Experience using the Quinton Permcath for haemodialysis in the Irish Republic

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Abstract

Background. The Quinton Permcath has been widely used for temporary vascular access in patients requiring haemodialysis. Placement under direct vision into the internal jugular vein minimizes the complication rate. This access modality is being used more and more for long-term access in the elderly and in patients where other access modalities are unavailable or have failed.

Methods. We reviewed the results of 50 central venous Permcaths inserted under direct vision in 61 patients, over a 4-year period. The overall survival and complication rates are estimated. A detailed description of the catheter insertion and removal is provided.

Results. Seventy-six per cent of patients were successfully managed using the Permcath for a median duration of 105 days. In addition, nine patients (18%) had catheters functioning without complications for over 1 year. Twenty-six (42.6%) catheters were removed for complications. Seven patients had a single and two had second catheter reinsertion during the course of the study.

Conclusions. The Quinton Permcath remains a reliable method for short-term vascular access. When other access modalities are unavailable, it may offer a valuable alternative for long-term haemodialysis.

Key words: dialysis-catheter; catheter infection; catheter obstruction; thrombosis; catheter embolism

Introduction

Definitive access for patients requiring haemodialysis is ideally achieved by the use of an arteriovenous (Brescia–Cimino) fistula in the arm [1]. At initial presentation, however, or while waiting for a fistula to mature, many patients urgently require short-term vascular access. In addition, some patients, who have no vessels suitable for creation of an arteriovenous fistula, or in whom there have been multiple failed attempts, need an alternative form of long-term vascular access. The subclavian percutaneous dialysis catheter is widely used for short-term temporary vascular access and is generally satisfactory, but complications, principally infection, limit its usefulness. In addition, the subclavian route is associated with a high incidence of central venous thrombosis [2–4] which may compromise future fistula or shunt placement in that extremity. For long-term access internal shunts offer the best alternative, but not all patients have suitable vessels.

Since 1985 we have been using the Permcath (Quinton Instrument Co., Seattle, USA), a double-lumen silicone rubber dialysis catheter inserted under direct vision mainly into the internal jugular vein (IJV). We have used this not only with patients requiring short-term vascular access but also with some in whom alternative methods of access have failed. This paper retrospectively reviews our 4-year experience with this device.

Subjects and methods

Patients

Survival, complication and failure rates of 61 catheter insertions performed in the National Renal Transplant Unit on 50 patients were retrospectively studied over a 47-month period. There were 24 male and 26 female patients. The median age was 48, with a range from 13 to 75 years. Forty-eight patients had chronic end-stage and two had acute renal failure. Catheters were inserted in patients awaiting the creation or maturation of an arteriovenous (AV) fistula, or patients in acute renal failure. Catheters were also inserted in patients in whom other forms of access were unavailable or had failed, where the duration of access was to be indefinite and for as long as possible.

End-points of the study were catheter removal, death of a patient or completion of the study period. The minimum follow-up period after catheter insertion was 18 months. Catheter failure was defined as non-elective removal of a catheter for a complication (including inadequate flows for dialysis i.e. < 200 ml/min.). Life-table survival curves were used to evaluate the performance of the catheter and to assess the impact of the common complications on catheter
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survival. Statistical analysis was performed using the log-rank test.

The catheter

The catheter (Figure 1) is a radio-opaque, soft silicone rubber catheter, designed for right atrial placement via the central veins and a subcutaneous tunnel. The standard catheter is 36 cm in length. A Dacron felt cuff is situated 19 cm from the tip, serving to anchor the catheter in its tunnel by the ingrowth of fibrous tissue. In cross-section the catheter is elliptical with external diameters of 5.9 mm × 3.3 mm. There are two parallel lumens, each with an internal diameter of 2 mm and priming volumes of 1.3 and 1.4 ml per lumen. The proximal (arterial) lumen ends 2.5 cm from the tip to minimize recirculation. At the periphery of the catheter is a hub from which the channels diverge, ending in colour-coded Luer locks; brown for arterial (outflow) and blue for venous (inflow). There is an attached clamp on each channel.

