Tunneled Femoral Central Venous Catheters in Children With Cancer

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ABSTRACT. Objective. We discuss the feasibility of long-term femoral venous access by means of a cuffed subcutaneously tunneled central venous catheter (Broviac catheter) in selected pediatric cancer and stem cell transplant patients in whom access via the veins of the upper part of the torso is difficult or contraindicated and in whom alternative routes must be used.

Patients and Methods. We report on our experience with 9 patients (3 of whom underwent stem cell transplantation) who received femoral Broviac catheters between December 1990 and November 1999.

Results. Time in place ranged from 4 to 155 days with a median of 58 days (mean: 71.2 days). Three catheters had to be removed: 1 because of infection of the subcutaneous tunnel and 2 because of catheter obstruction. The remaining 6 catheters functioned well without problems as long as they were needed; 1 of them got accidentally dislodged while the patient was off treatment. No episodes of catheter-related septicemia, thrombosis, kinking, or drug extravasation were noted; there were no catheter-related infectious complications in the transplant patients.

Conclusions. Our experience indicates that in those instances in which customary access to the superior vena cava is precluded, long-term venous access by way of the femoral vein is a feasible and safe alternative in children, even in the setting of stem cell transplantation. Pediatrics 2001;107(6). URL: http://www.pediatrics.org/cgi/content/full/107/6/e104; femoral long-term central venous catheters, Broviac, pediatric cancer patients.

Long-term central venous catheters are mandatory in the therapy of many pediatric cancer patients undergoing conventional chemotherapy and/or high-dose chemotherapy with stem cell transplantation. They are required for the administration of antineoplastic agents and supportive therapy, such as antibiotics, intravenous fluids, parenteral nutrition, and blood components, as well as for the repeated sampling of blood. In general, cuffed subcutaneously tunneled central venous catheters of the Hickman et al or Broviac et al type\textsuperscript{1,2} are inserted into the superior vena cava or the right atrium via the jugular or subclavian vein. In some patients, this approach may be difficult (eg, in small children) or contraindicated (eg, in patients with mediastinal masses or thrombosis of the superior vena cava). The percutaneous insertion of a tunneled femoral Broviac catheter might be an acceptable alternative in these selected patients.

METHODS

Patients

One adolescent and 8 pediatric patients under treatment for different malignancies received cuffed tunneled central venous catheters (Broviac catheters) via the femoral vein between December 1990 and November 1999. The age of the patients ranged from 2 months to 20 years; the median age was 22 months and 4/9 patients were infants. Body weight ranged from 5.0 to 52.8 kg with a median weight of 9.2 kg; 5/9 patients weighed <10 kg. Six patients received conventional chemotherapy, whereas 3 patients had their catheters inserted while undergoing high-dose chemotherapy and stem cell transplantation (patient 7 at day –7, patient 8 at day 0, and patient 9 at day +5); patient characteristics are reported in Table 1.

Reasons for Selection of Femoral Insertion Site

Patient 1, a 2-month-old infant suffering from rhabdomyosarcoma of the head and neck region, received primarily a femoral catheter because of tumor localization and low body weight (5.0 kg). All other patients had primarily received central lines via a subclavian vein, which had been removed either accidentally or secondary to catheter obstruction or infectious complications. Placement of a new catheter via the contralateral vena subclavia was impossible in 2 patients suffering from thrombosis of the superior vena cava; it was unsuccessfully attempted in the remaining 6 patients resulting in hemothorax in 2 cases.

Methods

Broviac catheters (Bard Access Systems, Salt Lake City, UT) 6.6 and 4.2 French (in children <10 kg) were used. All catheters were inserted by the pediatric oncologist (C.U.) under strictly aseptic conditions on the oncology ward (in either the procedure room or the laminar air flow unit). General anesthesia (ketamine) was administered to all children. Patients who were not on antibiotics received single-dose prophylactic antibiotic coverage.

