Long-term central venous catheters in patients with acquired immunodeficiency syndrome

Margot Sweed, RN, MSN, CNSN
Peggi Guenter, RN, PhD, CNSN
Kathy Lucente, RN, MT, CIC
John L. Turner, MD
Michael S. Weingarten, MD, FACS
Philadelphia, Pennsylvania

Background: As long-term vascular access becomes more prevalent among patients with AIDS, it is becoming more important to consider their potential complications.

Methods: One hundred two central venous access devices placed in 84 patients with AIDS were reviewed for septic and mechanical complications. Catheters were inserted by one surgeon by means of the cephalic vein cutdown technique. The sample included 88 implanted venous reservoir catheters (86.3%) and 14 tunneled central venous catheters (13.7%).

Results: Mean catheter life was 141 ± 15 days. Total number of catheter days was 14,383. The catheter-related infection rate was 0.125 episodes/100 catheter-days. Staphylococcus aureus was the most commonly isolated pathogen in the sample. Mechanical complications were rare (0.05 episodes/100 catheter-days).

Conclusion: When these data are compared with other, smaller series in the literature, the findings suggest that long-term central venous catheters inserted in patients with AIDS are safe and effective for the multiple infusion therapies required in these patients.

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Long-term central venous access devices are being placed more frequently in patients with AIDS for multiple infusion therapies. Therapies requiring long-term venous access include antibiotics, antivirals, chemotherapeutic agents, total parenteral nutrition (TPN), and transfusion of blood and blood products. The long-term central venous access devices most often used are the tunneled central venous access catheter (TCV) and the implanted venous reservoir catheter (IVR).

Catheter infection is the complication most often associated with these access devices. This risk of infection has been reported to be higher in patients with AIDS than in patients without HIV infection. Studies providing these data included multiple types of catheters and therapies.

To examine catheter sepsis in the population of patients with AIDS more closely, a retrospective analysis of medical records was performed. Specific aims of the study were to determine numbers and types of catheters placed, catheter duration in days, septic and mechanical complications associated with the catheters, types of infusion therapies delivered through the catheters, and T-helper lymphocyte (CD4) cell counts at both catheter insertion and the end of the catheter life. CD4 cell counts have been demonstrated to be a marker of HIV disease progression and of immune function in persons with HIV infection.

METHODS

After approval was obtained from The Graduate Hospital's committee for the protection of human subjects in experimentation, the inpatient and outpatient medical records of HIV-seropositive patients with long-term central venous access...
devices were reviewed. All patients with AIDS who had long-term central venous access devices placed from January 1, 1986, through January 31, 1992, by a single surgeon (M. S. W.) were included in the study. The case logbook of this vascular surgeon, who was the primary inserter of a large majority of the long-term catheters placed at this institution, was used to procure patient names for this convenience sample. Data collected included patient demographic variables such as age and sex, numbers and types of catheters placed, catheter duration in days, septic and mechanical complications associated with the catheters, types of infusion therapies delivered through the catheters, and CD4 cell count and percentage, as well as both catheter and patient outcomes. The data-collection period concluded on January 31, 1992.

The diagnosis of infection was based on matching blood and catheter-tip cultures or positive blood cultures with no other identifiable source of infection, as described by Maki and colleagues, Simmons, and Murphy and Lipman. In all cases except one of confirmed catheter infection, both peripheral and catheter blood cultures were performed. All catheter tips were cultured as well, except in those patients who died with catheters in place. Data collection did include catheter outcome, with "ruling out" infection given as one reason for removing the central access.

Catheters were inserted by one surgeon (M. S. W.) by means of the cephalic vein cutdown technique. This technique was used for placement of both TCVs and IVRs. This technique allows adequate visualization of the vessel as well as dissection well away from the pleura, decreasing the chance of a pneumothorax. The technique was well described by Heimbach and Ivey in 1976. The catheter type was chosen primarily based on patient preference.

All patients were managed by one medical physician group. Inpatient catheter care was performed by staff nurses on a specialized HIV unit. Outpatient catheter care was performed by visiting nurses, patients, and caregivers. The catheter care technique was similar for inpatients and home care and was as follows: (1) dressings were changed three times per week and Huber needles were changed weekly; (2) alcohol swabs were used to cleanse the skin around the catheter, followed by iodophor solution; (3) povidone-iodine ointment was used at the catheter site in inpatients only; and (4) the dressing consisted of a 2" × 2-inch gauze covered by a transparent dressing.

