Early enteral nutrition compared to outcome in critically ill trauma patients at a level one trauma centre

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Abstract

Objectives: The benefit of an early enteral nutrition start in critical ill patients is widely accepted. However, limited published data focus on trauma patients. This study aimed to investigate the effect of early enteral nutrition initiation on length of stay and mortality in an intensive care unit (ICU), as well as explore if enteral nutrition initiation could serve as a prognostic marker in trauma patients.

Design: This was a retrospective audit of a prospective ethics-approved database (University of KwaZulu-Natal Biomedical Research Ethics Committee No BE207-09) which compared enteral nutrition to outcome.

Setting: The setting was a level 1 trauma ICU in Durban, South Africa.

Subjects: The subjects were critically ill trauma patients.

Outcome measures: Demographic data, enteral nutrition timing, feed tolerance, and the outcome of early versus late initiation of enteral feeding were the outcome measures.

Results: Nine hundred and fifty-two patients were included. Eight hundred and ninety-eight received enteral nutrition and were divided into three subgroups (tertiles T1-T3) according to their Injury Severity Score (ISS). The statistical analysis demonstrated that an early enteral nutrition start had a significant positive effect on both length of stay (13.7 vs. 16.4 days, p-value 0.00315) and mortality (9.5 % vs. 20.7 % p-value 0.0062). A multiple logistic regression model was developed, using multiple variables, to test the factors that affected the outcome. There was a significant effect on length of stay with an early enteral nutrition start in patients with a low to medium ISS (T1), and a highly significant effect on mortality in patients with a low to medium, and high, ISS (T1 and T2). Early initiation of enteral nutrition is strongly favoured in regression analyses.

Conclusion: Patients in the trauma ICU benefit from an early enteral nutrition. The model used featuring the three independent variables, i.e. the day on which enteral nutrition is commenced, age and ISS, may serve as a prognostic marker with regard to length of stay and mortality in the ICU.

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Introduction

Trauma in South Africa is a major problem, second only to communicable disease as a leading cause of death. Despite prevention efforts, together with substantial improvements in pre- and in-hospital trauma care, it is the major cause of death in people aged 40 years and younger.[1] The injury rate in South Africa is estimated to be approximately 12 per 1 000 persons per year. This is one of the highest per capita rates in the world.[2] Socio-economic factors, high crime and the violence rate affect the cause and outcome of injuries.[1-3]

Nutritional support in critically ill patients, once regarded as a nicety, is now accepted as having an influence on the inflammatory response in both pro- and anti-inflammatory stimulation. The current focus is on a targeted feeding approach in the critically ill.[4,5] The benefits of early enteral feeding [initiation within the first 48 hours post admission to an intensive care unit (ICU)], instead of waiting for the recovery of bowel function, are now widely acclaimed.[5-9] Recent randomised controlled studies indicated a decreased mortality rate relating to early enteral feeding in trauma patients requiring intensive care.[8] Evidence-based clinical practice guidelines aim to support ICU physicians and clearly stress that enteral nutrition, rather than parenteral nutrition (PN), should be used, provided that there are no contraindications. PN should never be used routinely in critically ill patients with an intact gastrointestinal tract. The clinical practice guidelines also recommend that enteral nutrition should preferably be initiated within 24-48 hours of admission to the ICU, and that PN should not be initiated until all strategies to maximise enteral nutrition provision have been attempted.[10,11]

The guidelines must be followed using strategies for systematic implementation in order to improve clinical practice, such as the execution of the findings of recent international trials.[12,13]

