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Early Supplemental Parenteral Nutrition is Associated with Increased Infectious Complications in Critically Ill Trauma Patients

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Abstract

Background—Parenteral nutrition (PN) is often used in severely injured patients when caloric goals are not achieved enterally. The purpose of this study is to determine whether early administration of parenteral nutrition is associated with an increased risk for infection following severe injury.

Methods—Retrospective cohort study of severely injured blunt trauma patients enrolled from eight trauma centers participating in the “Inflammation and the Host Response to Injury” (Glue Grant) study. We compared patients receiving PN within seven days following injury to a control group who did not receive early PN. We then focused on patients who tolerated at least some enteral nutrition during the first week and evaluated the potential influence of supplemental PN on outcomes in this “enteral tolerant” subgroup. The primary outcome was the occurrence of a nosocomial infection following the first post-injury week. Secondary outcomes included the type of infection and hospital mortality.

Results—Of the 567 patients enrolled, 95 (17%) received early PN. Early PN use was associated with a greater risk of nosocomial infection (relative risk 2.1; 95% CI 1.6-2.6, $P < 0.001$). In the enteral tolerant subgroup ($n = 249$), early PN was also associated with an increase in nosocomial infections (RR=1.6; 95% CI 1.2-2.1, $P = 0.005$) in part due to an increased risk of blood stream

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infection (RR=2.8; 95% CI 1.5-5.3, P=0.002). Mortality tended to be higher in patients receiving additional EN + PN versus EN alone (RR 2.3; 95% CI 1.0-5.2, P=0.06).

Conclusion—In critically ill trauma patients who are able to tolerate at least some EN, early PN administration may contribute to increased infectious morbidity and a worse clinical outcome.

Introduction

Adequate nutritional support is vital to managing the severely injured patient. Enteral nutrition is preferable and when compared to the parenteral route, results in fewer complications and seems to lead to improved patient outcomes¹⁻⁴. However, not all severely injured patients tolerate enteral feeding to achieve pre-specified caloric, protein and micronutrient goals early in the post injury period. This raises the notion of what the role of parenteral nutritional support is in the early post-injury period in patients slow or unable to tolerate adequate enteral nutrition.

Although well-studied in patients undergoing elective surgical procedures, there is little evidence supporting the use of PN in severely injured patients^{5, 6}. In this setting, most published studies comparing parenteral and enteral routes have concluded that EN leads to better outcomes than PN. However, the relative benefits and potential harm of PN in the context of partial EN are not known. It is assumed that any detrimental effects of starvation might be overcome by parenteral support in patients unable to tolerate full enteral support. This assumption is the basis for recommendations by several organizations that include the administration of PN when adequate enteral nutrition cannot be reliably achieved within 7 days of injury in critically ill patients⁷. It is unknown whether earlier institution of PN would be beneficial particularly in circumstances where enteral support may be partially successful, but usual caloric targets are not achieved. There are conflicting recommendations regarding the use of supplemental PN when nutritional support targets are not reached. Some suggest that underfeeding is associated with adverse outcomes whereas others note that there is no advantage conferred by supplemental PN and recommend that PN not be used in combination with EN^{8, 9}.

Given that “adequate” or “sufficient” enteral nutrition remains poorly defined and that few studies address when PN should be used, we undertook this study in an attempt to determine whether the institution of PN in the initial post-injury week influenced outcome. Our initial analysis includes all patients who received PN during the first week. Acknowledging differences between patients receiving PN and those that do not, we further focused our analyses on patients who received at least a modest amount of enteral support in the first post-injury week, testing the null hypothesis that supplemental PN did not influence outcome.