Statistical analysis was performed on the data with SPSS software (SPSS, Inc., Chicago, Ill.). For continuous variables, t tests were used; χ² analysis was used to examine the difference between means for categoric variables.

RESULTS

During the study period, 102 catheters were placed in 84 patients. The sample included 88 IVRs (86.3%) and 14 TCVs (13.7%). One hundred one catheters (99%) were placed in men and one catheter (1%) was placed in a woman. The mean age for catheter recipients was 37.5 years. The HIV risk categories of this series of patients were as follows: male-male sex (87.3%), injecting drug use (2.0%), male-male sex and injecting drug use (3.9%), heterosexual contact (2.0%), and receipt of blood products (4.9%). Patients received multiple infusion therapies through the catheters, including antibiotics, TPN, chemotherapy, and blood products. Twenty-seven percent of patients received antibiotics alone, 21% of patients received TPN and antibiotics, 13% of patients received TPN alone, and 13% received TPN, antibiotics, and blood products. The remaining 26% patients received various other combinations of these infusion therapies. The infusion therapies were collapsed into two categories: 55 patients receiving TPN (53.9%) and 47 who did not (46.1%). Of note, only 20.6% of catheters were not used for any antimicrobial therapies.

At the conclusion of the data-collection period, 57 catheters (55.9%) were in place at the time of the patient's death, 14 catheters (13.7%) remained in at conclusion of the data-collection period, 13 catheters (12.7%) were infected and removed, nine catheters (8.8%) were removed to rule out infection but were not the source of infection, six catheters (5.9%) were removed at the conclusion of medical therapy, two catheters (2.0%) became clogged with clots, and one TCV (1.0%) was accidently removed by a patient's dog. In Fig. 1, these catheter outcomes were collapsed into four categories: no complications, infectious complications, suspected infectious complications, and mechanical complications. Mean catheter life was 141 ± 15 days. Total number of catheter days was 14,383.

There were 18 episodes of infection related to the long-term central venous catheters. The infection rate when normalized per unit of time was 0.125 episodes/100 catheter-days. The pathogens included Staphylococcus aureus, nine (50%); Staphylococcus epidermidis (coagulase-negative
Staphylococcus), five (28%); Klebsiella pneumoniae, one (5.5%); Enterococcus faecalis, one (5.5%); Candida albicans, one (5.5%); and Escherichia coli one (5.5%; Fig. 2). The mean length of time between insertion of devices and onset of infection in patients with infectious episodes was 114 days (range, 19 to 343 days).

Mechanical complications associated with the indwelling catheters included one episode each of pneumothorax, cellulitis, subclavian vein thrombosis, Huber needle dislodgement with subcutaneous TPN administration, and accidental removal. Two catheters became clogged with clots. The complication rate was 0.05 episodes/100 catheter-days.

The mean CD4 count at catheter insertion was 69.3 ± 16.6 cells/mm³; at removal, it was 67.9 ± 27.4 cells/mm³. The mean CD4 percentage at insertion was 5.4% ± 0.825%; at removal, it was 7.9% ± 3.14%. At the end of the study, 82% of the subjects had died and 18% were alive. All of the patients had died within 6 months of the study's end.

Variables thought to influence catheter infection rates include catheter type, use of TPN, catheter life (the number of days a catheter is in place), and
Table 1. Significance of catheter variables’ effects on infection rate

<table>
<thead>
<tr>
<th>Variable</th>
<th>Infection (N = 18)</th>
<th>No infection (N = 84)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
</tr>
<tr>
<td>Catheter type</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TCV</td>
<td>2</td>
<td>11</td>
<td>12</td>
</tr>
<tr>
<td>IVC</td>
<td>16</td>
<td>89</td>
<td>72</td>
</tr>
<tr>
<td>Catheter use</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TPN</td>
<td>11</td>
<td>61</td>
<td>44</td>
</tr>
<tr>
<td>No TPN</td>
<td>7</td>
<td>39</td>
<td>40</td>
</tr>
<tr>
<td>CD4 cells</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Count (cells/mm³)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>67.2</td>
<td>9.4</td>
<td>78.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Catheter life (days)</td>
<td>149.4</td>
<td>38.7</td>
<td>139.2</td>
</tr>
</tbody>
</table>

Significance established at p < 0.01.

