ACTA MEDICA LITUANICA. 2004. VOLUME 11 No. 3. P. 36–40

Efficiency of enteral nutrition in burned patients

Daiva Gudavičienė[1], Rytis Rimdeika[1], Kęstutis Adamonis[2]

[1] *Division of Plastic Surgery and Burns, Kaunas Medical University Hospital, Kaunas, Lithuania*
[2] *Department of Gastroenterology, Kaunas Medical University Hospital, Kaunas, Lithuania*

The aim of the study was to elucidate whether enteral nutrition reduces mortality in patients with severe burnt traumas and the in-patient treatment of the survivors. **Methods**. Two groups were investigated. The first was a prospectively studied group of enterally fed patients (n = 67) treated at the Kaunas Medical University Hospital over the period 2000–2003. In the wound surgery period they received enterally 30–40 kcal per kilogram of body weight per day. This group was compared with a retrospectively studied group of patients (n = 71) treated in 1998–1999. Patients that underwent early escharectomies and sking grafting were ruled out of the study. **Results**. The groups were matched with respect to age, general and deep burning area, the Baux and burning indices. The methods and aspects of treatment were compared between the groups. Their treatment duration at the intensive care unit (ICU) showed no statistically reliable differences. They received analogous local and surgical treatment. Neither was their antibiotic treatment statistically significantly different. Their care was analogous. The only difference between the groups was that in the retrospectively studied group the patients received no additional enteral nutrition, *versus* the prospectively studied group who received sufficient enteral nutrition. Thus, the groups could be regarded as analogous, and it was possible to assess the effect of enteral nutrition on the patients' mortality and in-patient treatment duration. In the enterally fed group, died 5 patients (7.5%) of 67. The in-patient treatment duration of the survivors was 37.43 days (SD 21.19). In the group that received no enteral nutrition died 21 patients (28.2%) of 71 and the patients that survived were on in-patient treatment for 48.57 (SD 21.04) days. **Conclusions**. Enteral treatment resulted in a statistically significant reduction of mortality in burned patients and of their in-patient treatment duration ($p < 0.05$).

Key words: burns, enteral nutrition, mortality

INTRODUCTION

Over the last decade, in Lithuania the average annual number of patients that experienced burnt traumas comprised 9740, or 2.6 per one thousand population. Despite an insignificant reduction in the total number of burnt traumas, the number of in-patients increased from 15.8% in 1993 to 22.4% in 2001, certainly because of an increased number of patients with severe burnt traumas (1). At the Department of Plastic Surgery and Burns of Kaunas Medical University Hospital (KMUH), in 1993–2002 on average 216 patients per year were treated for burns (SD 19.89). Most of these patients (87.6%) had deep burns. The total burnt area tended to decrease (from 12.7% in 1981 to 10.99% of body surface area (BSA) in 2001), however, the area of deep burns increased. Though the in-hospital stay of burned patients over the period 1981 to 2001 decreased nearly by half, it remains rather long reaching 26.6 days (2). Burnt mortality at the KMUH in 1973–1995 varied within 6% to 12% (3) and in the period 1996–2002 comprised 9% to 22% (mean, 15%, SD 6.4).

Until 1998, the bodily reserves of patients after severe burnt traumas were maintained by repeated refrigerated plasma and albumin infusions. This kind of treatment could not satisfy the energy and nutrients demands of the patients and could increase the rate of complications and influence the treatment results.

Since 1999, for the feeding of burned patients industrial mixes were introduced. The patients are usually administered a daily dose of 30–40 kcal per

Address for correspondence: D. Gudavičienė, Kalvarijų 126-49, 08210 Vilnius, Lithuania. E-mail address: daikle@centras.lt

kilogram of body weight (4). Burned patients, as a rule, can eat, therefore we consider this dosage sufficient in the period of wound surgery.

