

Bioelectrical Impedance Analysis: Advanced Technique To Obtain Nutritional Risk in a Patient With Major Burns

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ABSTRACT

Patients with major burns are similar to critically ill patients; knowing their premorbid nutritional status at the time of hospitalization is important for further interventions. Bioelectrical impedance analysis is an advanced technique that helps to assess the detailed information on body composition, including basal metabolic rate, fat percentage, muscle mass, total body protein, bone health, segmental distribution of muscles and fat, and extra- and intracellular water. Patients with burns and high percentage of total burn surface area are known to be in a hypermetabolic state; a prolonged period of hypermetabolism with insufficient nutrient supply can lead to catabolism and cachexia. Finding the patient's nutritional status at the beginning of hospitalization helps to prevent further complications and to support faster recovery. Here, we present a nutritional risk analysis by using bioelectrical impedance in a patient with catabolic symptoms and major burns for management of nutrition with successful outcome.

KEY WORDS: *Body composition analysis, Burns nutrition management, Nutritional assessment, Nutritional risk*

INTRODUCTION

Burn wounds are major injuries that require a holistic approach for faster and timely recovery. Nutrition plays a pivotal role in healing of wounds and better outcome. The nutrition care process begins with the early assessment of nutritional status, which helps with planning effective

provision of nutrition. Bioelectrical impedance analysis (Figure 1) is an effective tool to assess body composition because it gives us complete information about muscle mass, fat, body water, and basal metabolic rate. Bioelectrical impedance is a noninvasive, inexpensive, and portable method of body composition analysis, which is appealing for both research and clinical practice.¹⁻³

Our goal was to find the patient's premorbid nutritional status and risk of malnutrition as our patient was thin and weak. Malnutrition is a well-known factor that affects wound healing and can lead to sepsis and mortality in patients with burns. We wanted to provide appropriate and optimum nutritional support to the patient based on the bioelectrical impedance analysis findings. Good outcomes can result in faster wound healing and recovery and will ultimately reduce the length of hospital stay and reduce treatment costs.

FIGURE 1. Body Composition Analysis Machine With 4 Electrodes



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CASE REPORT

A 26-year-old woman with 45% of total burn surface area, calculated by our surgery team, and deep flame burns was seen at our burn unit on day 43 after burn injury. She was housewife and received a burn injury while cooking food on a stove. The patient had delayed arrival with infected wounds and was severely malnourished; thus, this was a challenging and interesting case to manage.

Management strategies

After admission to our burn unit, primary treatment and dressing were provided to the patient. Because of late arrival, the wounds were infected. Visible observations showed that the patient was very lean and thin. Nutrition care was initiated immediately by the dietician after the primary management. We conducted nutritional assessment using the ABCD method (where A is anthropometric assessment, including weight and height; B is biochemical assessment, including hemoglobin and total leukocyte counts; C is clinical history related to previous illnesses if any and whether there are any comorbidities; and D is dietary history, including 24-hour diet recall and any food allergies).

We performed body composition analysis using the Tanita MC780 analyzer (Figure 1) to assess the patient's nutritional status and then to calculate her nutritional requirements. Energy calculations were done with the Curreri formula ($25 \text{ kcal} \times \text{body weight [kg]} + 40 \text{ kcal} \times \text{percent total burn surface area}$).^{4,5} She was weighed (weight = 27.2 kg) with a digital scale. Her height was 152 cm, ideal body weight was 48 kg, and body mass index was 11.7. Her total recommended calorie allowance was 2480 kcal/day. Protein was calculated as 2 g/kg body weight/day + wound protein losses (until the wound was open and not covered by the graft). Total recommended protein allowance was 54.4 g/day. Fat allowance was 30% of nonprotein calories, and a diet rich in omega 3 fatty acids was suggested. Carbohydrate allowance was 70% of nonprotein calories. Fluid requirement was determined by the surgical team.

