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The journal aims to contribute to the literature by publishing high impact content and become one of the leading publications of the field while functioning as an open discussion forum on significant issues of current interest. Clinical Science of Nutrition also aims to have significant input in emphasizing the increasing importance of clinical nutrition in Turkey and the region, identifying the effects of differences between societies on study results in a clearer way and converting clinical applications into scientific publications as well as forming a bridge between West and East.

The scope of Clinical Science of Nutrition includes original research articles, review articles, case reports, conference reports, and letters to the editor as well as editorials, abstracts from international and national congresses, panel meetings, conferences and symposia. As an online-only publication, in addition to traditional manuscript submissions, Clinical Science of Nutrition is also able to process video, audio and interactive software submissions. Authors are encouraged to submit their content in the most appropriate medium to best convey their findings to the audience of Clinical Science of Nutrition.

The journal covers all aspects of nutrition and dietetics including prevalence of malnutrition and its effects on clinical results; nutritional support and delivery methods and their advantages and disadvantages; nutritional support products and their side effects; immune system and nutritional support; ERAS protocol and nutritional support; home parenteral and enteral nutrition; nutrition support teams and their necessity, challenges and potential solutions of nutritional support.

The journal's target audience includes academicians, practitioners, specialists and students interested in nutrition and dietetics.

The editorial and publication processes of the journal are shaped in accordance with the guidelines of the International Committee of Medical Journal Editors (ICMJE), World Association of Medical Editors (WAME),Council of Science Editors (CSE), Committee on Publication Ethics (COPE), European Association of Science Editors (EASE), and National Information Standards Organization (NISO). The journal is in conformity with the Principles of Transparency and Best Practice in Scholarly Publishing (doaj.org/bestpractice).

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2. Drafting the work or revising it critically for important intellectual content; AND
3. Final approval of the version to be published; AND
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- Grant information and detailed information on the other sources of support,
- Name, address, telephone (including the mobile phone number) and fax numbers, and email address of the corresponding author,
- Acknowledgment of the individuals who contributed to the preparation of the manuscript but who do not fulfil the authorship criteria.

Abstract: An abstract should be submitted with all submissions except for Letters to the Editor. The abstract of Original Articles should be structured with subheadings (Objective, Methods, Results, and Conclusion). Please check Table 1 for word count specifications.

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Original Articles: This is the most important type of article since it provides new information based on original research. The main text of original articles should be structured with Introduction, Methods, Results, and Discussion subheadings. Please check Table 1 for the limitations for Original Articles.

Statistical analysis to support conclusions is usually necessary. Statistical analyses must be conducted in accordance with international statistical reporting standards (Altman DG, Gore SM, Gardner MJ, Pocock SJ. Statistical guidelines for contributors to medical journals. Br Med J 1983: 7; 1489-93). Information on statistical analyses should be provided with a separate subheading under the Materials and Methods section and the statistical software that was used during the process must be specified.

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Letters to the Editor: This type of manuscript discusses important parts, overlooked aspects, or lacking parts of a previously published article. Articles on subjects within the scope of the journal that might attract the readers' attention, particularly educative cases, may also be submitted in the form of a "Letter to the Editor." Readers can also present their comments on the published manuscripts in the form of a "Letter to the Editor." Abstract, Keywords, and Tables, Figures, Images, and other media should not be included. The text should be unstructured. The manuscript that is being commented on must be properly cited within this manuscript.

Tables

Tables should be included in the main document, presented after the reference list, and they should be numbered consecutively in the order they are referred to within the main text. A descriptive title must be placed above the tables. Abbreviations used in the tables should be defined below the tables by footnotes (even if they are defined within the main text). Tables should be created using the "insert table" command of the word processing software and they should be arranged clearly to provide easy reading. Data presented in the tables should not be a repetition of the data presented within the main text but should be supporting the main text.

Figures and Figure Legends

Figures, graphics, and photographs should be submitted as separate files (in TIFF or JPEG format) through the submission system. The files should not be embedded in a Word document or the main document. When there are figure subunits, the subunits should not be merged to form a single image. Each subunit should be submitted separately through the submission system. Images should not be labeled (a, b, c, etc.) to indicate figure subunits. Thick and thin arrows, arrowheads, stars, asterisks, and similar marks can be used on the images to support figure legends. Like the rest of the submission, the figures too should be blind. Any information within the images that may indicate an individual or institution should be blinded. The minimum resolution of each submitted figure should be 300 DPI. To prevent delays in the evaluation process, all submitted figures should be clear in resolution and large in size (minimum dimensions: 100 × 100 mm). Figure legends should be listed at the end of the main document.

All acronyms and abbreviations used in the manuscript should be defined at first use, both in the abstract and in the main text. The abbreviation should be provided in parentheses following the definition.

When a drug, product, hardware, or software program is mentioned within the main text, product information, including the name of the product, the producer of the product, and city and the country of the company (including the state if in USA), should be provided in parentheses in the following format: "Discovery St PET/CT scanner (General Electric, Milwaukee, WI, USA)"

All references, tables, and figures should be referred to within the main text, and they should be numbered consecutively in the order they are referred to within the main text.

Limitations, drawbacks, and the shortcomings of original articles should be mentioned in the Discussion section before the conclusion paragraph.

References

Both in-text citations and the references must be prepared according to the Vancouver style.

While citing publications, preference should be given to the latest, most up-to-date publications. Authors should avoid using references that are older than ten years. The limit for the old reference usage is 15% in the journal. If an ahead-

Table 1. Limitations for each manuscript type

Type of manuscript	Word limit	Abstract word limit	Reference limit	Table limit	Figure limit
Original Article	5000	300 (Structured)	50	6	7 or total of 15 images
Review Article	6000	300	60	6	10 or total of 20 images
Case Report	2500	250	20	No tables	10 or total of 20 images
Letter to the Editor	1000	No abstract	5	No tables	No media
Editorial	1000	No abstract	5	No tables	No media

of-print publication is cited, the DOI number should be provided. Authors are responsible for the accuracy of references. Journal titles should be abbreviated in accordance with ISO 4 standards. When there are six or fewer authors, all authors should be listed. If there are seven or more authors, the first six authors should be listed followed by "et al." In the main text of the manuscript, references should be cited using Arabic numbers in parentheses. The reference styles for different types of publications are presented in the following examples.

Journal Article: Rankovic A, Rancic N, Jovanovic M, Ivanović M, Gajović O, Lazić Z, et al. Impact of imaging diagnostics on the budget – Are we spending too much? Vojnosanit Pregl 2013; 70: 709-11.

Book Section: Suh KN, Keystone JS. Malaria and babesiosis. Gorbach SL, Barlett JG, Blacklow NR, editors. Infectious Diseases. Philadelphia: Lippincott Williams; 2004.p.2290-308.

Books with a Single Author: Sweetman SC. Martindale the Complete Drug Reference. 34th ed. London: Pharmaceutical Press; 2005.

Editor(s) as Author: Huizing EH, de Groot JAM, editors. Functional reconstructive nasal surgery. Stuttgart-New York: Thieme; 2003.

Conference Proceedings: Bengisson S. Sothemin BG. Enforcement of data protection, privacy and security in medical informatics. In: Lun KC, Degoulet P, Piemme TE, Rienhoff O, editors. MEDINFO 92. Proceedings of the 7th World Congress on Medical Informatics; 1992 Sept 6-10; Geneva, Switzerland. Amsterdam: North-Holland; 1992. pp.1561-5.

Scientific or Technical Report: Cusick M, Chew EY, Hoogwerf B, Agrón E, Wu L, Lindley A, et al. Early Treatment Diabetic Retinopathy Study Research Group. Risk factors for renal replacement therapy in the Early Treatment Diabetic Retinopathy Study (ETDRS), Early Treatment Diabetic Retinopathy Study Kidney Int: 2004. Report No: 26.

Thesis: Yılmaz B. Ankara Üniversitesindeki Öğrencilerin Beslenme Durumları, Fiziksel Aktiviteleri ve Beden Kitle İndeksleri Kan Lipidleri Arasındaki Ilişkiler. H.Ü. Sağlık Bilimleri Enstitüsü, Doktora Tezi. 2007.

Manuscripts Accepted for Publication, Not Published Yet: Slots J. The microflora of black stain on human primary teeth. Scand J Dent Res. 1974.

Epub Ahead of Print Articles: Cai L, Yeh BM, Westphalen AC, Roberts JP, Wang ZJ. Adult living donor liver imaging. Diagn Interv Radiol. 2016 Feb 24. doi: 10.5152/dir.2016.15323. [Epub ahead of print].

Manuscripts Published in Electronic Format: Morse SS. Factors in the emergence of infectious diseases. Emerg Infect Dis (serial online) 1995 Jan-Mar (cited 1996 June 5): 1(1): (24 screens). Available from: URL: http:/ www.cdc.gov/ncidodlEID/cid.htm.

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Accepted manuscripts are copy-edited for grammar, punctuation, and format. Once the publication process of a manuscript is completed, it is published online on the journal's webpage as an ahead-of-print publication before it is included in its scheduled issue. A PDF proof of the accepted manuscript is sent to the corresponding author and their publication approval is requested within 2 days of their receipt of the proof.

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CONTENTS

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Nutrition treatment in pediatric burns patients

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ABSTRACT

Burn trauma causes obvious pathophysiological disorders that potentially affect the organ systems. For this reason, there are specific nutrient needs that require aggressive food intervention after burns. Nutritional support in burn patients differs from general intensive care patients. The nutritional support to be applied during the hospitalization process is changed and even changed according to the developments during the disease period. Therefore, a multidisciplinary approach must be provided for patient nutritional support planning. Nutritional support of pediatric burn patient is one of the important issues in the continuity of care. Early nutrition support is widely accepted as a standard of care. Estimating calorie needs remains a poorly defined science, and direct measurement is often impractical. Enteral nutrition, both safety concerns and care, are the preferred route for the benefits of intestinal mucosal integrity. Additional substances and pharmacological agents have been advocated by some people, but there is no consensus on their routine use. The clinician should still pay attention to reasonable judgment and the overall progress of the patient to maximize results. With the use of aggressive resuscitation, nutritional support, infection control, surgical treatment and early rehabilitation, as well as multidisciplinary collaboration, better psychological and physical outcomes can be achieved for burn children.

Keywords: Burn, enteral nutrition, nutrition, pediatric burn unit, parenteral nutrition

Tissue damage caused by factors, such as heat, electricity, chemicals, boiling water, and flame is termed "burns." The skin is not the only place that is affected by burns; it is a trauma that affects the whole body. The extent of tissue damage caused by the burn varies, depending on the size of the burned area and the continuity of the factor causing the burn.

Wounds resulting from burns are grouped as per the width and depth of the burn (1).

First-Degree Burns or Superficial Burns: They are painful and appear red. Vesicle and bulla formation is not observed. They heal spontaneously. Light sunburns without blistering are the best example of first-degree burns. First-degree burns are not considered significant and are not considered for the calculation of the burn surface area for fluid resuscitation. The use of these areas in fluid resuscitation is one of the most important reasons for excessive fluid delivery (2).