The topic of burned patients' nutrition is new in Lithuania; no research work in the field has been published. We undertook a thematical search of the MEDLINE and COCHRANE medical databases for the last 20 years and found a series of reports on the effects of different aspects of enteral nutrition, such as the ratio of essential nutritive substances (proteins, fat and carbohydrates), minor nutritive substances (glutamine, arginine, omega-3 and omega-6 fatty acids), different ways of feeding (enteral and parenteral) on the mortality and in-hospital stay of burned patients. However, we failed to find studies analyzing the indices of in-patient treatment of patients with and without supplementary enteral nutrition. It comes to no surprise, as a prospective study of this character would be unethical, implying that one group should be given enteral nutrition and the other would not. Therefore we thought it topical, to analyze the efficacy of enteral nutrition in patients with severe burnt traumas. We compared a prospective group which received enteral nutrition, and a retrospective group which did not receive it. These two groups are separated by a rather short period of time: the retrospective group was treated in 1998–1999 and the prospective one in 2000–2003. To assess the effect of enteral treatment and escape the influence of other factors, we excluded from the study patients after early escharectomies and sking grafting, as the number of such operations keeps increasing, particularly in treating 2B° burns, as this could influence the in-hospital stay and mortality of the patients. We compared the groups in various aspects, such as ICU stay, local and surgical treatment, antibiotic therapy, nursing. The only aspect in which the treatment of both groups of patients differed was enteral nutrition.

PATIENTS AND METHODS

The study cohort comprised patients aged 16 to 80 years with burns of >10% < 80% BSA, with no burns of the airways and without severe decompensated concomitant diseases. The study did not include patients after early escharectomies and skin-grafting, as changes in surgery tactics over the recent six years could influence the indices of interest. A prospective study of such patients was made in 2000–2003. On weighing a patient the energy demand is determined (30–40 kcal/kg b.w.) and the nutrition scheme is drawn. Mixes of usual (1 ml – 1 kcal) or increased (1 ml – 1.5 kcal) caloricity are administered through a nasogastic or nasoduodenal probe. In the course of treatment the number of calories received daily by the patient in the period of wound surgery is calculated and the sufficiency of his nutrition is determined. If a patient has received sufficient enteral nutrition, he is ascribed to the group of enterally fed patients (group A) and if not, he was not recruited into the study. In the prospective group we studied 67 patients. The retrospective study embraced a group of patients matched by age and by the total burned as well as deeply burned area ($p > 0.05$), treated in 1998–1999 (group B, $n = 71$). To prognosticate the outcome in burned patients, we used the burn indices proposed in 1962 by Baux and in 1954 by Bull and Fischer. The Baux index is the sum of the patient's age (years) and the percentage of the burnt area. The calculation is simple, but it disregards the depth of the burnt wound. Therefore more valuable is the burn index modified by Schwartz and his colleagues from the Brook Military Academy (U.S.A.), in which the percentage of deep burn is evaluated as one point and the percentage of surface burn as half of a point; also, the patient's age is accounted for. We used these indices for the standardization of the groups. The groups were homogeneous if evaluated by the Baux and the burn indices ($p > 0.05$).

We assessed the treatment aspects in the groups. The ICU stay was evaluated, the aspects of surgical treatment were compared. Local treatment since 1998–2003 has undergone no essential changes, as the same local antiseptics are being applied. Antibiotic therapy was compared in the groups, the spectrum of sepsis agents was analyzed. The aspects of nursing were compared: most severely burnt patients in the KMUH are treated in Clinitron beds (we counted the number of patients treated in these beds in both groups and the duration of treatment). Within the groups, we studied the mortality of patients and the duration of in-patient treatment. Since in the literature, because of sampling differences, the very different mortality is shown,we made a pilot study of patients treated in KMUH in 1995–1996. We found a 22.8% mortality in patients (age, 16 to 80 years) with burnt >10% <80% of BSA and no burns of airways and with no serious decompensated concomitant diseases. We regarded as significant a 15% mortality reduction. According to these criteria, we found that in order to obtain statistically significant data, each group should contain no less than 67 patients.

For the statistical analysis we used the STATISTICA 5.0 software package. As the distribution of the indices studied was skewed, (Shapiro–Wilx test), non-parametric statistics was applied. For comparison of categorical values the Mann–Whitney test was used. The chi-square criterion was employed to compare the quantitative values. The error probability $p < 0.05$ was considered acceptable.

RESULTS

The patients' age, total and deeply burnt area in the enterally fed group A and not enterally fed group B showed no statistically reliable differences, as did also the prognostic indices (p > 0.05, Table 1).

