Permanent twin catheter: a vascular access option of choice for haemodialysis in elderly patients

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Introduction

The increasing incidence and prevalence of elderly end-stage renal disease (ESRD) patients is an emerging problem for nephrologists in charge of renal replacement therapy (RRT). Co-morbid conditions (e.g. cardiovascular diseases, malnutrition, diabetes mellitus) frequently associated with ageing is an additional factor complicating the RRT strategy in elderly ESRD patients. Among technical difficulties encountered in treating this population, obtaining a reliable vascular access is probably one of the more frustrating [1,2].

Permanent vascular access [native or graft internal arterio-venous (AV) fistula] is very often difficult to construct (poor venous capital, mediacaicosis, arteriosclerosis, malnutrition) or useless due to low blood flow or poor venous network development. In patients with severe heart disease or atherosclerosis, an AV fistula is usually contraindicated to preserve a precarious general or regional haemodynamic equilibrium. Finally, in the elderly patients with limited life expectancy, very aggressive surgical attempts to create an AV fistula do not seem ethically justified. For these reasons, a long-term catheter, a so-called permanent catheter, offers a very interesting alternative to an AV fistula [3–6]. Permanent catheters offer several advantages: they are easy to insert under local anaesthesia; they provide an immediate and long-term vascular access for haemodialysis; they do not compromise the haemodynamic equilibrium; they preserve comfort and autonomy for the patient; and they allow the delivery of an adequate dialysis dose. However, as with any implanted foreign material, a permanent catheter increases the risk of infection and venous complications (i.e. thrombosis, stenosis) [7,8].

The aim of this report is to illustrate the pivotal role offered by permanent catheters (TwinCath, MedComp, Harleyville, USA) in the vascular options for RRT in elderly ESRD patients. The study reviews our experience during the period 1982–1997 using the TwinCath (TCath) as a permanent catheter for RRT in ESRD patients, with a particular emphasis on its potential role in elderly patients.

Subjects and methods

TCath vascular access option

In our department, TCath was established as a vascular access tool option for ESRD patients in the early 1980s [9]. From a global experience of 1580 TCaths used to treat acute and chronic renal patients, 738 TCaths satisfying the criteria of a permanent catheter (used for 3 months or more) inserted in ESRD patients were selected and analysed for this study [10].

TCath is a definite option in our vascular access strategy for RRT indicated as soon as an ESRD patient requires haemodialysis without permanent and usable vascular access. TCath offers a very flexible solution and it may be used for as long as necessary. TCaths are removed when the functionality and usability of another permanent vascular access is confirmed. TCaths are kept and used as permanent accesses when multiple attempts at creating AV fistulae have failed, in the very elderly patient or when a patient’s life expectancy is limited (e.g. myeloma).

Patients

A total of 738 permanent TCaths were inserted during the study period. Each catheter is considered as an individual patient despite the fact that some patients had more than one TCath at different treatment periods. Patients receiving TCath consisted of 384 males and 354 females with a mean age of 58.4 ± 16.3 years. All patients had chronic renal failure requiring chronic haemodialysis.

TCath insertion technique and handling

TCath consists of two independent catheters made of two removable parts joined together at the time of insertion [11]. The intravascular cannula is made of radiopaque silicone polymer tubing (inner/outer diameters 2.0/3.2 mm), the length differing according to the side of insertion: 28–30 cm and 32–34 cm for the right and left sides respectively. Six holes are disposed spirally along their distal tip. The extension or connecting cannula is made of 6–7 cm silicone polymer of larger diameter ending in a nylon luer lock connection device.

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TCaths were implanted in 95% of cases under local anaesthesia by experienced and trained physicians under strict rules of asepsia. TCath insertion, described in detail elsewhere, used a percutaneous method derived from the Seldinger method (Figure 1). Basically, it consists of four major steps: (i) insertion of the two silicone cannulae in the ipsilateral internal jugular vein; (ii) subcutaneous tunnelling downwards to the chest area; (iii) adaptation of the extension connection device and tight junction to the intravascular cannula; and (iv) subcutaneous fixation by a pulse ring suture. The correct positioning of the TCath is checked after insertion by a chest X-ray.

TCaths were used exclusively for RRT (haemodialysis, haemofiltration or haemodiafiltration) and not manipulated between sessions. Connection and disconnection to dialysis lines are performed under strict aseptic rules by trained and experienced nurses. Before dialysis starts, TCaths are declotted by syringe suction and rinsed with isotonic saline. After dialysis rinse back, the TCaths are closed with an heparin lock. In all cases, the TCaths are protected by a sterile dressing. Showers are permitted by means of a plastic and waterproof dressing.