Second-Degree Burns: In cases where the thermal damage extends to the dermis, a second-degree burn develops. These burns are classified as superficial and deep second-degree burns. Superficial second-degree burns are painful bullae from which serous fluid leaks develop. The wound is usually pink or splotchy red and blanches on pressure application. If infection does not develop, these wounds heal within 10-20 d without or with very little scarring. Fluid resuscitation and monitoring may be needed for superficial second-degree burns that exceed 20% of the total body surface area (TBSA). Deep second-degree burns are drier and redder. They blanch slightly when pressure is applied and are less painful. They usually heal with a combination of wound contraction and re-epithelization; however, there is commonly a significant degree of scar contraction (2).

Third-Degree Burns: These burns are full-thickness burns. All layers of the skin are destroyed, and the skin looks charred, leathery, or waxy. Third-degree burns are usually dry accompanied by loss of sensation. Damage and injury can extend to the muscles and deeper tissues. They are normally caused by flame, immersion in very hot water, electric current, or chemical agents. Partially smaller full-thickness burns eventually heal spontaneously with contraction; however, this always results in severe deformity and function loss (2).

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The cause of burn can be thermal, electrical, chemical, or radiation. Each type of burn is associated with unique results that may require specific treatment. In wars, serious burns can occur on the battlefield owing to flame weapons, burst of explosives, and ignition of flammable materials. In addition, 3%–10% of the burns in children are caused by non-accidental causes. Child abuse may also be one of the causes, and attention should be paid to identify cases of child abuse because 30% of children who are exposed to repeated abuse die because of it (2).

Metabolic Changes in Burn

The onset of the burn syndrome or the ebb response (1st phase) is short and occurs 3–5 d after injury. This phase is characterized by general hypermetabolism and is manifested by a decrease in oxygen consumption, cardiac output, blood pressure, and body temperature. Fluid resuscitation is performed in this period in response to large fluid losses that occur in the early period after the burn. There is substantial increase in the catabolic hormone production as well as oxygen consumption after the 1st phase, with a peak between the 6th and 10th d after the burn. Thereafter, the metabolic rate begins to decrease slowly, and catabolism gradually regresses. These metabolic and hormonal sequelae have important effects from a nutritional perspective.

With the resuscitative repair of the circulating blood volume, the body progresses to prolonged hypermetabolism and increased nutrient turnover this stage is called the flow phase (2nd phase). This second phase is affected by increased levels of catecholamines, glucocorticoids, and glucagon in the circulation. Insulin levels are usually within the normal range in this period. However, with the increase in the glucagon/insulin ratio, other hormonal imbalances initiate gluconeogenesis, lipolysis, and protein degradation (3).

Preventing infection and reducing the wound size decreases the metabolic rate. Adequate pain and anxiety control also helps metabolism (4, 5). In Figure 1 below, the metabolic responses in burn trauma are depicted schematically (6).

CHO Metabolism

One of the metabolic changes that occur after thermal injury is carbohydrate metabolism disorder. Glycosuria and hyperglycemia often occur as an early response to burns. The

Main Points

- In cases where oral nutrition is insufficient, enteral nutrition should be tried first in order to ensure the integrity of the intestinal mucosa. In terms of refeeding syndrome and existing impaired CHO metabolism, parenteral nutrition should not be preferred unless they are in a difficult situation.
- Most tube-feeding methods can be started at full dose. The initial hourly infusion rate should be started at about half of the desired final volume and increased, considering tolerance to 5 mL/h for infants and play-age children and 10 mL/h for school-age children, and at 20 mL/h for adolescents until the final hourly target rate is reached.
- Commercial infant formulas are traditionally used in enteral protocols specific to infants aged <6 mon. Normal dilution of baby food is 20 kcal/30 mL. It is safe to increase the concentration gradually to 24 kcal/30 mL. The baby should be closely monitored while increasing the energy intake to 27–30 kcal/30 mL to fulfill the needs of the baby owing to the increased renal solute load.
- Tube -feeding products for children aged >6 mon are selected from adult formulas containing 30 kcal/mL energy. If the protein content of the selected product is low, the product should be supported with protein modules such that 25%–30% of the energy content is protein.
- Glucose intake at 5–7 mg/kg/min is safe and effective while minimizing PN complications.
- Glutamine: While the positive effects of addition of 0.25–0.50 g/kg/d were observed in some studies, some studies showed that the plasma glutamine level increased and wound healing accelerated after 0.3 g/kg/d enteral glutamine use for 10 d.
- Arginine: Its use is not recommended in the absence of any conclusive study.

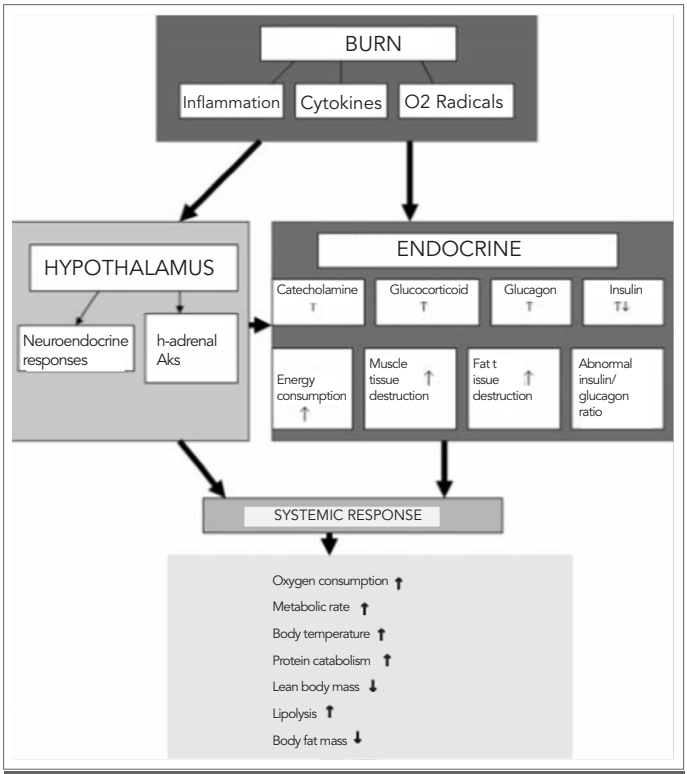

Figure 1. Stress response developing after burn injury (6)

susceptibility to glucose intolerance is related to the burn severity. Moreover, the increase in blood sugar is modulated by the injury phase. During the shock phase, the main cause of hyperglycemia is impaired tissue perfusion and decreased use of glucose by the peripheral tissues rather than low insulin levels (7, 8) Glucose intolerance usually continues during the flow phase. (7) Exogenous insulin administration is often needed to improve blood glucose levels and achieve maximum glucose utilization (9-12).

Gluconeogenesis significantly increases after burns. Stress-related diabetes can occur because this increased production results in more glucose than that the tissues require. The source of glucose production is doubled (13).

Protein Metabolism

The protein requirement of a pediatric burns patient increases because of increased tissue destruction, rapid repair, and losses during growth. Inability to meet the increasing protein requirement results in delayed wound healing and reduced infection resistance. Further, the patient adapts to insufficient protein intake by reducing cell growth and compromising his/her genetic potential (3).

In case a high-protein diet is given, wound healing is enhanced, infection rates decrease, excess protein catabolism in the muscle decreases, and survival improves (13). However, the protein intake needs to be closely monitored because protein overload or amino acid imbalance can cause azotemia, hyperammonemia, or acidosis. Excessive protein intake may exert adverse effects on immature and impaired kidney functions (increased solid load) (13, 14) therefore, protein-rich formulas should not be given to children aged <1 y (3).

However, as per a recent study, more than the recommended amount of protein is safe and beneficial in young children with extensive burns and infants who have not started walking. In pediatric burns patients aged <3 y, consumption of protein equivalent to 23% of energy shortens the length of hospital stay prominently (13, 14).

Fat Metabolism

During the second phase (flow phase), the burn-mediated increase in the catecholamine and glucagon levels accelerates fat metabolism and oxidation. Fats are crucial in the diet of pediatric burns patients because of their high-energy density, their role in myelization of nerve cells, their contribution to brain development, their role in flavoring of foods, and the transport of fat-soluble vitamins (3).

Burns patients may experience irregularities in the body's ability to use lipids. Excessive dietary burns may delay recovery in burns patients. Complications of excessive fat consumption include lipidemia, fatty liver, diarrhea, and reduced resistance to infections (3).

Determination and Evaluation of Nutritional Status

Regular evaluation of the nutritional status is an essential element of post-burn nutritional therapy. The most important goal of successful treatment is to fulfill the energy and protein requirements of the patient (from all sources). Further, thermal damage affects several organ systems; therefore, evaluation parameters used in other types of trauma may not be appropriate in burns patients (4).

The following nutritional tests are used to determine the patients' nutritional status: Screening Tool for the Assessment of Malnutrition in Pediatrics, Screening Tool for Risk on Nutritional Status and Growth (Strong-kids), Pediatric Yorkhill Malnutrition Score (PYMS)-UK, and Subjective Global Nutrition Assessment. In addition to these tests, growth curves are used for assessing the nutritional status (15).

Weight monitoring and other anthropometric measurements: Weight loss of 5% in the first month and 10% in the first 6 months indicated malnutrition in critically ill children. However, leaks in body fluids, improper amount of fluid replacement, dressings, mobilization impairments, diuresis, or edema because of capillary leakage are factors that may mislead weight monitoring and other anthropometric measurement methods in pediatric patients (15).

Prealbumin level is the most preferred parameter in burns trauma owing to the possibility of decreasing plasma albumin levels because of fluid leaks or excessive fluid replacement. Prealbumin is less affected by liver and kidney function changes and fluid replacement than other serum proteins, and protein is an important parameter that indicates malnutrition because of its short half-life (16). A prealbumin level of approximately 15 mg/dL indicates early malnutrition and the need for initiating nutritional support (17). In Table 1 below, we present the reference intervals of prealbumin and albumin levels (6).

