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Influence of Early Vs Delayed Enteral Nutrition on the Frequency of Complications in Major Burn Patients

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ABSTRACT

Burn injury is the most severe type of trauma known. It results in many pathophysiological changes. One of the most important effects of these changes is the postburn hypermetabolic state. It begins shortly after burn injury and persists till complete burn wound healing. This hypermetabolic state causes marked decrease in the lean body mass and marked weight loss. If this hypermetabolic state is not corrected early and promptly, serious complications might occur. During the recovery phase of major burn, providing early and adequate amounts of calories and proteins is considered a major cornerstone in the burn management. Early enteral nutrition has been demonstrated to minimize the catabolic loss, enhance the immunological response, decrease the incidence of infection and prolong survival. The purpose of this work was to study the value of early compared with delayed enteral nutrition in major burn patients and their influences on the frequency of post-burn complications. The study was carried out on 40 acutely burned patients between 19 and 40 years of age with more than 35% total body surface area (TBSA) burns. They were randomly divided into two groups, 20 patients each (A & B). Group A (early enteral nutrition group) was fed within 24 hour of burn injury and group B (delayed enteral nutrition group) feeding was delayed for about 72 hours post-burn. The caloric intake of each patient was calculated according to Curreri formula. Patients were observed clinically for the occurrence of pneumonia, pulmonary edema, wound infection and burn sepsis, body weight was measured weekly and serum albumin every 3 days. There was a significant decrease in body weight and serum albumin level more manifested in the delayed enteral feeding group. The incidence of burn related complications was higher but not significant in group B compared to group A except in case of burn sepsis which was significantly higher in group B. We may conclude that adequate early enteral nutrition is an important aspect in the management of major burns, as the healing process is associated, with fewer incidence of wound infection, burn sepsis, mortality and less health care costs.

INTRODUCTION

Burn injury is the most severe type of trauma known. Several decades have passed since early pioneers in the field of surgical metabolism such as Kenney et al. **[10]** first definitively demonstrated that burn injury results in a dramatic increase of the basal metabolic rate. Subsequent investigations have consistently confirmed that severe burn injury doubles resting energy expenditure and that burn related hypermetabolism results in loss of body fat stores and loss of visceral and structural protein mass **[20]**.

The clinical effects of these changes include immunosuppression, delayed wound healing and generalized muscle weakness that prolongs the period of rehabilitation **[7,8]**. Early attempts to nourish burn patients with oral feeding were largely unsuccessful. Altered mental status, ileus and gastrointestinal dysfunction and inhalation injury often precluded significant oral intake.

Patients are often not able to meet the increased requirements through oral feeding alone, thus enteral feeding is often used. Enteral feeding is continued until sufficient oral intake is established to meet the patients' need **[17]**. Clinical and laboratory investigations have pointed towards the gastrointestinal tract as a reservoir of organisms which in certain circumstances leave the confines of the gastrointestinal tract lumen to produce septic state. Translocation of bacteria and endotoxins after major burns have been well demonstrated in experimental models **[14]**.

Enteral support is the best feeding method for maintaining gastrointestinal mass and functions. This may explain the improved digestive, absorptive and immunological status acquired with enteral alimentation **[15]**. It is generally accepted that enteral nutrition is superior to parenteral nutrition with management of severely burned patients **[6]**, but questions remain regarding the value of early compared with delayed enteral feeding in major burn patients and their influences on the frequency of post-burn complications.

PATIENTS AND METHODS

(Previous approved and informed consent was obtained from the patients, their parents, or their guardian).

The present study was carried on 40 acutely burned patients between 19 and 40 years of age. They were admitted to Mansoura University Emergency Hospital within 12 hours of their injury, with more than 35% total body surface area (TBSA) burns. Patients were followed-up during the first 2 weeks post-burn. Data of patients were analysed as regards age, sex, burn depth and TBSA. All patients were resuscitated using isotonic saline and lactated Ringers' solutions followed by colloids according to Parkland's formula [2]. Nasogastric or nasoduodenal tubes were inserted following hospitalization. Burn wounds were treated using occlusive dressing daily with silver sulphadiazine (Dermazine). After resuscitation, patients were randomly assigned to one of two groups using sealed opaque envelop method.

- *Group A (20 patients):* They received nutritional support within 24 hours of burn injury using tube feeding.
- *Group B (20 patients):* They received conventional treatment, but tube feeding was delayed for about 72 hours post-burn.

