PERCUTANEOUS FEMORAL VEIN CATHETERISATION

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Introduction

There is no doubt that the best type of blood access is the internal Cimino-Brescia A-V fistula. Both its ease of use and its long life-span surpass all other types of internal A-V fistulae.

From 1967 up to 31 July 1977, A-V fistulae were created in 83 patients in our centre, 41 of them were dialysed on the original fistulae for five years or more. Most remarkable is the fact that at present six patients are still on dialysis using the original fistulae in the lower arm after 10 to 14 years.

There are circumstances, however, when one cannot use an A-V fistula and has to resort to another technique to perform haemodialysis. One of the methods is femoral catheterisation introduced by Shaldon in 1961 [1]. Initially he cannulated both the femoral artery and the femoral vein for haemodialysis, but subsequently the catheters for dialysis were placed in the femoral vein only [2, 3]. Shaldon left the catheters in place for many days to months while perfusing them with heparin, whereas others commonly used repeated catheterisation for each dialysis.

In our centre femoral vein catheterisation has been used for over 15 years and the procedure is carried out by a doctor.

Materials

A 16 Gauge butterfly needle is used for puncture of the femoral vein. The adapter to the needle is a commercially available plastic piece (Polystan) or a metal piece made in our workshop. The Seldinger wire is 80 to 100cm in length (Avon, Kimal and others). The femoral catheter (Avon) is either 25cm in length or 15cm in length; for single needle dialysis with a double pump system (Bellco), usually the shorter catheter is used. The side holes are in the first 6cm from the tip. The diameter of the catheter is 2mm.
Technique

The doctor uses a mask, headcover, sterile gown and sterile gloves. The patient lies flat on his back with the leg rotated outwardly. The groin is shaved if necessary. The course of the femoral artery below the inguinal ligament can be marked on the skin with a pen (Figure 1). Betadine iodine is applied over an area covering the whole groin.

![Figure 1](image)

Figure 1. Right groin of a patient viewed from the foot with markings along the inguinal ligament and femoral artery. Punctures wounds from previous catheterisations are seen medial to the artery.

The patient is covered by sterile drapes, leaving an open area around the femoral artery. A local anaesthetic is injected medial to the femoral artery below the inguinal ligament.

While one or two fingers of one hand are on the femoral artery, with the other hand a 16 Gauge butterfly needle is inserted into the skin one or two centimetres medial to the artery at an angle of about 45°, aiming at the femoral vein which lies adjacent to the artery.

Usually the needle should not come closer than 0.5cm to the artery. In some patients the femoral vein is superficially located and the blood is obtained at a depth of 1cm, in other patients this may occur only at a depth of 2cm. Sometimes blood is not obtained during advancement of the needle, but it appears when the needle is slowly withdrawn. Once dark non-pulsating venous blood is obtained (Figure 2), an adapter is put into the needle hub. Some blood loss is inevitable with this technique, but this can be kept to a minimum. The soft flexible end of a Seldinger guide wire is inserted through the adapter and the needle into the femoral vein (Figure 3); the length of the wire lying in the vein
Figure 2. A butterfly needle in the femoral vein

Figure 3. An adapter on the needle hub, and a Seldinger guide wire is being inserted
should be longer than the length of the catheter to be placed in the vein. The length of the Seldinger wire should be more than twice the total length of the catheter.

Advancing the wire has to be done gently. Do not force the wire further if resistance is felt or when the patient experiences pain in the back. Pull back the wire and try to go further slowly by rotating the wire. If the wire cannot be advanced far enough, the needle is taken out, manual pressure is applied on the puncture wound until the bleeding has stopped. The needle is then reinserted at another site.

If the femoral artery is inadvertently punctured, as indicated by red blood pulsating out of the needle, remove the needle and apply pressure at the puncture site and the artery for at least three minutes until the wound is dry, to prevent haematoma formation.

When the guide wire is advanced far enough, the needle is removed. A second guide wire is introduced in the femoral vein the same way, at a distance of 1 cm or more from the first wire.