Another method for evaluating malnutrition is the monitoring of the nitrogen balance. This can be done by exam-

Table 1. Prealbumin, and albumin protein status in pediatric patients (6)

Prealbumin (mg/dL)		Albumin (g/dL)	
Normal	Deficiency	Normal	Deficiency
14–43	<10	3.0–5.4	<2.5

Table 2. Anatomical and physiological underdevelopments in children of various ages (3)			
System	**Deficiency**	**Clinical Reflection**	**Maturity Age**
Temperature regulation	Labile system Surface area to body weight ratio increased considerably	Increased radiant and evaporative fluid loss Increased metabolic rate to maintain temperature	10–12 y
Skin	Thin skin	Heat penetrates faster and deeper burns develop	16–18 y
Gastrointestinal	Unmatured system Restricted surface area in the small intestine mucosa Decreased gastric volume capacity	Restricted digestion of some nutrients Tendency to antigen absorption High incidence of diarrhea	1–2 y
Renal	Glomerular underdevelopments Excretion of other sodium chlorides and other ions is insufficient as in water resorption in young kidneys.	Renal concentration ability is reduced. Therefore, more water is needed to eliminate the kidney solute load produced by protein and electrolyte metabolism.	1–2 y

Table 3. Common formulas used to calculate the calorie needs of burn patients (23)		
Pediatric Formulas	**kcal/day**	**Comments**
Galveston	0-1 year 2100 (body surface area) +1000 (body surface area x TBSA)	Focuses on maintaining body weight
	1-11 year 1800 (body surface area) +1300 (body surface area x TBSA)	
	12-18 year 1500 (body surface area) +1500 (body surface area x TBSA)	
Curreri junior	<1 year Recommended dietary allowance + 15 (TBSA)	Commonly overestimates caloric needs
	1-3 year Recommended dietary allowance + 25 (TBSA)	
	4-15 year Recommended dietary allowance + 40 (TBSA)	
TBSA: total body surface area		

ining the urea nitrogen level, considering the nitrogen lost from the wound site (15).

Protein turnover measurement with labeled phenylalanine, another parameter used for monitoring the nutritional status, gives precise results; however, it is not preferred owing to its high cost (6).

Planning of discharge should include the determination of the patient's oral intake, meeting and provision of nutrient requirements, and outpatient follow-up. The patient should be followed up for up to 12 mon after discharge (18).

Medical Nutrition Treatment

The purpose of providing nutritional support to pediatric burn patients is to facilitate wound healing, increase immunocompetence, restore organ function, and provide sufficient energy and nutrients to prevent the loss of lean tissue mass. Special care is taken when fluid restriction, organ failure, septicemia, mechanical ventilation, or any

other existing condition limits the body's ability to absorb vital nutrients.

Weight Monitoring

Weight gain is important for pediatric patients for continued growth and development. The child's weight should be monitored as per age- and sex-specific standard growth curves (19).

Owing to their dynamic growth and physical activities, children need more energy per unit weight than adults. Although the intake of insufficient calories is harmful, consumption of too many calories is also associated with an increased metabolic rate, hyperglycemia, liver dysfunction, and increased carbon dioxide production (19).

Small burns that cover <20% of the surface area and are not accompanied by superficial injury, psychological problems, respiratory distress, and pre-burn malnutrition are generally supported by oral diets containing high protein and high-energy snacks.

In pediatric patients with burns that cover >20% of the surface area, the patient may not meet their nutritional needs only with oral intake. The enteral route is preferred over intravenous (IV) feeding (20).

Energy Needs

The complex metabolic difficulties that occur in burn injuries have a direct relation with the subsequent morbidity and mortality. Pediatric burn injuries have a high mortality rate (21). Older children are more metabolically and physically similar to adults than younger children. Therefore, they respond faster to treatment. However, younger age groups need special nutritional support due to anatomical and physiological immaturity (22). In Table 2 below, we can see the anatomic and physiological development ages in children (3).

Burns patients are hypersensitive to diarrhea, dehydration, and malnutrition; this increases the degree of catabolism. In the acute phase after the burn, the energy requirement for activity decreases greatly. The large number of formulas available for calculating the energy requirement is an indication of the uncertainty in this approach. For energy calculation, information about body weight, age, and burn area is required. Although these 3 factors predominantly affect the metabolic rate, energy expenditure is also influenced by factors, such as operation, pain, anxiety, and sepsis. Excessive energy delivery should be avoided because it may increase the metabolic rate, hyperglycemia, liver disorders, and CHO consumption. In pediatric burn patients, indirect calorimetry is the ideal method for determining energy expenditure; however, it is not used in routine clinical practice owing to its high cost (3). In Table 3 and Table 4 below, we have schematically shown the formulas used to calculate the energy requirement in pediatric burn patients.

As a hypothetical example of energy requirement, it is calculated as "The daily calorie need of a 5-year-old male patient who weighs 20 kg and has 30% burns is calculated as 750 calories per day (30×20+[5×30])." (3)

Needs for Macronutrients (CHO, Protein, Fat)

Carbohydrate: The CHO ratio should be at least 60% of the total energy. Non-protein kilocalories and nitrogen balance should be 150: 1 (19).

Fats: Lipids should be used in the diet at a rate of 12%–15% of the total calories (25). To prevent omega-3 YA deficiency, the ratio of dietary energy from linoleic acid should be 2%–3%. This requirement can be easily achieved due to the high content of fat and linoleic acid in enteral support products and IV fat emulsions. The use of fat, especially linoleic acid, the source of immunosuppressive metabolites, is recommended to be used in moderation in children aged >6 mon with burns. It is recommended to provide a source of omega-3 YA (3).

Protein: As per recommendations, 20%–25% of the energy requirement of babies and children >6 mon of age who have burns that cover >30% of their TBSA should come from proteins. This value corresponds to a protein intake of 2.5–4.0 g/kg/d (6) and a non-protein energy/nitrogen ratio of 80:1. Assuming that sufficient energy is being consumed, another factor that affects the protein adequacy is the quality of dietary protein. As a result, intact (complete) whey protein is recommended (3). Protein supplements given in high amounts may increase the renal solute burden, especially in young children and the elderly. However, a recent study has shown that intake of more than the recommended amount of protein intake is safe and beneficial in young children and infants who have not started walking who have extensive burns. In burns patients aged <3 y, protein intake equivalent to 23% of the energy requirement significantly shortens the hospitalization stay (26).

Needs for Micronutrients (Vitamin and Mineral)

The vitamin and mineral requirements increase with the severity of the thermal burn and are associated with the following:

- Increased protein synthesis,
- Increased energy expenditure,
- Increased micronutrient losses.

Table 4. Formulas for calculating the approximate nutritional needs in burn cases (24)

Formulas for calculating approximate nutritional needs in burn cases. Electronic archive study, 2010

Author	Gender	Formula
Harris&Benedict BMR	Male Female	Estimated Energy Requirements: BMR x Activity factor x Injur factor 66 + (13.7 x weight in kg) + (5 x height in cm) – (6.8 x age) 665 + (9.6 x weight in kg) + (1.8 x height in cm) – (4.7 x age) Activity Factors Confined to bed: 1.2 Minimal ambulation: 1.3 Injury Factors: <20% TBSA = 1.5 20-40% TBSA = 1.6 >40% TBSA = 1.7
Curreri	For all patients	Estimated Energy Requirements: (25 kcal x w) + (40 x % TBSA)
Pennisi	Adults Calories Protein Children Calories Protein	Estimated Energy Requirements: (20 x w) + (70 x %TBSA) (1 g x w) + (3 g x %TBSA) (60 kcal x w) + (35 kcal x %TBSA) (3 g x w) + (1 g x %TBSA)
Toronto Formula	For all patients	Estimated Energy Requirements: [-4343 + (10.5 x %TBSA + (0.23 x kcals) + (0.84 x Harris Benedict) + (114 x T (0C)) – (4.5 x days post-burn)] x Activity Factors Activity factors non-ventilated: Confined to bed: 1.2 Minimal ambulation: 1.3 Moderate act, 1.4 Ventilated-Depedent: 1.2
Modified Schofield	Men Women	Estimated Energy Requirements: BMR x Injury factor 10-18 yrs = (0.074 x w) + 2.754 18-30 yrs = (0.063 x w) + 2.896 30-60 yrs = (0.048 x w) + 3.653 60 yrs = (0.049 x w) 2.459 10-18 yrs = (0.056 x w) + 2.898 18-30 yrs = (0.062 x w) + 2.036 30-60 yrs = (0.034 x w) + 3.358 60 yrs = (0.038 x w) 2.755 Injury Factors: <10% TBSA = 1.2 11-20% TBSA = 1.3 21-30% TBSA = 1.5 31-50% TBSA = 1.8 >50% TBSA = 2.0
ASPEN	For all patients	25 a 35 kcal/kg/day
Ireton-Jones Formula	For spontaneously breathing patients Ventilated-Dependent	Estimated Energy Requirements: 629 – (11 x yrs) + (25 x w) – (609 x O) 1784 – (11 x yrs) + (25 x w) + (244 x S) + (239 x t) + (804 x B)

Table 4. Formulas for calculating the approximate nutritional needs in burn cases (24) (Continued)		
WHO	For Children Male <3 years Male 3 to 10 years Female<3 years Female 3 to 10 years	 (60,9 x weight in kg) – 54 (22.7 x weight in kg) + 495 (61 x weight in kg) – 51 (22.5 x weight in kg) + 499
Mayes	For Children Male & Female <3 years Male & Female 3 to 10 years	Estimated Energy Requirements: 108 + (68 x weight in kg) + (3.9 x %TBSA) 818 + (37.4 x weight in kg) + (9.3 x %TBSA)
kcals: calorie intake in past 24 hours; Harris Benedict: basal requirements in calories using the Harris Benedict formula with no stress factors or activity factors; T: body temperature in degree Celsius; Days post burn: the number of days after the burn injury is sustained using the day itself as day zero; w: weight in kg; yrs: age in years; S: male = 1 Female = 0; t: trauma present: 1 / No trauma present: 0; O: presence of obesity> 30% above IBW: 1 / absent:0; B: burn present = 1 / No burn present = 0		

Table 5. Vitamin and mineral needs in burn patients (27)										
Age (years)	Vitamin A (IU)	Vitamin D (IU)	Vitamin E (IU)	Vitamin C (IU)	Vitamin K (mcg)	Folate (mcg)	Cu (mg)	Fe (mg)	Se (mcg)	Zn (mg)
0-13										
Nonburned	1300-2000	600	6-16	15-50	2-60	65-300	0.2-0.7	0.3-8	15-40	2-8
Burned	2500-5000			250-500		1000[a]	0.8-2.8		60-140	12.5-25
≥13										
Nonburned	200-3000	600	23	75-90	75-120	300-400	0.9	8-18	40-60	8-11
Burned	10,000			1000		1000[a]	4		300-500	25-40
[a]Administered three times weekly										

Individual vitamin and mineral requirements depend on the pre-burn condition of the patient.

Decreased gastrointestinal absorption, increased urine losses, altered distribution, and altered carrier protein concentrations after severe burns can cause several micronutrient deficiencies if not supported. In Table 5, we can see a schematic presentation of the vitamin and mineral requirements in pediatric burn patients (27).

