ISR Journal of Medical Case Reports (ISRJMCR)
Homepage: https://isrpublisher.com/isrjmcr/
Volume 1, Issue 1, May, 2025 ISSN: XXXX-XXXX (Online)

How Much can Supplementation Prevent Malnutrition in Burnt Patients?

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Article History

Received: 01-05-2025

Accepted: 09-05-2025

Published: 17-05-2025

Abstract: **Case Report**

Burn injuries result in a complex physiological response characterized by hypermetabolism, increased catabolism, and profound alterations in nutrient requirements. Optimal nutritional support is critical in improving clinical outcomes, promoting wound healing, reducing infections, and preserving lean body mass. This article reviews current evidence on the metabolic demands following thermal injury, the role of macronutrients and micronutrients, and best practices for nutritional assessment and intervention in burn patients. Emphasis is placed on early enteral nutrition, individualized caloric and protein needs, and the supplementation of key nutrients such as vitamin C, vitamin A, zinc, and glutamine. Understanding and implementing effective nutritional strategies is essential for enhancing recovery and reducing morbidity and mortality in this vulnerable population. We Conducted a comparative and prospective study of 3 months between January and March 2025, in the university hospital Mohamed VI of Marrakech (Morocco), and specifically in the aesthetic and reconstructive surgery department along with the burn care unit, tracking the different clinical and nutritional parameters available of 3 groups of patients to evaluate the magnitude of the effect that supplementation, and secondarily, proper nutrition can have in the prevention of Malnutrition.

Keywords: Nutrition, Burns, Glutamine, Malnutrition.

INTRODUCTION

Severe burn injuries precipitate a profound hypermetabolic and catabolic response, markedly increasing patients' nutritional demands. This metabolic upheaval can persist for months, leading to significant loss of lean body mass, impaired immune function, delayed wound healing, and heightened susceptibility to infections. Consequently, tailored nutritional support is paramount in the management of burn patients, aiming to mitigate these adverse effects and promote recovery.

Early initiation of enteral nutrition, ideally within 6 to 18 hours post-injury, has been associated with improved nitrogen balance and reduced hypermetabolic response. Protein requirements are substantially elevated, with recommendations suggesting intakes of 1.5 to 2.0 g/kg/day for adults to support wound healing and immune competence [1].

Micronutrient supplementation plays a critical role in burn care. Vitamins A, C, and E, along with trace elements like zinc and selenium, are vital for immune function and tissue repair. Burn injuries often lead to deficiencies in these nutrients due to increased losses and metabolic demands, necessitating their replenishment to facilitate optimal healing [2].

Furthermore, specific amino acids such as glutamine and arginine have been identified as conditionally essential in the context of burns. Glutamine supports gut integrity and immune function, while arginine contributes to nitric oxide production and lymphocyte activity. Supplementation with these amino acids may enhance recovery, although further research is warranted to establish standardized protocols [2].

This article delves into the intricate nutritional challenges faced by burn patients, Examining the impact of targeted supplementation strategies on clinical outcomes. By synthesizing current evidence, we aim to provide a comprehensive overview of the best practices in nutritional support for this vulnerable population.

METHODS

Our study is comparative and prospective, based on 22 patients divided into 3 groups (10 in Group A, 5 each in group B and C), of burnt patients that were hospitalized between 1st January 2025 and 31st March 2025 (2 Patients were excluded because they didn't fall into any of the group's criteria).

Group A: Patients that consumed hypercaloric and hyper protein meals of the hospital as well as available supplements.

Group B: Patients that consumed non-optimal meals from outside the hospital but had proper supplementation.

Group C: Patients that consumed hypercaloric and hyper protein hospital meals, but didn't take supplements.

RESULTS

Of the 22 patients, 15 were males (68.1%), and the average age was 31.6 years old. 14 out of the 22 patients (64%) had a low income.

Flame burns were the most frequent mechanism and occurred in 13 patients (59%), followed by solid contact burns in 6 patients (27%), then liquid contact burns in 3 patients (13.6%) that all happened to be children.