Catheter insertion

Catheter insertion took place in the operating theatre. Throughout the study period, general anaesthesia was used on all but two occasions, where local anaesthesia was used. We now routinely use local anaesthesia, and would recommend this in most cases. Side of insertion was chosen based on attempting to avoid using an extremity which had been involved in multiple previous venous access attempts.

For IJV insertion the patient is placed in the Trendelenburg position and a transverse incision is made in the root of the neck over the interval between the two heads of the sternocleidomastoid muscle. Vascular slings are placed around the IJV for proximal and distal control. A stab incision is made below the clavicle, lateral to the mid-clavicular line, in or near the deltopectoral groove. The catheter is manoeuvred against the chest wall to estimate the distance to the right atrium. The cuff, as it lies in the tunnel, should be at least 2 cm from the exit site. The cuff should not touch the vein as it may traumatize it on removal. A haemostat is passed from the cervical incision to emerge in the infraclavicular vein and used to draw a malleable probe up the tunnel. The lower end of the probe is inserted into the distal limb of the catheter, which is then drawn up into the main incision. The channels are flushed, filled with sterile saline and the clamps are shut.

With the slings controlling the IJV a longitudinal venotomy is made; the lower sling is relaxed and the catheter is passed down the superior vena cava to the right atrium. The catheter is oriented in such a way that the venous lumen is medial to the arterial. In the earlier part of this series a purse-string suture was used to close the IJV around the catheter. Due to the occurrence of a catheter tip embolus (see catheter complications below), we now close the upper part of the venotomy with a continuous longitudinal 6/0 polypropylene suture. Flow through the channels is then tested. If necessary the catheter position is adjusted to achieve satisfactory flows. The channels are flushed, primed with heparinized saline (1:5000) and sterile caps are fitted. The cervical incision is closed in layers. Sutures are placed to secure the catheter at the exit site while adhesion of the Dacron cuff is awaited. A postoperative chest X-ray is taken to confirm the position of the catheter tip which should ideally lie just inside the right atrium.

Catheter removal is also carried out in the operating theatre with the patient in the Trendelenburg position. If the catheter has been in position for less than 2–4 weeks gentle traction may be all that is required to dislodge the Dacron cuff. If more than minor resistance is encountered, a small incision is made over the cuff under local anaesthesia. The cuff is dissected free and the catheter is transected on its exit side. The catheter is then removed in two pieces. Any resistance to removal of the central part of the catheter at this stage suggests attachment of the catheter at the venotomy site. Dissection in this area may be necessary to free the catheter.

Results

Fifty patients had 61 catheters placed for vascular access. Seven patients had two catheters inserted. Two patients had three catheters inserted. Access was via the right external jugular vein on two occasions and the left long saphenous vein once. The internal jugular vein was used in the remaining 58 cases. Twenty-nine catheters were placed in the right IJV and 29 in the left.

Catheter survival

The median duration of catheter survival was 105 days (range 3–1101). Overall catheter survival is shown in Figure 2 in which catheter failure only is considered. Patient death or removal of a catheter for any reason other than failure (e.g. maturation of an AV fistula or transplant), meant that those catheters were no longer available to the study and thus were not included in the total number of ‘available catheters’ from that time forward. At different points along the curve, therefore, the total number of ‘available catheters’ may differ. The estimated catheter survival rates were 70% at 6 months, 45% at 1 year, 34% at 2 years and 34% at 3 years. Nine patients (18%) had functioning catheters for over a year. Catheter survival curves comparing sex and side of insertion are shown in Figure 3. There was a significantly worse survival of catheters inserted in the left internal jugular vein of male patients than in the other three groups ($P<0.005, 0.01, 0.025$).

![Fig. 1. The Quinton Permcath dialysis catheter.](image-url)
**Patient outcome**

Five patients died with functioning catheters during the study. No patient died from catheter-related complications.

Overall, 31 (62%) of 50 first catheterizations succeeded. Nine patients had a second catheterization, of which five (55.5%) succeeded. Two patients had a third catheterization with success. Thus, 38 (76%) of the 50 patients were successfully managed with the catheter, though at the price of multiple procedures for some.

