Nutrition 29 (2013) 52–59

Contents lists available at ScienceDirect

Nutrition

journal homepage: www.nutritionjrnl.com

Applied nutritional investigation

Characterization of post-hospital infections in adults requiring home parenteral nutrition

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ARTICLE INFO

Article history:
Received 21 October 2011
Accepted 14 March 2012

Keywords:
Bloodstream infection
Post-hospital infection
Parenteral nutrition
Risk factors

ABSTRACT

Objective: Limited data are available on the incidence and risk factors for infection in patients requiring home parenteral nutrition (HPN).
Methods: A retrospective study was conducted in 101 consecutive adults (63 female, 38 male) discharged on HPN from the Emory University Hospital, Atlanta, GA. New bloodstream infections (BSIs) requiring rehospitalization and other infections were evaluated.
Results: Most infections (75%) developed during the initial 6 mo after hospital discharge; rates of BSI were particularly high during the first 4 mo. Fifty-six patients (55.4%) developed 102 BSIs (11.5 BSIs/1000 catheter-days). Most BSIs were attributed to gram-positive organisms (46%), including coagulase-negative *Staphylococcus*, *Staphylococcus aureus*, *Enterococcus* species, and others, followed by *Candida* species (20%) and gram-negative organisms (13%). Twenty-one percent of BSIs were polymicrobial. The BSI incidence rate ratio was significantly increased for patients with mean prehospital discharge blood glucose concentrations in the highest quartile versus the lowest quartile (incidence rate ratio 2.4, $P = 0.017$). Patients with a peripherally inserted central catheter versus non-peripherally inserted central catheter central venous catheters had significantly higher rates of BSI ($P = 0.018$). Thirty-nine patients (38.6%) developed 81 non-BSIs, including pneumonia, urinary tract infections, and surgical site infections. Postdischarge PN dextrose, lipid, and total calorie doses were unrelated to BSI but were variably related to the rate of non-BSIs.
Conclusions: Adult patients on HPN exhibit a very high incidence of post-hospital infections. Higher mean blood glucose levels during predischarge hospitalization and the use of peripherally inserted central catheters at discharge are associated with an increased risk of BSI in the postdischarge home setting.

Introduction

The administration of parenteral nutrition (PN) is routine for patients with intestinal failure who are unable to maintain an adequate nutritional status with enteral and/or oral intake alone. Home PN (HPN) was first implemented in the late 1960s [1], with a yearly prevalence of use of approximately 120 patients per million population in the USA [2]. PN is associated with serious metabolic, mechanical, and infectious complications; infections, particularly catheter-associated bloodstream infections (BSIs), are the most serious PN complications and contribute significantly to the cost of care in patients using HPN [3–7]. Infections in patients receiving PN may not be due simply to the presence of a central venous catheter and the specific macronutrients (calories, dextrose, and fat) infused; these patients are typically

This study was supported by grant K24 RR023356 (T.R.Z.) from the National Institutes of Health.
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doi:10.1016/j.nut.2012.03.010

immunocompromised by virtue of their underlying illnesses and are otherwise at higher risk for infection from chronic wounds, fistulae, prolonged hospitalization, prior use of broad-spectrum antibiotics, and other factors [3–7]. Unfortunately, there are limited data characterizing the BSI and non-BSI burdens and potential risk factors for infection in the post-hospital setting in patients receiving HPN [8–13].

In recent years, we have noted an apparent increase in the rate of BSI and other infections acquired after hospital discharge in complex and high-risk adult patients using HPN. Therefore, this retrospective study was designed to comprehensively evaluate the incidence of post-hospital infections, putative infection sites, associated microorganisms, and potential risk factors for infection in adults requiring HPN after discharge from Emory University Hospital (EUH; Atlanta, GA, USA).

Materials and methods

Study design, clinical setting, and participants

This retrospective study was conducted using medical records of patients on HPN who had been discharged from EUH, a 587-bed tertiary care academic medical center. All patients requiring HPN and discharged during a predefined 3-y period (July 2004 through June 2007) were screened for eligibility. Eligible patients were at least 18 y of age and were anticipated to receive HPN for at least 30 d as prescribed by the EUH Nutrition and Metabolic Support Service, which is responsible for the home nutritional management and follow-up of all such patients using HPN and conventional methods for home-based nutritional support monitoring and care. All catheters for HPN were placed in the radiology department of EUH by staff dedicated to central line placement using conventional sterile technique and protocols. Ethanol or antibiotic catheter locks and antibiotic or chlorhexidine-coated dressings were not used during the study period in any patient. The study was approved by the Emory University institutional review board and ethical guidelines were followed throughout the study.

Data collection

Patient medical records were reviewed for demographic characteristics, primary indications for HPN, days of HPN therapy, number and types of infectious complications, results of blood and other cultures performed, and type of venous access device at hospital discharge. In addition, the following variables were recorded: history of diabetes mellitus (type 1 or 2), type of central venous catheter (CVC), total number of catheters used, number of catheter lumens, total catheter days, time to initial post-hospital infection, mean hospital blood glucose (BG) levels before initial hospital discharge, and macronutrient content of the HPN administered. Infections diagnosed at least 48 h after hospital discharge were included in the analyses to minimize counting infections already developing at hospital discharge.

