinine and urea nitrogen rates before and after sessions since Kt/V index was not used in these three centres.

Samples were taken from the catheter and exit site for bacteriological cultures. When possible (56 times), the catheter tips were systematically cultured on removal, whether the catheters were functional or not. Exit-site was systematically cultured on catheter removal in one centre (22 times) and in the two other centres, it was cultured only when an infection was suspected, either during use or on removal (23 times).

Doppler or echo-Doppler examination of the iliofemoral veins was performed at least 1 month after catheter removal.

Results

Duration of cannulation

The average catheter dwell time was 41.5 ± 30 days (range 4–134 days). Unless removal was required (12 cases), catheters were left in situ until the resolution of renal failure or availability of a permanent vascular access. Durations of catheter use are indicated in Figure 1.

Overall, the catheters were used for a total of 933 dialysis sessions, i.e. a mean of 14.5 sessions for each catheter (range 3–56) or of 17 sessions for each patient if replacements are not taken into account.

Complications

No significant immediate complication was retrospectively noted at the time of catheter insertion. In particular, there was no important local or retroperitoneal

Figure 1: Duration of femoral catheter (KT) use.

Thirteen patients received dialysis therapy in the hospital but they were not immobilized. Dialysis sessions took place on an outpatient basis for eight patients. Thirty-four patients received therapy in both settings. In these latter two groups, the mean duration of ambulatory treatment was 31.5 ± 30 days (range 0–115).

Hospitalization was generally for the initiation of the dialysis treatment, or to create or correct vascular access. For four patients, it was prolonged because of severe illness.

Patient tolerance

Three patients (two because of their underlying disease and one who was blind) had reduced mobility, but the catheter did not cause any problem. For the other patients with normal mobility, tolerance was good. One patient complained of discomfort when walking and one when sitting; one patient felt a tickling sensation in the thigh, without an identifiable neurological lesion; bleeding occurred from the orifice in two patients, one only when walking and one continuously; lymph leakage occurring in two patients continued for a few days after removal for other reasons.

Quality of dialysis

Mean blood flow was 195 ± 35 ml/min (range 145–240) and dialysis sessions lasted a mean of 4 h.

Blood creatinine decreased by 54% with pre- and post-dialysis rates of 838 ± 189 and 385 ± 132 mol/l respectively.

Blood urea nitrogen decreased by 61.4% with pre- and post-dialysis rates of 25.4 ± 6.4 and 9.8 ± 2.1 mmol/l respectively.
bleeding and haematoma linked to vascular damage due to an arterial puncture or to traumatic or repeated venous punctures.

**Mechanical problems linked to the catheter and its position**

Blood flow was at the minimal acceptable in two catheters and inadequate in two others (which were replaced on the same side) probably because of mal-position. The flow rate was deliberately reduced in one case because of pain.

One catheter associated with persistent local bleeding was replaced on the contralateral side, with no further complications.

Three catheters had to be replaced on the same side, one because of fissure and the other because the catheter was lost; other measures were required for one patient with psychiatric problems who pulled out the catheter deliberately.

**Thrombotic complications**

Intraluminal clots frequently formed in 29 patients. They were small and easily aspirated in 26 patients. In each of the three other patients, intracatheter injection of urokinase had to be given on two or three occasions in order to dissolve these clots: 75,000 units in five cases and 100,000 in three cases.

Seven total catheter thromboses occurred. Three were treated by intracatheter urokinase (150,000 units in one case and 225,000 in two cases). Four thromboses (one in a patient with sepsis) led to catheter removal, of which two were replaced (one ipsilateral and one contralateral).

One patient probably developed a fibrin sheet covering the catheter tip, as indicated by the intermittent poor flow rates and by the phlebography. After removal without difficulty, another catheter was implanted on the same side and the problems did not recur.

Bilateral phlebitis of the legs, with probable pulmonary embolism, occurred on the 43rd day in one hospitalized patient with cancer. It was not clear whether this occurred due to the catheter, since it was used afterwards for some time with no further problems.

Doppler or echo-Doppler examinations were performed in 33 patients (60% of all patients). Thirty-one were normal and although the other two patients had neither thrombosis nor infection, a marked flow reduction in the iliac vein in one case and a thrombosis of the superficial femoral vein in the other were observed.

**Arteriovenous fistula or femoral artery pseudoaneurysm**

None was detected clinically or by echo-Doppler in the relevant cases.

**Infectious complications**

Superficial dermal inflammation was observed in one patient and local necrosis occurred in another. Organisms were isolated in 14 cases (13.8% of samples; 21.8% of catheters). *Staphylococcus aureus* (5 cases), *S. epidermidis* (1 case), *Serratia marcescens* (1 case). *Proteus* and *Serratia marcescens* (1 case) were isolated from the exit site. *S. epidermidis* (1 case), *S. haemolyticus* (1 case) and *S. capitis* (1 case) were isolated from the catheter tip. *S. aureus* (2 cases) and *S. epidermidis* (3 cases) were isolated from both sites.