Exclusion criteria:

Inhalation injury, electrical burn, severe decompensated diseases, early escharectomies and skin grafting and intolerance to enteral feeding.

Dietary plans:

These plans were designed individually for both groups. They were modified according to the patients' condition, presence of infection and level of serum albumen.

Nutrient calculation:

Caloric intake was based on Curreri formula (Curreri et al., 1974).

- Calories: (25Kcal x body weight in kg) + (40Kcal x % burned body surface area).
- Daily total caloric intake was divided on macronutrients as follows:
  1- Proteins represented 20% of caloric intake but not more than 2g/kg body weight.
  2- Carbohydrates represented 60% of the caloric intake.
  3- Fats represented 20% of the caloric intake.

Tube feeding was continued for 18 hours (started at 8 am and stopped at 2 am). The rate of feeding was 25ml/hour, to be increased by 25ml every 8 hours to reach 150ml/hour. Parenteral nutrition was added as supplementation if enteral feeding was not satisfying the caloric requirement of the patient.

Monitoring:

Frequency of complications to burn injury as pneumonia, pulmonary oedema, sepsis, renal insufficiency and death in different groups were studied.

- Pneumonia and pulmonary oedema were diagnosed according to clinical symptoms, findings in X-ray examinations and conclusions of chest physician.
- Sepsis was diagnosed according to clinical symptoms after the confirmation of microorganisms growth in blood culture.
- Renal insufficiency was diagnosed according to serum creatinine level which was examined every 3 days.
- Patients were subjected to routine investigations in the form of:

Arterial blood gases (ABG), blood sugar every 12 hours, complete blood count, liver function (including serum albumin) every 3 days. Blood cultures, coagulation profile, plain chest X-ray were done every week.

- Body weight was measured on admission and every week.

Statistical analysis:

Statistical analysis of data was done by using excel program and SPSS program statistical package of social science version 10 on windows 98. *P* was considered significant if ≤0.05 at confidence interval 95%.

RESULTS

Number of patients in each group was 20, 7 males and 13 females. Their ages ranged between 19 and 40 years. TBSA of burns ranged between 35 to 70% in each group and full thickness burn constituted between 10 to 45% of the TBSA burned. There was a significant decrease in the body weight of patients in both groups during the study period when compared with their body weights on admission. This weight loss was more significant in group B than group A (Tables 1,2).

Table (1): Bodyweight changes in group A and group B during the study period.

Wt (kg)	On admission	1st week	2nd week
Group (A):			
Mean	79.025	77.425	77.132
S.D.	13.723	13.532	13.311
*p*1		0.001*	0.001*
Group (B):			
Mean	68.325	66.025	63.816
S.D.	10.917	10.735	10.295
*p*1		0.001*	0.001*
*p*2	0.06	0.005*	0.001*

*p*1 = Comparison between on admission different follow-up periods.
*p*2 = Comparison between the two groups at the same time.
* = Significant *p* value

Table (2): Amount and percentage of weight loss in group A and group B during the study period.

Wt (kg)	Amount of weight loss (kg)		% of weight loss	
			1st week	2nd week
Group (A):	1.6	2.6	2.04%	3.3%
Mean	0.6	0.7	0.8	0.7
S.D.				
Group (B):				
Mean	2.3	3.6	3.4%	5.4%
S.D.	0.7	1.2	1	1.7
p	0.002*	0.002*	0.001*	0.001*

* = Significant *p* value

Serum albumin changes:

There was no significant difference in the serum albumin levels on admission (Table 3). However, their values showed a significant decrease during the study period which was more significant in group (B) (delayed enteral nutrition group).

Table (3): Serum albumin levels in the studied groups on admission and during the study period.

Serum albumin (gdl)	On admission	Day 3	Day 6	Day 9	Day 12	Day 15
Group (A):						
Mean	3.9	3.3	2.9	2.8	2.8	2.8
S.D.	0.2	0.4	0.5	0.5	0.4	0.3
*p*1		0.001*	0.001*	0.001*	0.001*	0.001*
Group (B):						
Mean	3.8	2.9	2.5	2.4	2.4	2.4
S.D.	0.3	0.3	0.3	0.4	0.3	0.2
*p*1		0.001*	0.001*	0.001*	0.001*	0.001*
*p*2	0.08	0.001*	0.001*	0.001*	0.001*	0.001*

*p*1 = Comparison between on admission different follow-up periods.
*p*2 = Comparison between the two groups at the same time.
* = Significant *p* value

Burn related complications:

The number of cases that developed wound infection in group A was 11 and in group B was 14 cases. 4 cases in group A, 11 cases in group B developed burn sepsis. 3 cases in group B and non in group A developed pneumonia. The number of deaths was 3 in group B and 1 in group A.