- Disruptions in the electrolyte balance are common after severe thermal damage. It is necessary to monitor the serum sodium, potassium, chlorine, phosphorus, calcium, and magnesium levels several times a day. In the acute post-burn phase, electrolyte manipulation is mostly performed via the IV route.
- In addition to daily multivitamin intake and vitamin A, C, and D supplements, zinc intake is often necessary.
- Excessive bleeding is common after burns and burn surgery. In the postoperative period or during antibiotic therapy, IV vitamin K support at the therapeutic level may be beneficial.
- Oral, tube, and IV overfeeding often does not meet the increased micronutrient needs. Therefore, additional nutritional support should be provided to the patient.
- Thiamine, riboflavin, niacin, folate, biotin, vitamin K, magnesium, chromium, and manganese are cofactors in energy-dependent processes.
- Vitamin B12, folate, and zinc are cofactors in collagen synthesis.
- In addition to zinc, copper, and iron deficiency, the deficiency of many micronutrients, such as vitamin A, C, and E and pyridoxine may adversely affect the immune function.
- Iron supplementation may not be required because excessive iron intake increases the patient's susceptibility to infections (4).
- Owing to the presence of blistering wounds, losses and changes in metabolism, the needs for micronutrients increase in burn patients; thus, micronutrient intake is crucial to replace those that are lost. Daily multivitamin supplementation enriched with vitamin C and zinc is recommended (28).

- Zinc and copper supplementation may not be sufficient in children during hospitalization (29), and 30–220 mg/kg zinc sulfate (30), and 0.08 mg/kg copper sulfate supplementation is recommended (19).
- Vitamins and trace elements are frequently used in pediatric burns to support wound healing. Vitamin C takes contributes to collagen synthesis; vitamin A supports immunological functions and epithelization. A 1000-calorie enteral diet is recommended to contain 5000 IU of vitamin A (30).
- Research has shown that the blood levels of children remain below normal even if copper and zinc replacement is provided during hospitalization. In pediatric burns, supplements of 30–220 mg zinc sulfate and 0.08 mg/kg copper sulfate are recommended (29).
- Increasing reactive oxygen in the burn causes the antioxidant systems to decrease (31).
- The replacement of ascorbic acid, glutathione, carotenoids, and vitamins A and E decreases the irregularities secondary to burn, regulates microvascular circulation, and prevents the impairment of lipids by oxidizing (32).
- Children who have experienced major burns need to be given vitamin supplements in the form of multivitamins in addition to vitamin C, vitamin A, and zinc sulfate to ensure adequate wound healing. High doses of vitamin C (250–500 mg) and vitamin A (5000–10000 IU/d) were given to our burns patients during hospitalization (33).
- Pyridoxine requirement is closely associated to protein intake, diet, and protein metabolism (3).

Vitamin D Metabolism

Patients with burns have a high rate of demineralization because of several reasons, such as prolonged bed rest and long hospital stay, increase in glucocorticoids, and decrease in growth hormone; the high demineralization rate increased the risk of bone disease. The etiology of burn-related demineralization depends on many factors, some of which are prolonged bed rest, increased glucocorticoids, hypoalbuminemia, low cholesterol levels, and vitamin deficiencies (34, 35). The most effective method for treating this acute insufficiency is vitamin D3 supplementation. Furthermore, vitamin D deficiency affects bone growth and development in the long term, even during the recovery period, and may occur in pediatric burn patients (34-36).

In a study on a pediatric burns population, multivitamins containing 400 IU of vitamin D2 did not correct the vitamin D deficiency. Methods of dealing with calcium and vitamin D deficiency need to be investigated further (37).

Liquid Need

It is recommended to evaluate the tolerance and adequacy of BUN, plasma proteins, and nitrogen balance individually for assessing the fluid requirement. However, a high-protein diet is generally well tolerated by patients who have adequate fluid intake, do not have any renal or hepatic dysfunction, and have partially developed mediating metabolic pathways (3).

The change in capillary permeability causes fluid, electrolyte, and protein leakage from the vascular compartment around the burn wound into the interstitial space. Furthermore, the wound area loses its barrier ability for water evaporation. Owing to the high surface area per body weight, invisible fluid loss is critical in pediatric burns patients. Babies and young children are susceptible to insufficient fluid intake because compulsory urinary and invisible fluid losses are higher in children than in adults. Pediatric burns patients need more fluid per square meter of body surface area than adult burns patients (38). Adequate and rapid supply of fluid resuscitation preserves tissue perfusion and prevents organ system failure (37).

The most commonly used pediatric fluid replacement formula is the modified Parkland Formula for children (3). In Table 6 below, we have presented a schematic depiction of the nutritional rehabilitation stages in burn patients (39).

If the total burn width (TBW) is >10% of the TBW, intravenous fluid should be administered. The suggested formulas are recommendations and are only guidelines. They should be revised as per the clinical course of the patient. The following are recommended during the first 24 h:

- Galveston formula: 2000 mL/m^2 body surface+5000 mL/m^2 TBW, Lactated Ringer's solution. (Half of the calculated amount is given in the first 8 h, and the remaining half is administered in the subsequent 16 h).
- Patients with large burns or perineal burns who will be followed up closely should have a urinary catheter. The amount of urine to be removed per unit time should be 1–2 mL/kg/h) (The target urine density is 1015) (40).

More fluid than calculated is required in the presence of additional trauma, alcoholic patients, inhalation injury, delayed/insufficient fluid resuscitation, dehydration, and electrical burns (40).

Nutritional Support Systems (Enteral & Parenteral Nutrition)

Enteral feeding should be started as soon as possible in order to ensure the integrity of the intestinal mucosa and to increase the tolerance to tube feeding. The hypermet-

Table 6. Volume resuscitation in the first 24 hours (39)				
	Formula Name	**Solution**	**Volume in Firs 24 hr**	**Rate of Administration**
Adult	Pakland	Lactated Ringer's	4 mL/kg/%burn	Over 8 hr, over 16 hr
	Modified Brooke	Lactated Ringer's	2 mL/kg/%burn	over 8 hr, Over 16 hr
Children	Shriners-Cincinnati	Lactated Ringer's	4 mL/kg/%burn + 1500 mL/m^2 BSA	Over 8 hr, over 16 hr
	Shriners-Cincinnati (for young pediatric patients)	Lactated Ringer's + 50 mcQ $NaHCO_3$ Lactates Ringer's 5% Albumin in Lactated Ringer's	4 mL/kg/%burn + 1500 mL/m^2 BSA	1st 8 hr 2nd 8 hr 3rd 8 hr
	Galveston	Lactated Ringer's	5000 mL/m^2 burn + 2000 mL/m^2 BSA	over 8 hr, Over 16 hr

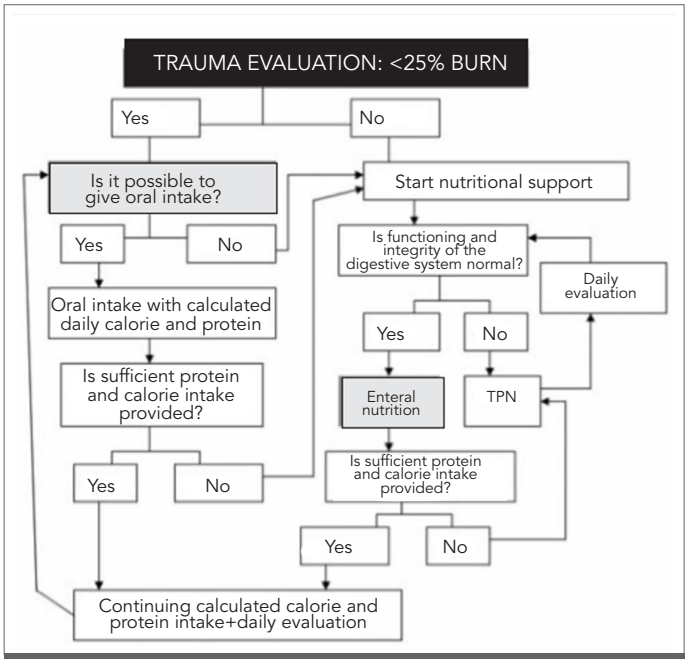

Figure 2. Algorithm of the Nutritional Support Methods in Burn Trauma (6)

abolic response is partially suppressed. Enteral nutrition passing the stomach and using the functional small intestine is preferred. The feeding tube placed in the third part of the duodenum is a safe tool because it provides enteral nutrition even in the case of patients with septic ileus. The protein content of infant formulas varies from 9% to 12% of the total energy requirement. This level is sometimes insufficient in patients with burns over a large surface area. A protein module may need to be added to the infant formulation with close monitoring. Soy formulas should not be used unless casein or whey protein intolerance has been confirmed in the patient. Fat is a vital nutrient during the maturation of the central nervous system; therefore, fat intake should not be reduced in infant burns patients (3).

Contraindicated situations for EN: Gastric nutrition cannot be used owing to reasons, such as the development of gastric ileus after burns that prevents the increase in the beginning of enteral nutrition and the delivery of full volume. In addition, NG increases the risk of aspiration because of various position changes such as feeding, changing clothes, physical therapy, and operation procedures. The patient feels minimal hunger during gastric feeding; therefore, oral intake is limited. In Table 7 below, we show the schematic presentation of the nutritional rehabilitation stages in burn patients (41).

External support given to patients to fulfill their energy, macronutrients, and micronutrients requirements by using their digestive systems is called enteral nutrition. The delivery of necessary nutrients via the intravenous route in patients whose digestive system cannot be used for nutrition delivery for various reasons is called parenteral nutrition. In Figure 2 below, we present the schematic algorithm of the nutritional support methods used for burn trauma patients (6).

Enteral Nutrition: It provides better regulation of inflammatory cytokine responses and may contribute less to immunosuppression following major surgery. Moreover, enteral feeding can decrease the intestinal permeability, protect the intestinal mucosal barrier, and exert a beneficial effect on reducing enterogenic infections (42). High calorie intake, mortality, sepsis, and pneumonia rates decreased significantly in patients. Although early EN is proven effective in burns patients, it is not associated with a decrease in the hypermetabolic response to burn wounds (14). Large amounts of protein intake with enteral support accelerate visceral protein synthesis and stimulate positive nitrogen balance and host defense factors. Early EN decreases the increasing energy deficit and stimulates insulin release while maintaining the lean

Table 7. Staged nutritional rehabilitation of severely malnourished burn patient (41)			
	Stage 1: Days 0-2 asses and initiate	**Stage 2: Days 3-7 achieve maintance**	**Stage 3: Days 7 and greater promote anabolism**
Nutritional assessment	Anthropometrics/diet history • Obtain admission weight and Height • Clarify usual weight • Diet history prior to admission Biochemical measures • Electrolytes, glucose • Protein labs: CRP, Prealbumin, UUN Clinical observation • Wound status • Physical signs of wasting or malnutrition	Anthropometrics/diet history • Daily or biweekly weights • Daily intake and output • Daily calorie intake Biochemical measures • Frequent monitoring (every 4-6 h) of electrolytes • Fluid balance • Protein labs Clinical observation Monitor signs of refeeding syndrome • Tachycardia • Fluid retention • Shortness of breath	Anthropometrics/diet history • Weekly weight • Calorie counts • Dual energy X-ray Absorptiometry Biochemical measures • Electrolytes • Protein labs • Vitamin D work-up • Physical appearance / signs of weight gain • Donor site healing • Progress with physical therapy
Determination of nutritional requirements	Energy needs • REE by indirect calorimetry with slight factor for activity (1.2) • Predicted equation (BMRx1.3-1.75) Protein needs • 3-3.5 g protein/kg	Energy needs • Repeat indirect calorimetry • Adjust predicted stress factor per clinical factors Protein needs • Adjust protein needs based on protein labs	Energy needs • REE by indirect calorimetry with slight factor for activity (1.2) • Predicted equation (BMRx1.3-1.75) Protein needs • Adjust to support anabolism vs wound healing
Nutritional support	Slow initiation of feeds Enteral • Initiate 5-10 mL/h – advance every 6 h Parenteral • Begin 30% of goal volume rate	Achieve full feeds Enteral • Provide at goal rate. If unable to advance, begin parenteral Parenteral • Provide at goal rate; continue trophic feeds	Promote anabolism • Enteral feedings to meet weight gain goal; or • Allow oral intake with supplementary tube feeding overnight
Adjunctive nutritional pharmacology		May need to add micronutrient supplement	Add oxandralone or other anabolic agent

body mass. Polymeric products should be used in burns patients when digestion and absorption capabilities are intact. Elemental or dipeptide formulas are not generally required. Most tube feedings can be started at a full dose. The initial hourly infusion rate should be started at about 50% of the desired final volume and increased as per patient tolerance to 5 mL/h for infants and play-age children, 10 mL/h for school-age children, and 20 mL/h for adolescents until the final hourly target rate is reached (3).

