

CENTRAL VENOUS CATHETERIZATION IN PEDIATRIC PATIENTS AFFECTED BY HEMATOLOGICAL MALIGNANCIES

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ABSTRACT

Objective of this retrospective study was to evaluate the significance and complications of percutaneous central venous catheterization in pediatric patients affected by hematologic malignancies. One hundred and fifty-eight central venous catheters were inserted in 125 pediatric patients (male/female 67/58; median age: 4 years; range 10 m - 6 y.) affected by hematological malignancies. Venous access was obtained by means of a tunnelled silicone rubber Groshong catheter inserted percutaneously in the subclavian vein (91.1%), the internal jugular vein or in the femoral vein. The median duration of catheterization was 213.8 days (range 8-1014 days). The total number of catheter days was 33.792 (92.6 years). There were no any complications related to catheter insertion. Only one patient developed significant post-operative bleeding. One hundred and nine catheters (68.9%) were removed when they were no longer needed and 49 (31.1%) were removed due to complications: 6 catheter occlusions (12.2%), 7 were accidentally withdrawn (14.3%), 3 for local infections (6.1%) and 33 for catheter-related infection (67.3%). A Groshong catheter seems to provide good access to the blood stream for a long period of time with a low incidence of complications in children with acute hematological malignancies.

Key words: central venous catheterization, subclavian vein, Groshong catheter

Successful modern treatment strategies for childhood hematological malignancies include prolonged infusion of chemotherapy drugs administered at standard or high doses. For this reason, maintaining venous access in infants and children is a persistent problem. Central venous catheters guarantee a reliable access to the blood stream.

Several authors have reported successful long-term use of central venous catheters in adult and pediatric patients.¹⁻⁴

Objective of this retrospective study was to evaluate the significance and complications of the percutaneous central venous catheterization in pediatric patients affected by hematologic malignancies.

Patients and Methods

We inserted 158 catheters in 125 pediatric patients (male/female 67/58; median age: 4 years; range 10 months-6 years) affected by acute hematological malignancies (Table 1). Venous access was obtained by means of a tunnelled Groshong catheter (5F and 7F).

All catheters were inserted percutaneously in the subclavian vein by anesthesiologists using an aseptic technique in the operating room under fluoroscopic control.

Indications for an internal jugular vein or the femoral vein approach were as follows: 1) previous cannulation of both the subclavian veins with infection at the exit site; 2) mediastinal adenopathy with partial superior vena cava

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Table 1. Patient characteristics at the time of CVC insertion.

Patients (n°)	125
Catheters (n°)	158
Sex (male/female)	67/58
Age (median)	4 y (range 10 m - 6 y)
<i>Diagnosis</i>	
Acute lymphocytic leukemia	75
Acute myeloid leukemia	34
Non-Hodgkin lymphoma	14
Myelodysplasia	2
<i>Platelet count (x 10⁹/L)</i>	
< 30	37
30-100	28
> 100	60
<i>Granulocyte count (x 10⁹/L)</i>	
< 0.1	38
0.1-0.5	25
> 0.5	62

occlusion; 3) failed percutaneous subclavian approach.

A silicone rubber Groshong catheter has a rounded, closed distal end tip and an adjacent, side, pressure sensitive two-way valve. A subcutaneous Dacron cuff stabilizes catheter placement.

Blood cultures were periodically obtained. If fever occurred, blood cultures from the catheter and the peripheral vein were performed before starting antibiotic treatment. Blood cultures were grown in biphasic media for anaerobic and aerobic bacteria. For CVC-tips a semiquantitative culture method was used.⁵

Catheters were removed: 1) when no longer needed; 2) if technical or mechanical problems were encountered; 3) in the case of CVC-related persistent bacteremia, tunnel or exit-site infection.

The catheters were removed under aseptic conditions and the tip was microbiologically tested.

Results

The median duration of catheterization was 213.8 days (range: 8-1014 days). The total number of catheter days was 33,792 (92.6 years). The subclavian vein was cannulated in 145

cases (91.1%) and the internal jugular vein in 13 (8.2%). In one patient the right femoral vein was cannulated because of partial occlusion of the superior vena cava.