Table 1. **Patients' age, total and deep burn area, prognostic indices in the study groups (mean ± SD)**

Index	Group A	Group B	P
Age, years	44.36 ± 16.04	45.39 ± 13.798	0.32
Total burn area, %	30.55 ± 17.27	31.21 ± 15.86	0.38
Deep burn area, %	19.09 ±12.10	17.39 ± 13.96	0.06
Baux index	74.94 ± 20.54	76.47 ± 19.47	0.90
Burn index	36.42 ± 30.98	34.64 ± 32.11	0.84

We compared the time of stay in ICU, where the vital functions of the worst patients are ensured, shock is treated, intensive infusive therapy is administered. In group A 18 patients (27%) and in group B 28 patients (39%) were treated in the ICU. In group A, 15 patients were treated for shock immediately following hospitalization, one patient was treated in the course of treatment against pneumonia and respiratory function insufficiency, and four patients were treated in the exit stage for septic shock and respiratory insufficiency. In group B, in the ICU because of shock were treated 24 patients, three patients stayed in the ICU in the course of treatment because of respiratory function insufficiency, renal insufficiency and septic shock; five patients were treated in the ICU at the exit stage for septic shock and respiratory insufficiency. The aspects of ICU treatment are analyzed in Table 2.

The aspects of surgical treatment were analyzed. In group A escharotomies were performed for three patients (4.4%) and in group B for four patients (5.6%). In group A, for 55 patients (81%) escharectomies were performed, their number varying from 0 to 4, on average 1.24 per patient (SD 0.89). Escharectomies were performed on average on day 11.56 in the hospital (SD 6.12). In group B, escharectomies were performed for 41 patients (57%). The significantly higher number of escharectomies in group A (p = 0.01) can be explained by a lower mortality in this group, a higher – over the acute period, and they could be operated on. In group B, the number of escharectomies per patient varied within 0–3 (mean, 1.32 per patient, SD 0.53). In group B, escharectomies were perfored on average on day 10.71 of in-hospital stay (SD 4.84). The term of necrectomies showed no statistically significant difference (p = = 0.83). Skin-grafting in group A was performed for 15 patients (22.06%) and in group B for 25 patients (35.21%). The first skin-grafting was performed in group A on average on day 18.40 and in group B on day 19.52 of hospital stay (SD 8.62). No statistically significant difference between the groups was found in the term of performing the first skin-grafting (p = 0.39). In total, the number of skin-grafting per patient in group A varied from 0 to 4 (mean, 1.31) and in froup B from 0 to 5 (mean, 1.52, SD 1.44). The numbers of skin-grafting between the groups showed no statistically reliable difference (p = 0.63). The term of repeated skin-grafting in group A was 34.65 (SD 15.05) and in group B 35.11 (SD 12.57) and showed no statistically significant difference (p = = 0.69).

Table 2. **Duration of treatment at ICU (mean ± SD)**

Index	Group A	Group B	P
ICU stay, days	1.80 ± 4.90	0.89 ± 1.32	0.48
ICU stay after hospitalization	1.66 ± 4.89	2.10 ± 1.95	0.41
ICU stay in the course of treatment	0.04 ± 0.37	0.13 ± 0.61	0.68
ICU stay at exit stage	0.18 ± 0.80	0.17 ± 0.58	0.82

In 1998–2003, at the Department of Plastic Surgery and Burns of KMUH the methods of wound dressing and the local antiseptics applied did not change. Patients with extensive burns are treated in Clinitron beds. In group A, in Clinitron beds were treated 22 patients (33%) and in group B 21 patient (29%) (p < 0.72). The treatment lasted 1 to 24 days (mean, 12.32; SD 6.00) and in group B 1 to 25 days (mean, 8; SD 7.81). The difference is not statistically significant (p = 0.42).

Pulmonary complications (pneumonia and lung oedema) were diagnosed in 21 patients from group A (31%). They were diagnosed on day 8.78 of hospital stay (SD 9.73). In group B, these complications were diagnosed on average on day 12.44 of hospital stay (SD 17.65). Pulmonary complications were diagnosed significantly more frequently in group B (p = 0.000). The term of their diagnosing differed insignificantly (p = = 0.57).