The Total Burnt Surface Area (TBSA) ranged between 2% and 43% with an average of 17.4%. The average hospital stay was 18.3 days, ranging from 2 days all the way to 87 days.

The weight of our patients ranged from 23 kg to 85 kg, with an average value of 51.6 kg. 20 of our patients, or 91%, showed significant weight loss during hospitalization, ranging from 2 kg to 14 kg, with an average loss of total body weight calculated at 9.73% of admission weight.

Daily weight measurements were established for our patients, with weekly mean calculations to ensure reliable monitoring of the weight curve, with little influence from weight variation related to body fluid dynamics and transit.

Due to a lack of resources, the only nutritional markers performed were albuminemia and proteinemia, every other day, or even daily in some patients.

Albumin levels ranged from 11.3 g/l to 43.5 g/l, with an average of 21.78 g/l, and protein levels from 31 g/l to 78 g/l, with an average of 42.62 g/l.

21 of our patients presented with hypoalbuminemia during their hospitalization, i.e. 95.45%. 18 patients with hypoalbuminemia benefited from albumin transfusion, i.e. 85.7%.

The high-calorie, high-protein diet for burn patients is prepared by our university hospital kitchen, with meal trays of 1,200 Kcal each, combined with a protein supplement of 1,000 Kcal or a prescription for a protein concentrate powder when it isn't available. The diet is adapted to the patient's age, weight and taste preferences, in cooperation with the dietician, and is based on the Toronto formula for adults and the Schofield formula for children.

Caloric intake was calculated for all our patients, according to their food intake, number of meals and snacks. We found however that 20 patients (91%) consumed fewer calories than they needed.

We calculated weekly caloric intakes for all our patients, using the Toronto formula for adults and the Schofield formula for children.

Calculated daily caloric intake values ranged from 1965 Kcal to 4183 Kcal, with a mean value of 3292 Kcal.

20 (91%) patients had a calculated caloric intake higher than their mean caloric intake, between 12% and 103% higher.

Oral feeding was the most common mode used in our patients, with 19 cases (86.6%), followed by enteral feeding via nasogastric tube (9.1%) and parenteral feeding in a single patient (4.5%).

During the nutritional interview with our patients, several factors were identified as opposing the fluidity and quality of food intake.

The most prominent factors were pain caused by procedures in 18 patients (81.2%), drastic changes in eating rituals in 15 patients (68.2%), lack of appetite in 14 patients (63.7%), non-appreciation of hospital meals in 9 patients (41%), and transit disorders in 6 patients (27.2%).

For the reasons explained above, 21 of the patients in our study (95.4%) were unable to finish their hospital meals. The percentage of meals consumed ranged from 35% to 100%.

In terms of macronutrients, patients had more difficulty finishing their protein ration (16 patients or 76.2%) than their carbohydrate ration (3 patients or 14.3%) or lipid ration (2 patients or 9.5%).

Access to supplementation was relatively limited in our series of patients, mainly due to a lack of availability in the hospital therapeutic arsenal, forcing the prescription of the most common supplements (The lack of resources amongst many of our patients was the reason why they couldn't always buy the recommended supplements).

The main supplements used were:

- Iron, Vitamins, and Minerals (Vit A, Vit C, Vit D, Zinc, Copper, rehydration salts, etc.).
- Protein concentrate powder: received by 17 patients
- High-calorie and high-protein drinks: Received by 16 patients.
- Glutamine: Received by 4 patients.

Comparatively, we noticed that patients from group A had overall the leanest body mass conservation with a body weight degradation averaging only 4,76 Kg, and the least decline in albumin and serum protein levels with a mean albumin of 26.96 g/l.

Patients from group B had a non-regular pattern, with numbers from both extremes based on the type of food the patient is consuming.

Patients from group C had the lowest albumin numbers with a mean value of 18.56 g/l and the highest lean mass weight loss at around 13.72 Kg, added to a generally higher hospital stay due to a slower skin healing pace.

DISCUSSION

In critically burnt patients, malnutrition is a very frequent complication that in turn will drastically hinder the healing process, either by a general underconsumption of food or a specific nutrient deficit.