Tube feeding may be terminated gradually as oral intake improves and nutrient requirements decrease. Tube feeding can be discontinued during meals to stimulate appetite in the beginning. Tube feeding may be required only during the night when the patient can obtain 20%–25% of his/her energy requirement by mouth. Thus, tube feeding can be terminated when 75% or more of the patient's energy requirement is being met with oral intake.

Includes tube feeding programs for pediatric burn patients:
- Suitable for children <6 months,
- Suitable for patients ≥6 months.

Commercial infant formulas are conventionally used in enteral protocols specific to infants aged <6 mon. Normal dilution of baby food is 20 kcal/30 mL. It is safe to increase the concentration gradually to 24 kcal/30 mL. The baby should be closely monitored while increasing the energy intake to 27–30 kcal/30 mL in order to fulfill the needs of the baby owing to increased renal solute load.

Tube-feeding products for children aged >6 mon are selected from among adult formulas containing 30 kcal/mL energy. If the protein content of the selected product is low, the product should be supported with protein modules such that 25%–30% of the energy is supplied from proteins.

No commercially available tube-feeding formula in the market is specifically designed for burn patients. However, this group of patients has atypical nutritional needs that exceed the conventional recommendations for high energy and high protein. With the modular tube, it offers the only way to combine recipes with only fat, amino acid, vitamin and mineral requirements (3).

The use of modular tube feeding is associated with a lower infection rate and shorter hospital stay. However, complex recipes may not always be applicable; therefore, it is recommended to evaluate the existing enteral products that are designed to be high in protein, low in fat, low in linoleic acid, and low in omega-3 acid as practical alternatives.

Due to the severe sedation and analgesia required by burn patients, delayed gastric emptying is common. In severe cases, post-pyloric feeding can be used to prevent energy deficiency during a long surgical procedure. Careful observation is necessary for prevention of pulmonary aspiration. Slow administration of pyloric or gastric support is better tolerated than bolus administration. Gastric suction can be performed simultaneously with the nasogenal feeding process. With the increased use of antibiotics and the administration of hyperosmolar products, diarrhea is a common complication of enteral feeding. During diarrhea episodes, if possible, at least some nutrients should be given enterally via trophic nutrition. However, constipation is also common in health centers that provide strong doses of opioids for sedation (25). Nutritional therapy should be improvised as per the symptoms observed in the patient.

CHO: Inappropriate carbohydrate replacement; While it causes protein catabolism by being inadequate to meet the increased need in the burn patient, excessive amount of carbohydrate may cause glucose to be stored as fat, glycosuria, polyuria, hyperglycemia, dehiscation and respiratory problems.. The administration of >7 mg/kg/min carbohydrate prevents its oxidization, and it is stored as fat (25).

Glucose homeostasis is an important parameter in children. In young children, hepatic glycogen stores are depleted after 12–14 h of fasting; thereafter, amino acids, glycerol, and lactate are used to create new glucose molecules. Therefore, it is vital to provide adequate glucose substrates during the first 24 h of resuscitation. This can be accomplished either by adding dextrose to the maintenance fluid or by providing early enteral feeding (grade C) (39).

Parenteral Nutrition: Parenteral nutrition is indicated in cases of gastrointestinal trauma, Curling's ulcer, severe pancreatitis, superior mesenteric artery syndrome, gastrointestinal system obstructions, severe vomiting and abdominal distension, persistent diarrhea, and necrotic intestine conditions; it is also indicated as an addition to insufficient enteral support (6).

If the essential YA requirement is met with trophic enteral nutrition, additional IV fat may not be needed. Patients for whom 100% of the energy requirement is fulfilled via the PN route need additional fat via the IV route. Giving 500 mL, 10% lipid emulsion (or 250 mL, 20% lipid emulsion) 2 or 3 times a week is sufficient to meet the essential YA requirement (6).

The PN right should only be applied to patients who cannot meet the requirements through EN because PN is associated with a large number of metabolic and mechanical complications and a high incidence of sepsis. Strict compliance to infection control standards and regular tolerance monitoring are required. Every attempt should be made to reduce PN to increase the EN ratio and subsequently reduce the risk of immunosuppression (6).

Glucose intake at 5–7 mg/kg/min is safe and effective, with minimum PN complications. As a patient recovers, his/her insulin resistance decreases, leading to improved glucose metabolism. This allows for a higher supply of glucose that is necessary for rehabilitation and growth (43).

Despite the advantages of total parenteral nutrition, there may be serious complications. Hyperglycemia, hyperkalemia, metabolic acidosis, thrombophlebitis, and cholestasis are the main complications. However, the most common complication is infection. Burns patients already have a

Table 8. Suggested pediatric total parenteral nutrition compositions (19)				
Suggested Pediatric Total Parenteral Nutrition Compositions				
	Total Fluids (mL/kg/d)	**Total Calories (kcal/kg/d)**	**Amino Acids (g/kg/d)**	**Fat (g/kg/d)**
Infants	135–150	90–100	2–2.5	2–3
Children	60–80	70–100	1.5–2.0	1–2

Table 9. Commercially available pediatric enteral feeding (19)					
Feeding	**kcal/mL**	**PRO (g/mL)**	**Fat (g/mL)**	**CHO (g/mL)**	**Comments**
Human milk	0.67	0.011	0.04	0.68	Easily digestible, low in calcium/phosphorus, vitamin D
Standard					
Enfamil	0.67	0.015	0.038	0.069	Contains palm oil that will decrease calcium absorption
Smilac	0.67	0.015	0.036	0.072	Contains nucleotides that increase immunity
Isomil	0.67	0.018	0.037	0.068	For cow protein allergy, lactose free
Prosobee	0.67	0.020	0.036	0.068	For cow protein allergy, lactose free
Special					
Alimentum	0.67	0.019	0.038	0.069	For generalized malabsorption
EleCare	0.67	0.020	0.032	0.072	For protein malabsorption
NeoSure	0.67	0.019	0.041	0.077	For former preterm infants <1 y old
PM 60/40	0.67	0.015	0.037	0.069	For renal or cardiac impairment
Pregestimil	0.67	0.019	0.028	0.091	For generalized malabsorption
Portagen	0.67	0.022	0.030	0.074	For long-chain fatty acid malabsorption
Smilac 2	0.67	0.014	0.037	0.071	For patients 9-24 mo old
SSC 30	1.00	0.030	0.067	0.078	Not to be used for infants >3.6 kg
Pediatric					
Compleat	1.00	0.038	0.039	0.013	Blend of traditional foods (chicken, fruits, etc.)
Kindercal	1.06	0.030	0.044	0.135	For ages 1-10 y, available with fiber
Pediasure	1.00	0.030	0.038	0.131	Comes with fiber, for ages 1-13 y
Vivonex	1.25	0.030	0.030	0.163	Free amino acids, semi-elemental

CHO: carbonhydrate; PRO: protein; SSC: Similac Special Care

higher susceptibility to infections, and the use of intravenous routes without strict adherence to aseptic practices further increase the infection risk. One of the complications that can be seen during TPN is refeeding syndrome. Although its etiology remains unclear, it is known to occur with more than required feeding. Abnormalities in the cardiovascular system and fluid and electrolyte balance are observed in this syndrome.

The use of PN with EN until the target EN is reached is not recommended because it is related to a significantly high mortality rate (14). In Table 8 below, we have presented the recommended total parenteral nutrition compositions in pediatric burn patients (19).

In Table 9 below, we can see the macronutrient contents of pediatric enteral nutrition products in the market schematically (19).

In Table 10 below, we have schematically shown the micronutrient contents of some pediatric products that are commercially available in the market (44).

Table 10. Selected presentations of the vitamin and trace elements available in the united states (44)

Age, y	Enteral	Parenteral
0-12	Enfamil Poly-Vi Sol (1 mL) Vitamin A: 1500 IU Vitamin D: 400 IU Vitamin C: 35 mg Vitamin E: 5 IU Vitamin A: <2 y, 2500 IU 2-12 y, 5000 IU Vitamin C: 250 mg Vitamin E: 5 mg Folic acid: 1 mg[a] Zinc sulfate: 50-110 mg	MVI Pediatric (5-mL vial) Vitamin A: 2300 IU Vitamin D: 10 mcg Vitamin C: 80 mg Vitamin E: 7 mg Folate: 140 mcg Vitamin K1: 200 mcg Multitrace-4 Pediatric (3 ml vial) Each mL provides: Zinc: 1 mg Manganese: 25 mcg Copper: 0,1 mg Chromium: 1 mcg Selenium (sodium selenite-10 mcg/mL)
≥12	Rx Choice Thera-Plus (5 mL) Vitamin A: 5000 IU Vitamin D: 400 IU Vitamin C: 35 mg Folic acid: 1 mg[a] Vitamin a: 10,000 IU Vitamin E: 10 mg Zinc sulfate: 200 mg	Infuvite Adult (5-mL vial) Vitamin A: 3300 IU Vitamin D: 200 mcg Vitamin C: 200 mg Vitamin E: 10 mg Folate: 6000 mcg Vitamin K1: 150 mcg Multitrace-4 Pediatric (10 mL vial) Each mL provides: Zinc: 1 mg Manganese: 100 mcg Copper: 0.4 mg Chromium: 4 mcg Selenium (sodium selenite-10 mcg/mL)

IU: International Units; mcg: micrograms; mg: milligrams; mL: milliliters.
[a]Administered Monday, Wednesday, and Friday

Immunonutrition

Immunonutrition has recently been an important research subject in the area of nutrition support for burn patients. In vitro studies and animal experiments have shown that these nutrients reduce the cytokine and inflammatory responses that develop after burn injury, positively affect wound healing, prevent excessive fat and muscle loss, and reduce the infection risk (45). Some studies have shown that immunonutrition is associated with increased mortality risk in intensive care patients (46, 47). Arginine and glutamine are accepted as essential amino acids due to the increased needs of patients with burns, depending on the conditions, the loss of high amount of amino acids from the burn wound, and the decreased efficiency of their production and use. Although studies have reported the positive effects of arginine on wound healing and protein balance in terms of reduced infection risk and antibiotic use in burn patients (48, 49), one study has demonstrated an increased risk of mortality with the use of arginine (50). Although glutamine is also reported to reduce the mortality risk, particularly by reducing infections in the blood (51), research has shown that glutamine is not beneficial in such patients (48).