Cardiopulmonary shock, fractures, organ injuries and soft tissue injuries are described as "first hits". "Second hits" refer to endogenous and exogenous factors, i.e. ischaemia, compartment syndrome, surgical intervention and infection, which contribute to the onset of post-traumatic complications, i.e. organ dysfunction and failure.[4,14,15] Severe trauma is often accompanied by damage to the intestinal barrier. It has been reported that the administration of enteral nutrition reduces damage to the gut barrier function and maintains associated lymphoid tissue mass and function.[16,17] Enteral nutrition is an important treatment in patients with an inflammatory response because of its beneficial effects on gut immunology and function.[18] Even a low rate of feeding (10-30 ml/hour), described as a "trickle feed", has a trophic effect on the gastrointestinal mucosa.[19] When compared to total parenteral nutrition (TPN), enteral nutrition has been shown to have a greater impact on improving gut motility and on the reduction of translocation of bacteria from the gut.[16,20] Enteral nutrition is considered to be less associated with complications than PN, and is less expensive to administer.[19,20] Recent studies have shown that there are no benefits to initiating PN before day 5 post admission.[8,11,21] Later commencement of PN, i.e. before day 5, is associated with fewer infections and enhanced recovery, compared to early PN.[8,21]

Aim

The primary aim of this audit was to study early enteral feeding compared to outcome in critically ill trauma patients, in terms of ICU length of stay and ICU mortality. The secondary aim was to explore if the success of enteral nutrition initiation could serve as a prognostic parameter in trauma patients. Two hypotheses were generated, namely that delayed-onset enteral nutrition results in a prolonged ICU stay, and that later goal rate achievement is associated with increased mortality.

Method

An audit of enteral feeding practices in the trauma unit and trauma ICU at Inkosi Albert Luthuli Central Hospital, a purpose-built exclusive level one trauma centre (tertiary academic) in Durban, in the province of KwaZulu-Natal, South Africa, was performed. Data were extracted from the University of KwaZulu-Natal Biomedical Research Ethics Committee-approved trauma registry system (No BE207-09) and hospital electronic information system (Soarian® and Innovian,® Siemed, South Africa).One thousand and ninety-one patients were admitted to the trauma ICU at the Inkosi Albert Luthuli Central Hospital from the opening of the unit on 26 March 2007 until 31 December 2011. The trauma centre is the only one of its type in this vast province, with over 10 million inhabitants.[22] Nutritional support is coordinated by the trauma surgeon in discussion with a dedicated ward dietitian. Patients are managed until stable for discharge to a regional base hospital or until death. A compulsory medico-legal post-mortem examination is carried out with respect to all deaths.

The patients were admitted to the unit either directly from the scene within the eThekwini functional region, or were referred from hospitals within the province of KwaZulu-Natal. The study was designed as a single-unit retrospective audit. Patients who survived for more than 24 hours were reviewed. However, those who survived but were discharged under 48 hours were excluded. The recorded data points and definitions used are listed in Table I. "Enteral feed" was defined as the tube feed or oral intake, and "goal feed" as the time to achievement of the estimated goal within one hour of accuracy, starting from the time of admission to the trauma ICU. "Early initiation" of enteral feeding meant feeding within 48 hours of the ICU admission, and "late initiation" meant enteral feeding after 48 hours post ICU admission. A further criterion was that the cause for the latter had to have been recorded, e.g. high-dose inotropic support.

Table I: The collected data

Demographic and ICU data	Mechanisms of injury	Scoring systems
• Age • Sex • Outcome • Length of stay • Complications • Nutrition care plan • Feed termination > 1 hour* • Inotropic support** • *Feed intolerance:* High output drainage from the nasogastric tube, vomiting, abdominal distension, diarrhoea or abdominal cramps, and the presence of enteral fistulas and ileus	• A motor vehicle collision • A gunshot injury • A stab injury • Injury due to blunt or penetrating trauma • *Other:* Including a shark bite, snake bite and animal goring)	• *Abbreviated Injury Score:* Severity of individual injuries per system per body region • *Injury Severity Score:* Sum of the squares of the single worst injuries in the three most injured body regions

ICU: intensive care unit
*Termination was noted and described, owing to intolerance, while other interruptions, for example due to surgery, were noted only in cases when the interruption exceeded 24 hours
**For example, the administration of high-dose inotropic support

Statistical analysis was performed using Stata®, GraphPad Software® and R® for Windows®. The data were found to be normally distributed using a Shapiro-Wilk test. Descriptive statistics [mean, standard deviation (SD) and quartiles] were used to characterise the study population. Continuous variables were described as the mean with SD, except for variables measured in days, e.g. length of stay and ventilator days, which are described as the median, together with the range and quartile. Patient characteristics were compared using an unpaired Student's t-test for the continuous variables, and the chi-square test for dichotomous variables. Primary outcomes were length of stay and ICU mortality.