The main obstacles to proper nutrition in our study are like the ones in literature, hens' poor appetite, inability to feed oneself or requiring assistance to eat, impaired sense of taste and smell, or simply inadequate or excessive intake of calories, protein, fluid, or micronutrients. The elderly are disproportionately burdened with the risk of nutritional deficiency due to medical, psychological, physiological, social, and economic difficulties associated with increased age [3].

Although albumin, serum proteins, transferrin, and ferritin have not been validated for use in critical care or patients with chronic inflammation due to their high variability with other factors, they did have a place, whereas pre-albumine, nitrogen load, and retinol binding protein were not used as markers in our patients because they were not readily available. Low albumin levels, for instance, can be caused by acute or chronic infections, fluid status and fluid shifts, protein-losing states, and hepatic function without necessarily indicating malnutrition. Nevertheless, normalization of values indicates an improvement in the metabolic state, irrespective of the reason for low albumin. It is advised to use BMI in conjunction with C-reactive protein, albumin, and prealbumin to evaluate protein status in wound care patients receiving outpatient evaluation [4-6].

As most of our patients were unable to consume their full carbohydrate portions, significant weight loss is to be expected.

Supplementing carbohydrates is essential for burn patients because it not only acts as a fuel source for wound healing but also prevents muscle oxidation for energy. It is crucial to determine the minimum baseline adult carbohydrate requirement (2 g/kg/d) before giving burnt patients carbohydrates. In patients with severe burns, the maximum rate of glucose absorption is 7 g/kg/d [7].

These are crucial numbers to remember because burn patients need far more calories than their bodies can absorb from glucose. Consequently, it is generally advised that 55–60% of energy in burns be provided as carbohydrates, with a maximum of 5 mg/kg/min for adults and children, or 7 g/kg/d for adult patients. Therefore, inadequate carbohydrate delivery after burn injury may result in unchecked protein catabolism, while overdosing supplements may cause the burn patient to experience hyperglycemia [8].

Proteins were the meal portion that our patients consumed generally less off due to their filling effect, which aggravates protein catabolism and causes large losses in lean body mass. According to estimates, postburn catabolism can surpass 150 g/d, or nearly half a pound of skeletal muscle [9].

For these patients, a prolonged loss of lean body mass may have negative consequences that hinder their recuperation. According to clinical recommendations, healthy individuals should consume 0–8–1 g/kg/d of protein [8, 10].

Nevertheless, research indicates that burn patients oxidize amino acids 50% more frequently than healthy people [11].

Because of this, burn patients need to consume more protein (1-2 g/kg/d for burned adults and 2–4–0 g/kg/d for burned children). There has been no evidence of any additional benefits from giving adult burn patients more protein than the 1 to 2 g/kg/d that is advised, except for people who have kidney disorder, where lower doses should be preconized [8, 11].

The lipid fraction of the meals is the one that suffered the least in our patients, probably due to cultural cuisine reasons. Although there is an increase in lipolysis in burn patients during the hypermetabolic response, the amount of lipid catabolism is not nearly as great as that of proteolysis. Although burn patients do have higher rates of lipolysis and β-oxidation of fat, only around 30% of the free fatty acids that are released are broken down; the rest are reesterified into triglycerides. There aren't many studies on lipid recommendations for burns. Since several studies have indicated that consuming too much fat can result in immunosuppression, it is believed that fat should make up no more than 25% of nonprotein calories in burn patients.

What's more crucial is the makeup of fat supplements, with a focus on unsaturated fatty acids like ω-3 fatty acids that are metabolized without producing proinflammatory substances.

Research is now being done to determine how ω-3 fatty acids improve immunity and serve as a substrate to produce prostanoids and leukotrienes. Despite the lack of data to support clinical recommendations for ω-3 fatty acids, a recent study has shown some promise in terms of positive effects like decreased rates of hyperglycemic episodes and stay in intensive care units [10, 12-15].