**Catheter complications**

Twenty-six catheters were removed for complications (42.6%) (Table 1). The most common complication was partial obstruction or inadequate flow leading to catheter removal (13 catheters; 21%). Radiography
Table 1. Complications

<table>
<thead>
<tr>
<th></th>
<th>No. catheters (%)</th>
<th>Median catheter survival (range)</th>
<th>Catheters removed (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Partial obstruction</td>
<td>13(21.3)</td>
<td>20(4–535)</td>
<td>13(21.3)</td>
</tr>
<tr>
<td>Catheter thrombosis</td>
<td>4(6.6)</td>
<td>14(7–23)</td>
<td>4(6.6)</td>
</tr>
<tr>
<td>Central venous thrombosis</td>
<td>2(3.3)</td>
<td>33(3–62)</td>
<td>2(3.3)</td>
</tr>
<tr>
<td>Suspected sepsis</td>
<td>9(14.8)</td>
<td>30(9–271)</td>
<td>6(9.8)</td>
</tr>
<tr>
<td>Tunnel abscess</td>
<td>1(1.6)</td>
<td></td>
<td>1(1.6)</td>
</tr>
<tr>
<td>Haemorrhage</td>
<td>1(1.6)</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Haematoma</td>
<td>1(1.6)</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Catheter damage</td>
<td>4(6.6)</td>
<td>530(66–882)</td>
<td>0</td>
</tr>
<tr>
<td>Catheter embolism</td>
<td>1(1.6)</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>36(59.0)</td>
<td></td>
<td>26(42.6)</td>
</tr>
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</table>

demonstrated inadequate positioning to be the cause in the majority of these (eight of 13). Four catheters needed to be removed for complete obstruction i.e. catheter thrombosis (6.6%) and a further two were removed due to the development of central venous thrombosis (3.3%).

Catheter infection was suspected because of unexplained fever in nine patients. In three patients systemic antibiotics avoided the need for catheter removal. The other six catheters were removed, four of which had positive blood/catheter tip cultures. In one additional patient, tunnel infection with abscess formation necessitated catheter removal.

Other complications which did not lead to catheter removal were intraoperative haemorrhage, postoperative haematoma, damage to the catheter structure, and catheter embolism (Table 1).

Significant intraoperative haemorrhage requiring blood transfusion occurred in one case where controlling slings could not be placed around the IJV during catheter placement. Postoperatively, one patient with thrombocytopenia developed a large haematoma in the cervical incision; this resolved with appropriate treatment. Fracture of the catheter occurred four times, at an average of 502 days after insertion (range 66–882). All were successfully repaired using the kit supplied by the manufacturers.

Catheter tip embolism occurred on one occasion during elective catheter removal on the 70th day after insertion. Following dissection of the cuff and removal of the peripheral part of the catheter, traction was applied to the remaining part. Moderate resistance was encountered at this stage and upon removal of the catheter part of the tip was noted to be missing. Exploration of the venotomy site revealed a small fragment caught in the purse-string suture which we routinely used for venotomy closure until this time. X-rays showed the remainder of the catheter tip (1.5 cm) to be lodged in the periphery of the right lung. The patient showed no adverse sequelae. The catheter tip was left in situ and the patient was given antibiotics for 5 days. This patient has since had a successful renal transplant and remained well 29 months after removal of her catheter.

Discussion

The Quinton Permcath was first introduced in 1984 and since that time it has been extensively used for short term [5–9] and occasionally for long term [5,6,10] access for haemodialysis. The results presented in this report (a median catheter survival of 105 days and an estimated 2-year survival of 34%) compare favourably with results of other workers [5–8,10–12]. It is worthy of note that 76% of the patients in this series were successfully managed using the catheter and that nine patients (18%) had catheters functioning without complications for over 1 year (Figure 2). Although we do not recommend use of the catheter as a first choice in patients requiring long-term access, in cases where other forms of access have failed, it should be considered as an important alternative. Others have observed that some patients, particularly the elderly, often elect to continue using the catheter indefinitely, as it is a relatively painless form of access, without the need for transcutaneous needle sticks [13]. Although most of these catheters were placed under general anaesthesia, we now recommend their placement under local anaesthesia wherever possible.