Glutamine: Glutamine, the use of which has been studied extensively in burns patients, is a situationally essential amino acid for this patient group. Glutamine decreases the infection rate, increases the visceral protein levels, accelerates wound healing (52), and consequently lowers the mortality and hospital stay duration. The enteral route has been used in most studies on glutamine use in burns patients (53). While positive effects of the addition of 0.25–0.50 g/kg/d have been observed in some studies (18), other trials have shown that the plasma glutamine level increased after 10 d of 0.3 g/kg/day enteral glutamine use and the wound healing accelerated. The use of glutamine in burns patients was also included with A-level evidence in the guideline published by ESPEN in 2006 (53). In studies on the cost associated with glutamine administration, although glutamine-supplemented enteral products are more expensive than standard products, they are associated with a significant reduction in the total hospital costs (54).

Arginine: The adverse effects of arginine completely overshadow the positive effects stated in the literature, and these effects were particularly observed in patients with sepsis and pneumonia; therefore, arginine is not recommended for use in burn patients at present. Data from laboratory and clinical studies have shown that other branched-chain amino acids are ineffective in protein synthesis, immune functions, and general clinical course in burn patients. Therefore, the use of branched-chain amino acids is not recommended in burns patients (18).

Finally, research has indicated that diarrhea, infections, muscle mass loss, hospital stay reduction, and faster wound heal-

ing are enhanced with the addition of fish oil in the diets of burned patients. However, a definite conclusion cannot be drawn owing to insufficient researches on the subject (6).

Conclusion

Burn trauma potentially causes significant pathophysiological disorders that affect organ systems. Thus, there are nutritional needs specific to burns that require aggressive food intervention. Early continuous enteral nutrition with high calorie, protein, carbohydrate, and low fat is recommended for burns patients. In addition to multivitamin supplements, pharmacological doses of vitamins A and C and zinc are also indicated. Moreover, the comparison of the ongoing follow-up and nutritional care plan is essential for achieving the goals. Recent studies have focused on arginine and glutamine supplementation and determination of optimal lipid support. Moreover, studies on pharmacological intervention in metabolism and acceleration of wound healing are ongoing. Various nutrients are found beneficial in immunological functions after burns and in sequelae repair. While researches trying to determine the final nutritional regime to be applied after thermal damage continue, the most accurate recommendations regarding nutrient needs are expected (14).

In burn patients, early enteral feeding is the preferred route owing to the safety, care, and advantages in terms of intestinal mucosal integrity (42). Better psychological and physical outcomes for burn children can be achieved with the use of multidisciplinary collaboration and aggressive resuscitation, medical nutritional therapy, infection control, surgical treatment, and early rehabilitation (27).

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Earlier consultation of patients to the nutrition support unit is associated with lowers length of hospital stay

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ABSTRACT

Objective: Owing to the increasing awareness regarding malnutrition, the number of nutrition support units has increased. However, given that a limited number of healthcare professionals work in the field of malnutrition area, strategies to increase the number of these healthcare professionals are warranted. To investigate the relationship between length of hospital stay (LOS) and the consultation time, defined as the duration between hospitalization and consultation to the nutrition support team.

Methods: Total 337 patients who consulted our team and were given enteral and/or parenteral nutritional support were enrolled. General characteristics, reasons for admission, consultation time, nutritional support method, and LOS were examined. The correlation between LOS and consultation time was investigated. Factors that were independently associated with the LOS were analyzed using a linear regression analysis model.

Results: The median patient age was 76 y (18–95 y); 53.7% of them were men, and 49.3% had at least one co-morbidity. The wards from which the patients consulted our team were intensive care (61.4%), non-surgical (32.6%), and surgical (5.9%) units. Further, 78% of the patients were at nutritional risk at the time of admission. The median LOS was 28 d (0–261 d). The median consultation time was 8 d (0–112 d). There was a significant, moderate, positive correlation between consultation time and LOS ($r=0.531$; $p<0.001$). Pressure ulcer, consultation time, nutritional risk, parenteral nutrition, and gastrostomy were independent factors associated with the LOS in the linear regression analysis model.

Conclusion: Early detection and management of malnutrition in hospitalized patients may offer benefit in terms of LOS. Our study showed that the earlier the patients are consulted by the nutrition support team, the lower is their LOS and vice versa.

Keywords: Length of hospital stay, malnutrition, nutrition support

Introduction

Malnutrition is defined as a condition accompanied by a change in body composition (decreased lean body mass) caused by nutritional deficiency and a decrease in the body cell mass, with a decline in the physical and mental functions and impaired clinical parameters (1).

The identification and treatment of malnutrition have significant effects on patient care and can reduce hospital costs (2, 3). Every hospitalized patient should be screened regularly for malnutrition (4). During hospitalization, a patient's nutritional status deteriorates owing to the catabolic effects of acute inflammation along with iatrogenic hunger and anorexia (5, 6). Negative consequences related to hospital-based malnutrition pose a problem for healthcare services (7). As nutritional care can improve the clinical outcomes and reduce healthcare costs, increased attention to nutrition during hospitalization is vital for good-quality care (8).

Malnutrition is associated with increased complications, such as pressure sores, nosocomial infections, and delayed healing; further, it raises the mortality rate, increases

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the LOS, and elevates the healthcare costs (9). Therefore, nutritional evaluation should be performed for all patients at risk for malnutrition, and the required next steps should be identified and implemented.

Although awareness about malnutrition is progressively rising in our country, the number of physicians and other healthcare professionals who are equipped to manage patients with malnutrition remains inadequate, especially outside the centers in big cities. Although nutrition support units (NSUs) are present in almost all tertiary state hospitals, the rate of patient consultation to these units remains low. The importance of NSUs and their success in the clinical management of patients are indisputable. It is crucial to share the necessary clinical observations so that these units become more widely available.

NSUs have been functional at our hospital for about 2.5 y. The number of patients receiving consultation at these units is constantly increasing. In this study, we aimed to examine the relationship between the duration from the time of hospitalization to the time of consultation to our NSU (consultation period) and the LOS for patients who were hospitalized and consulted to the NSU.

Materials and Method

We retrospectively reviewed the hospital data of patients who were hospitalized at University of Health Sciences Turkey, Konya Training and Research Hospital, were evaluated daily by the consulting NSU, and provided enteral and parenteral nutrition support.

The data of patients consulted to the NSU at our hospital were entered into the hospital automation system by dieticians working in the NSU on the day of the consultation. The following information was recorded:

- Age
- Sex
- Weight (kg), (The weight of every patient consulted at the NSU was measured using a weighing machine, if possible. Alternatively, the weight was recorded as per the statement of the patient or her/his relative or measurement was made by the help ofbeds those have weighing scale in intensive care units).
- Height (cm), (The height of every patient consulted at the NSU was measured, if possible. Alternatively, the height was recorded as per the statement of the patient or her/his relative. The height of inpatients, especially intensive care patients was measured in bed using a tape measure).
- Body mass index (kg/m^2)
- Underlying chronic diseases
- *Nutritional Risk Screening (NRS-2002)* scores filled by the clinic nurses on the day of hospitalization,
- The presence of pressure sore daily evaluated and recorded by clinic nurses on the day of hospitalization
- The reasons for hospitalization
- The dates of hospitalization
- The dates of consultation to the NSU
- Nutritional support suggestions of the NSU
- Nutritional support treatment methods applied to the patients (enteral, parenteral, gastrostomy status), whether feeding is interrupted (if yes, the reasons for interruption, such as interruption of enteral feeding for percutaneous endoscopic gastrostomy (PEG) insertion, PEG occlusion, PEG entry site infection, septic shock, interruption of feeding before invasive procedures, gastrointestinal system intolerance, and nutritional support treatment not desired by the patients or their relatives)
- Clinics and units those consulted of the patients to NSU
- Dates of discharge from the hospital.

Main Points

- The sooner the nutritional support team is consulted for patients with malnutrition or nutritional risk from their hospitalization, lower is the patient's hospital stay for the management of malnutrition.

Total 337 patients whose data were registered in the system were enrolled and analyzed retrospectively. The patients whose data were incomplete and who were not followed up daily at the NSU (it was observed that patients who were given oral nutrition solution support were not followed up daily) were not included. The data of patients who were receiving enteral or parenteral nutritional support were analyzed because they were followed up more closely and daily. As per the clinical and nutritional records of the 337 enrolled patients, all of them were identified as being at nutritional risk at the NSU.

"Nutritional risk screening-2002" (NRS-2002) scores were calculated by the clinic nurse to determine the nutritional status and were recorded in the hospital system. By using these scores, patients with a score of at least three were categorized as risky in terms of nutritional status (10). The NRS-2002 is one of the most commonly used screening tools to determine a patient's nutritional risk, especially in those who are hospitalized. It is a screening tool that has two stages and evaluates anthropometric data, food consumption information, and disease activities and ages of the patients; a score of 3 or more indicates that the patient is at risk of malnutrition (10, 11).

The duration between the dates of hospitalization and consultation to NSU was calculated and determined as the "*consultation period*". Feeding methods and treatment plans were retrospectively reviewed and recorded. The outcome of the hospitalization process (discharge, referral, hospitalization ongoing or death) was recorded with dates.

Approval for this study was obtained from the Necmettin Erbakan University Meram Faculty of Medicine Ethical Committee.

Statistical analyses

The data were analyzed using IBM Statistical Package for the Social Sciences version 22.0 (IBM SPSS Corp.; Armonk, NY, USA) software. Categorical variables are expressed as numbers and percentages; the normality of the numerical parameters was checked using the histogram and Kolmogorov-Smirnov tests. Normally distributed numerical parameters are presented as mean ± standard deviation values, while the non-normal numerical parameters are expressed as median (minimum - maximum) values. Student's t- test was used for comparing the means of the two groups; the Mann-Whitney U test was used for comparing the medians, and the Chi-square or Fisher's exact tests were used for comparing the categorical variables. The correlation between the LOS and other numerical parameters was analyzed using the Spearman's correlation test. Parameters related to the LOS were evaluated with a linear regression analysis model. Statistical significance was accepted at $p<0.05$.

Results

Total 53.7% of the 337 patients were men, and 49.3% had at least one chronic disease. The median patient age was 76 y (18–95 y). The most prevalent chronic diseases were neurological diseases (59.3%) and pulmonary diseases (42.4%). Patients from the intensive care units (61.4%), internal clinics (32.6%), and surgical clinics (5.9%) consulted to the NSU. The general characteristics of the patients are summarized in Table 1.