In the absence of clinical evidence of infection, removal of the catheter and systemic administration of antibiotics were avoided, with the exception in one case of severe febrile syndrome, without identified bacterial pathogen, and in one another case with *S. aureus* sepsis complicated by catheter thrombosis, the same organism being isolated from the exit site and the catheter tip.

**Discussion**

Indications for central venous cannulation in the 55 patients of this study were consistent with those in the literature [1–4, 10, 11]. Only four cases had acute renal failure or needed plasmapheresis and the other patients had end-stage renal failure. All had to obtain an immediate temporary access since no other possibility was available.

The choice of the femoral route was compulsory in only four cases because of the patients’ histories. In the other patients the site was chosen not only for the purpose of the study but also for the specific advantages of this approach [1,2,11]. In some cases it was due to previous use of the central thoracic veins (pacemaker, stenosis, thrombosis) or problems of more physical (respiratory distress or acute pulmonary oedema) than morphological nature to guarantee a safe use of the thoracic approach. It is also desirable to preserve the upper central veins for future vascular access sites in these chronic dialysis patients, whose improved life expectancy depends on careful management of their venous potential. Finally the femoral route is convenient and safe [1,3,7,11], which was confirmed by the absence of significant complications linked to the insertion of the catheters, even with four junior doctors amongst the 10 operators.

Both immediate and delayed complications [1,2,3,10,12] must be considered. The occurrence rate varies greatly from one study to the other and this partly due to the fact that older trials involved catheter insertion at each dialysis session [6,7].

The frequency of retroperitoneal or iliac fossa haematomas, either spontaneous [13] or by internal perforation of the vein [1,3,14–16], sometimes together with uremic or therapeutic coagulation disorders, is high in a few studies: 0.2–5.5% [2,3,10,11]. This frequency seems due to multiple cannulations, together with difficulties in finding the vein because of its variable position in relation to the femoral artery, accidental arterial puncture, and insufficient manual compression after catheter removal. We have not encountered this kind of inconvenience, mostly because the catheters remained in place.
We also did not have vascular complications such as arteriovenous fistula—even if it seldom occurs [5,14,17,18] compared to the frequency of puncture of the femoral artery [7,18]—or pseudoaneurysm.

There was no evident cause or nerve injury to explain the tickling sensation in the thigh experienced by one patient. There were no damages which are sometimes caused by a puncture or a compressive haematoma: transient paraesthesia and sensory deficit of the quadriceps [19] or crural paralysis [2].

Thrombotic events remained limited and had no major consequences. The different anticoagulation regimens did not have any influence on the incidence or severity of these thrombotic events.

The fibrin sheet presented by one patient is frequent. It has been well described by Hombrouckx et al. [20]. It develops around the tip of a single-lumen catheter, causing a valve effect with a double pump (impaired blood flow during aspiration and normal return during reinjection). It appears as a greyish sleeve composed of fibrin and platelets, about 1 mm thick and 3 cm long, which is bacteriologically sterile. Upon catheter removal, it can detach itself, but usually remains under the skin without any complications (such as the present case). Sometimes it goes into the vascular lumen, where it can cause embolic migration. In cases of inadequate blood flow during aspiration, this kind of complication must be considered and confirmed by radiology. The catheter should be replaced or filled with a fibrinolytic agent because leaving it in place could induce caval thrombosis. Catheters with an antithrombotic coating might avoid this complication.

The femoral site is deemed to be associated with a higher infection rate because inguinal areas are naturally more infected. Tunnelling, which immobilizes the catheter and protects it against retrograde infection, was never used in this study. The three different staffs were familiar with femoral cannulation and its care. So regardless of the disinfection protocol used, there was no difference between clinical presentation and incidence of the infectious complications.

Two limitations must be discussed. We observed one case of fissure and three losses (two spontaneous and one autoablation) of catheters which could have been avoided by tunnelling or by use of another site. The long-term outcome of the catheterized iliofemoral vessels must be studied to establish whether, even in the absence of complications, they recover their natural properties and do not therefore compromise subsequent renal transplantation.

Conclusion

Central venous catheterization represents an integral part of acute and/or chronic dialysis treatment for rapidly obtaining vascular access and/or preserving vascular potential of the patients.

The indwelling silicone femoral catheters inserted in the 55 patients we studied have a low complication rate. Three-quarters of these patients received partial or full ambulatory dialysis treatment.

These results suggest that improvements in the design and above all in the material of these catheters allow their more extensive use, even for long-term haemodialysis.

References


Received for publication: 27.3.96
Accepted in revised form: 1.11.96