The enteral nutrition patients were divided into two subgroups based on the time that the EN was started, i.e. either an early start (within the first 48 hours) or a late start (those commenced on enteral nutrition after 48 hours). The recorded ISS scores were divided into three subgroups (tertiles) to control for severity of illness. Length of stay and ICU mortality were assessed in the early and late enteral nutrition groups according to the ISS, and compared with the unpaired Student's t-test and the chi-square test. Survival analysis was performed using the Kaplan-Meier estimator and the relationship between early enteral nutrition start and length of stay and ICU mortality, using linear multiple regression analysis. P-values were set at < 0.05.

Results

In total, 1 091 patients were initially assessed for inclusion in the study, i.e. all patients admitted to the trauma ICU at the Inkosi Albert Luthuli Central Hospital from March 2007 until December 2011. One hundred and twenty-seven were excluded owing to death or discharge within the first 48 hours, while there was insufficient information on a further 12 cases. The final cohort was 952 patients (Figure 1).

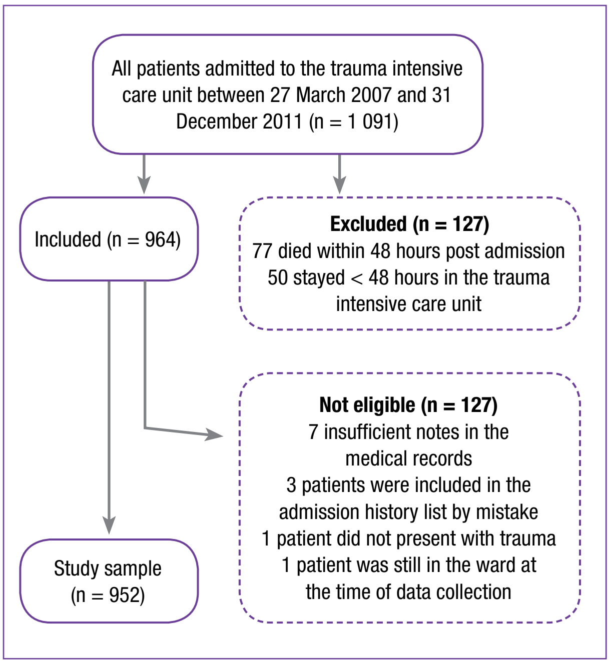


Figure 1: The selection of patients for the retrospective study

The patient characteristics are described in Table II, and the mechanism of injury in Figure 2. Almost 75% of the patients were male, with an average age of 29.1 years. A motor vehicle collision (62%) was the most common mechanism of injury. Injury due to a blunt (other than a motor vehicle collision) or penetrating trauma (a gunshot or stab injury) was 38%. The median ISS was high (23), but with a wide range. The need for mechanical ventilation was very high (80%), and the median time on ventilation support was six days. The nutritional support given during the ICU stay is described in Table III. Complications, in terms of ventilator-associated pneumonia (VAP) or sepsis, were high (17% and 22%, respectively), with multiple episodes being experienced in some cases. The median length of stay in the ICU was 10 days, with a wide range. ICU mortality was 16%.