Methods

Study Subject Inclusion and Data Collection

This study was performed as a secondary analysis of the prospective, large scale collaborative research program, entitled, Inflammation and the Host Response to Injury (2 U54 GM-062119-07), the details of which have been reported elsewhere¹⁰. In this program,

severely injured adult patients are enrolled following blunt trauma if they have evidence of shock as manifested by either a base deficit ≥ 6 or hypotension (systolic blood pressure <90 mm Hg) within 60 minutes of arrival to the emergency department and also require blood transfusion. Exclusion criteria include isolated severe traumatic brain injury, significant pre-existing organ dysfunction and ongoing immunosuppression. All patient demographics, injury, and outcome data are collected prospectively from eight participating centers, de-identified and entered into a web based database. Institutional Review Board approval from Harborview Medical Center, University of Washington was obtained to extract information from the database. Data collection for the parent study began on September 25th, 2003. For this study, the trauma related database was accessed on May 25th, 2006 and all patients 16 years of age or older who survived 72 hours were included.

Demographic data and clinical measures of anatomic and physiologic severity of illness or injury were collected and include abbreviated injury score (AIS), injury severity score (ISS), APACHE II score, admission base deficit, and initial red blood cell transfusion requirement. Procedural data, although available for both abdominal and non-abdominal procedures, was limited in detail to those relating to laparotomy (non-therapeutic, splenectomy, nephrectomy, laparotomy NOS) and laparotomy with a bowel perforation (stomach, small intestine, colon or rectum). An “open abdomen” was defined as any time the abdominal fascia was left open as part of “damage control” laparotomy or where the diagnosis of “abdominal compartment syndrome” was recorded. The administration of all medications, including corticosteroids during the patient's hospital course was also documented.

Patient Care Protocols

Patients at each institution received care based upon standard operating procedures developed to minimize treatment variability between centers. These guidelines covered the following aspects of critical care: sedation in the ICU, mechanical ventilation, diagnosis of ventilator associated pneumonia, trauma resuscitation, venous thromboembolism, nutritional support, transfusion threshold, and strict glycemic control¹¹⁻¹⁶. The remainder of the care was determined by the individual practitioners and local intensive care unit protocols. Preference was given to enteral support and PN was reserved for cases where enteral support was deemed inappropriate or inadequate, according to the treating physician.

Definition of Nutritional Support Groups

Daily enteral and parenteral caloric totals were available for post-injury days 2-28. Enteral calories were administered through a gastric or small bowel feeding tube. Patients who received ≥ 1000 enteral calories on any day during the first week after injury were considered “enteral tolerant” (EN group). This was an arbitrary selection and corresponds to an estimate of 10 – 30 kcal/kg/day. The specific enteral formula used was at the discretion of the treating physician.

Parenteral calories consisted of all nutritional support provided as intravenously administered protein, carbohydrate and lipid. In the database, propofol (1.1 kcal/ml) is included in the parenteral calorie total but not distinguished from PN calories. We used a threshold value of 750 parenterally administered calories per day as indicating that the

patient did, indeed receive PN. This threshold was chosen given that it would be unlikely that this amount of calories would be given as propofol and 5% dextrose. For example, the maximum daily dose of propofol is approximately $3\text{mg/kg/hour} \times 70\text{ kg} \times 24\text{ hours} \times 1.1\text{ kcal/ml}$ of 1% solution which would contribute 554 kcal.

Study Outcomes

The primary outcome was the occurrence of any nosocomial infection that occurred after the 7th post-injury day. This time point was chosen in order to exclude early infections that would unlikely be influenced by the mode of nutritional support during the initial 7 days after injury. Further analysis of the type of infection counted each site separately based on standard CDC criteria¹⁷. Ventilator associated pneumonia was diagnosed using quantitative culture of bronchoalveolar lavage fluid in the majority of cases.

Secondary outcomes included mortality, non-infectious complications, duration of mechanical ventilation, intensive care unit and hospital length of stay. Non-infectious complications of interest were determined prior to data abstraction and were limited to acute respiratory distress syndrome (ARDS) and venous thromboembolism (combined pulmonary embolism and deep venous thrombosis) occurring after the 7th post-injury day. We also examined nosocomial infections occurring before 7 days, given that we would expect PN support to have little if any effect on these early complications.