Forty-nine catheters (31%) were removed for complications. Only one patient developed significant post operative bleeding which consisted of a thoracic hematoma that resolved spontaneously without blood transfusions. Catheter obstruction was recognized in 6 patients (12.2%); all catheters were removed despite urokinase infusion.⁹ Accidental withdrawal occurred in 7 patients (14.3%) under 3 years of age.

Three catheters (6.1%) were removed because of a local infection; in all of them cultures from the catheter exit-site showed *Staphylococcus epidermidis* growth. All infections resolved after catheter removal and broad spectrum combination antibiotic therapy. A new catheter was not inserted at the same site.

All the children experienced prolonged chemotherapy-related granulocytopenia (< 0.1×10⁹/L) (median duration: 22 days; range: 12-32 days) and 65 patients (98 episodes) had fever. Neutropenic patients with pyrexia and/or bacteriemia were routinely treated with broad spectrum combination antibiotic therapy while leaving the CVC in place. Suspected catheter-related infections led to catheter removal in 33 patients (67.3%). Catheter tip cultures demonstrated bacterial or fungal growth in 26 of them (Table 2).

Patients with acute myeloid leukemia had the highest incidence of catheter removal for related sepsis (0.18/100 catheter days); in the ones with acute lymphocytic leukemia and non-Hodgkin's lymphoma the incidence of catheter removal was lower (0.09 and 0.06/100 catheter days, respectively).

Discussion

In our series of patients the catheters were used for all kinds of infusions, including blood products as well as antineoplastic therapy and hyperosmolar solutions.

Only one complication related to catheter insertion was observed and this consisted of a thoracic hematoma; no pneumothoraxes,

Table 2. Results of blood and cvc-tip cultures.

<i>Bacteremias</i>	
Staphylococcus epidermidis	16
Staphylococcus aureus	3
Pseudomonas aeruginosa	6
Enterococcus	1
Corynebacterium sp.	1
Streptococcus pneumoniae	2
Candida albicans	4
<i>CVC - tip cultures</i>	
Staphylococcus epidermidis	15
Pseudomonas aeruginosa	4
Enterococcus	3
Corynebacterium sp.	2
Candida albicans	2

hemothoraxes or hydrothoraxes or any other complications related to the catheter insertion procedure occurred in our patients. With the support of pre- and intra-operative platelet infusions and local bleeding control measures (i.e. ice-bag), catheter insertion is possible and safe even in patients with very low platelet counts ($< 30 \times 10^9/L$).

The complication rate was very low in our experience and this could be related to the uniformity of the insertion technique, which was made possible by having only two anesthesiologists in charge of all insertions. The percutaneous technique provides a faster, more efficient method of insertion of the central venous catheter than the cutdown technique. In addition, the vein can be reused if necessary because the vessels are not ligated. We believe that the cutdown technique should be considered only in patients with severe coagulopathy and when difficulty in performing a percutaneous insertion is anticipated.

Infections were our most serious problem. Neutropenia and other therapy-related immunologic defects make patients with hematological malignancies susceptible to infectious complications. In the present study the incidence of sepsis in all patients was 0.29/100 catheter days; the incidence of catheter removal for infection

was 0.10/100 catheter days.

Direct comparison of the frequency of bacteremia among different reports is difficult because the definition of bacteremia is not uniform. Other studies in children on chemotherapy using catheters with an open distal end report a much higher incidence of bacteremia, ranging from 0.40-0.60/100 catheter days.^{1,4,6,7} The low incidence of catheter removal for infection in our patients was probably due to early treatment with antibiotic therapy, to the efficacy of the Dacron cuff, which acts as a bacterial filter, and to the closed distal end of the Groshong catheter.

In conclusion, a Groshong catheter seems to provide good access to the blood stream for a long period of time (beyond two years) in children with acute hematological malignancies. The only disadvantage to the use of this catheter is the difficulty and inaccuracy of central venous pressure measurements due to the presence of the distal two-way valve.

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