Table II: Patient characteristics in the total study sample (n = 952)*

Variables	Measure
Age (year)	29.1 ± 15.1
Sex	
Male	713 (74.9)
Female	239 (25.1)
ISS (score)	22.8 ± 11.8
Mechanical ventilation	
Patients with ventilation	758 (79.6)
Ventilator days (n = 758) (median, range and IQR)	6 (1/88; 3/12)
Complications	
Patients with ≥ 1 VAP	166 (17.4)
VAP (number of episodes)	180
Patients with ≥ 1 sepsis	206 (21.6)
Sepsis (number of episodes)	242
ICU length of stay (days) – mean and SD	14.0 ± 13.8
ICU length of stay (days) – median, range and IQR	10 (3/110, 5/17)
ICU mortality	156 (16.4)

ICU: intensive care unit, ISS: Injury Severity Score, VAP: ventilator-acquired pneumonia
*Data are presented as n (%), mean ± standard deviation, or median (range and interquartile range)

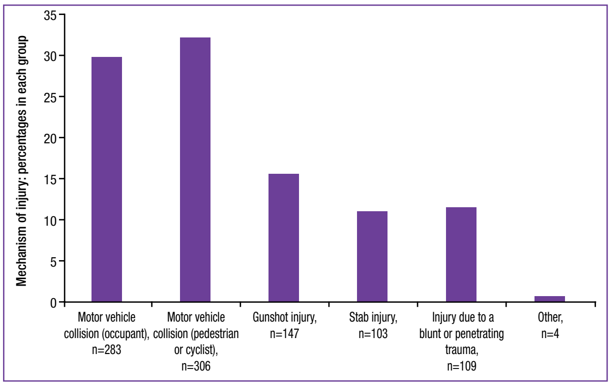


Figure 2: Mechanism of injury (percentages in each group)

Table III: Nutritional support in the intensive care unit (n = 952)*

Variables	n (%)
Enteral nutrition	
Patients receiving enteral nutrition	898 (94.3)
Patients who never received enteral nutrition	54 (5.7)
An early enteral nutrition start (≤ 48 hours)	603 (63.3)
A late enteral nutrition start (> 48 hours)	295 (31.0)
Patients who reached their enteral nutrition goal	782 (82.1)
Achievement of the early enteral nutrition goal (≤ 96 hours after the enteral nutrition start)	600 (63.0)
Achievement of the late enteral nutrition goal (> 96 hours after the enteral nutrition start)	182 (19.1)
Total parenteral nutrition	**79 (8.3)**
Days on total parenteral nutrition (n = 79) (median,range and IQR)	4 (1/70, 3/7)
Combined enteral nutrition and parenteral nutrition	**66 (6.9)**
Days on combined enteral nutrition and parenteral nutrition (n = 66) (median, range and IQR)	3 (1/37, 2/5.5)

IQR: interquartile range
* Data are presented as n (%) or median (range and interquartile range)

Almost 95% of the 952 patients included in the study received enteral nutrition, and approximately 63% had an early enteral nutrition start (≤ 48 hours). Approximately 8% of the patients received TPN with a duration of one, or several days, and with a median of four days and a wide range. Of the patients given TPN, 95% received enteral nutrition at some point during their length of stay. Combined enteral nutrition and PN were administrated to 7% of the patients, with a median of three days. Eighty-two per cent of the patients on enteral nutrition (n = 898) reached the enteral nutrition goal, of whom 63% achieved the early enteral nutrition goal (≤ 96 hours after the enteral nutrition start).

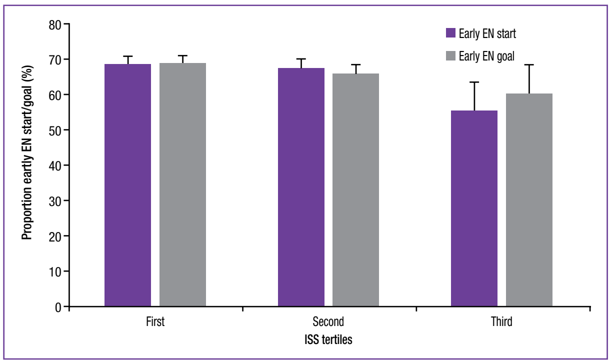
The 898 patients receiving enteral nutrition were divided into two groups, i.e. one group with an early enteral nutrition start (n = 603), and one group with a late enteral nutrition start (n = 295). The recorded ISS scores were divided into three subgroups (tertiles T1-T3) to control for severity of illness. T1 included scoring from 1-21 (a low and medium ISS), T2 scoring from 22-43 (a high ISS), and T3 scoring from 44-66 (a very high ISS). The differences between the early and late enteral feeding groups were compared using Student's t-test.