Statistical Analysis

All statistical analyses were performed using STATA 9.2 (College Station, TX.) and SPSS 11.0 (Chicago, Ill). Infectious complications were treated as dichotomous outcomes, regardless of the number of nosocomial infections experienced by an individual patient. Statistical comparisons between patients receiving and not receiving early PN were conducted using Pearson's chi-square and the Students t-test for categorical and continuous data, respectively. Non parametric continuous data were analyzed using the Wilcoxin rank sum test. Actual *p-values* are reported as well as the relative risk (RR) or odds ratio (OR) with associated 95% confidence intervals. Adjustment for covariates was performed using logistic and linear regression where appropriate. The initial covariates included age, gender, injury severity score (ISS), APACHE II, red blood cell transfusion during the first 12 hours, admission base deficit, steroid administration, abdominal abbreviated injury score (AIS), laparotomy with and without hollow viscus injury, , and the presence of an open abdomen. ISS, admission base deficit, and red blood cell transfusion volume were analyzed as both continuous and dichotomous variables. In addition, baseline comorbid conditions such as diabetes, liver disease and home steroid use were also included in analyses. The final model incorporated age, gender, injury severity score (<25 vs. 25), APACHE II score, massive transfusion (> 6 units in the first 12 hours post-injury), steroid administration, abdominal AIS (as a continuous variable), and any laparotomy. The inclusion of hollow viscus injuries as a separate covariate from laparotomy, did not alter the results. Our final analysis included a variable indicating which of the 8 consortium hospitals the patient was admitted.

Results

In the initial analysis of 567 patients, those who received early PN (95/567, 17%) had more severe injuries, had a greater severity of shock and received more red blood cell transfusions in the first 12 hours than patients who did not receive early PN (Table 1). Abdominal injuries were more severe (higher abdominal AIS score, a greater percentage with hollow viscus injuries and treatment with laparotomy and/or an open abdomen) in those receiving early PN. Patients received PN for a median of 4 days (25th – 75th percentile = 2 – 9 days). A substantial number (63/95) of patients receiving early PN received little or no enteral support during the first post-injury week. Of the entire 567 patients, those receiving early PN were more likely to develop a nosocomial infection than those who did not receive early PN (relative risk (RR) = 2.1; 95% CI = 1.6 – 2.6, $p < 0.001$). Adjusting for the variables indicated in the methods by logistic regression, the association between early PN and nosocomial infection remained (Table 2). In addition to including patients receiving the vast majority of their nutritional support parenterally, this analysis also included less seriously injured patients who were tolerating an oral diet within 3 – 4 days and therefore did not receive any enteral or parenteral support. As these factors would likely bias the risk associated with PN in an unfavorable way, we subsequently focused on the group of patients who received a modest amount of EN during the first week (≥ 1000 kcal for at least 1 day during the initial post-injury week; referred to as “enteral tolerant”), a proportion of whom received additional parenteral calories

Influence of PN on Outcomes in “Enteral Tolerant” Patients

A total of 249 (44% of the original 567 patients) were “enteral tolerant” during the first week. Of these, 217 (87%) received only EN during the initial week and 32 (13%) received additional PN. Demographic and clinical information for these 2 groups are shown in Table 3. The median day of PN initiation was 3 days post-injury (IQR: 2 – 5 days).

The frequencies of infectious and non-infectious complications for patients who were “enteral tolerant” are presented in Table 4. The risk of nosocomial infection was higher in the group receiving early EN+PN (RR = 1.6, 95% CI = 1.2 – 2.1, $p = 0.005$). After adjustment, early EN+PN remained associated with an increased risk for nosocomial infection when compared to patients receiving EN alone. Considering the association between EN+PN use and specific infections, the largest increase was observed in the risk of blood stream infections (RR = 2.8, 95% CI = 1.5 – 5.3, $p = 0.002$). The patients in this cohort were enrolled from 8 member hospitals. While there were differences between these institutions in numbers of patients enrolled (range 1 – 133) and the frequency of early PN use (0 – 23%), there was no difference between institutions in the frequency of nosocomial infections. Adjusting for the hospital of admission did not affect the association between early EN+PN and subsequent nosocomial infections.