Table 2. Reported catheter infection rates in patients with AIDS or HIV infection

<table>
<thead>
<tr>
<th>First author</th>
<th>Year</th>
<th>Ref.</th>
<th>HIV/AIDS</th>
<th>Control group</th>
<th>Primary pathogen</th>
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<tbody>
<tr>
<td>Afheldt</td>
<td>1992</td>
<td>12</td>
<td>66</td>
<td>20</td>
<td>S. aureus</td>
</tr>
<tr>
<td>Mukau</td>
<td>1992</td>
<td>9</td>
<td>63</td>
<td>50</td>
<td>S. aureus</td>
</tr>
<tr>
<td>Raviglione</td>
<td>1989</td>
<td>3</td>
<td>44</td>
<td>25</td>
<td>S. aureus</td>
</tr>
<tr>
<td>Singer</td>
<td>1991</td>
<td>10</td>
<td>22</td>
<td>93</td>
<td>S. aureus</td>
</tr>
<tr>
<td>Skouvelis</td>
<td>1990</td>
<td>2</td>
<td>54</td>
<td>98</td>
<td>S. aureus</td>
</tr>
<tr>
<td>Stanley</td>
<td>1993</td>
<td>11</td>
<td>72</td>
<td>93</td>
<td>S. aureus</td>
</tr>
<tr>
<td>Sweed</td>
<td>CS</td>
<td>CS</td>
<td>102</td>
<td>93</td>
<td>S. aureus</td>
</tr>
<tr>
<td>van der Pilj</td>
<td>1982</td>
<td>13</td>
<td>51</td>
<td>93</td>
<td>S. epidermidis</td>
</tr>
</tbody>
</table>

Rates are in infections/100 catheter days. Ref., Reference; CS, current study.

The infection rate in this study of 0.125 infections/100 catheter-days demonstrates a lower or equal rate than reported in other AIDS-related catheter literature. Singer and associates reported a rate of 0.12 episodes/100 catheter-days, Skouvelis and coworkers reported a rate of 0.2 episodes/100 catheter-days, and Raviglione and colleagues reported a rate of 0.47 episodes/100 catheter-days. This incidence of infection is higher than for the non-AIDS control groups reported on in the literature. Skouvelis and coworkers reported a rate of 0.041 incidents/100 catheter-days for immunodeficient patients without AIDS and a rate of 0.023 episodes/100 catheter-days for the immunocompetent control group. Raviglione and colleagues found a rate of 0.09 episodes/100 catheter-days for a non-AIDS control group. In a more recent study, Mukau and associates demonstrated that their group with AIDS (n = 56) had an infection rate of 0.17 episodes/100 catheter-days, whereas the non-AIDS group (n = 44) receiving home TPN had a catheter-related infection rate of 0.20 episodes/100 catheter-days. A recent study from Stanley and coworkers at San Francisco General Hospital (n = 72) examined individuals receiving antiviral therapy for cytomegalovirus and found a serious infection rate of 0.20 episodes/100 catheter-days. Serious infection was defined as an infection necessitating catheter removal or hospitalization for intravenous antibiotic therapy. Other series in the literature have reported from 0.12 to 0.47 infectious episodes/100 catheter-days for patients with AIDS. Overall, these studies demonstrate that patients with AIDS run an only slightly higher risk of sepsis—or even a lower risk of infection as in the study of the Mukau and coworkers—compared with those without HIV infection (Table 2).

The primary pathogens in this study, S. aureus...
infected patients had CD4 counts of 50 cells/mm$^3$ or less. Significance was not reported. In that study, catheter life also made no statistically significant difference in terms of infection.

The limitations of this study include the retrospective nature of the data collection and the sample size. We are confident, however, in the charting reviewed and the number of mechanical complications found. Use of both nursing and physician documentation and of both inpatient and outpatient records increased the validity of the findings. The power to detect differences between infected and noninfected catheters was low because of sample size. This study, however, still represents the largest sample of catheters in patients with AIDS presented to date in the literature. The ideal study would be a prospective, randomized trial investigating multiple independent variables such as catheter type, infusion type, level of immunosuppression, catheter insertion site, and catheter care technique. Such a study would most probably require a sample of more than 1000 catheters to have adequate power to detect clinically and statistically significant differences.

**CONCLUSION**

Our reported catheter-related infection rate is lower than or equivalent to those reported in the literature. This demonstrates that long-term central venous access catheters may be used safely in patients with AIDS for multiple infusion therapies. Practitioners caring for patients with AIDS should encourage placement of permanent central venous access devices when medically necessary. Nurses caring for these permanent central catheters must be up to date regarding appropriate infection control measures to avoid complications.

**References**

5. Maki DG, Weise CE, Sarafin HW. A semi-quantitative