In 1 patient the catheter was placed by venous cutdown, whereas 8 patients had their catheters inserted percutaneously using a modified Seldinger technique\textsuperscript{3–5}: an introducer needle was inserted into the femoral vein well below the inguinal ligament using the pulse of the femoral artery as a landmark\textsuperscript{6,7} and a guide wire with a J-tip advanced through the needle. After withdrawal of the needle, a small incision was made at the wire insertion site and at the skin exit site on the anterior circumference of the thigh. A subcutaneous tunnel was created with a tunneler as atraumatically as possible, the catheter was pulled through the tunnel, and the Dacron cuff was placed approximately halfway between the skin exit site and the femoral insertion site. Catheter length was trimmed as needed. A dilator-introducer sheath combination was advanced over the guide wire into the vein. The dilator and guide wire were withdrawn and the catheter inserted into the sheath, which was subsequently peeled apart while keeping the catheter in place. Patency of the catheter was ensured by withdrawal of blood. The 2 incisions were closed with sutures and the catheter was secured with a nonabsorbable suture, which was tied around the catheter to prevent accidental dislodging. The exit site and the
incision in the groin were covered with polyvidone-iodine ointment and a dry sterile dressing.

The following precautions regarding operative technique were paid attention to: 1) skin incisions were made only through healthy skin; 2) skin incisions were as small as possible; 3) the subcutaneous tunnel had to be of sufficient length, ie, the exit site was moved to the anterior circumference of the middle third of the thigh (more distally in infants and more proximally in older children, respectively); and 4) the tunnel was created as atraumatically as possible.

Catheter position was verified with a radiograph. The catheter exit site was inspected and redressed daily by a nurse during hospitalization. Manipulations of any component of the delivery system were performed under strictly sterile conditions.

**RESULTS**

There was a total of 641 days of catheter placement (range: 4–155 days), median time in place was 58 days (mean: 71.2 days). No complications occurred during the insertion procedure. One catheter had to be removed after 4 days because of infection of the subcutaneous tunnel. Two other catheters had to be removed because of catheter obstruction after 17 and 103 days, respectively. The remaining 6 catheters functioned without problems and remained in place until the end of therapy (n = 3) or until the patient’s death (n = 2). A toddler girl accidentally dislodged her catheter during her stay at home. Complication rate per catheter day was 0.62%.

There were no catheter-related infectious complications in the 3 patients undergoing high-dose chemotherapy and stem cell transplantation. Complications, such as thrombosis, kinking, migration of the catheter, or extravasation of drugs, were not observed.

**DISCUSSION**

The femoral vein is the access site of choice for cardiac catheterization in children. In most pediatric intensive care units, femoral and internal jugular veins are the most frequently used central venous catheter sites. Catheterization of the femoral vein is relatively easy to perform, safe, and convenient. In contrast to access via the subclavian or internal jugular veins, which may involve life-threatening complications, there is a comparatively low risk of insertion-related complications. The pulse of the femoral artery serves as a landmark for the vein; in case of bleeding, the vessels can be directly compressed against the hard surfaces of the femur and the pelvis. In patients requiring cardiopulmonary resuscitation, the femoral site is also the common access site. In a prospective study analyzing 395 catheters placed in pediatric intensive care patients, it was shown that central venous catheter complications occur at equal rates for femoral and nonfemoral catheters.

Thrombosis of the superior vena cava or mediastinal masses may preclude placement of a central catheter via the upper route. In such patients, insertion of a long-term central venous line by way of a femoral vein would seem to be a rational alternative. However, long-term access to the inferior vena cava by way of the inguinal area was not recommended for a long time because a high incidence of infection and septicemia was reported. Subsequently, successful use of the saphenous vein approach (by venous cutdown) with creation of a subcutaneous tunnel from the groin area up to the level of the umbilicus was reported in 19 patients without malignant disease; the catheters remained in place for a mean of 111 days, with complications requiring removal of the catheter occurring in only 4 cases. There are very few reports on the use of the femoral approach in immunocompromised patients. Lazarus et al reported on 5 adult patients undergoing transplantation of autologous bone marrow in whom tunneled femoral central venous catheters were placed and remained in place for a median of 35 days; there were 2 infectious complications that resolved with antibiotic therapy without removal of the catheter. There is another report on 1 adult patient who received high-dose chemotherapy and allogeneic peripheral blood stem cell transplantation via a femoral Hickman catheter for recurrence of high-grade non-Hodgkin’s lymphoma; this catheter was successfully used for 3 months and then had to be removed because of Staphylococcus epidermidis bacteremia.