Table IV shows a male predisposition in the group with a late enteral nutrition start, with a higher average age. These differences were not significant. On average, the group with an early enteral nutrition

Table IV: Patient characteristics in the total study sample (n = 952), and a comparison of the patient characteristics in the two groups, i.e. those with an early or late enteral nutrition start (n = 898)*

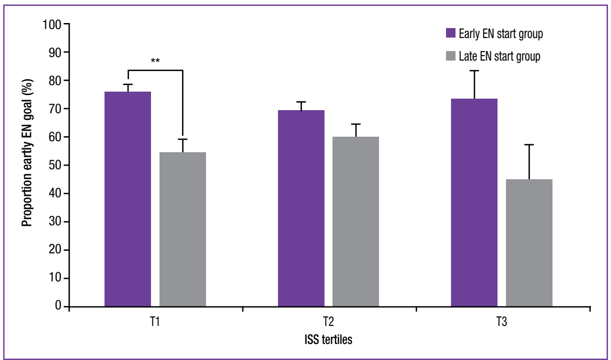
Variables	Total group (n = 952)	Group with an early enteral nutrition start (n = 603)	Group with a late enteral nutrition start (n = 295)	p-value
Sex				
Male	669 (74.5)	444 (73.6)	225 (76.3)	
Female	229 (25.5)	159 (26.4)	70 (23.7)	
Age	29.1 ± 15.1	28.7 ± 15.6	29.3 ± 13.5	0.5434
ISS (score)				
Total	22.8 ± 11.8	22.0 ± 11.6	23.4 ± 11.9	0.1124
T1 (1-21)	13.4 ± 5.4	13.0 ± 5.8	14.0 ± 4.5	0.0461
Number of patients in T1	471 (49.4)	309 (51.2)	144 (48.8)	
T 2 (22-43)	29.9 ± 5.9	30.0 ± 5.8	29.5 ± 5.9	0.3785
Number of patients in T2	436 (45.8)	272 (45.1)	133 (45.1)	
T 3 (44-66)	52.0 ± 6.0	51.2 ± 5.2	52.9 ± 6.8	0.3840
Number of patients in T3	45 (4.7)	22 (3.6)	18 (6.1)	
Complications				
VAP (number of episodes)	180 (18.9)	112 (18.6)	66 (22.4)	
Episodes per patient	0.2 ± 0.4	0.2 ± 0.4	0.2 ± 0.5	0.2259
Sepsis (number of episodes)	242 (25.4)	116 (19.2)	113 (38.3)	
Episodes per patient	0.3 ± 0.5	0.2 ± 0.5	0.4 ± 0.6	0.0001
Mechanical ventilation (days)	7.4 ± 9.0	6.8 ± 8.8	8.7 ± 9.3	0.0033
ICU length of stay (days)				
Total	14.6 ± 14.0	13.7 ± 13.1	16.4 ± 15.5	0.0058
ICU mortality	156 (16.4)	57 (9.5)	61 (20.7)	0.0001

* Data are presented as n (%), mean ± standard deviation
ICC: intensive care unit, ISS: Injury Severity Score, VAP: ventilator-associated pneumonia, T1: Tertile 1, T2: Tertile 2, T3: Tertile 3



EN: enteral nutrition, ISS: Injury Severity Score

Figure 3: The proportion of patients with an early enteral nutrition start and who achieved the early enteral nutrition goal within the three Injury Severity Score tertiles (n = 898)*



EN: enteral nutrition, ISS: Injury Severity Score, T1: Tertile 1, T2: Tertile 2, T3: Tertile 3