While 78% of the patients that were consulted were at nutritional risk, pressure sores developed in 54.3% of these patients. Enteral nutrition therapy was administered to 46.9% of the patients during their hospitalization. The most common reason for interruption of enteral nutrition was problems related to PEG (PEG opening, obstruction, and infection). Other reasons were gastrointestinal system intolerance, invasive procedures, septic shock, and refusal for nutritional therapy.

The consultation period and LOS were positively and significantly correlated ($r=0.531$; $p<0.001$) (Figure 1). Other parameters related to the LOS were body mass index, NRS-2002 score, neurological diseases, pressure sore, nutritional risk during hospitalization, parenteral nutrition, and nutrition with PEG (Table 2). LOS was associated with

Table 1. General characteristics, co-morbidities, and other clinical properties of the patients

Properties	
Age, years, median (min-max.)	76 (18-95)
BMI, kg/m^2, median (min-max.)	25.4 (14.7-46.3)
Gender, male, n (%)	181 (53.7)
Co-morbidities, n (%)	
Neurologic disorders	200 (59.3)
Pulmonary disorders	143 (42.4)
Hypertension	103 (30.6)
Cardiovascular disorders	85 (25.2)
Diabetes mellitus	72 (21.4)
Malignancies	41 (12.2)
NRS-2002* score, median (min-max.)	3 (0-7)
Length of hospital stay, days, median (min-max.)	28 (0-261)
Consultation-time, days, median (min-max.)	8 (0-112)
Wards the patients were staying, n (%)	
Intensive care unit	207 (61.4)
Medical wards	110 (32.6)
Surgery wards	20 (5.9)
Last status of the patients, n (%)	
Dead	174 (51.6)
Discharged	101 (30.0)
Still staying in the hospital	33 (9.8)
Referred to the another hospital	29 (8.6)
Nutritional support strategies, n (%)	
Nasogastric feeding	247 (73.3)
Total parenteral nutrition	166 (49.3)
Nutrition via percutaneous endoscopic gastrostomy	120 (35.6)
Oral nutrition support	81 (24.0)

* measured at the time of admission to the hospital

pressure sores, consultation period to NSU, nutritional risk during hospitalization, parenteral nutrition and PEG nutrition in the linear regression analysis model (Table 3).

Discussion

This retrospective study showed that there may be a relationship between the early consultation of patients to the nutritional support unit and a lower LOS. In contrast, nutritional risk, pressure sores, neurological diseases, parenteral nutrition, and gastrostomy during hospitalization were associated with a longer LOS.

Table 2. Factors significantly correlated and related to the length of hospital stay (LOS)

Parameters			
	rho		p
BMI	0.112		0.041
Consultation-time	0.531		<0.001
NRS-2002 score	0.243		<0.001
	Differences of LOS, days, median (min-max)		
	Absent	Present	
Neurologic disorders	23 (0-261)	33 (0-451)	0.004
Pressure ulcer	22 (2-261)	32 (0-451)	0.001
Nutritional risk*	17 (0-94)	32 (0-451)	<0.001
Total parenteral nutrition	25 (0-261)	31 (3-451)	0.015
Percutaneous endoscopic gastrostomy	22 (0-126)	46 (0-451)	<0.001

*Nutritional risk was defined as NRS-2002 score ≥3 points at the time of hospitalization

Malnutrition and nutritional risk increase the LOS (12). However, both the conditions negatively affect the morbidity, mortality, LOS, and cost effectiveness, independent of other variables (13). In our study, the LOS in those with nutritional risk during hospitalization was more (32 d vs. 17 d as presented in Table 3).

Pressure sores are associated with morbidity and mortality, and they prolong the LOS. In a prospective study on about 2000 patients, pressure ulcers increased the LOS by about 4.3 d (14). Although the presence of pressure sores in a patient was related to higher LOS, the possibility of developing pressure sores increases in patients who are hospitalized for a long time (15). In our study, pressure sores increased the LOS independently. However, the presence of a neurological disease significantly prolonged the LOS, and one of the many reasons for prolonged hos-

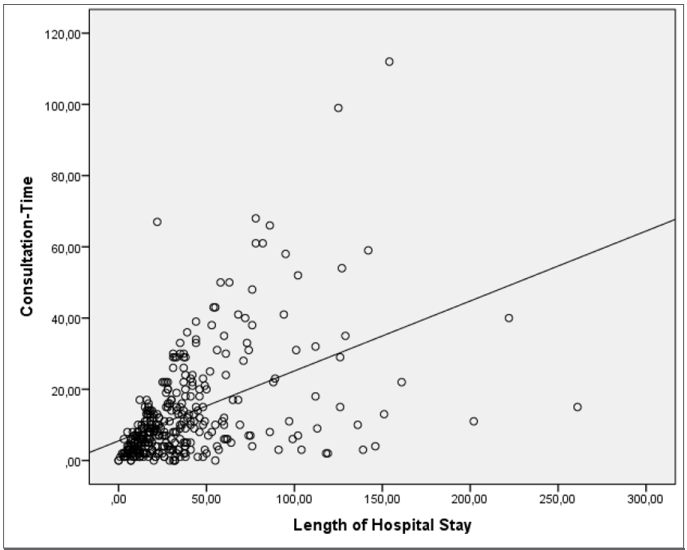

Figure 1. It was shown there was a positive, statistically significant correlation between LOS and consultation-time in this figure (rho=0.531 p<0.001)

Table 3. Linear regression analysis model showing independently associated factors for hospital length of stay

Parameters	Beta coefficient	t	95% CI	p
Pressure ulcer	8.427	2.177	0.813-16.041	0.030
Consultation-time	0.850	6.473	0.592-1.109	<0.001
Nutritional risk at the time of hospitalization	14.741	3.027	5.161-24.320	0.003
Total parenteral nutrition	8.229	2.129	0.627-15.832	0.034
Percutaneous endoscopic gastrostomy	34.470	8.011	26.005-42.934	<0.001

Linear regression analysis model was conducted by adding the parameters that were significantly related to LOS in univariate analysis. The parameters included in regression analysis were having neurologic and renal disorders, pressure ulcer, nutritional risk at the time of admission, total parenteral nutrition, percutaneous endoscopic gastrostomy, wards that the patients staying and consultation time. Stepwise model with backward regression was used. The last model (model 3) was presented in the table and this model was containing the parameters that having significant p values. The model had R square 0.344, ANOVA p value as <0.001.

pitalization in these patients may be the development of pressure sores secondary to immobility. Parenteral nutrition and higher LOS in patients treated with PEG may be associated with underlying severe disease and disease severity. In our study, it is seen that there is a patient profile with a high pressure sore during admission to the hospital. It may be possible to explain this situation as follows; Since NSU in our hospital has recently begun to accept patients actively, the patients consulted are mostly those who were hospitalized in the intensive care unit and who had neurological problems. Therefore, pressure sores are more commonly observed in this group with severe disease. In fact, if these patients could be contacted by the NSU in the early stages, these rates could be lowered with appropriate nutritional support.

Based on our results, early consultation to the NSU can shorten the LOS. The NSU is managed by a team that closely monitors the nutritional status of patients, determines the appropriate nutritional route and treatment plan, and thus helps the patients meet their daily calorie, protein, and micronutrient needs. Follow-up with early and effective diagnosis and treatment contributes positively to morbidity, mortality, health costs, and LOS (16, 17). With increasing awareness about malnutrition, the number of NSUs in hospitals increases. However, the low number of healthcare professionals, especially those dealing with malnutrition, is the most important obstacle toward the establishment of NSUs.

Research has shown that NSU intervention with a proactive nutritional support strategy is among the parameters that lower the LOS and mortality (18). However, studies have shown that NSUs are important units that should be emphasized in terms of creating a more effective strategy for combating malnutrition, decreasing hospital complications, and reducing LOS and costs (19-22). The emphasis in these studies is the early detection of patients under nutritional risk and the fight against malnutrition. It is emphasized that earlier intervention for malnutrition ensures better the clinical results. Our results differ from previous findings in that if support is received from the unit dealing with nutrition, the LOS may be shortened. Although the causality relationship could not be fully demonstrated owing to the retrospective nature of the study, our most important result was that if this patient group were consulted 1 day late, the LOS would be increased by about 0.9 d. We believe that our study paves the way for a more detailed examination of this subject with prospective and randomized studies.

Our study has certain limitations. The most important limitations are that this was a single-center, retrospective study that did not employ a control group. In addition, the inability to access the nutritional status data of patients during discharge is another important limitation, which evaluates the relationship between the consultation period to NSU and the duration of hospitalization. However, we believe that our results are valuable owing to the lack of sufficient studies on this subject in the literature. Multi-center, prospective controlled studies are needed in the future for more robust data on this subject.

Thus, prolonged hospital stay because of malnutrition can be prevented with effective NSUs in hospitals. It is important to increase the awareness regarding NSU among all healthcare professionals and in all hospitals.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Necmettin Erbakan University (Date: 08.02.2019, Decision No: 2019/1690).

Informed Consent: Due to the retrospective design of the study, informed consent was not taken.

Peer-review: Externally peer-reviewed.

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Determination of the malnutrition risk in overweight and obese patients with cardiovascular disease

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ABSTRACT

Objective: This study was performed to determine the risk of malnutrition in overweight and obese individuals with cardiovascular disease.

Methods: We enrolled 238 patients who were undergoing treatment at the hospital. The demographic characteristics and health status of the patients were recorded, and their anthropometric parameters were measured. The Nutritional Risk Screening-2002 and Mini Nutritional Assessment-Short Form were used to determine the patients' risk of malnutrition.

Results: As per Nutritional Risk Screening-2002, 39.95% of the subjects were at risk of malnutrition. According to the Mini Nutritional Assessment-Short Form evaluation, 42.4% of the patients were at risk of malnutrition, and 7.1% of them were malnourished. As per Nutritional Risk Screening-2002, 18.8% of the overweight patients and 21.1% of the obese patients were at risk, and as per the Mini Nutritional Assessment-Short Form, 20.6% of the overweight patients and 21.8% of the obese patients ($p > 0.05$) were at risk of malnutrition. As per the Mini Nutritional Assessment-Short Form, 2.5% of the overweight patients and 4.6% of the obese patients had malnutrition ($p > 0.05$). There was a significant and poor consistence between the two screening tools (kappa = 0.308).

Conclusion: About 40% of the overweight and obese patients were found to be at risk of malnutrition; this demonstrates the importance of nutrition screening in this patient group. We recommend that nutrition screening be performed by dieticians using appropriate screening tools for all patients undergoing treatment in the clinics.

