Constipation in the Critically Ill Child: Frequency and Related Factors

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Objective To analyze the incidence and factors associated with constipation in critically ill children.

Study design We performed a prospective observational study that included children admitted to the pediatric intensive care unit for more than 3 days. Constipation was defined as more than 3 days without a bowel movement. Relationships between constipation and demographic data; clinical severity score; use of mechanical ventilation, use of vasoconstrictors, sedatives, and muscle relaxants; nutritional data; electrolyte disturbances; and clinical course were analyzed.

Results Constipation developed in 46.7% of the 150 patients studied (mean age, 34.3 ± 7.1 months). It was most common in postoperative, older, and higher-body-weight patients, and in those with fecal continence ($P < .01$). Compared with patients without constipation, patients with constipation had higher severity scores and more frequently received midazolam, fentanyl, muscle relaxants, and inotropic support ($P < .05$). Patients with constipation also started nutrition later and with a lower volume of nutrition ($P < .01$). There were no between-group differences in mortality or length of pediatric intensive care unit stay. In multivariate analysis, independent factors associated with constipation were body weight (OR, 1.08; 95% CI, 1.03-1.13), Pediatric Index of Mortality 2 score (OR, 1.05; 95% CI, 1.02-1.09), admission after surgery (OR, 7.64; 95% CI, 2.56-22.81), and treatment with vasoconstrictors (OR, 10.28; 95% CI, 3.53-29.93).

Conclusion Constipation is common in critically ill children. Body weight, Pediatric Index of Mortality 2 clinical severity score, admission after surgery, and the need for vasoconstrictor therapy are major independent risk factors associated with constipation. *(J Pediatr 2015;167:857-61)*.

Alterations in gastrointestinal motility, a complex neurohormonal process regulated by various peptides and hormones, are common in critically ill patients. Up to 62% of adult patients admitted to an intensive care unit (ICU) have symptoms related to altered motility.[1-4] Constipation is one of the most common alterations of gastrointestinal motility in critically ill patients. Its incidence in adults varies between 15% and 83%, depending on the study and the criteria applied.[5-9]

Constipation in critically ill patients is associated with various factors, including immobility, splanchnic hypoperfusion, inflammation, sepsis, cerebral and spinal cord lesions, surgery, delayed administration of enteral nutrition (EN), electrolyte disturbances (eg, hypercalcemia, hypokalemia, hypomagnesemia), and use of opiate and anticholinergic drugs.[3,4,6,10] Some studies have found associations between constipation in critically ill adults and the inability to deliver adequate EN and longer durations of mechanical ventilation (MV) and ICU stay[5,11]; however, other studies have not confirmed these findings.[6]

Constipation has a high prevalence in children, affecting between 0.3% and 8% of the pediatric population.[12] A pilot study with 47 patients that analyzed bowel function in critically ill children reported a state of "nondefecation" for the majority of the time spent in the pediatric ICU (PICU).[13]

The objective of the present study was to determine the incidence of constipation and related factors in critically ill children, and to investigate the association with nutrition and prognosis.

Methods

This prospective observational study was conducted in a university-affiliated tertiary children's hospital. The hospital's PICU is a 11-bed mixed medical-surgical

CRRT	Continuous renal replacement therapy
ECMO	Extracorporeal membrane oxygenation
EN	Enteral nutrition
ICU	Intensive care unit
MV	Mechanical ventilation
NIV	Noninvasive ventilation
PICU	Pediatric intensive care unit
PIM2	Pediatric Index of Mortality 2

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unit with almost 400 admissions per year of children aged 1 month to 16 years. The study was approved by the Institutional Review Board of the Hospital General Universitario Gregorio Marañón.

The study population comprised patients who were admitted to the PICU for more than 3 days and whose parent or legal guardian provided signed informed consent. Exclusion criteria included a PICU admission of <72 hours and the preadmission presence of a known gastrointestinal condition that could affect intestinal transit, such as abdominal surgery. This study was carried out between December 2012 and June 2014 (**Figure**; available at www.jpeds.com).

Data were collected by surveying parents/guardians and included age, sex, weight, fecal continence (defined as voluntary control of rectal sphincter), history of constipation (defined as hard stools and/or a frequency of less than 1 bowel movement every 48-72 hours), and use of laxatives during the year before admission. Other data collected by medical staff in a prospective manner included diagnosis, reason for admission, illness severity scores at admission (Pediatric Risk of Mortality III, Pediatric Index of Mortality 2 [PIM2], and Pediatric Logistic Organ Dysfunction),[14-16] length of PICU stay, and mortality.