The spectrum of sepsis agents was analysed in the groups. In group A, 24 sepsis episodes were noted; in one patient there were two episodes. In group B there were 19 sepsis episodes; two episodes of sepsis occurred in two patients. The spectrum of sepsis agents is presented in Table 3. In

Table 3. **Sepsis agents in the study groups**

Agent	Total number		Per cent from sepsis cases		Per cent from total patients	
	Group A	Group B	Group A	Group B	Group A	Group B
MRSA	13	9	54	47	19	13
SA	5	1	21	5	7.5	1.5
PAs	1	1	4	5	1.5	1.5
PAr	0	3	0	16	0	4.5
Gr(–)B	2	2	8	10.5	3	3
Unknown	3	5	12.5	26	4.5	10.5

MRSA – meticillin-resistant *Staphylococcus aureus*, SA – meticillin-sensitive *Staphylococcus aureus*, PAs – antibiotic-sensitive *Pseudomonas aeruginosa* strain, PAr – resistant *Pseudomonas aeruginosa* strain. Gr(–)B – Gram(–) bacilli.

group A, sepsis occurred on average on day 11.2 of in-patient stay (range, 3–36 days, SD 8.13) and in group B on day 26.76 (range, 1–68 days, SD 21.09). In group A, sepsis was stated statistically significantly earlier than in group B ($p = 0.02$). In one group B patient sepsis was stated *post mortem* during expertise. Clinically, sepsis was stated in 3 group A and 4 group B patients.

Antibiotic therapy was compared. Vancomycin has been used in KMUH since 1994–1995. Vancomycin was administered to 14 group A and to 10 group B patients. Oxacillin was given to four group A and one group B patients and gentamycin to 1 and 1 patients, respectively. One group A patient was treated with imipenem, two patients in group B received amikacin.

The patients' mortality was evaluated by the Mann–Whitney test and found to be statistically reliably lower in the group that received enteral nutrition (Table 4).

We analyzed also treatment duration in patients whose exit was lethal. Five patients in group A before death were treated for 4–12 days (mean, 9.8 days, SD 4.60). In group B, 20 patients before death lived 1–67 days (mean, 19.15; median, 7; SD 21.19). Thus, in group A, which received enteral nutrition, patients survived for a significantly shorter period ($p = 0.00$). The possible explanation is a lower mortality in this group, as in the acute period the most severely ill patients died from shock. In group B, patients died later; we may suppose that part of patients died because of the insufficiency of vital functions, as the bodily reserves were poorly replenished, possibly because of insufficient nutrition.

For the patients that survived we calculated the in-patient treatment duration and wound epithelization rate (the ratio of the burnt BSA percentage and in-patient stay, in days). These indices were statistically significantly better in group A (Table 5).

Table 4. **Mortality of patients**

	Group A	Group B	P
Died/total	5/67	20/71	–
Mortality, %	7.5	28.2	0.04

DISCUSSION

The first studies drawing on the nutrition aspects of severely burned patients appeared in the MEDLINE and COCHRANE data bases in 1980s.

At present, most authors recommend enteral nutrition as a first choice method for severely burned patients. Researchers from the U.S.A., on summarizing their experience, in 1997 reported that sufficient enteral nutrition significantly reduced the mortality rate in burned patients, improved the immune state and wound healing, shortened the in-patient treatment (6). In 2003, a review paper on nutrition peculiarities in burned patients was published by Canadian researchers. They analyzed all MEDLINE, CINAHL (Cumulative Index to Nursing and Allied Health), EMBASE, Cochrane Library randomized controlled studies and metaanalyses concerning nutrition of burned patients published before 2002. The summarized conclusion was as follows: the first choice method is enteral nutrition. Only in cases when enteral feeding is impossible, parenteral nutrition is recommended. Nutrition should be started within the first 48 h on admission (7).

Table 5. **Duration of in-patient treatment**

	Group A	Group B	P
In-patient treatment duration, days	39.34 (SD 19.50)	48.57 (SD 21.04)	0.02
Wound epithelization rate, % (burned BSA / in-patient stay, days)	0.87 (SD 0.54)	0.68 (SD 0.45)	0.00

BSA – body surface area.