Study definitions

Patients were considered to have a BSI based on the U.S. Centers for Disease Control and Prevention (CDC) criteria [14]: 1) a pathogen was isolated from at least one blood culture and the pathogen was not related to infection at another site; 2) documented fever (>38°C), chills or hypotension in association with common skin flora (e.g., *Bacillus* sp., *Propionibacterium* sp., coagulase-negative staphylococci) isolated from at least two blood cultures drawn on separate occasions and unrelated to an infection at another site (unless in association with evidence of local infection at the access site of intravascular devices); and 3) common skin contaminant isolated from at least two blood cultures from a patient with an intravascular access device and a physician instituting appropriate antimicrobial therapy [14]. All non-BSIs (e.g., pneumonia, urinary tract infection, surgical site infection) that developed after discharge on HPN were also diagnosed according to CDC criteria [14].

Infections were considered polymicrobial if more than one pathogen was isolated from cultures of the same site obtained within 48 h after the initial evaluation, irrespective of whether the isolates came from the same or different cultures. Most microbial culture results were obtained from samples analyzed in the microbiology laboratory of EUH. In these cases, the investigators reviewed the final microbiological reports, the medical records documenting the clinical data, and the antimicrobial agents ordered by the primary physicians for the putative infection. A small percentage of cultures (four BSIs [3.9% of total] and three non-BSIs [3.7% of total]) were performed from outside hospital microbiology laboratories during admission to those institutions for infection, and the data were confirmed after a review of the available medical records and/or discussion with the attending physicians or home health care company nursing staff.

Statistical analyses

Infection rates per 1000 catheter-days of follow-up were estimated and compared using exact methods based on the Poisson distribution [15]. These estimates were calculated for BSIs, non-BSIs, and total infections (BSI + non-BSI). Statistical modeling was limited to data collected in the first 6 mo of follow-up in individual patients because most BSIs were identified during the initial 6 mo after hospital discharge. The median follow-up was approximately 2 mo and the number of patients under follow-up 6 to 12 mo after hospital discharge was smaller than 20% of the study patients. However, the incidence of infections was also determined for the entire period of observation in all subjects. Baseline covariates included gender, age, body mass index (kilograms per meter squared), history of diabetes mellitus, initial catheter type, and mean predischarge hospital BG level. The mean of all BG levels (point-of-care glucose meter and laboratory values) obtained during each patient's initial hospital stay was calculated, and this single value was assigned to each patient, regardless of the number of separate levels obtained. We also calculated the mean home BG value during the home period of observation for each subject for analysis. Mean daily HPN total calories (kilocalories), dextrose, and lipid emulsion doses per kilogram of body weight administered during the period of observation for each subject was determined from medical records and analyzed for effects on infection risk.

The monthly incidence rates of infection were estimated by performing a generalized estimating equation Poisson regression analysis of the monthly counts, implemented using SAS Proc Genmod [16], using an exchangeable correlation structure for the repeated monthly counts within each subject. The incidence rate ratio (IRR) is the ratio of the incidence density in one group to that of another group. The results by each baseline covariate are presented as the IRR and the 95% confidence interval (CI). Baseline covariates that were significant at $P < 0.05$ in the univariable analyses of BSI were included in the multivariable analyses. The IRR and its 95% CI were calculated for each factor in the presence of others in the final model.

Results

Demographic data and nutritional support

During the 3-y observation period, 101 patients (63 female, 38 male) with a mean age of 51 ± 13 y (range 28–87 y) met eligibility criteria and were included in the analyses (Table 1). The median follow-up time for study subjects discharged on HPN was 65 d (range 2–1045 d) and the median HPN administration during the study period was 47 d (range 2–921 d), with a frequency of 3 to 7 d of HPN infusion weekly in individual subjects. The indications for HPN included intestinal fistulae, postoperative bowel dysfunction, and other forms of intestinal failure that precluded adequate nutritional delivery by oral food or tube feedings. Given the different degrees of intestinal failure, patients received a relatively wide range of average total HPN calories, dextrose, and lipid doses (expressed as mean daily HPN dose during the observation period for each subject; Table 1). Lipid emulsion was given as a standard soybean-oil based product (Intralipid; Baxter, Deerfield, IL, USA). Most patients were able to consume some oral food during the study despite various types and severities of intestinal failure, but these intakes were not recorded. During the study period, six cases of death occurred during hospital readmission in our 101-subject cohort; however, the details of death in these subjects were not recorded and, in any event, may not be entirely clear. There were three patients with a terminal illness transferred to hospice care. No other reasons for dropout were evident.

Catheter types used for HPN

During the 3-y study period, HPN was infused through a total of 196 CVCs, for a total of 12,877 catheter-days; HPN was infused during 6655 d of this total. A total of 69 subjects (68.3%) were initially discharged home with a peripherally inserted central venous catheter (PICC), 26 (25.7%) received a tunneled Hickman or