**TCath survey and evaluation**

TCath performances were checked monthly for in-centre patients during a regular haemodialysis session. Effective blood flow is measured using the bubble test method over a 1 m calibrated arterial tubing segment. Recirculation is evaluated according to the low flow method with the three blood samples method. Validation of both measurements was obtained recently using an ultrasound device (Transonic®) [12,13]. Instantaneous urea body clearance and effective dialysis dose delivered (Kt/V) are evaluated during the same haemodialysis test session.

The TCath survey was obtained through a collaborative registry collecting information concerning functionality, date of removal and possible complications noted during the follow-up period.

**Calculation and statistics**

Results were expressed as mean ± standard deviation for the group analysed. Each TCath was considered as an individual patient. Descriptive statistical analysis used number and/or frequency to express distribution. Incidence was calculated as the ratio of the number of events over the total number of cases. The risk for TCath complications was analysed according to the actuarial survival method.

**Results**

**TCath overall experience**

The population analysed in this study consists of 738 TCaths used for 3 months or more in a group of ESRD patients with a mean age of 58.4 ± 16.3 years. Mean duration of use was 14.2 months (3 months to 10 years).

Distribution of TCath according to the age of patients is presented in Figure 2. As shown, ESRD patients aged 65 years or more account for 46.6% of the overall population.

The sex ratio (M/F = 384/354) is 1.085, confirming the predominance of male patients on RRT.

The internal jugular vein was considered exclusively in this study. The right side was cannulated preferentially as the primary approach for anatomical reasons, accounting for 663 TCaths (89%), while the left side was indicated in 75 cases (10%) as a secondary and complementary approach.

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**Fig. 1.** TCath inserted in the internal jugular vein. Three major parts are shown: intravascular segment, subcutaneous segment, and external extension and connecting device.
Table 2. Complications with TCath

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<tr>
<td>Infection</td>
<td>71</td>
<td>9.6</td>
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<tr>
<td>Mechanical failure</td>
<td>12</td>
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<td>Stenosis/thrombosis</td>
<td>10</td>
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<td>Dysfunction</td>
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<td>Haematoma</td>
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<td>Pneumo/hemothorax</td>
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Infection (all types) calculated according to the actuarial method is presented in Figure 6. The risk of infecting TCath was 7.38% of patients were older than 65 years.

**TCath technical survival**

In the overall population, the mean duration of use of TCath was 14.2 months, ranging from 3 months to 10 years. Actuarial technical survival for the whole group is presented in Figure 3. As shown, the median survival achieved is 2.5 years. However, due to our TCath strategy consisting of removing the TCath as soon as a permanent vascular access is functional, actuarial survival is not an appropriate method. The percentage of TCaths remaining operational over time is a more representative approach.

The percentage of functioning TCaths over time in five major age groups is presented in Figure 4. As shown, no significant difference was noticeable in terms of TCath longevity whatever the age of the patient.

**TCath performances**

TCath was used in all forms of RRT with blood flow ranging from 200 to 400 ml/min. When used in conventional haemodialysis, TCath provided an effective mean blood flow rate of $328 \pm 13$ and $317 \pm 15$ ml/min in patients $<65$ years and $>65$ years respectively. The recirculation rate was $8 \pm 2\%$. The effective blood flow compared with blood pump speed is presented in Figure 5. As shown, a significant difference appears only at high blood flow ($>350$ ml/min) contributing to reduce slightly the dialysis dose delivered to the patient.

**TCath complications**

The complications observed with TCath were classified into five major categories and their incidence is presented in Table 2. As shown, infection (including skin exit infection, tunnel infection, bacteraemia or sepsis, isolated fever) was the most frequent, accounting for 9.6% of cases, followed by mechanical failure with 1.62% of cases and venous complications (thrombosis, stenosis) accounting for 1.35% of cases. Other complications were of marginal importance, accounting for $<1\%$ of cases.

The infectious risk associated with the use of TCath (all types) calculated according to the actuarial method is presented in Figure 6. The risk of infecting TCath...
Fig. 3. Technical survival of permanent TCaths (used 3 months or more). Median survival was between 2.5 and 3 years.

