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Appropriate use of total parenteral nutrition in children with perforated appendicitis

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ABSTRACT

Background: Total parenteral nutrition (TPN) is often used in children with perforated appendicitis, despite the absence of clear indications. We assessed the validity of specific clinical indications for initiation of TPN in this patient cohort.

Methods: Data were gathered prospectively on duration of nil per os (NPO) status and TPN use in a cohort of children treated under a perforated appendicitis protocol during a 19-month period. TPN was started in the immediate postoperative period in patients who had generalized peritonitis and severe intestinal dilatation at operation, or later per the discretion of the attending surgeon. At discharge, TPN was considered to have been used appropriately, according to consensus guidelines, if the patient was NPO ≥ 7 days or received TPN ≥ 5 days.

Results: During the study period, TPN was initiated in 31 (25.4%) of 122 patients operated for perforated appendicitis. Sixteen (51.6%) received TPN per operative finding indications and 15 (48.4%) for prolonged ileus. The operative indications demonstrated 47% sensitivity, 86% specificity, a positive predictive value (PPV) of 35%, and a negative predictive value (NPV) of 91%, when adherence to TPN consensus guidelines was considered the gold standard.

Conclusion: Patients without severe intestinal dilatation and generalized peritonitis at operation should not be placed on TPN in the immediate postoperative period. Refinement of selection criteria is necessary to further decrease inappropriate TPN use in children with perforated appendicitis.

Type of study: Diagnostic Test.

Level of study: II

Perforated appendicitis is the most common cause of acute surgical admission, peritonitis, and prolonged ileus in children. Total parenteral nutrition (TPN) is often used in these patients, despite the absence of clear indications. The decision to initiate TPN is based on a weighted risk–benefit ratio that has tended towards shorter permissible fasting periods in children and lower thresholds for initiating parenteral nutrition [1–3].

Guidelines on pediatric parenteral nutrition fail to set clear indications for when to commence TPN [1]. Guidelines from adult critically ill patients suggest that TPN is beneficial if required for at least 5 days or the patients are nil per os (NPO) for a minimum of 7 days [3–7]. These conditions are difficult to predict on admission. Owing to the paucity of formal recommendations for children, time to implementation of TPN is often arbitrarily relegated to physicians' clinical judgment or institutional protocols [8–10].

Our group implemented a new standardized clinical practice guideline for the care of pediatric perforated appendicitis in May 2015, which covers all points of care, and includes specific criteria for use of TPN [11]. We prospectively assessed the validity of our specific clinical indications for initiation of TPN in pediatric patients with perforated appendicitis compared to the aforementioned consensus "guidelines".

1. Methods

1.1. Patient Population

All children less than 18 years old who were diagnosed with perforated appendicitis at operation were enrolled in the study, which lasted 19 months (May, 2015–December, 2016). Patients were treated using a comprehensive clinical practice guideline instituted in May 2015, which covered all aspects of care from admission to final resolution of the disease and any associated complications. This included standardized

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antibiotic treatment and operative interventions, in addition to defined criteria for placement of percutaneously inserted central catheters (PICC), TPN use, postoperative imaging, use of invasive procedures, and discharge [11].

Data were prospectively collected starting at diagnosis and ending at the last postoperative clinic follow-up visit. Data collection was detailed and included clinical presentation and work-up, intraoperative findings, antibiotic treatment, intravenous access and TPN use, discharge criteria, outcomes, and follow-up.

1.2. Indications for parenteral nutrition

Findings at operation were graded by the surgeon on a scale of I–IV as follows:

I. Contained or early perforation: perforation completely encased by omentum or surrounding structures, or resulting in free purulence only adjacent to the appendix.
II. Contained abscess without generalized peritonitis: discrete and distinct collection of contained pus.
III. Generalized peritonitis without abscess: purulence involving two or more of the 5 regions of the abdomen (pelvis, right lower quadrant, left lower quadrant, right upper quadrant/sub-diaphragmatic space, left upper quadrant/subdiaphragmatic space).
IV. Generalized peritonitis with abscess: discrete abscess with purulence involving two or more regions of the abdomen as described above.

In the operating room, the surgeon also recorded the presence of a free fecalith and the presence of intestinal dilatation significant enough to qualify as a bowel obstruction or severe ileus.

Indications for immediate initiation of TPN after operation were generalized peritonitis (Grade III or IV perforation) *and* severe ileus or bowel obstruction identified intraoperatively (Fig. 1). The practice guideline also allowed for initiation of TPN during the postoperative period if there was a prolonged ileus, per the discretion of the treating surgeon. Clinical nutritionists were involved in the care of all patients once TPN was initiated. Patients continued to receive TPN until they could consume sufficient calories enterally for their weight, age, and height. PICCs were installed if patients required parenteral nutrition or had poor intravenous access.