Enteral tolerant patients who received additional PN had an approximate 2-fold increased risk of death before (RR = 2.3; 95% CI = 1.0-5.2, $p = 0.06$) and after adjustment (aOR = 2.7; 95% CI= 0.8-8.8, $p = 0.10$). Other adverse outcomes were more common in patients receiving EN+PN. Late ARDS (defined as ARDS whose onset was after the 7th post-injury day) was also more common in those receiving EN+PN (RR = 5.1, 95% CI = 1.2-21.7, $p =$

0.016), whereas early ARDS was not. This difference persisted after adjustment for potential confounding variables (Table 4). Duration of mechanical ventilation (14 *versus* 19 days, $p = 0.007$), and ICU length of stay (18 *versus* 23 days, $p = 0.008$) were longer in patients receiving early EN+PN. There was no significant difference in hospital length of stay (29 *versus* 34 days, $p = 0.23$). We also compared nosocomial infections occurring in the initial 7 post injury days between patients receiving early EN+PN and those receiving only enteral support. The risk was similar in patients receiving early EN+PN and those receiving only enteral support (5/32 and 50/217, $p = 0.49$). We would expect that early EN+PN should, in fact, have minimal if any effect on the risk for these early infections. This similar incidence of early infection supports the notion that the overall baseline risk for nosocomial infection did not differ between patients who did and did not receive early supplemental PN.

Nutritional Support, Caloric Intake and Serum Albumin Levels

The mean daily parenteral calories received over the first 7 days in the enteral tolerant group are shown in Figure 1. The groups differed substantially in regard to the amount of parenteral support received over this period indicating that the 2 groups did, in fact, experience distinctly different nutritional support. This difference in parenteral calories translated into a difference in total caloric intake over the first 2 weeks, whereas the enteral intake was similar between the 2 groups. When adjusted for predicted or adjusted body weight ($\text{ideal} + [\text{actual-ideal}/2]$), the patients given EN+PN received more calories per day over the first 2 weeks than did patients who did not receive PN support. These data are summarized in Figures 2a and 2b, which show average maximum caloric intake by days 3, 7, 10 and 14 after injury. In summary, the parenteral support seemed only to add to the caloric intake rather than replace relatively less enteral support.

There was no evidence that patients receiving EN+PN had higher blood glucose concentrations nor were they more likely to be “hyperglycemic” when using different serum glucose concentrations to define hyperglycemia (110 g/dL or 130 g/dL, for example). The maximum serum glucose concentration measured during the first week was similar in patients who did and did not receive early PN (165 ± 28 g/dL *versus* 164 ± 34 g/dL, $p\text{-value} = 0.5$). Figure 3 shows the maximum daily glucose concentrations for enteral tolerant patients during day's 2 – 7 post injury, indicating no effect of PN on serum glucose concentration in this subgroup.

There was no difference in the maximum serum albumin between groups during the first week, with serum albumin in both groups generally below normal (2.0 *versus* 1.8 g/dL, $p = 0.11$). However, during the subsequent days and weeks, the maximal albumin was, indeed higher in patients receiving EN+PN support as shown in Figure 4. Although these data do suggest a beneficial biochemical effect of PN that is manifest by serum albumin concentrations, this was not accompanied by an improved clinical outcome.

Discussion

In this study we found that early PN administration, when administered along with a modest quantity of enteral nutrition, was associated with an increased risk of nosocomial infection and an increased mortality in severely injured trauma patients. The analysis involving the

entire cohort of 567 patients is likely biased against patients receiving early PN given that those patients (n = 63) who received PN exclusively during the first 7 days were more severely injured than the remainder of the cohort. We therefore focused our analyses on those patients who tolerated a modest amount of enteral nutrition, of whom, 32 of 249 (13%) still received early PN. The results of this analysis were not markedly different from the analysis of the entire cohort with regard to the increased risk of nosocomial infection associated with receiving PN within 7 days of injury.

