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ORIGINAL ARTICLE

Incidence and risk factors for central venous access port-related infection in Chinese cancer patients



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Background/Purpose: Cytotoxic chemotherapy via central venous access ports is an important part of the standard treatment for most cancers, but it is accompanied with the risk of infections. This study aimed to analyze the incidence and risk factors for central venous access port-related infection (CPI) among Chinese patients receiving cytotoxic chemotherapy.

Methods: Between January 1, 2002 and December 31, 2005 a total of 1391 cancer patients with 1449 totally implantable central venous access ports were evaluated. The log-rank test and Cox proportional hazards model were used for the analyses of risk factors.

Results: The overall CPI incidence rate was 0.21 per 1000 catheter-days. Hematological malignancies and head and neck cancer were associated with an increased risk of CPI (hazard ratio 4.00 and 4.11, respectively, both $p < 0.001$) and less infection-free catheter longevity ($p < 0.001$) compared with other cancer types. Chemotherapy in an adjuvant setting was associated with a lower risk of infection than for patients in a nonadjuvant setting ($p < 0.001$). The most common pathogens isolated from CPI were *Pseudomonas aeruginosa* and *Candida*.

Conclusion: Infection remains to be a challenging issue for totally implantable central venous ports. Implementation of an insertion bundle for the prevention of central line-associated bloodstream infections is warranted, especially for those patients with hematological and head and neck cancers, as well as for patients receiving chemotherapy in the metastatic settings.

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Introduction

Cytotoxic chemotherapy is an important part of the standard treatment for most cancers. To avoid frequent venipunctures, which are increasingly difficult after multiple courses of chemotherapy, and to facilitate the administration of continuous infusional chemotherapy, it is common to insert totally implantable central venous access ports.^{1,2} However, central port-related bacteremia and fungemia, including catheter tunnel infection, pocket infection in port devices, and skin-site infection, remain a challenging issue for clinicians. The incidence rate of central port-related infections (CPI) has been reported to vary from 7% to 19%.^{3,4} Many risk factors for CPI have been reported, including hematological malignancy, neutropenia, chronic steroid use, lacking perioperative antibiotic use, pancreatic cancer, poor performance status, previous infection, parenteral nutrition, immediate palliative care after implantation, and an inexperienced surgeon.^{5–8} Considering the evolution of new materials in the make-up of central port devices, and prolonged cancer survival resulting in longer period of chemotherapy, it is possible that the incidence of CPI and associated risk factors have changed. The aim of this study was to examine the incidence and risk factors for CPI among Chinese patients receiving cytotoxic chemotherapy.

Methods

Patient population and implanted devices

Between January 1, 2002 and December 31, 2005 a total of 1391 cancer patients receiving 1449 totally implantable central venous access ports at Chang Gung Memorial Hospital, Chiayi, Taiwan were evaluated. All the devices had been used for at least one cycle of intravenous antineoplastic chemotherapy administration. Electronic medical records provided patient age, sex, disease status, primary tumor location, chemotherapy setting, time of catheter insertion, and the cause of catheter failure. All patients were followed up until death, last port removal, or until December 31, 2006, whichever came first. Port implantation was performed by well-trained surgeons in the operating room. The catheter tip was inserted in the superior vena cava under fluoroscopic guidance. Local anesthesia (10 mL of 2% mepivacaine hydrochloride) was administered for most patients during the implantation of the central venous access ports. General anesthesia was used only when a central port was implanted in conjunction with another major surgery. Prophylactic perioperative antibiotics (a single dose of cefazolin) was administered routinely. The surgical approach was either cephalic cut-down or subclavian vein puncture on either side, depending on the surgeon's preference. Implantation from the jugular or femoral vein system was performed only when the cephalic and subclavian vein systems failed. The port was fixed to the underlying pectoral muscle fascia with a single, nonabsorbable suture. Filling of the port system with diluted heparin saline was performed at the end of each procedure. The port was routinely flushed with diluted heparin saline by trained oncology nurses, following the administration of chemotherapy agents. The device was then maintained by

flushing with a heparinized solution every 4–8 weeks without using any prophylactic antibiotics. Noncoring Huber needles were utilized for all injections.

Central port-related infection (CPI) and risk factors

Blood cultures were collected from port and peripheral veins in patients who had clinical symptoms or signs of infection (fever > 38°C, chills, or leukocytosis). A diagnosis of CPI was made based on at least one set of positive blood cultures from the catheter tip upon removal, > 10-fold increase in colony-forming units (CFU) per mL of blood aspirated from the port in comparison to peripheral blood cultures, or > 1000 CFUs of bacteria cultured through the device in the absence of peripheral blood cultures. In addition, clinical signs such as local cutaneous erythema, induration, or purulent discharge from the port pocket, and resolution of fever or sepsis after catheter removal also suggested CPI despite a negative culture.^{9–13} All occurrences of CPI were stratified by patient age, sex, primary tumor type, and chemotherapy setting. Chemotherapy settings were divided into two groups, adjuvant and nonadjuvant. Adjuvant settings included ports for adjuvant chemotherapy (chemotherapies given after main treatment, such as curative surgery or concurrent chemoradiotherapy with the goal to prevent recurrence) and neo-adjuvant chemotherapy (chemotherapies given before main treatment with the goal to reduce tumor size or prevent tumor spreading). Ports for chemotherapy for metastatic disease or other curative intent were regarded as nonadjuvant. Catheter longevity was defined as the number of days the device remained *in situ* and the time from catheter insertion until removal due to infection, vessel or device thrombosis, device breakage, the completion of chemotherapy (in adjuvant and curative settings), death, or until December 31, 2006. Incidence of CPI was estimated as the number of infectious episodes per 1000 catheter-days. Infection-free catheter longevity was defined as the duration between port implantation and the development of an infection or last follow-up date.

Statistical analysis

Continuous variables were presented as mean \pm standard deviation. The number of days for which a catheter remained in place was expressed as the median with the standard error due to censoring. The log-rank test and Pearson's Chi-square test was used to evaluate differences in catheter longevity and infection rate between sexes, types of malignancy, and chemotherapy settings. The Cox proportional hazards model was used to simultaneously examine all risk factors. A *p* value < 0.05 indicated statistical significance. All statistical analyses were performed using IBM SPSS 19 software (IBM Corp. Released 2010. IBM SPSS Statistics for Windows, Version 19.0. Armonk, NY: IBM Corp.).

Results

Incidence of CPI among primary malignancies

A total of 1449 central venous access ports were implanted in 1391 patients, including 1288 solid tumors (93%) and 103

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