Figure 4. The catheter is threaded over the guide wire, an adapter is put on the end of the catheter. The free end of the wire is clamped to the drapes.
The Teflon catheter is then threaded over the guide wire, the end is covered with an adapter to prevent excessive blood loss. The wire sticking out of the adapter is placed in the direction of the knee and clamped to the sterile drape (Figure 4). The catheter is now advanced with a rotating movement through the skin and subcutis to the vein, it is pushed far into the vena cava. Blood fills the catheter when it is in the vein (Figure 5). The guide wire is removed, and the catheter flushed with heparinised saline solution. Thereafter the second catheter is inserted in the same manner.

![Image](image_url)

Figure 5. The catheter has been inserted in the vein and the guide wire removed

To avoid recirculation, the tip of the return catheter should lie about 7cm higher than the tip of the catheter used to draw blood from the patient. After priming with heparin, the catheters are connected to the bloodlines. The connections should be taped securely. The catheters and the bloodlines are taped to the upper leg at several places to avoid inadvertent dislocation. The insertion procedure usually takes about 15 minutes.

If only one catheter can be introduced, a fistula needle in a large peripheral vein (antecubital or cephalic vein) can be used as a return.

119
For dialysis with a single needle machine *usually* the shorter catheter (15cm in length) is used. A Y-connector is attached to the catheter and to the bloodlines (Figure 6).

![Figure 6. A Y-piece is connected to the catheter and bloodlines, for dialysis with a single needle machine. The catheter and bloodlines are taped securely on the leg](image)

Recirculation tests show insignificant recirculation which is contrary to the observations made by Raja et al [4] and Fried [5]. They used single needle machines of other manufacturers.

After dialysis the catheters are removed, and pressure is applied on the puncture sites until bleeding has stopped completely; this may take 15 to 20 minutes. Usually the patient is given protamine sulphate at the end of dialysis.

Preferably the left and right femoral vein should be used alternately for repeated dialysis.

As with subclavian catheterisation, it is safer to have femoral catheterisation performed by experienced members of the medical team.
Indications

Femoral vein catheters have the advantage of immediate use for dialysis, and freedom of movement after dialysis. Furthermore vessels are not sacrificed for future A-V fistulæ formation.

In our unit it is the method of first choice for emergency dialysis in cases of intoxication, and for dialysis in acute renal failure. Furthermore in chronic patients it is used as temporary blood access while waiting for maturation of a new A-V fistula or when due to complications an A-V fistula cannot be used.

An exceptional indication is long term use in chronic patients without blood access. Shaldon et al [2] described the use of indwelling femoral catheters and heparin perfusion for two months with 24 dialyses. Long term use of repeated femoral catheterisation was reported among others by Nidus et al [6], who used the technique for 68 dialyses in one patient, and by Friedman [7] who dialysed a patient 102 times using this method.

One of our chronic patients underwent 340 dialyses using femoral vein catheters, over a total period of three and a half years. Of these 340 dialyses, 272 were carried out consecutively in the last two and a half years. This patient started haemodialysis in 1967, and up to August 1977 the following blood access procedures were created and failed after a variable period: Scribner shunts in both arms and legs, Cimino-Brescia A-V fistulæ in both arms, a Thomas shunt in the left groin (used for three years) and a PTFE graft in the lower arm. Between September 1974 and August 1977 she was treated with intermittent peritoneal dialysis at home using a reverse osmosis machine. From August 1977 up to a successful renal transplantation in February 1980, the patient was dialysed using femoral catheters (Table I). The catheters were only inserted in the right femoral vein; the left femoral vein was damaged when the Thomas shunt was removed and could not be used for catheterisation.

<table>
<thead>
<tr>
<th>TABLE I. Mrs E born in 1942</th>
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<tr>
<td>FEMORAL VEIN CATHETERISATION</td>
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<tr>
<td>Number of dialyses</td>
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<tr>
<td>1967</td>
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<td>1968</td>
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<td>1978</td>
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<td>1979</td>
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<td>1980 (46 days)</td>
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<td>TOTAL</td>
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Single catheter dialysis – 116
(December 1977 – February 1979)
The patient tolerated the procedure quite well, although it was not always easy to insert the catheter. Scar tissue formation as a result of repeated local anaesthetic injections, needle punctures and cannulations was extensive. Sometimes it was hard to penetrate this very firm scar tissue. During one year single catheter dialysis was performed. She was in an excellent condition when renal transplantation was performed in February 1980 and she is alive today with a well functioning transplant.