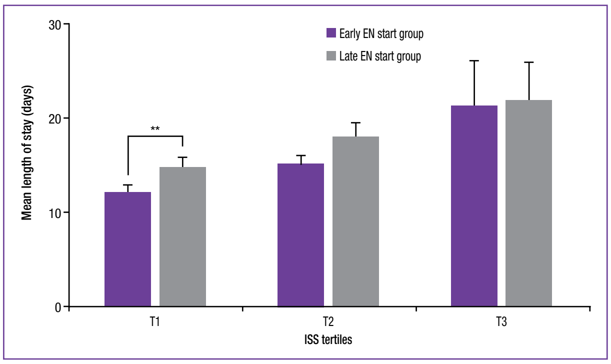
* Tertile 1: total: 310 (68.4), early: 232 (75.1), late: 78 (54.2), p-value < 0.0001 (chi-square test)
Tertile 2: total: 266 (65.7), early: 187 (68.8), late: 79 (59.4), p-value 0.0629 (chi-square test)
Tertile 3: total: 24 (40.0), early: 16 (72.7), late: 8 (44.4), p-value 0.0723 (chi-square test)

**Indicates the group with significant difference between the two subgroups in T1

Figure 4: The proportion of patients in the groups with an early and late enteral nutrition start within the three Injury Severity Score tertiles who achieved the early enteral nutrition goal (n = 898)*

start had a lower ISS. This difference was significant in T1 (p-value 0.0461). The group with an early enteral nutrition start experienced less complications, i.e. VAP and sepsis. There was no difference between early and late enteral nutrition with regard to episodes of VAP (p-value 0.2259). However, a significant difference was noted regarding episodes of sepsis (p-value 0.0001). There was also a significant difference in ventilation days between the two groups (p-value 0.0033), and a shorter length of stay (p-value 0.0058) with a benefit of early enteral nutrition. The mortality rate was lower in the group with an early enteral nutrition start, which was highly significant (p-value 0.0001).

A relationship between severity of trauma (ISS tertiles T1-T3) and the likelihood of being successful with the early initiation of enteral nutrition (Figure 3) (grey bars) and the early achievement of the enteral nutrition goal (Figure 3) (dark grey bars) was tested. The chi-square test showed that none of these differences were significant. The chi-square test also showed that none of the enteral nutrition goal differences were significant. Figure 4 demonstrates the differences between the early and late enteral nutrition start in the three ISS tertiles regarding success in reaching the early enteral nutrition goal. There was a highly significant difference between the groups with an

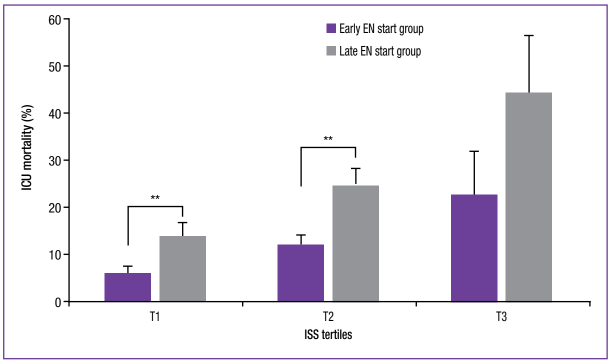


* Tertile 1: total: 12.9 ± 12.0, early: 12.0 ± 11.8, late: 14.6 ± 12.0, p-value 0.0315 (chi-square test and Student's t-test)
Tertile 2: total: 15.9 ± 15.0, early: 15.0 ± 13.2, late: 17.7 ± 18.1, p-value 0.0929 (chi-square test and Student's t-test)
Tertile 3: total: 21.4 ± 19.5, early: 21.1 ± 21.5, late: 21.7 ± 16.4, p-value 0.9209 (chi-square test and Student's t-test)

**Marker of the group with statistical significance

ISS: Injury Severity Score, T1: Tertile 1, T2: Tertile 2, T3: Tertile 3

Figure 5: Length of intensive care unit stay for the groups with an early and late enteral nutrition start within the three Injury Severity Score tertiles, according to severity of injury (n = 898)*