There was a significant difference in the number of cases with burn sepsis between the two groups being higher in group B (Table 4).

Table (4): Incidence of wound infection, pneumonia, burn sepsis and mortality in both groups.

	Group A	Group B	*p*
Wound infection:			
+ve cases	11/20 (55%)	14/20 (70%)	0.33
–ve cases	9/20 (45%)	6/20 (30%)	
Pneumonia:			
+ve cases	–	3/20 (15%)	
–ve cases	20/20 (100%)	17/20	
Burn sepsis:			
+ve cases	4/20 (20%)	11/20 (55%)	0.02*
–ve cases	16/20 (80%)	20 (45%)	
Mortality:			
+ve cases	1/20 (5%)	3/20 (15%)	0.29
–ve cases	19/20 (95%)	17/20 (85%)	

* = Significant *p* value

DISCUSSION

The importance of nutritional support in burned patients was overlooked by most of the physicians and surgeons and it was not considered seriously. At best, they prescribe a high protein diet as a routine to their patients without going deeply into the basis of the increased patients' demands **[3]**.

Reviewing the subject of nutrition in burned patients shows how severe are the metabolic changes after burn and consequently the nutritional demands. The impact of adequate nutritional support on the improvement of the local and general condition of the patients and the rate of healing and the regain of activities, muscle power and rehabilitation is well documented **[13,19]**.

The profound catabolism occurring after major burns leads to the complications predicted from a significant loss of lean body mass namely, weakness, increased susceptibility to infection and impaired healing **[19]**.

The results of this study demonstrate that early and delayed enteral nutrition do not reduce post burn hypermetabolism as shown by significant reduction in the body weights of patients in groups A and B. However, there was more significant body weight loss in group B (delayed nutrition group), when compared with group A (early nutrition group) during the study period.

On the other hand, serum albumin in all patients of both groups dropped significantly after burn and remained low during the study period. However, the decrease was more significant in group B when compared with group A. Data concerning the impact of early enteral nutrition to catabolism is controversial. The study published by Wang et al. **[16]** proved that early enteral nutrition lessens catabolism after burn. In this work the energy needed by burned patients was studied as well as plasma glucagon, serum insulin, urine cortisol and catecholamines. Decrease of these indices has proven to be statistically reliable in the group of early enteral nutrition compared to the delayed enteral nutrition one.

Noodenloss et al. **[11]** reported that early enteral nutritional support combined with aggressive burn wound excision did not modify the metabolic response to burn injury. In another study, Hart et al. **[8]** reported the beneficial effects of early enteral nutrition and aggressive burn wound excision on the metabolic and catabolic effects of burn injury. Wound colonization and sepsis were diminished with early feeding group as well.

On the other hand, Peck et al. **[12]** reported that early enteral feeding did not decrease the average energy expenditure associated with burn injury. This work and others can explain the findings in the present study that show significant drop in the values of body weights and serum albumin level in both groups, which is more evident in the delayed feeding group. Whereas it coincides with the results reported by Hart et al. **[8]** as regards the decrease in the incidence of wound infection and sepsis in the early enteral feeding group.

There are different data about time interval during which the enteral nutrition should be started. Studies indicate that even brief periods of fasting (12 to 24 hours) can compromise gut barrier, structure and function, mesenteric blood flow and immune function, leading to the translocation of pathogens **[1,5]**.

Translocation is believed to be associated with nasocomial sepsis and multisystem organ dysfunction **[4]**. Jenkins et al. **[9]** conducted a clinical trial that focused on the safety and efficacy of immediate nutrition support after thermal injury. They reported that early fed patients developed 7 infectious complications versus 12 in the control group. Serum albumin and total protein were significantly higher post-burn in the early group. The above mentioned results agree with data obtained in the present study as regards serum albumin level and infectious complications.

