



Original article

Dramatic increase of central venous catheter-related infections associated with a high turnover of the nursing team



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SUMMARY

Background & aims: This retrospective study evaluated the impact of new organization during the moving to a new university pediatric hospital on the incidence of central catheter-related blood stream infections (CRBSIs) among children on long-term parenteral nutrition.

Methods: The study ran from April 2007 to March 2014, starting a year prior to reorganisation of the department of pediatric Hepato-Gastroenterology and Nutrition associated to moving the children to a new hospital in April 2008, and continuing for 6 years following the move. During this time, data from all children hospitalized in this department who received parenteral nutrition (PN) for more than 15 days were analysed.

Results: During this 7-years study, 183 children aged 4.6 ± 0.5 years received prolonged PN. Intestinal diseases were the main aetiologies (89%), primarily short bowel syndrome (18.4%), Hirschsprung disease and CIPO (13.5%) and inflammatory bowel disease (13.8%). The mean durations of hospitalization and of PN during hospitalization were, respectively, 70 ± 2.1 and 55.7 ± 3.6 days. During the study period, 151 CRBSIs occurred in 77 children (42% of all patients), i.e. 14.8 septic episodes/1000 PN days and 12.0 septic episodes/1000 CVC days. No patient died of a central venous catheter-related infection.

However, following the move from the older hospital to the newer one, the rate of CRBSIs significantly doubled, from 3.9/1000 to 8.8/1000 CVC days ($p = 0.02$). During the following 4 years, the incidence of CRBSIs tended to increase between the 2nd and the 5th year after the move: 11.3 ($p = \text{NS}$); 21.4 ($p = 0.01$); 17.3 ($p = \text{NS}$), 20.3/1000 ($p = \text{NS}$) CVC days. We also observed that after evaluations by the Department of Infection Control, nurse training and stabilization of the nursing team, the incidence decreased significantly from 20.3 to 11.1/1000 CVC days during the 6th year after the move ($p = 0.01$).

Conclusion: Our results reveal the deleterious impact of the reorganization during the hospital moving on the CRBSI incidence rate, and the possible implication of inexperienced team of nurses.

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1. Introduction

Since it was first described in the 1960s, central venous catheter (CVC) use has increased dramatically and is now considered a common and essential tool in caring for hospitalized patients, especially for critically and chronically ill patients. Parenteral nutrition (PN) is one of the main indications for CVC [1].

PN allows for the feeding of patients who cannot be fully fed by the oral or enteral route due to severe intestinal failure (IF) [2]. The

main causes of IF in children are short bowel syndrome (SBS), congenital severe protracted diarrhea, neuromuscular intestinal diseases including chronic intestinal pseudo-obstruction syndrome (CIPO), Hirschsprung disease, inflammatory bowel disease and food allergies. CVC is a major improvement in caring for patients with IF. However, sepsis remains the most frequent and serious complication during long-term PN, causing central venous catheter-related bloodstream infections (CRBSIs) which can lead to severe consequences (mortality, morbidity and increased hospital costs) [3].

The healthcare-associated infections (HCAI) are among the main adverse events in hospitalized patients. According to national surveys, 5–10% of hospitalized patients had one or more infections acquired during hospitalization [4]. This proportion is higher among the most fragile patients (e.g. the chronically severely immunocompromised, those undergoing invasive procedures, and patients in intensive care) leading to increased hospital mortality. Beyond their impact on morbidity and mortality, they are a major cause of disability, affect the patients' quality of life and have a significant economic and psychosocial impact. It is estimated that between 20 and 30% of HCAs could be prevented by conducting routine preventive measures [4].

Insufficient training in CVC management seems to be an important risk factor for the development of CRBSIs [5]. However, data about this specific risk factor in pediatrics are scarce.

In April 2008 in our town, an important reorganization was started to group together and modernize the pediatric departments and to optimize costs. This reorganization included: i) sharing nurse team between 2 pediatric specialities (Hepato-Gastroenterology and Nutrition and Pneumology for example); ii) changing from single to double bedroom; iii) and moving from a 39 beds unit in a general hospital to a 27 beds unit in a brand new pediatric teaching hospital in the same town. The subjective impression of an increase of CRBSI in the new unit led us to assess the effect of the new organization on the CRBSI rate in children on long-term PN and to analyse the associated factors.

