CANNULATION FOR REGULAR HAEMODIALYSIS

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Reported experience from other centres

Published figures for mean shunt life vary from 11 days to the 11.4 months for both arteries and veins, reported from the Swedish Hospital in Seattle (Murray et al., 1964). A widely quoted, but poorly documented, average figure is 6 months.

Newcastle experience

We have used teflon-silastic cannulae inserted and maintained by standard Seattle techniques except in the following respects: silastic tubes have been connected over number 9 teflon, to eliminate the teflon-to-teslon junction; shunts have been held in place by Micropore tape instead of the usual stabilisers; daily toilet with Phisohex has been replaced by the use of a swab wrung out in 0.5% chlorhexidine in spirit as recommended by Parsons, the shunt remaining undisturbed between dialyses; some teflon tips have been hand-drawn locally; a few of the silastic tubes have been of British manufacture (Esco); a blood pump has been used for most dialyses. None of these factors has operated throughout the period of observation and none is definitely correlated with success or failure.

TABLE I

Table summarising 115 patient-months experience with teflon-silastic arterio-venous shunts at Newcastle upon Tyne

<table>
<thead>
<tr>
<th>Patient</th>
<th>Duration of treatment (months)</th>
<th>Approx number of de-clottings</th>
<th>Total number of arterial cannulae</th>
<th>Total number of venous cannulae</th>
<th>Anticoagulants</th>
<th>Infection</th>
</tr>
</thead>
<tbody>
<tr>
<td>J.Ki</td>
<td>14</td>
<td>150</td>
<td>2</td>
<td>3</td>
<td>+</td>
<td>+</td>
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<tr>
<td>K.B.</td>
<td>14</td>
<td>60</td>
<td>2</td>
<td>7</td>
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<tr>
<td>J.G.</td>
<td>13</td>
<td>65</td>
<td>5</td>
<td>5</td>
<td>+</td>
<td>+++</td>
</tr>
<tr>
<td>D.S.</td>
<td>12</td>
<td>12</td>
<td>1</td>
<td>2</td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td>T.Y.</td>
<td>11</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>J.Ke</td>
<td>11</td>
<td>8</td>
<td>4</td>
<td>2</td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td>E.H.</td>
<td>9½</td>
<td>40</td>
<td>4</td>
<td>5</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>J.W.</td>
<td>8</td>
<td>25</td>
<td>2</td>
<td>3</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>W.T.</td>
<td>8½</td>
<td>5</td>
<td>1</td>
<td>1</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>M.W.</td>
<td>5</td>
<td>5</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>M.P.</td>
<td>4</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>B.K.</td>
<td>3</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>D.J.</td>
<td>2</td>
<td>6</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

(Calculations include cannulae in use at present time.)

Average life of arterial cannula 4.1 months
Average life of venous cannula 3.4 months
Our results in 115 patient-months are set out in Table I. Every operative procedure on a shunt has been classified as a cannula failure. The calculation of the average shunt life yields a pessimistically low result because it includes the cannulae which are currently in use and makes the assumption that they have no future.

Causes of thrombosis and stenosis

Factors which are alleged to influence clotting in shunts but which are difficult to assess quantitatively include the use of small and pathological vessels and trauma to the intima from careless manhandling during declotting or dialysis, poor immobilisation of cannulae and indiscriminate exercise.

Coagulation defects must have some influence and this presumably explains the common observation—supported by our own experience—that shunts inserted into patients with acute renal failure remain patent during the oliguric phase but often clot during recovery.

The following statements about thrombosis are based on strong clinical impression which we are currently attempting to test statistically:

It is commonest on the day after dialysis, possibly due to a rebound after heparinisation.

It is commoner if blood has been given during dialysis, possibly because of increased blood viscosity.

It frequently occurs during the night and on these occasions the patient often wakes with the shunt arm bent underneath him, or the shunt leg compressed by its fellow.

Precautions against thrombosis

Patients are taught to monitor their shunts frequently by palpation or auscultation and they become very good at it. We are trying to develop a portable shunt monitor for use at night. Night splints of moulded plastic are prescribed to prevent compression during sleep.

Patients are encouraged to call the emergency ambulance service if they suspect clotting. Some have learnt to declot their own shunts. Long term anticoagulants are used when necessary.

If adequate flow is not restored by declotting, radiographs are taken to locate the blockage. The defective cannula is then replaced promptly, to prevent secondary damage to the other vessel.

Causes of cannula failure at Newcastle

Infection: This has been fairly common and has sometimes resulted in loss of a cannula. Once a shunt wound has become infected we have seldom been able to withdraw antibiotics during the life of that shunt without a recrudescence.

In spite of its benign reputation (it has been employed as a marker in studies of bacteraemia following dental extraction) Serratia marcescens has been isolated from several shunts and has caused septicaemia on two occasions. It thrives in our bath water.

Clotting: The incidence of thrombosis can be inferred from the number of declotting procedures (Table I). The oldest clot is almost always found in the artery or vein and when radiographs of shunts have been taken, the subcutaneous part of the cannula has never been the site of adherent clot. Early declotting usually re-establishes normal flow and cannulae have survived for over 7 months in spite of more than 50 declotting procedures. Some clot is usually displaced into the circulation from the vein, but we have never seen clinical evidence of pulmonary embolism. One patient died after more than 50 declotting episodes; her lungs were inflated and sectioned in many planes; no evidence of past or present embolism was detected.
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**Embolism:** Two shunts have failed following displacement of clot from dialyser to vein. All venous circuits available at present have either a thrombogenic clot-catcher or no filter at all.

**Stenosis of vessels:** The end of a cannula’s life is usually heralded by increasingly frequent clotting episodes and a declining flow. This syndrome is nearly always associated with partial obstruction of one of the vessels within 2 cm of the teflon tip. The usual cause is firmly adherent clot (Figure 1); occasionally there is a smooth constriction suggesting fibrosis (Figure 2). The site of obstruction can be demonstrated by radiography during the injection of 25% Hypaque. The shunt can often be reestablished by moving the teflon tip 2–3 cm proximally. Occasionally radiography reveals a total occlusion of the vein with some flow through collaterals. This can also be detected by a change in the position of the venous murmur. Shunts have run for up to 4 months on collateral flow.

![Fig. 1. Photomicrograph of section through cannulated artery. Note successive layers of thrombus, of varying age, and cellular infiltration, particularly of the adventitia.](image)

On two occasions a firmly adherent clot in a cannulated artery or vein was dissolved by slow infusion of fibrinolyisin.

**Possible explanations of the site of thrombosis**

1. **Foreign tissue reaction.** Figures 3 and 4 show the tissue response to cannula tips during the development of a thrombus. This shunt had functioned normally, without any evidence of infection, until the patient died suddenly from pulmonary haemorrhage.

   It may be that silastic and teflon are not always inert or that they are chemically altered during preparation of the shunt, e.g., during the manufacture of teflon tips.
Fig. 2. Corresponding section through cannulated vein. Note muscular hypertrophy, and cellular infiltration of all coats. As in the artery, many of the infiltrating cells are eosinophile leucocytes.

Fig. 3. Venogram showing localised obstruction just beyond the teflon tip, due to adherent thrombus.
Fig. 4. Venogram showing smooth constriction beyond the teflon tip, probably due to fibrous stenosis of vein.

2. *Bernoulli effect.* A fall in pressure occurs when fluid flows through a constriction. This will tend to suck in the walls of the vein just beyond the tapered tip and may explain intimal damage at this point. We have demonstrated the Bernoulli effect in thin rubber tubes of similar diameter and consistency to veins when fluid is pumped into them through teflon tips.

REFERENCE