The beneficial and adverse effects of PN on infectious morbidity have been explored previously. In the majority of cases, PN is compared to enteral feeding regimens. The common finding is generally an increase in infectious morbidity and mortality^{3, 18, 19}. These observations are often attributed to the protective effect of enteral nutrition on gut mucosal function and innate immunity²⁰. Our data do not refute such interpretations, but given that the average daily amount of enteral calories (in the 249 enteral tolerant patients) was similar in patients who did and those who did not receive early PN, the data suggest that nosocomial infections may, in part, be due to the administration of PN.

Our results are similar to a recent observational study in trauma patients documenting a significant decrease in the use of TPN at a single institution over a six year period. The authors noted that the administration of TPN was associated with increased infections, ARDS and multi-organ dysfunction syndrome²¹. Interestingly, TPN use was associated with the greatest risk for bacteremia whereas the risk of pneumonia and urinary tract infections were only minimally or not at all associated with TPN. Although these findings are similar to our own, we feel that this should be interpreted with caution as their analysis did not attempt to account for the relationship between the timing of PN initiation, EN administration, and outcome.

One explanation for our observations is that the PN itself is harmful. Studies in elective surgical, acute burn, trauma, and critically ill patients have failed to demonstrate a beneficial effect of PN on patient outcome^{18, 21-24}. Given that the majority of these studies were performed prior to the widespread use of protocols for tight glycemic control, it is possible and has been posited, that poorly controlled hyperglycemia contributes to the increased morbidity seen with PN use. In our study, patients were managed using a protocol for tight glycemic control when even mild hyperglycemia was present (>110 mg/dl). We saw no evidence that patients receiving PN had poorer glycemic control than those receiving only EN. In addition, there was no relationship between hyperglycemia and infectious morbidity. Although it is possible that unmeasured hyperglycemia contributed to infectious morbidity in this cohort, we feel that this is unlikely to have resulted in significant bias, either for or against PN, given that the sampling protocol was applied to both groups.

Other explanations for the association between early PN and nosocomial infection include differences in caloric quantity and the composition of administered PN. Patients given EN +PN received more calories than those receiving EN alone. When corrected for body weight (using adjusted body weight in patients with a BMI > 30), a greater number of those given EN+PN received over 35 kcal/kg at some point during the first week (47% versus 23%). It is not certain, however, exactly how an increased number of calories might lead to an

increased infection rate, beyond the possibility of an excess of specific caloric sources. However, the lack of differences in glucose concentrations and hyperglycemia risk suggests that excess glucose calories are not causative. It is possible that excess lipid calories contributed to infectious morbidity. The use of intravenous fat emulsion has been observed to suppress both neutrophil and lymphocyte function in animal and human studies²⁵⁻²⁸. In addition, intravenous fat emulsions have been shown to affect pulmonary function in patients with lung injury and have been associated with mortality^{27, 28}. This is consistent with our finding that patients receiving early EN+PN had a greater risk of later developing ARDS. It is possible therefore, that it is the lipid administration which is responsible for detrimental effects of parenteral support.

The questions of when and whether PN should be given to severely injured patients are difficult to answer and our data address only one aspect of this issue. Several studies have demonstrated critically ill patients frequently receive enteral nutrition in quantities insufficient to meet nutritional goals yet the addition of parenteral calories seems to come at a significant cost^{8, 29-31}. While available guidelines recommend PN when caloric goals are not met during the first week, it has not been shown that this approach is beneficial. Given the potential consequences of malnutrition in trauma victims, the risk to benefit ratio will eventually favor PN over prolonged starvation³²⁻³⁵. However, our data suggest that the time point where the benefits of PN outweigh its complications does not occur in the first post-injury week. We, however, note that this conclusion applies only to patients who are able to tolerate some enteral calories and not necessarily to patients unable to take any enteral support during the first week.