In contrast to these reports from adult patients, to the best of our knowledge very few pediatric cancer patients with tunneled femoral central venous catheters have been reported to date. Therefore, complication rates can only be compared with lines placed by conventional routes. The analysis of a series of 100 consecutive Broviac catheters placed percutaneously at our institution during the same period (99% via subclavian access, 1% via internal jugular access) showed that 76% of lines were electively removed (ie, at the end of therapy or when noncatheter-related death occurred with the line in place). Twenty-four

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**TABLE 1.** Patient Characteristics

<table>
<thead>
<tr>
<th>Patient</th>
<th>Age (Months)</th>
<th>Body Weight (kg)</th>
<th>Diagnosis</th>
<th>Time in Place (Days)</th>
<th>Complications</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>5.0</td>
<td>Head and neck ERMS</td>
<td>155</td>
<td>None</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td>7.1</td>
<td>ALL</td>
<td>4</td>
<td>Tunnel Infection</td>
</tr>
<tr>
<td>3</td>
<td>12</td>
<td>9.2</td>
<td>ERMS</td>
<td>128</td>
<td>Dislodgment</td>
</tr>
<tr>
<td>4</td>
<td>22</td>
<td>7.5</td>
<td>FHL</td>
<td>103</td>
<td>Obstruction</td>
</tr>
<tr>
<td>5</td>
<td>68</td>
<td>20.0</td>
<td>ALL</td>
<td>41</td>
<td>None</td>
</tr>
<tr>
<td>6</td>
<td>240</td>
<td>52.8</td>
<td>AML-relapse</td>
<td>51</td>
<td>None</td>
</tr>
<tr>
<td>7</td>
<td>11</td>
<td>7.9</td>
<td>FHL/UCBTx</td>
<td>84</td>
<td>None</td>
</tr>
<tr>
<td>8</td>
<td>37</td>
<td>17.5</td>
<td>CMML/UCBTx</td>
<td>58</td>
<td>None</td>
</tr>
<tr>
<td>9</td>
<td>95</td>
<td>20.4</td>
<td>Medulloblastoma-relapse/</td>
<td>17</td>
<td>Obstruction</td>
</tr>
</tbody>
</table>
percent of lines were removed early because of complications: causes for removal were infectious complications in 46% (tunnel or exit site infections in 25%, suspected or proven line infections in 21%), accidental dislodgment in 25%, catheter obstructions in 12%, thrombosis of the subclavian vein in 4%, and other mechanical causes in 16%. The apparently higher complication rate in the small group of patients with femoral access may be explained by an overrepresentation of stem cell transplant patients (30% vs 15%), of infants (44% vs 6%), and of reimplantations (89% vs 15%) in this group. Moreover, potentially life-threatening insertion-related complications (such as pneumothorax and hemothorax) occurred in the subclavian access group in 4%, in contrast to none in the femoral access group.

Published data on long-term central venous access are somewhat difficult to compare because there are considerable variations in study design, patient population, access route, and insertion technique. A recently published study on percutaneous insertion of 27 Hickman catheters via the subclavian route in pediatric mainly oncological patients reports early removal of lines in 33.3%, while 29.6% of lines were still in place at the end of the study. A survey of central venous catheter use in Children’s Cancer Study Group oncology centers in the United Kingdom, including data of 347 lines (84% external catheters, 16% subcutaneous ports; surgical access mainly via the internal jugular vein), shows that 26% of central venous catheters were reinsertions. These findings are in line with previous reports of 23% reinsertions and of irreversible line failure rates of 20% to 53%. A US prospective multicenter Children’s Cancer Study Group study reports on 735 external catheters in children with cancer, 42% of which were removed early for complications.

Without doubt, the customary approach for long-term venous access by way of the external or internal jugular or the subclavicular vein to the superior vena cava remains the technique of choice. However, in selected patients the femoral route provides a useful alternative.

It is our experience that percutaneous insertion of a femoral Broviac catheter is feasible when attempts at other sites failed or were contraindicated, especially in small children, even in critical clinical situations, such as stem cell transplantation. There were no insertion-related complications; only 1 infectious complication occurred in a patient receiving conventional dose chemotherapy but none in the 3 stem cell transplant patients. By constructing a long subcutaneous tunnel to move the catheter exit site away from the groin and anogenital region to the anterior circumference of the thigh, the hazards and disadvantages of a femoral vein access in the groin can be avoided, thus greatly reducing the risk of bacterial contamination of the exit site without unduly impairing physical activities.

CONCLUSION

Percutaneous femoral catheterization for long-term central venous access seems to be a safe and valuable alternative in pediatric cancer patients and even in severely immunocompromised stem cell transplant patients in whom customary access to the superior vena cava is precluded.

REFERENCES

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