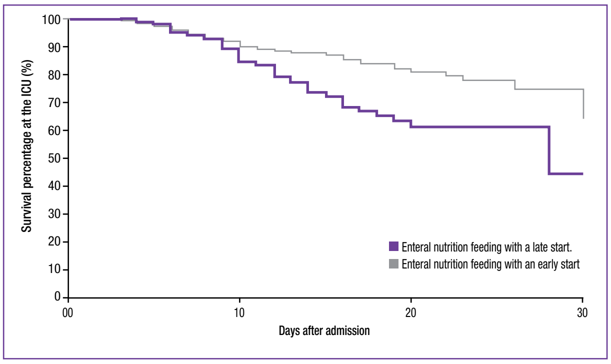


EN: enteral nutrition, ICU: intensive care unit, ISS: Injury Severity Score, T1: Tertile 1, T2: Tertile 2, T3: Tertile 3

* Tertile 1: total: 39 (8.6), early: 19 (6.1), late: 20 (13.9), p-value 0.0062 (chi-square test and Student's t-test)
Tertile 2: total: 66 (16.3), early: 33 (12.1), late: 33 (24.8), p-value 0.0011 (chi-square test and Student's t-test)
Tertile 3: total: 13 (32.5), early: 5 (22.7), late: 8 (44.4), p-value 0.1521 (chi-square test and Student's t-test)

** Marker of the groups with statistical significance

Figure 6: Intensive care unit mortality (percentage) in the groups with an early and late enteral nutrition start within the three Injury Severity Score tertiles, according to severity of injury (n = 898)



ICU: intensive care unit

Figure 7: Kaplan-Meier estimates of survival following a comparison of the group with an early enteral nutrition start with the group with a late enteral nutrition start (n = 898)

early and late enteral nutrition start in T1, i.e. the patients with a low to medium score (p-value < 0.0001), and a trend toward significance in the two other ISS tertiles. Figure 5 demonstrates that on average, the length of stay was lower in all of the ISS tertiles in the early enteral nutrition group. A significantly decreased length of stay was found in T1 (a low to medium ISS) in the group with an early enteral nutrition start (p-value 0.0315). Figure 6 demonstrates that mortality was lower in all of the ISS tertiles in the early enteral nutrition group. The differences in mortality between the groups with an early and late enteral nutrition start, i.e. T1 and T2, were highly significant (T1, p-value 0.0062; and T2, p-value 0.0011). The Kaplan-Meier estimator illustrates the survival rate in the first 30 days in the ICU (Figure 7), and that patients who received early enteral nutrition (p-value 0.0008) experienced significantly increased survival.

Using a multiple linear regression model, the day of enteral nutrition start, age and ISS supported the first hypothesis, namely that delayed-onset enteral nutrition results in a prolonged ICU stay. The analysis predicted that when the number of days before the start of enteral nutrition increase, so does the probability of a prolonged ICU stay, by 1.24 days for each additional day prior to feed initiation. Each additional year of age increased the length of stay in the ICU by 0.09 days, and each additional ISS point increased the length of stay in the ICU by 0.2 days. Secondly, the day of enteral nutrition start, age and ISS were highly significant, supporting the second hypothesis that later goal rate achievement is associated with increased mortality. The results predicted that with each additional day without enteral nutrition, the probability of death was increased by 0.05 (5.0%). The probability of death increased by 0.003 (0.3%) for each additional year of age, and by 0.05 (0.5%) with each additional ISS point.

Discussion

Nutritional support is an essential component in the care of critically ill trauma patients.[5,6,19,23] Limited data from nutritional studies have focused purely on critically ill trauma patients. The data supported the two study hypotheses. The study also showed that there was no support for the assumption that an increase in ISS reduced the likelihood of being successful in the initiation of early enteral nutrition, or early enteral nutrition goal (≤ 96 hours after the enteral nutrition start) achievement. The study reinforces the decision that early enteral nutrition should be provided, as supported by the findings of Doig et al.[8] The regression model used may serve as a prognostic marker with regard to length of stay and mortality in critically ill patients in the trauma ICU.

