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Spectrum of external catheter-related infections in children with acute leukemia—Single-center experience

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Abstract
Background: External catheters (ECs) are commonly used in children who are receiving treatment for acute leukemia.
Aims: To study the spectrum of microorganisms and to compare the rates of infection.
Methods: A total of 42 ECs were inserted, including 28 Port-A-Caths, 11 CVC lines and 3 Hickman lines. Single ECs were required for 19 patients (45.2%), whereas 2, 3 and 4 ECs were required in 8, 1 and 1 patients, respectively.
Results: Overall, 37 culture-documented infections were present in 18 (62%) patients who had ECs. Gram-positive microorganisms were identified in 20 cases, Gram-negative microorganisms in 14 cases and fungal infections in 3 cases. Of the 42 devices implanted, 10 out of 28 Port-A-Caths (35.7%), 2 out of 3 Hickman catheters (66.7%) and 9 out of 11 central venous catheters (81.8%) required removal due to infection. The average length of working life for the ports was 330.6 days (range: 40—1043 days). The median rate of complications due to infection was 2.84 infections per 1000 catheter days (interquartile range: —1.55 to 5.8), and the number of infections was correlated with the number of ports (Pearson's $r = 0.51$; $p < 0.05$).

Introduction

External catheters (ECs) are widely used in the management of acute leukemia, although the need, optimal timing of insertion and type of ECs used are variable [1—4]. Individual circumstances

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may vary, but early placement is often desirable, as these patients become neutropenic soon after therapy is begun.

Several types of ECs can be differentiated either by the type of vessel they occupy (i.e. peripheral venous, central venous (CVC), or arterial), their site of insertion (i.e. subclavian, femoral, internal jugular, peripheral, and peripherally inserted central catheter) or their pathway from skin to vessel (i.e. tunneled (Hickman) versus non-tunneled (Port-A-Cath)). The use of ECs and their relationship to blood stream infection rates are influenced by several factors, some of which are patient-related, such as severity of illness and type of illness, or catheter-related, including the condition under which the catheter was placed and the catheter type. Other factors could be institutional, such as bed size, local hygiene and cleanliness, and medical personnel care, among other considerations [5].

This study was undertaken to compare the rates of infection with ECs (Port-A-Cath, central venous catheters, Hickman lines) in children with culture-proven infections receiving treatment for acute leukemia and to study the spectrum of microorganisms cultured in these patients. Although these devices are extremely necessary, they pose a serious risk of increased morbidity and mortality [6]. The increased risk is due to higher incidences of infection, thrombosis, mechanical occlusions and other complications [6—8].

Materials and methods

After obtaining ethical review approval, a retrospective study of the medical records was conducted. The hospital medical record database was searched for all admissions with ICD-10 codes related to acute leukemia. All such records were individually reviewed to identify patients with CVCs, Hickman lines and Port-A-Cath insertions. All inserted Port-A-Cath devices were the lightweight and durable titanium/polyurethane portal reservoir type that were kink-resistant, biocompatible, MRI-compatible, latex-free, PVC-free and radiopaque (Celsite®, Aesculap, Inc., Center Valley, PA, USA). Infections were defined using the Centers for Disease Control (CDC) criteria for catheter-related blood stream infections [9].

This retrospective study covered a two-year period (2009—2010). Incidentally, there were 50 patients with acute leukemia that were enrolled consecutively during the study period. The median age (±SD) was 5 ± 3.3 years. There were 43 patients with acute lymphoblastic leukemia (ALL), whereas 7 cases had acute myelogenous leukemia (AML). All ALL patients were treated using a standard protocol [MRC-UKALL 2003], whereas AML patients received AML-15 chemotherapy according to the current departmental treatment policy for acute leukemia at our institution. Data were collected from patient-specific leukemia protocol flow sheets regarding demographics and blood counts (white blood cells (WBCs), absolute neutrophil count (ANC), hemoglobin and platelets) at the time of diagnosis. Additionally, EC type and the date of EC placement were noted. All devices were inserted in the operating room using a full aseptic technique under fluoroscopic guidance. A chest X-ray was taken to confirm the correct position of the tip of the catheter. Nurses trained in the care of ECs performed dressing changes, which involved skin preparation at the insertion site with an iodine solution and a sterile dressing. Patients suspected of having an EC-related infection had blood cultures taken from both the device and a peripheral vein. Patients were considered to have an EC-related infection if they had a fever of 38 °C or more without any obvious cause or had fever and rigors associated with flushing of the ECs. Line flushing with a dilute heparin solution was undertaken whenever CVC and Hickman lines were accessed.

Statistical analysis

Normally distributed continuous variables were expressed as means ± standard deviations. However, continuous variables that were not normally distributed were expressed as medians with interquartile ranges. Categorical variables were expressed as percentages. Port complications were correlated using Pearson's correlation coefficient. Differences were considered to be significant when $p < 0.05$, and all analyses were performed using SPSS version 15.0 for Windows.

Results

ECs

Table 1 summarizes the patient demographic characteristics. A total of 42 ECs were placed in 29/50 (58%) patients with a total period of 12,271 catheter days. The average length of working life for the ports was 330.6 days (range: 40—1043 days) (Table 2). In 28, 11 and 3 patients, single or multiple Port-A-Caths, CVCs or Hickman lines were inserted, respectively. Single ECs were required for 19 patients (45.2%), whereas 2, 3 and 4 ECs were required in 8, 1 and 1 patients, respectively.