1.3. Statistical analyses

Only patients who received TPN during their initial admission were counted in the TPN group. Those who received TPN were compared to those who did not to identify risk factors for TPN using T-Tests, Fisher's Exact Tests, Kruskal–Wallis Tests, and multiple logistic regression. TPN was considered to have been used appropriately, per consensus guidelines, if the patient was NPO ≥ 7 days or received TPN ≥ 5 days (Fig. 1). A subgroup analysis of patients who received TPN was done to identify patients who met either consensus guideline using T-Tests, Fisher's Exact Tests, and Kruskal–Wallis Tests. The sensitivity, specificity, and predictive values of our operative indications for TPN were generated using the aforementioned consensus guidelines as a gold standard. A p-value of <0.05 was deemed statistically significant. All analysis was performed on STATA / MP 13.0 (StataCorp, College Station, TX).

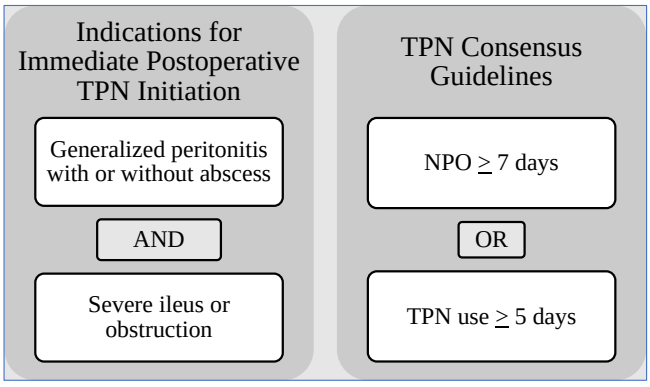

Fig. 1. Indications for Postoperative Initiation of TPN and Consensus Guidelines.

1.4. Study approval

The study was approved by the Pediatric Research Ethics Board of the McGill University Health Centre (14-483-PED).

2. Results

2.1. Patient cohort

During the study period 122 patients were operated for perforated appendicitis. Follow-up occurred in 100% of patients at a median of 25 days. Two patients who did not receive TPN on their initial admission went on to receive parenteral nutrition on a subsequent admission, and were therefore not included in the TPN group. The clinical and operative details of the patient cohort are shown in Table 1. Thirty-one (25%) patients received TPN during their initial admission. Patients who received TPN had significantly longer duration of symptoms and were significantly more likely to present with diffuse abdominal pain and

Table 1
Comparison of patients who received and those who did not receive TPN.

		No TPN (N = 91)	TPN (N = 31)	P-value
DEMOGRAPHICS:				
Age (years);	mean (±SD)[a]	9.5 (3.6)	8.7 (4)	0.262
Transfer from outside institution;	n (%)[b]	17 (18.7)	6 (19.4)	1.0
SYMPTOMS:				
Symptom duration (days);	median (IQR)[c]	2 (2,4)	3 (2,5)	0.012
Diarrhea;	n (%)[b]	25 (27.5)	13 (41.9)	0.178
Diffuse abdominal pain;	n (%)[b]	32 (35.2)	20 (64.5)	0.006
Vomiting;	n (%)[b]	78 (85.7)	24 (77.4)	0.277
Abdominal distension;	n (%)[b]	23 (25.3)	16 (51.6)	0.013
WBC COUNT;				
WBC	median (IQR)[c]	16 (13, 20)	18 (15, 24)	0.057
Neutrophil %	median (IQR)[c]	83 (79, 87)	83 (79, 86)	0.916
OPERATIVE DETAILS:				
Grade of Perforation;	n (%)[b]			
I		23 (25.3)	2 (6.5)	0.037
II		40 (44)	6 (19.4)	0.018
III		7 (7.7)	6 (19.4)	0.092
IV		21 (23.1)	17 (54.8)	0.002
Ileus/Obstruction;	n (%)[b]	11 (12.1)	20 (64.5)	< 0.001
Free fecalith;	n (%)[b]	9 (9.9)	9 (29)	0.017
Laparoscopy completed;	n (%)[b]	89 (97.8)	28 (90.3)	0.103
OUTCOMES:				
PICC line;	n (%)[b]	1 (1.1)	30 (96.8)	< 0.001
Postoperative abscess;	n (%)[b]	6 (6.6)	6 (19.4)	0.073
Postoperative invasive procedures;	n (%)[b]	5 (5.5)	4 (12.9)	0.230
Incidence of postoperative imaging;	n (%)[b]	17 (18.7)	12 (38.7)	0.030
Length of postoperative stay (days);	median (IQR)[c]	5 (4,6)	8 (6, 11)	0.001
Readmission;	n (%)[b]	3 (3.3)	1 (3.2)	1

[a] T-test.
[b] Fisher's Exact Test.
[c] Kruskal–Wallis Test.