Micronutrients were provided (Table 1), including multi-vitamin tablets, potassium-rich food items, and probiotic supplements. Immunosupplements included oral glutamine at 0.5 g/kg body weight/day for 1 month. Nutrition requirements were recalculated as her burn percentage was reduced. Nutrients were provided through oral and enteral route (continuous drip method) for 4 weeks (Table 2), along with anabolic steroids and regular monitoring of nutritional intake and clinical parameters. During this period, surgery was performed and her wounds were covered with a graft.

A monitoring sheet documented the patient's daily intake, gastrointestinal symptoms, temperature, and wound status. Diet history over the previous month through 24-hour diet recall showed that she consumed only 1200 kcal, which was 50% of her daily requirement. Therefore, we started the patient on nutrition provisions according to her tolerance considering the risk of refeeding syndrome. This was maintained until her wounds had healed and she was discharged.

The patient had a high nutritional risk, as shown by her initial body composition analysis (Tables 3, 4, and 5), which used bioelectrical impedance. We could not monitor body fat, and the patient had extremely high metabolic rate, with 0 visceral fat. We also could not record the segmental distribution of muscles and fat.

From this initial assessment, we decided to feed her with gradual increments of calories and proteins as she was at the risk of refeeding syndrome. Her daily intake was strictly monitored, and her nutrient intake was increased as per her tolerances. Her nutritional status gradually improved, allowing surgical skin grafting to be performed. Her wounds were covered, and the final outcome was good in terms of skin grafting, wound healing, and faster recovery. Follow-up body composition analysis showed overall improvement (Tables 3, 4, and 5).

DISCUSSION

Nutritional support practices in patients with burns can be more effective with body composition analysis. This useful tool allows appropriate nutrition requirements to be discovered and nutrition plans to be individualized for each patient, optimizing the relationship between nutrition and wound healing. This tool can also be a

TABLE 1. Vitamin and Mineral Supplements in the Patient's Daily Diet

Vitamin	Daily Dose
Vitamin C	1000 mg
Vitamin E	400 IU
Minerals, zinc	50 g

TABLE 2. Daily Calorie Provision With Different Modes of Feeding

Day	Calorie, kcal	Route
1	1200	Oral
2	2000	Oral+ continuous drip method
3	2000	Oral+ continuous drip method during night
4	2480	Oral+ continuous drip method

TABLE 3. Body Composition Analysis: Initial and Follow-Up Results

Parameter	Initial Result	Follow-up Result	Desirable Range
Weight, kg	26.7	41.3	42.7-57.8
Fat, %	3	22.2	21.0-35.0
Fat mass, kg	0.8	9.2	8.5-17.3
FFM, kg	25.9	32.1	
Muscle mass, kg	24.8	30.4	31.9-36.3
BMI	11.6	17.9	18.5-25.0
Metabolic age, y	13	18	

Abbreviations: BMI, body mass index (in kilograms divided by height in meters squared); FFM, fat-free mass

TABLE 4. Basal Metabolic Rate and Visceral Fat Results From Body Composition Analysis

Parameter	Result 1	Result 2
Basal metabolic rate	775 kcal	971 kcal
Visceral fat	0	1

TABLE 5. Fat Mass, Bone Mass, Protein, and Extracellular Water From Initial and Follow-Up Body Composition Analysis

Parameter	Initial Result	Follow-Up Result
Weight, kg	26.7	41.3
Fat mass, kg	0.8	9.2
Bone mass, kg	1.1	1.7
Protein, kg	6.9	8.1
Extracellular water, kg	6.6	8.7

prognostic indicator. There are several formulas available to calculate the nutrition requirements in burn patients; in our practice, we have observed patients who lost their muscular weight and seemed cachexic. Body composition analysis after burn injuries is an effective and useful tool to find a clear picture about nutritional status. However, patients who have had amputations and those who have burns in their palms and feet cannot be assessed through body composition analysis. Critically ill patients also may not be able to hold the machine.

CONCLUSIONS

The bioelectrical impedance method can be a useful tool to assess the nutritional risk of major burn patients and can prevent malnutrition, infection, sepsis, and weight loss. The body composition method is an example of evidence-based work where we can exactly find the metabolic rate, muscle distribution, protein, and other important information required for timely nutritional intervention. We believe that this method prevented mortality in our patient.

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