Complications

A small local haematoma is not serious and can usually be avoided by applying manual pressure to any mispuncture sites, and by careful and prolonged pressure on the puncture sites after removal of the catheters. Furthermore the use of protamine sulphate after dialysis will decrease the chance of after bleeding.

Large inguinal haematoma were seen in five patients, in one of them from inadvertent arterial puncture. On two occasions a haematoma was visible in the loin after the dialysis; this was attributed to retroperitoneal bleeding. Nidus et al [6] reported a large femoral haematoma after an artery puncture, and Kjellstrand et al [13] severe retroperitoneal bleeding with shock in two patients in whom the catheter was forced even when resistance was felt during insertion of the guide wires, in one patient a lumbar vein was torn, indicating that the catheter must have been pushed out of the femoral vein.

Superficial infections of the skin were seen occasionally in our patients. Deep inguinal soft tissue infection has been reported [14]. To prevent infections it is necessary to adhere to strict aseptic techniques and to apply iodine to the puncture wounds after removing the catheters.

Thrombosis of the femoral vein was not seen in our patients, nor in Friedman’s large series [7]. Kjellstrand [13], however, mentioned three cases of proven femoral vein thrombosis after the catheters were left in place for 24 to 72 hours. Shaldon et al [3] reported no thrombosis with the catheters left in place for days and perfusing them with heparin. Achiardo et al [12] also left the catheter in place during 24 to 120 hours without complications.

Arterio-venous fistulae between the deep femoral artery and a vein were reported in four cases by Nidus et al [6], twice by Schleifer et al [14], once by Fuller et al [15] and once by Rankin et al [16]. In five of these patients the femoral artery was cannulated for dialysis. As arterial cannulation involves more risk, we strongly recommend using only the femoral vein.

Other complications were reported by Schleifer et al [14]: haemoperitoneum and puncture of the urinary bladder. Others have not seen these problems. In our centre there were no deaths attributable to the procedure.

In the past seven years (1975–1981) we have performed 1704 haemodialyses using femoral vein catheters; 1200 haemodialyses were in chronic patients and 504 dialyses in acute patients.

In Table II the number of haemodialyses [1–3, 6–14] carried out using femoral vessel catheters reported from other centres are listed; the largest series being of 1822 dialyses from Friedman’s unit [7].
TABLE II. Femoral vessel catheterisation

<table>
<thead>
<tr>
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<th>Number of haemodialyses</th>
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<tbody>
<tr>
<td>Shaldon et al</td>
<td>1961</td>
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<tr>
<td>Kvasnicka et al</td>
<td>1962</td>
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<tr>
<td>Shaldon et al</td>
<td>1963</td>
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<tr>
<td>Serf et al</td>
<td>1964</td>
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<tr>
<td>Shaldon et al</td>
<td>1964</td>
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<tr>
<td>Matalon et al</td>
<td>1970</td>
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<tr>
<td>Arana et al</td>
<td>1971</td>
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<tr>
<td>Achiardo et al</td>
<td>1973</td>
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<tr>
<td>Nidus et al</td>
<td>1974</td>
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<tr>
<td>Kjellstrand et al</td>
<td>1975</td>
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<tr>
<td>Schleifer et al</td>
<td>1976</td>
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<tr>
<td>Friedman</td>
<td>1979</td>
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<tr>
<td>Boen et al</td>
<td>1982</td>
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* Catheters left in place: heparin perfusion
† Report was on the number of punctures: 775

Conclusion

Femoral vein catheterisation is a valuable method for haemodialysis in emergency situations, in acute renal failure, and temporary in chronic patients. Occasionally it has been used for a prolonged period in chronic patients; in one patient we have used it for two and a half years with 274 consecutive dialyses. Plasmapheresis can also be carried out using this method.

Regarding the procedure, a team of experienced members of the medical staff should be trained to master the technique for inserting the catheter, in order to minimise the occurrence of complications.