Fig. 4. Percentage of TCaths remaining functional over time according to age groups. No significant difference was noted between the different groups.

increased exponentially up to 96 months and appeared to plateau thereafter. It should be noted, however, that the number of TCaths exposed to the risk of infection is too small (<10) to be interpreted. From these data, the infectious risk may be estimated at 11.7, 17.8, 21 and 27.7% at 1, 2, 3 and 4 years respectively.

The risk of mechanical failure associated with TCath was also calculated from the actuarial method. Here again, the risk of failure increased steadily up to the third year, and plateaued thereafter. Mechanical failure was evaluated in our experience at 1.4, 3.9, 5 and 7.6% at 1, 2, 3 and 4 years respectively.

- No significant difference was observed in the incidence of complications according to age groups. In contrast, some nephropathies were strongly associated with a higher actuarial risk of infection: haemolytic
Extracorporeal blood flow obtained with TCath easily ensured the adequate delivery of dialysis dose in all kinds of patients independent of their age. From a general perspective, it is interesting to note that due to its simplicity and reliability, TCath has become over time our first vascular access modality in the ESRD programme. TCath use gave a greater flexibility in the management of RRT. For a particular patient, TCath warranted uninterrupted dialysis when conventional permanent connections failed. In a large group of patients (dialysis unit, regional organization), TCath facilitated the global management of our ESRD programme. TCath was the first to introduce the concept of bedside percutaneous insertion of silicone polymer catheters [14]. As illustrated by the present series, and in keeping with the concept of a permanent catheter, TCath o

Discussion

As shown in this study, a permanent TCath was an excellent alternative for long-term vascular access in ESRD patients. Extracorporeal blood flow obtained with TCath easily ensured the adequate delivery of dialysis dose in all kinds of patients independent of their age.

From a general perspective, it is interesting to note that due to its simplicity and reliability, TCath has become over time our first vascular access modality in the ESRD programme. TCath use gave a greater flexibility in the management of RRT. For a particular patient, TCath warranted uninterrupted dialysis when conventional permanent connections failed. In a large group of patients (dialysis unit, regional organization), TCath facilitated the global management of our ESRD programme. TCath was the first to introduce the concept of bedside percutaneous insertion of silicone polymer catheters [14]. As illustrated by the present series, and in keeping with the concept of a permanent catheter, TCath offered several advantages by comparison with other double-lumen catheters [15]. TCath was easy to insert under local anaesthesia, permitting haemodialysis to be started within 30–45 min [16], it permitted the achievement of a high blood flow (300–350 ml/min) with a low recirculation rate on a regular basis, ensuring dialysis dose delivery [17–19]. It ensured patient comfort while relieving the stress due to a non-functioning fistula; it reduced morbidity by shortening hospitalization time while keeping patient treatment on an ambulatory mode; and its use was associated with a relatively low morbidity rate and a satisfactory technical survival rate [7,20,21].

TCath shared with other permanent catheters the risks of any venous implanted device with a skin exit site. The emerging part of the catheter facilitated infection either from bacteria migrating into the sub-

Infectious Risk, %

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<th>738</th>
<th>203</th>
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<th>48</th>
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Fig. 5. Effective vs set blood flow obtained with TCath.

Fig. 6. Infectious risk (any types) evaluated according to the actuarial method in 738 TCath.
Permanent twin catheters for haemodialysis in the elderly

Although rarely observed in our experience with extracorporeal blood flow resistance, the quality of treatment in the elderly patient. RRT while the draining venous system was developing. Furthermore, the combined or alternate use was an excellent vascular access alternative for elderly patients. Creating an AV fistula increased when the patient's condition had improved. In this respect, ease of insertion and reliability have promoted the technical survival of TCaths compared favourably with graft AV fistulae, with a median survival of 2.5 years [1]. The incidence of complications with TCath appeared limited in our hands staying in an acceptable range for long-term clinical use. New perspectives based on antithrombotic surface treatments and on a totally implantable device, including catheters and a subcutaneous chamber, are presently under study. By suppressing the skin emerging site of TCath, it seems reasonable to predict that the infectious risk will be reduced and the comfort of the patient will be enhanced. However, prospective studies are required to validate this new and very attractive concept.

In conclusion, permanent TCaths have been successfully used over the last decade by our group. TCaths have changed our vascular access strategy in ESRD. Ease of insertion and reliability have promoted the TCath to the forefront of our RRT programme. By playing a pivotal role, TCath gave more flexibility to the management of ESRD patients. Permanent TCath was an excellent vascular access alternative for elderly patients. New perspectives of totally implantable catheters will certainly enhance this new trend.

References