The two study groups were comparable, i.e. significant differences were not found regarding the variables of sex, age, ISS and VAP. However, studies have shown an increase in episodes of VAP in groups who have received early enteral nutrition.[8,24] This was proposed to be the result of aggressive enteral nutrition therapy and a higher rate of aspiration of feeds.[8] Furthermore, the group with a late enteral nutrition start experienced a significant increase in the number of days with mechanical ventilation, and also in the number of sepsis episodes per patient. This may indicate that these patients had a more complicated clinical picture, despite no significant differences in terms of ISS, age and VAP. Other studies have also shown that early enteral nutrition can be associated with a decrease in septic complications.[8,25]

Critically ill patients often have interruptions in enteral nutrition for different reasons, and hence do not reach the required nutritional goals.[24] The individuals with an early enteral nutrition start achieved an early enteral nutrition goal more frequently than those with a late enteral nutrition start across all of the ISS tertiles. This situation trended towards significance in T2 and T3, and was highly significant in T1.

This supports the assumption that an early enteral nutrition start increases the likelihood of successfully reaching an early enteral nutrition goal, especially in patients with a low and medium ISS. This study demonstrated that an early enteral nutrition start had a significantly positive effect on decreasing the length of stay and mortality. The average length of stay in the ICU was lower in the early enteral nutrition group (13.7 days vs. 16.4 days). In other words, an early enteral nutrition start was associated with an almost 17% decrease in the length of stay. A comparison between the three ISS tertiles showed that an early enteral nutrition start had a positive effect on the length of stay in the ICU in all of tertiles, but a significant effect could only be seen in T1, which implies that an early enteral nutrition start reduced the length of stay for patients with a low and medium ISS. Average ICU mortality was considerably lower in the early enteral nutrition group (9.5% vs. 20.7%). In other words, the provision of early enteral nutrition was associated with an approximate 54% decrease in mortality in all of the tertiles, and was highly significant in T1 and T2. This differs from the result of a previous study that focused on critically ill medical patients,[22] but was similar to the results of a recent meta-analysis.[8] This study demonstrated a significant effect of early feeding on ICU mortality in the group with respect to the patients who were the most ill, but not in the groups who were not as severely ill. The diverse results between the studies may be explained by differences in the study population, i.e. medical versus trauma patients, and/or the scoring systems.

The variables of VAP and sepsis were not included in the regression model, but it can be assumed that these variables are an important part of the explanation behind the demonstrated strong correlation between early enteral nutrition and the decrease in length of stay and mortality. It was not possible to exclude these, and other unmeasured variables, which may have had a confounding effect. The secondary aim of this study was to explore whether or not the success of an early enteral nutrition start could serve as a prognostic parameter in trauma patients. The regression model, using the three independent variables, showed a highly significant effect on the outcomes of both length of stay and mortality. In summary, the study adds support, whenever possible, to the decision to provide early enteral nutrition.

Limitations

The strengths of this study include the fact that it included a large, reasonably homogenous study group. All of the patients were trauma patients with relatively severe physical injuries. The main limitation was that it was a retrospective single-centre study. An attempt was not made to control possible differences in nutritional protocols which may have influenced the result to some extent. Therefore, it may not be possible to generalise the study results to all trauma patients. A randomised representative sample may provide a different result. Since enteral nutrition was the primary focus of this study, analysis was not conducted to investigate the effects of PN, or combined enteral and PN, on length of stay and mortality. This may be a topic for further research in future studies. There are inherent limitations to regression models as other factors have an effect on length of stay and mortality, and the model only predicts mortality in the ICU, and does not allow a prediction of long-term survival. The lack of information about health status, previous disease and admission at the potential referral hospitals further limits the ability to interpret each patient's overall clinical picture.

Conclusion

An early enteral nutrition start significantly reduces length of stay and mortality in critically ill trauma patients in the ICU, especially in patients with a low to medium ISS, i.e. T1, 1-21, and has a highly significant effect on mortality in patients with a low to medium and high ISS, i.e. T1 and T2, 1-44. While these are interesting findings, many areas for further prospective research remain, including the levels of inotropes at which early enteral feeding may be safely commenced, the role of various immunonutrients in modern trauma patient feeding and the long-term outcome of micronutrient and electrolyte deficiencies in this patient population.

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