References

1 Shaldon S et al. Lancet 1961; ii: 857
3 Shaldon S et al. Trans ASAIO 1964; X: 133
4 Raja RM et al. Dial and Transplant 1977; 6: 53
6 Nidus B et al. Nephron 1974; 13: 416
7 Friedman E. Trans ASAIO 1979; XXV: 526
9 Serf B et al. Lancet 1964; i: 476
10 Matalon R et al. JAMA 1970; 214: 1883
11 Arana VA et al. J Urol 1971; 106: 492
Open Discussion

MION (Montpellier) I would just like to comment to Dr Scribner that we have used, in home haemodialysis, the single site puncture and we have seen a real increase in infection in these patients. These were home haemodialysed patients who preferred for their comfort to always insert the needle at the same site and really these patients had a marked increase in infection by comparison with the standard technique of changing sites. I think this emphasises the point you made, that you may get infection from this technique. The second point, I would like to address to Dr Kootstra, is that we have been using the Thomas shunt on a rather large scale in selected patients: the indication was precisely and exclusively those home haemodialysis patients who did not have good, easily punctured A-V fistulae. This was our second choice aimed at maintaining those patients in the home with a comfortable method of connecting themselves to dialysis. We have implanted about 130 shunts in 97 patients and the overall survival of these shunts is 70 per cent at five years.

KOOTSTRA I think it is not the patency rate that is important but the complication rate. You mentioned a patency rate, can you give a complication rate on this patient material?

SHALDON The first comment I would like to make is addressed to Dr Uldall. The mobility of patients with femoral catheters was never a problem in the sixties. In fact we used them to develop the technique of self-dialysis leaving both hands free and our first experience was in chronic patients. Perhaps the groin has become more septic than it used to be or less flexible, but if you put these catheters in correctly patients can walk around as easily as with those in the neck. I really did not want to dwell on the differences between the two techniques because listening to Dr Boen and Dr Uldall most of us would agree that both are saying very similar things and both have the wisdom to stress the risks associated with the inexpert use of these techniques. This to me therefore, leads to the fundamental question of not what the benefits are but what are the hazards of this technique? I wonder whether it is better to consider the risk of perforating organs in the thorax versus perforating organs in the abdomen, and I wonder if you have any experience of haemopericardium being recorded with your technique?

ULDALL I think those are all valid points Dr Shaldon, and one of the things that I felt very uncomfortable about since becoming enthusiastic about subclavian cannulation for haemodialysis is the possibility that deaths might occur from puncture of viscera in the thorax. There have been one or two reported
deaths both from haemothorax on the right side and haemopericardium when the catheter was introduced from the right and punctured the left side of the superior vena cava. Now I think it's possible to avoid traumatic puncture of the superior vena cava simply by careful insertion. What is more disconcerting are reports of apparent spontaneous penetration of catheters which have been left in place and working well for two or three weeks; then they apparently spontaneously perforated the superior vena cava. A theory has been proposed that perhaps with single needle machines there is an oscillation or whipping action of the catheter under the influence of alternating positive and negative pressure and gradually endothelial damage may occur at the tip of the catheter, and finally the catheter pops through. If this does happen then that is very disconcerting. What one never really knows is whether a nurse or somebody at some point was tempted to give the catheter a little bit of a push because it appeared to be slipping out; and that is something that you have to be very brave to own up about if that's what caused the problem. I think it's an open question whether these things occur spontaneously or whether they occur due to ill-advised manipulation.

NAGA (Alexandria) I would like to ask Dr Boen about the incidence of pulmonary embolism in femoral vein catheter patients. Secondly about applying two catheters, one to the femoral artery and the other to the femoral vein. We have done this and not found any complications.

BOEN We have not seen pulmonary emboli but this has been described in a few patients in the literature and mainly when the catheter is left in place for some period of time. If you pull out the catheter after dialysis I think you will never see pulmonary emboli. Concerning the use of the artery for cannulation this has been described many times by others, but personally I am against this because the risk of haematoma formation is greater and furthermore arteriovenous fistulae have been reported. If you use only one catheter in the femoral vein, you can use a peripheral vein for returning the blood to the patient, for instance a good-sized vein in the arm.