2. Materials and methods

2.1. Study design

This was a retrospective, seven-years, single-center study. We analysed data collected from April 1st, 2007 to April 1st, 2014, on all children hospitalized in the pediatric hepato-gastroenterology and nutrition unit, who had received long-term parenteral nutrition (PN) for more than 15 days during their hospitalisation. The main pathologies treated in this unit included hepatic transplantation (biliary atresia, fulminant hepatitis), inflammatory bowel disease, pancreatic diseases and severe intestinal insufficiencies (short bowel syndrome, intractable diarrhea of infancy, long-segment Hirschsprung disease). Medical data was extracted from the hospital electronic and chart information system and methodological review of each chart was performed. Included in the review were gender, age, pathology, duration of hospitalization, duration of CVC and PN, and number of sepsis episodes with clinical symptoms and germs identified. Furthermore, we analysed the composition of the medical team, the CVC material and technique of insertion, and CVC maintenance techniques during the study.

To evaluate the annual variation of CRBSI, we divided the 7-years study into 7 equal periods of one year each from April to the end of March of the following year; April corresponding to the date of the move of the hospital.

During the P1 period (from April 1, 2007 to April 1, 2008) the pediatric gastroenterology unit was located in a general hospital. The structure included different pediatric medical specialities

(gastroenterology, nephrology, psychiatry and general pediatrics), and was divided into 2 departments according to the patients' ages. Service 1 (S1) included children from 3 to 18 years old; there were 21 beds, of which 7 were for gastroenterology patients housed in single rooms. The S2 service admitted children from birth to age 3 for the same specialities as the S1 service; there were 6 single rooms for gastroenterology patients. In total, S1 and S2 services had a capacity of 39 patients, for whom there were 6 senior physicians, 2 fellows, 4 residents and a total of 33 nurses. Each day, 16 nurses were present for both services S1 and S2, resulting in each nurse caring for about 7 children during the day.

On April 1, 2008, the pediatric gastroenterology unit moved to a new pediatric hospital. This unit treated all children from birth to 18. It was a speciality unit (gastroenterology) but it was located near the pediatric pneumology unit, and nurses were alternately allocated to either unit. Altogether, there were 27 beds (15 beds in gastroenterology with only 1 single bedroom, and 12 beds for pneumology). This unit had 6 senior physicians, 2 fellows, 4 residents and 23 nurses. Each day, there were 11 nurses present for both pneumology and gastroenterology units resulting in each nurse caring for about 7 children.

2.2. CVCs

All CVCs were taken into account, including those that were placed in another hospital. In our unit, protocols for CVC maintenance are done in accordance with current guidelines [6,7]. During hospitalization, only nurses from the gastroenterology and nutrition unit are authorized to handle CVCs following specialised training, validated by the nurse in charge of CVC care. It consists of a 4-h theoretical and practical training, which includes epidemiology and consequences of CVC infections. They are also taught the specific protocol to manage CVCs by a specialized teaching nurse. During hospital stays, the catheters are handled and taken care of by nurses, always using sterile techniques. If children are on cyclic PN, the catheter is flushed with 10 ml of saline solution before each closing.

2.3. Nosocomial infections (septicemia)

Only nosocomial CRBSIs were considered for this study. Therefore, bacteremia that developed at home and required hospitalization thereafter were excluded. In accordance with the definition of the National Council of Public Hygiene [8], we included only infections occurring at least 48 h after admission to the hospital. The relapsing CRBSI were not counted as independent episodes.

Both CVC and peripheral blood cultures were collected using aseptic techniques whenever systemic infection was suspected as previously described.

CRBSI was defined as a positive blood culture from the CVC and/or peripherally obtained from a symptomatic patient with a systemic infection (that included fever, septic shock, increased C-reactive protein, or leucocytosis) with the absence of other potential sources of infection [9].

The treatment was considered successful if clinical symptoms of infection decreased within 48 h and blood cultures converted to negative with systemic antibiotics being administered, without changing the catheter. Relapses of CRBSI were excluded if they occurred within 2 weeks after the first episode. The catheter was removed in case of poorly controlled CRBSIs within 48 h after beginning administration of systemic antibiotics; or in the case of an obstruction resistant to intra-catheter instillation of fibrinolytic treatment.

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