Percutaneously placed subclavian catheters have been used with acceptable results [6,7]. However, there is a higher incidence of immediate local complications such as haemothorax, pneumothorax, haematoma, and nerve damage [7,9,11,14]. Subclavian catheters have also been associated with perforation of the superior vena cava [15,16] and right atrium [17]. Because of the more direct route to the heart and direct visualization of the vessel, these complications occur less frequently with catheters inserted by IJV cutdown [5,11]. No such complications were encountered during the course of this study. In addition, central venous thrombosis and stenosis is a major problem with percutaneously placed subclavian catheters [2–4]. The venous obstruction may remain subclinical until an arteriovenous fistula or conduit is created. The resultant venous hypertension predisposes the new permanent access to early thrombosis and failure [2–4]. Preoperative Doppler ultrasonography [2] or venogra-
phy [3] are thus advised by many authors before creating an arteriovenous fistula in patients who have undergone previous subclavian vein catheterization. The 3.3% incidence of central venous thrombosis encountered in this series is higher than other open cutdown IJV series [5], but does not approach the 23% obtained by the percutaneous subclavian route [3].

The main complications we encountered were partial obstruction and infection. In the 13 cases of severe partial obstruction reported here, flows through one or both channels deteriorated over a matter of days or weeks, until they were inadequate for dialysis. Recirculation studies were not routinely performed during the study period. Occasionally, the nursing staff inverted the arterial with the venous limb in order to obtain adequate flows for dialysis; unfortunately our records did not allow us to estimate exactly how often this occurred. This of course further increased recirculation, but served to maintain adequate (>200 ml/min.) flow rates for dialysis and allowed continued use of the catheter. Again, partial obstruction was the most common complication leading to catheter removal in catheters placed on the left hand side. The shorter survival rates of catheters inserted on the left side in males can probably be explained by the fact that catheters inserted via the left side have a greater distance to travel and a less direct route to the right atrium (Figure 2). Other authors have commented on the poorer catheter survival rates when the left IJV is used [6,10] but not all consider the side of insertion to be an important factor [10]. When the left IJV was used, we often found difficulty in reaching the right atrium, even with the catheter advanced to its full length. A 40-cm catheter is now available and we now feel this should always be used on the left side, especially in patients with a large build. A valid criticism of this study is the lack of on-table fluoroscopy, which may offer the least expensive option to determine placement in the future.

Complete obstruction of the catheter due to catheter thrombosis led to catheter failure on four occasions. One catheter was exchanged over a wire for this complication and is included as one of the nine second catheter insertions. Had urokinase been available to us during the course of the study [5,6,10] it is probable that this number would have been less. Filling the blocked lumen with this agent is frequently successful in relieving obstruction. Catheter stripping, a percutaneous technique to mechanically strip the fibrin sleeve off the shaft of the catheter, using a snare introduced usually through the femoral vein [20], was not practiced in our unit. Central venous thrombosis occurred twice in our series. Both patients had multiple previous subclavian dialysis catheters placed percutaneously. Both patients had their catheters removed. Although some authors have reported indwelling catheter preservation and even increased catheter survival in oncology patients using long-term anticoagulant therapy in cases of central venous thrombosis, this was not our practice [21,22].

With regard to infection, as two of the six catheters removed for persistent unexplained fever were in patients with negative blood or catheter tip cultures, our infection rate lay between 8.2% (5/61) and 16.4% (10/61). Others have reported infection rates of 0–28% [5–7,10].

One catheter was accidentally cut when a dressing was being removed. The cause of catheter fracture in the other three cases is unknown. Although none of the patients suffered any adverse effect, the possibility of air embolism occurring in these circumstances should not be discounted.

Removal of the catheter seems (and usually is) extremely simple. However, as the catheter is soft, and at body temperature even softer; it can be damaged quite easily by blunt instrumental trauma. In one patient, when traction was applied, the catheter tip was severed by the polypropylene purse-string suture and embolized to the lung. A similar experience has been described by Dunn et al. [5]. We now no longer use a purse-string suture for the venotomy closure.

In conclusion, while the Quinton Permcath is not the ideal form of vascular access for haemodialysis, when other forms of vascular access are not available, it may offer a very useful alternative. Inserted under direct vision into a jugular vein, it has demonstrated durability with a limited number of complications.

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References


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