As this is not a randomized trial, this study is limited by the possibility that patients receiving EN+PN differed systematically, in unmeasured, but important ways from those receiving only EN. It is possible that we failed to account for factors leading to an increased risk for nosocomial infections, particularly bloodstream infections that also lead to, or were associated with the need for parenteral nutritional support in the initial post injury week. Despite this observed association, we cannot determine if the nutrient composition or simply the provision of additional parenteral calories was contributory.

Clearly there are additional limitations of our study, such as our choice of various thresholds and definitions. First, our selection of 7 days to define both early PN and subsequent late infections could be considered arbitrary. However, 7 days seems a reasonable threshold by which to define early PN given existing literature and nutritional support recommendations. Second, we characterized patients as enteral tolerant if they received 1000 kcal/day at any point within the first week. Of these patients, 190 never received PN, 32 received early PN and 27 ultimately required delayed (after 7 days) PN. This indicates that most of these patients were successfully managed with EN alone. Importantly, delaying PN until after 7 days did not appear to be detrimental, given that those receiving late PN did not have a higher mortality than those who were managed solely with EN (8% *versus* 7%).

Finally, the interpretation of our data would change little if we altered the threshold to define enteral tolerance from 1000 kcal/day on any day in the first post-injury week. For example, lowering the threshold to 500 kcal/day would increase the number of “enterally tolerant”

patients from 249 to 295, of whom 43 (15%) received early EN+PN. Early EN+PN remained associated with an increased risk of nosocomial infection even with this lower threshold of enteral intake in the first week (RR = 2.5, 95% CI = 1.4 – 4.5). We do not take this to indicate that PN is not beneficial under any circumstances in the first post-injury week, but rather that benefits of enteral support may be achieved at lower caloric intake than previously considered necessary.

Given that a number of patients received PN for relatively few days it could be questioned whether early PN could have any effects, whether beneficial or detrimental. However, despite a short duration of EN+PN, patients did, in fact, demonstrate an improvement in serum albumin concentrations beginning by 14 days post injury. While this does not confirm that parenterally delivered calories caused or led to infections, it does indicate that the supplemental parenteral support achieved higher caloric intake and did seem to influence biochemical nutritional parameters.

Conclusion

Our data suggest that parenteral nutritional support, when commenced during the first post-injury week along with a moderate amount of enteral calories, does not provide measurable clinical benefit and is associated with an increase in the risk of nosocomial, particularly blood stream, infections.

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Figure 1. Daily Parenteral Calories during Initial Post-Injury Week

2a: Daily Total Calories **2b: Daily Enteral Calories** **Figure 2. Daily Total and Enteral Caloric Intake Adjusted for Body Weight**

Figure 3. Maximum Daily Serum Glucose Concentrations on Post-Injury Days 2 – 7

Figure 4. Weekly Maximum Serum Albumin Concentration

Table 1
Baseline Characteristics of Study Cohort (n=567)

	Early EN only (n = 472)	Early EN + PN (n = 95)	p-value
Age	40 (26 – 52)	43 (26 – 53)	0.35
Male (%)	297 (63)	69 (73)	0.07
Admission base deficit (mmol/L)	7.8 (5 – 10)	9.5 (7 – 13)	<0.001
Total 12 hour PRBC transfusion (ml)	1500 (700 – 2800)	2300 (1250 – 4900)	<0.001
Abdominal AIS Score 3 (%)	189 (40)	52 (55)	0.008
ISS	27 (20 – 38)	34 (27 – 43)	<0.001
APACHE II	28 (23 – 32)	33 (28 – 36)	<0.001
Number Requiring Laparotomy (%)	191 (40)	56 (59)	0.001
Number with Hollow Viscus Injuries Including Stomach, Small Intestine, Colon, and Rectum (%)	18 (4)	5 (5)	0.51
Open Abdomen (%)	64 (14)	25 (26)	0.002

Continuous data are presented as median with interquartile range in parentheses and categorical data are presented as number with percentage in parentheses.