With respect to enteral feeding after burn injury, we may conclude that adequate early enteral nutrition is an important aspect in burn management. Early enteral nutrition in patients undergoing thermal injuries and burn healing is associated with fewer incidences of wound infection, burn sepsis, mortality and less health care costs.

REFERENCES

1- Barga M., Gianottil, Constantini E., et al.: Impact of enteral nutrition on intestinal bacterial translocation and mortality in burned mice. Clin. Nutr., 13: 256-261, 1994.

2- Baxter C.R.: Fluid volume and electrolyte changes of the early post-burn period. Clinical Plastic Surgery, 1: 693-703, 1974.

3- David G.G., Terry A.H. and Richard J.K.: Maintenance of serum albumin level in pediatric burn patients: A prospective, randomized trial. Journal of Trauma Injury Infection and Critical Care, 39: 67-72, 1995.

4- Deitch E.A.: Multiple organ failure: Pathophysiology and potential future therapy. Ann. Surg., 216: 117-134, 1992.

5- Gianotti O., Nelson J.L., Alexander J.W, et al.: Post injury hypermetabolic response and magnitude of translocation prevention by early enteral nutrition, 3: 32-231, 1994.

6- Gottschlich M.M.: Early preoperative nutrition support. In: Matarese L.E., Gottschlich M.M. editors. Contemporary nutrition support practice. Philadelphia: WB Saunders Co., 265-278, 1998.

7- Gottechlich M.M., Jenkins R.N., Mayes T., et al.: The 2002 clinical research award: An evaluation of the safety of early Vs delayed support and effects on clinical, nutritional, and endocrine outcomes after severe burn. J. Burn Care Rehabil, 23: 401-415, 2002.

8- Hart D.W., Wolf S.E., Chinkes D.L., et al.: Effects of early excision and aggressive enteral feeding on hypermetabolism, catabolism and sepsis after severe burn. J. Trauma, 54: 755-765, 2003.

9- Jenkins M., Gottschlich M., Alexander J.W. and Warden G.D.: Enteral alimentation in early post-burn phase. In: Blackburn G.L., Bell S.J., Mullen J.L., editors. Nutrition Medicine. A case management approach. Philadelphia, WB Saunders, 1-5, 1989.

10- Kinney J.M., Duke J.M., Long C.L. and Gump F.E.: Tissue fuel and weight less after injury. J. Clin. Pathol., 23 (Suppl. 4): 62-72, 1970.

11- Noodenloss J., Hansbrough J.F., Gustmacher H., et al.: Enteral nutritional support and wound excision and closure

do not prevent post-burn hypermetabolism as measured by continuous metabolic monitoring. J. Trauma, 49 (4): 667-671, 2000.

12- Pek M.D., Kessler M., Cairns B.A., et al.: Early enteral nutrition does not decrease hypermetabolism associatd with burn injury. J. Trauma, 57: 143-149, 2004.

13- Steat S.J., Beddo A.H. and Hill G.L.: Aggressive nutritional support does not prevent protein less in peptic care patients. J. Trauma, 27: 262-266, 1987.

14- Shalaby H.A., Higazi M. and El-Far N.: Selective gastrointestinal decontamination and burn wound sepsis. Ann. MBC, 11: 23, 1998.

15- Suchner V., Senflteben U., Ekart T., et al.: Enteral versus parenteral nutrition: Effects on gastrointestinal function and metabolism. Nutrition, 12: 13-22, 1995.

16- Wangs, Wangs and You Z.: Clinical study of the effect of early enteral feeding on reducing hypermetabolism after sever burns Zhonghua Wai Kezahi, 35 (1): 44-47, 1997.

17- Wasiak J., Deland H. and Jaffery: Early versus delayed enteral nutrition support for burn injuries. Cochrane Data base of systematic review, Issue, 3 Art. No.: CD005489, 2006.

18- Wilmoze D.W. and Curreri P.W.: Sapranounal dietary intake in thermally injured hypermetabolic patients, 1971.

19- Wilmore D.W., Long J.M., Mason A.D., et al.: Catecholamin: Mediations of the hypermetabolic response to thermal injury. Ann. Surg., 180: 653-669, 1974.

20- Yu Ym Tompkins R.G., Ryan C.M. and Young V.R.: The metabolic basis of the increase in energy expanditure in severe burn patients. JPENJ parenteral Nutr., 23: 160-180, 1999.