There are studies to show that adequate enteral nutrition, when the necessary amount of energy is ensured, improves the treatment results of burned patients. Raff and co-authors from Germany in 1997 published their study on the efficiency of early nasogastric feeding in severely burned patients. They examined 55 severely burned ventilated patients, of them 45 received an adequate quantity of energy. Enteral feeding was found to decrease significantly the mortality in these patients (8). In this study, an attempt was made to feed all patients, though additional feeding in some of them was insufficient. An analogous study in 2002 was published by Hart who examined 250 patients with 10–99% BSA burns. He found that when the feeding of patients did not ensure an adequate quantity of energy (energy demand was determined by indirect calorimetry), the mortality of patients was significantly higher ($p < 0.05$). In such cases, also sepsis was more frequent and in-patient stay longer (9).

However, some authors doubt as to the beneficial effect of enteral nutrition in patients with severe traumas. For instance, Wilmore (U. S. A.) argues that only fully parenteral nutrition with glutamine is undoubtfully efficient in treating major burns, whereas the beneficial effect of enteral nutrition has not been proven as there are no studies to compare the groups with and without enteral feeding (10).

The absence of such studies can be easily explained by ethical reasons. The scheme of our research allowed to escape ethical considerations, because half of our study cohort were analyzed retrospectively.

Our results are in favour of enteral nutrition. In the group of burned patients that received enteral feeding the number of pulmonary complications and the mortality rate were lower and the in-hospital stay was shorter.

CONCLUSIONS

1. Enteral nutrition of severely burned patients statistically significantly reduces their mortality.

2. Enteral nutrition of severely burned patients significantly reduces their in-patient treatment time.

Received 14 February 2004
Accepted 28 April 2004

References

1. Pundzius J. ir kiti. Nacionalinės sveikatos tarybos metinis pranešimas 2002 m. Lietuvos gyventojų traumas, nelaimingi atsitikimai ir kitos visuomenės sveikatos aktualijos. Vilnius, Baltijos kopija, 2003 m., p.44-47.
2. Rimdeika R., Jankūnas V., Pilipaitytė L, Mikužis M. Suaugusiųjų nudegimų traumatizmo pokyčiai ir prevencijos kryptys. Sveikatos mokslai 2003; 13(1): 69-74.
3. Rimdeika R. Chirurginių metodų efektyvumas gydant riboto ploto nudegimus. Daktaro disertacija. Kaunas, 1999, p. 4-14.
4. Sobotka L, Allison SP, Furst P, Meier R, Pertkiewicz M, Soeters PB et al. Basic in clinical nutrition. 2end ed. Publishing House Galén; 2000, p. 234-239.
5. Rimdeika R. Nudegimų chirurgija. Mokomoji knyga. Kaunas, katechetikos centro leidykla, 2002 m.
6. Mayes T. Enteral nutrition for the burn patient. Nutr Clin Pract 1997; 12 (1): S43-5.
7. Heyland DK, Dhaliwal R, Drover JW, Gramlich L, Dodek P. Canadian clinical practice guidelines for nutrition support in mechanically ventilated, critically ill adult patients. JPEN J Parenter Enteral Nutr 2003; 27 (5): 355-73.
8. Raff T, Hartmann B, Germann G. Early intragastric feeding of seriously burned and long-term ventilated patients: a review of 55 patients. Burns 1997; 23(1): 19-25.
9. Hart DW, Wolf SE, Herndon DN, Chinkes DL, Lal SO, Obeng MK et al. Energy expenditure and caloric balance after burn: increased feeding leads to fat rather than lean mass accretion. Ann Surg 2002; 235 (1): 152-61.
10. Wilmore DW. Postoperative protein sparing. World J Surg 1999; 23 (6): 545-52.

Daiva Gudavičienė, Rytis Rimdeika, Kęstutis Adamonis

ENTERINIO MAITINIMO VEIKSMINGUMAS GYDANT NUDEGIMUS

S a n t r a u k a

Darbo tikslas buvo nustatyti, ar enterinis maitinimas sumažina nudegusių ligonių mirtingumą. Kauno medicinos universiteto klinikose tirtos dvi ligonių grupės: 2000–2003 m. gydyti ir enteraliai maitinti (n = 67) ir 1998–1999 m. gydyti ir enterinio maitinimo negavę ligoniai (n = 71). Abiejų grupių ligoniai buvo gydyti analogiškai. Tyrimo rezultatai parodė, kad enteraliai maitinti ligoniai trumpiau gydėsi ligoninėje ir jų mirtingumas buvo statistiškai patikimai mažesnis.

Raktažodžiai: nudegimai, enterinis maitinimas, mirtingumas