



Infectious complications of implantable ports and Hickman catheters in paediatric haematology-oncology patients

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Summary The aim of this study was to define and compare the infectious and non-infectious complications associated with Hickman catheters and implantable ports in children. The study was conducted over a three-year period in the Department of Haematology-Oncology at the Schneider Children's Medical Center of Israel. All patients who required a central venous catheter (CVC) were included in the study. For each episode of catheter-associated bloodstream infection, demographic, clinical and microbiology data were recorded. During the study period, 419 tunnelled CVCs (246 implantable ports and 173 Hickman) were inserted in 281 patients. Compared with implantable ports, Hickman catheters were associated with a significantly higher rate of bloodstream infections (4.656 vs 1.451 episodes per 1000 catheter-days), shorter time to first infection (52.31 vs 108.82 days, $P < 0.001$), shorter duration of catheterization (140.75 vs 277.28 days, $P < 0.001$), and higher rate of removal because of mechanical complications ($P < 0.005$). Gram-positive bacterial infections were more prevalent in the implantable port group (63.6% vs 41.6%), whereas Gram-

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negative rods, polymicrobial infections and mycobacterial infections were more prevalent in the Hickman group (31.4% vs 50.9%, 17% vs 36% and 0% vs 4.4%, respectively; $P < 0.05$ for all). Haematopoietic stem cell transplantation was identified as an independent risk factor for infection [odds ratio (OR) – 1.68, $P = 0.005$] and for catheter removal due to complications (OR – 2.0, $P < 0.001$). Implantable ports may be considered the preferred device for most paediatric oncology and stem cell transplantation patients.

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Introduction

Tunnelled central venous catheters (CVCs) are an essential tool in the management of children with cancer, in whom frequent and prolonged venous access is required for the administration of chemotherapeutic agents, total parenteral nutrition and blood sampling. Despite their benefits, catheters are often associated with local or bloodstream infections (BSI). Most studies comparing infectious complications between implantable and externalized catheters^{1–7} report a significantly higher rate of infection in patients with an externalized catheter.^{1,2,4,5} In two studies,^{3,7} the infection rate was higher in the externalized catheter group but the difference did not reach statistical significance, and the rates were similar in another study.⁶ However, many studies were limited by retrospective design^{6,7} or lack of microbiological data.^{1,4,7} The more comprehensive studies of Mirro *et al.*^{2,3} were published more than a decade ago, and did not include patients with haematopoietic stem cell transplants (HSCT). The aim of the present study was to compare rates of infection associated with implantable ports and Hickman catheters in a large number of paediatric haematology-oncology and HSCT patients. Microbiological findings and non-infectious causes of catheter removal were also recorded.

Patients and methods

Patients and data collection

The study sample included all patients treated at the Paediatric Haematology-Oncology Department and HSCT Unit of Schneider Children's Medical Center of Israel, the largest paediatric hospital in the country, between November 2000 and November 2003 who were catheterized with an implantable port or a Hickman device. Data were collected

prospectively by the hospital epidemiology nurse as part of an ongoing surveillance of CVC infections in the institution. The following data were collected for each patient: demographic details (age and sex); underlying diagnosis and HSCT status; catheter type; date of placement; date of removal; reason for removal (infection, prolonged fever, occlusion, tearing, displacement, end of treatment or unrelated death); and clinical and laboratory characteristics of the infectious episodes [date of infection; type of infection (exit site, tunnel or pocket infection); catheter-associated bloodstream infection (CABSI); and culture results]. These data were compared between patients with Hickman catheters and implantable ports.

Definitions

CABSI was diagnosed in the presence of the following conditions: (1) at least one of the following signs or symptoms—fever ($> 38^\circ\text{C}$), chills or hypotension; (2) tunnelled CVC in use during the 48-h period before development of the infection; and (3) recognized pathogen cultured from one or more peripheral or central venous blood cultures, with the pathogen cultured from the blood unrelated to an infection in another site (e.g. pneumonia, urinary tract infection), or in cases of common skin contaminants (e.g. diphtheroids, *Bacillus* spp., coagulase-negative staphylococci or micrococci), at least two positive blood cultures drawn within 48 h.⁸

The absence of quantitative blood cultures and time-to-positivity comparison of peripheral compared with catheter blood cultures precluded the diagnosis of catheter-related BSI.⁸

Exit-site infection (ESI) was defined as erythaema or induration within 2 cm of the catheter exit site.⁸ Tunnel infection was defined as tenderness, erythema or site induration > 2 cm from the catheter site along the subcutaneous tract of a tunnelled catheter.⁸ Pocket infection was

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