Table 2
Infectious and Noninfectious Outcomes in Study Cohort (n=567)

Complications (%)	No PN (n = 472)	PN (n = 95)	Adjusted OR (95% CI)	p-value
<u>Late Infectious</u>				
Nosocomial Infection (excluding SSI)	128 (27)	53 (56)	2.1 (1.3 - 3.5)	0.003
Pneumonia	68 (14)	31 (33)	1.7 (1.0 - 3.0)	0.06
Blood Stream Infection (BSI)	38 (8)	25 (26)	2.9 (1.6 - 5.4)	0.001
Catheter Related BSI	8 (2)	4 (4)	3.8 (0.9 - 15.6)	0.06
Urinary Tract Infection	39 (8)	21 (22)	2.5 (1.3 - 4.9)	0.006
Surgical Site Infection (SSI)	47 (10)	17 (18)	1.5 (0.8 - 2.9)	0.24
<u>Non-Infectious</u>				
Late ARDS (onset after 7 days)	7 (1)	8 (8)	3.4 (1.0 - 11.0)	0.04
Late Thromboembolic (onset after 7 days)	29 (6)	9 (9)	1.4 (0.6 - 3.2)	0.48
Death	38 (8)	22 (23)	1.5 (0.8 - 3.0)	0.24

Data are presented as number of patients in each group with percentage in parentheses. Associated p-values are based upon aOR.

Table 3
Baseline Characteristics-“Enteral Tolerant” Subgroup

	Early EN only (n = 217)	Early EN + PN (n = 32)	p-value
Age	41 (27 – 54)	43 (25 – 53)	0.74
Male (%)	133 (61)	24 (75)	0.13
Admission base deficit (mmol/L)	8.4 (6 – 11)	9.1 (8 – 12)	0.08
Total 12 hour PRBC transfusion (ml)	2100 (1100 – 3200)	2250 (1200 – 3325)	0.70
Abdominal AIS Score 3 (%)	79 (36)	14 (44)	0.42
ISS	34 (24 – 41)	33 (28 – 44)	0.24
APACHE II	30 (26 – 34)	30 (26 – 34)	0.91
Number Requiring Laparotomy (%)	83 (38)	14 (44)	0.55
Number with Hollow Viscus Injuries Including	8 (4)	1 (3)	0.87
Stomach, Small Intestine, Colon, and Rectum (%)			
Open Abdomen (%)	36 (17)	5 (16)	0.89

Continuous data are presented as median with interquartile range in parentheses and categorical data are presented as number with percentage in parentheses.

Table 4
Infectious and Noninfectious Outcomes in “Enteral Tolerant” Group

Complications (%)	Early EN only (n = 217)	Early EN + PN (n = 32)	Adjusted OR (95% CI)	p-value
<u>Late Infectious</u>				
Nosocomial Infection (excluding SSI)	92 (42)	22 (69)	2.5 (1.1-5.9)	0.03
Pneumonia	55 (25)	12 (38)	1.4 (0.6-3.3)	0.39
Blood Stream Infection (BSI)	24 (11)	10 (31)	3.4 (1.4-8.3)	0.007
Catheter Related BSI	2 (1)	2 (6)	9.8 (0.9-112.9)	0.07
Urinary Tract Infection	24 (11)	5 (16)	1.5 (0.5-4.6)	0.48
Surgical Site Infection (SSI)	31 (14)	6 (19)	1.3 (0.5-3.4)	0.65
<u>Non-Infectious</u>				
Late ARDS (onset after 7 days)	4 (2)	3 (9)	5.4 (1.1-27.4)	0.04
Late Thromboembolic (onset after 7 days)	15 (7)	4 (13)	1.7 (0.5-5.7)	0.37
Death	18 (8)	6 (19)	2.7 (0.8-9.3)	0.10

Data are presented as number of patients in each group with percentage in parentheses. Associated p-values are based upon aOR.