A daily record of bowel movements was kept throughout the patient's PICU admission (up to discharge or the first 30 days in the PICU). Based on criteria used in critically ill adult patients,[2,3,5-7] constipation was defined as an absence of bowel movements for longer than 3 days. In addition, a daily record was kept of the doses of oral and intravenous sedative, analgesic, muscle relaxant, and inotropic agents administered; the need for MV and noninvasive ventilation (NIV); the route, type, and daily volume of EN; gastric residue; episodes of vomiting; and the presence of abdominal distension.

Data analysis was performed using the SPSS 21.0 software package (IBM, Armonk, New York). Normality of continuous variables was tested using the Kolmogorov-Smirnov test. Continuous variables are expressed as mean ± 2 SD, and categorical variables as number and percentage. Comparisons of continuous and categorical variables were performed using the *t* test or Fisher exact test and the χ^2 test, respectively. Statistical significance was taken as a *P* value of <.05. Univariate and multivariate analysis were performed to identify factors associated with constipation, with results expressed as OR with 95% CI. Multivariate analysis was then performed using a predictive logistic backwise regression model that included all variables with $P < .10$ in the univariate analysis.

Results

A total of 150 patients (62% boys) were included in the study. The mean patient age was 34.3 ± 7.1 months, and 63.9% of the patients were fecally continent. Constipation during the year before admission was reported by parents in 16.7% of the children, and laxative use in 12.6% (pepsin with magnesium salts, 43.8%; enema, 25%; polyethylene glycol, 25%; lactulose, 6.2%). Reasons for admission were postoperative cardiac surgery in 56.7%, heart failure in 14%, respiratory disease in 13.3%, and other medical and/or surgical issues in 16%. The mean scores on the clinical severity scales were as follows: Pediatric Risk of Mortality III, 12.8 ± 1.4; PIM2, 12.2 ± 3.2; and Pediatric Logistic Organ Dysfunction, 11.3 ± 1.6.

MV was required by 67.3% of patients; NIV, by 45.3%. Continuous renal replacement therapy (CRRT) was provided in 15.7% of patients; extracorporeal membrane oxygenation (ECMO) support, in 12%.

The mean time to initiation of EN was 1.8 ± 0.3 days. EN was administered via transpyloric tube in 50.7%, via the oral route in 31.1%, via nasogastric tube in 12.8%, and via gastrostomy in 1.4%. Parenteral nutrition was given to 4.1% of the children. In 20.7% of patients, EN was interrupted for more than 24 hours during PICU admission for suspected gastrointestinal disease, surgical intervention, or diagnostic tests or procedures. Vomiting occurred in 31.3% of patients during PICU admission. EN was interrupted in 25.5% of patients who presented with vomiting compared with 18.4% of those who did not ($P = .32$). Abdominal distension was detected at some time during admission in 14% of the patients. These patients required more frequent EN interruption compared with those who did not develop abdominal distension (47.6% vs 16.3%; $P < .01$).

The prevalence of constipation was 46.7%. Patients with constipation were older and more frequently fecally continent compared with those without constipation (**Table I**). The frequency of constipation was higher in patients who had undergone surgery compared with medical patients. Patients with constipation had higher illness severity scores than those without constipation and more frequently required intravenous sedoanalgesia, muscle relaxants, inotropic support, CRRT, and ECMO (**Table I**). No differences were found with oral sedoanalgesia: dipotassium clorazepate, methadone, or clonidine (data not shown). Patients with constipation also were more likely to require MV and NIV, and had a longer median duration of ventilation, although the differences did not reach statistical significance.

Compared with patients without constipation, those with constipation started nutrition later and remained longer on nil per os status. They received a smaller daily volume of EN, had a higher percentage of gastric residue via nasogastric tube with regard to the volume of feed administered, and a higher prevalence of abdominal distension. Patients with constipation also had higher frequencies of hypocalcemia, hyponatremia, and hypokalemia, although the differences in the latter 2 variables did not reach statistical significance.

Mortality of our entire cohort was 5.3%, slightly higher than the overall mortality of 3.2% in the PICU during the study period, but the difference was not statistically significant ($P = .24$). Mortality was higher in the children with constipation compared with those without constipation (7.1% vs 3.8%), although the difference was not statistically significant