Micronutrients, including vitamins and trace elements, play a key role in immunity and wound healing after burns. Severe burns cause intense oxidative stress and inflammation, depleting antioxidant defenses that rely heavily on these nutrients [16].

Deficiencies in vitamins A, C, D, and trace elements such as Fe, Cu, Se, and Zn have been linked to impaired healing and compromised skeletal and immune function [17, 18].

Vitamin A promotes epithelial growth, shortening wound healing time, while vitamin C supports collagen synthesis and cross-linking. Vitamin D, essential for bone health, is often deficient post-burn, though its optimal dosing remains unclear. In pediatric patients, burns disrupt calcium and vitamin D homeostasis due to increased bone resorption, osteoblast apoptosis, urinary calcium loss, and impaired cutaneous vitamin D3 production. Supplementing with 400 IU of vitamin D2 was ineffective in correcting deficiency in these patients, highlighting the need for further research. Trace elements like Zn, Fe, Se, and Cu are also lost through burn wound exudate. Zn is vital for DNA replication, lymphocyte function, and wound healing; Fe supports oxygen transport; Se enhances cell-mediated immunity; and Cu is crucial for collagen synthesis and immune function. Cu deficiency is associated with arrhythmias and worse outcomes. Supplementation with these micronutrients has been shown to reduce morbidity in severe burn patients [19, 20].

While protein supplementation is beneficial for burn patients who struggle to meet their daily intake through regular food, amino acid supplementation requires more nuanced consideration. For instance, alanine, though potentially involved in wound healing, is generally not recommended. It has been shown to increase urea production and nitrogen excretion, which may worsen catabolism in burn patients. Moreover, alanine's role in the nitric oxide pathway can be particularly harmful in septic patients or those at risk of sepsis [12, 21].

In contrast, there is strong evidence supporting the use of enteral glutamine supplementation in adult burn populations. Glutamine reduces oxidative stress as a precursor to glutathione, supports immune cell function (macrophages, fibroblasts, lymphocytes), and helps maintain gut barrier integrity by serving as a key fuel source for enterocytes. Supplementation has been linked to improved wound healing, reduced infection rates, and shorter hospital stays, thereby lowering overall healthcare costs and mortality. However, a key challenge lies in optimizing delivery routes to ensure adequate intracellular uptake, where glutamine exerts its primary effects. Current literature recommends enteral glutamine supplementation at 0.3–0.5 g/kg/day for 14–21 days post-burn in patients with >20–30% TBSA involvement. At the Ross Tilley Burn Centre, glutamine is administered via feeding tube in 10 g doses, given 2–4 times daily based on individual needs. Patients with burns covering more than 30% TBSA receive doses closer to 0.5 g/kg/day, while those with <30% TBSA are dosed nearer to 0.3 g/kg/day. The center is also participating in the multi-center re-energize trial, aiming to determine the optimal glutamine supplementation strategy for adult burn patients [22, 23]. We hope to be able to introduce glutamine supplementation for all our patients in the near future, as it showed better outcomes in the few who could consume it, even though the number wasn't high enough to come with a significative conclusion.

CONCLUSION

Optimal nutritional support is a cornerstone of care for patients with severe burns, as it directly influences wound healing, immune function, and overall clinical outcomes. The hypermetabolic response to burn trauma significantly elevates energy and protein requirements, necessitating early and individualized nutritional intervention.

While protein supplementation is essential for maintaining lean body mass and supporting tissue repair, the use of specific amino acids—such as glutamine—shows additional promise in enhancing recovery and reducing complications. In contrast, caution is warranted with amino acids like alanine, which may have deleterious effects in septic patients. Micronutrient supplementation, including vitamins A, C, D, and trace elements such as zinc, selenium, and copper, plays a vital role in mitigating oxidative stress and promoting tissue regeneration.

Emerging evidence and ongoing clinical trials, such as the Re-energize study, continue to refine best practices for supplementation. Ultimately, a targeted and evidence-based nutritional approach remains essential in improving outcomes and quality of life for burn patients.

Conflicts of Interest: Authors declare not having a link of interest regarding this work.

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