Keywords: Malnutrition, nutrition, screening, obese

Introduction

The prevalence of overweight and obesity is increasing rapidly across the world, and excess weight is considered one of the most important global public health problems. Obesity, a preventable cause of death, is reported as an important risk factor for various diseases, especially cardiovascular diseases (1, 2). Moreover, obesity reportedly has a negative effect on the nutritional status of individuals, and overnutrition may be accompanied by malnutrition in these patients (2, 3). The European Society of Clinical Nutrition and Metabolism (ESPEN) classifies overweight and obesity as nutrition disorders; however, routine nutrition screening is not performed in clinics because these patients are not considered to be at risk of malnutrition (3, 4).

It is recommended that nutrition screening be performed using appropriate screening tools for all individuals who consult health institutions in order to determine their risk of malnutrition. Although many screening tools exist for determining the risk of nutrition, the ESPEN guidelines recommend the use of Nutrition Risk Screening-2002 (NRS-2002) for hospitalized patients, Malnutrition Universal Screening Tool (MUST) for adults, and the long or short form of the Mini Nutritional Assessment (MNA) for the elderly (3, 5).

Thus far, few studies have determined the risk of malnutrition in overweight and obese patients. The present study was designed to assess the risk of malnutrition in overweight and obese patients with cardiovascular disease by using two different screening tools. The risk of developing cardiovascular disease is high for obese individuals; thus, our study population comprised patients with cardiovascular disease. NRS-2002 and MNA-SF were selected as screening tools because the enrolled patients were hos-

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pitalized, and most of the subjects belonged to an older age group (>65 ages).

Methods

Study plan

This cross-sectional, descriptive study was performed at the Erciyes University Faculty of Medicine Yılmaz-Mehmet Öztaşkın Heart and Vascular Hospital from October 2018 to March 2019. The study population included patients aged ≥18 y with a body mass index (BMI) of ≥25 kg/m^2 who were undergoing treatment following a diagnosis of cardiovascular diseases. Patients who were in the terminal period and had difficulty in communicating because of dementia and other reasons were excluded. The minimum number of patients that were to be included in the study was determined as 235, with the expectation that malnutrition would be observed in 50% of the obese and overweight individuals at an accuracy rate of 5% and confidence interval of 95% (α=0.05, N=600) (6); the study was completed with 238 patients.

The work permit and ethics committee approval were obtained from the Erciyes University Faculty of Medicine Hospitals (21.11.2018 date and decision no. 2018/599) before initiating the study. Furthermore, all the study subjects were informed about the study, and their written and verbal consents were received.

Data collection

Data regarding the patients' demographic characteristics and health status were obtained using the questionnaire prepared by the researchers. The patients' body weight, height, waist circumference, and hip circumference were measured by the researchers using standard methods. Based on the weight and height measurement values, the BMI [weight (kg)/height (m)²] values were calculated. The World Health Organization (WHO) Adult Classification was used to classify the subjects as per their BMI, waist circumference, and waist-hip ratio. Thus, those with a BMI value of 30.0–34.9 kg/m^2 were classified as 1st degree obese, those with a value of 35.0–39.9 kg/m^2 were classified as 2nd degree obese, and those with a value of ≥40.0 kg/m^2 were classified as 3rd degree obese. Waist circumference can be used as a descriptor for the risk of developing obesity-related chronic diseases; women with a waist circumference value between 80 cm and 88 cm were considered to be at risk and those with values > 88 cm were considered to be at high risk; men with a waist circumference value of 94–102 cm were considered to be at risk, while those with values > 102 cm were considered to be at high risk. The waist/hip ratio was calculated using waist circumference and hip circumference measurements; in women, a ratio > 0.85 and in men, a ratio > 0.90 was considered to indicate high risk for chronic diseases (7).

The NRS-2002 and MNA-SF forms were used to screen the nutritional status of the patients. NRS-2002 form is a screening tool that consists of two parts and scores the deterioration in the nutritional status of patients and the severity of diseases. Information about the BMI values of patients, weight loss in the previous 3 mon, decrease in food intake in the previous week, and disease severity is collected in the first part of the form. The second part of the form is administered to patients who had answered yes to any of the questions in the first part. In the second part, the patients are evaluated in terms of nutritional deficiency and disease severity; if the patient is ≥70 y, the total score is determined by adding 1 point to the total score. Patients with a total score of ≥3 are considered to be at risk of malnutrition (8).

In the MNA-SF form, patients are asked 6 questions. Decrease in food intake, weight loss during the previous 3 mon, activity status, psychological stress, acute illness complaints, neuropsychological problems, and BMI values are examined. Based on the score obtained from the scale, 0–7 points indicate malnutrition, 8–11 points indicate risk of malnutrition, and 12–14 points indicate normal nutritional status (9).

Statistical analyses

The data were analyzed using IBM Statistical Package for Social Sciences (IBM SPSS Corp.; Armonk, NY, USA) Windows 22.0. Frequency and percentage values of

Main Points

- In our study, we evaluated the nutritional status of overweight and obese patients.
- As per NRS-2002, 18.8% of the overweight patients and 21.1% of the obese patients were at risk of malnutrition.
- As per the MNA-SF, 20.6% of overweight patients and 21.8% of obese patients were at risk of malnutrition.
- As per the MNA-SF form, 2.45% of the overweight patients and 4.6% of the obese patients had malnutrition.
- When the NRS-2002 form was considered as a reference, the sensitivity and selectivity of the MNA-SF form were 80.6% and 60.1%, respectively. Further, there was significant and poor consistence between the two scales (kappa=0.308).
- Nutrition screening is recommended for all hospitalized patients by expert dieticians using appropriate screening tools; thereafter, the required nutritional interventions should be implemented in patients who are identified as being at risk of malnutrition.

descriptive statistics were interpreted using mean and standard deviation values. The normality of the data was tested using the Shapiro-Wilk test. Independent sample t-test was used for comparing the averages values of the normal variables, and the Mann–Whitney U test was used to compare the averages of non-normal parameters. Chi-square test was used for the categorical data. Spearman's correlation test was used for examining the relationships between variables, and the compatibility between the scales was determined using Kohen's Kappa analysis; $p<0.05$ was considered to indicate statistical significance.

Results

The study was performed on 238 patients, including 117 men and 121 women. The average patient age was 65.02±12.18 y.

Table 1 includes the average anthropometric measurements of the patients and their distribution according as per sex. There was a significant difference in the average anthropometric measurements and anthropometric characteristics distribution of male and female patients ($p<0.05$).

The mean NRS-2002 score of the patients was 2.40±1.03, and 39.9% of those who were administered the second part of the form were at risk of malnutrition. As per the MNA-SF evaluation, 42.4% of the patients were at risk of malnutrition and 7.1% were malnourished (Table 2).

As per the NRS-2002, 18.8% of the overweight patients and 21.1% of the obese patients were at risk of malnutrition. As per the MNA-SF, 20.6% of the overweight patients and 21.8% of the obese patients were at risk ($p>0.05$). As per the MNA-SF form, 2.5% of the overweight patients

Table 1. The mean anthropometric measurements of the patients and the distribution as per the anthropometric characteristics

Anthropometric Measurements	Male	Female	Total	p
Body Weight (kg)	88.0±12.5	84.4±14.4	86.18±13.60	0.030*
Height (cm)	170.5±5.7	156.8±7.2	163.56±9.51	0.000*
BMI (kg/m^2)	30.2±4.3	34.2±5.9	32.30±5.57	0.000*
Waist Circumference (cm)	109.5±10.1	114.9±12.2	112.31±11.58	0.001*
Hip Circumference (cm)	105.0±13.1	115.2±16.5	110.24±15.81	0.000*
Waist-to-Hip Ratio	1.02±0.05	0.98±0.08	1.00±0.07	0.000*
BMI				
Overweight	70 (29.4v)	30 (12.6%)	100 (42.0%)	0.000*
1st degree obese	30 (12.6%)	42 (17.6%)	72 (30.3%)	
2nd degree obese	13 (5.5%)	31 (13.0%)	44 (18.5%)	
3rd degree obese	4 (1.7%)	18 (7.6%)	22 (9.2%)	
Waist Circumference	n = 99**	n = 102**	n = 201**	
Low risk	3 (1.5%)	0	3 (1.5%)	0.000*
Normal	16 (8.0%)	1 (0.5%)	17 (8.5%)	
High risk	80 (39.8%)	101 (50.2%)	181 (90.0%)	
Waist-to-Hip Ratio				
Low risk	2 (1.0%)	2 (1.0%)	4 (2.0%)	0.026*
Normal	24 (12.0%)	10 (5.0%)	34 (17.0%)	
High risk	73 (36.5%)	89 (44.5%)	162 (81.0%)	

*p < 0.05
** Waist and hip circumference measurements could not be performed on every patient.
BMI: Body Mass Index

Table 2. Comparison of NRS-2002 and MNA-SF scores according to gender					
NRS-2002 (n = 128*)	**Score**	**Male**	**Female**	**Total**	**p**
NRS-2002 (Pre-assessment)	Yes	65 (27.8%)	63 (26.5%)	128 (53.8%)	0.605
	No	52 (21.8%)	58 (24.4%)	110 (46.2%)	
Total Score		2.35±0.98	2.46±1.09	2.40±1.03	0.757
Risk of malnutrition	≥ 3	27 (21.1%)	24 (18.8%)	51 (39.9%)	0.920
No Risk	< 3	38 (29.6%)	39 (30.4%)	77 (60.1%)	
MNA-SF	**Score**	**Male**	**Female**	**Total**	**p**
Total Score		11.38±2.41	11.14±2.46	11.26±2.43	0.412
Normal nutritional status	12-14	61 (25.6%)	59 (24.8%)	120 (50.4%)	0.873
Risk of malnutrition	8-11	48 (20.2%)	53 (22.3%)	101 (42.4%)	
Malnutrition	0-7	8 (3.4%)	9 (3.8%)	17 (7.1%)	

* The patients who were not administered the second part of the NRS-2002 form were not evaluated for malnutrition risk.
NRS-2002: Nutritional Risk Screening-2002
MNA-SF: Mini Nutritional Assessment- Short Form

Table 3. Comparison of the results of the NRS-2002 and MNA-SF as per the BMI classification					
NRS-2002 (n = 128*)	**Score**	**Overweight**	**Obese**	**Total**	**p**
Pre-assessment	Yes	61 (25.6%)	67 (28.2%)	128 (53.8%)	0.066
	No	39 (16.4%)	71 (29.8%)	110 (46.2%)	
Risk of malnutrition	≥ 3	24 (18.8%)	27 (21.1%)	51 (39.9%)	0.396
No risk	< 3	37 (28.9%)	40 (31.2%)	77 (60.1%)	
MNA-SF	**Score**	**Overweight**	**Obese**	**Total**	**p**
Normal nutritional status	12-14	45 (18.9%)	75 (31.5%)	120 (50.4%)	0.215
Risk of malnutrition	8-11	49 (20.6%)	52 (21.8%)	101 (42.4%)	
Malnutrition	0-7	6 (2.5%)	11 (4.6%)	17 (7.1%)	

* The patients who were not administered the second part of the NRS-2002 form were not evaluated for malnutrition risk.
NRS-2002: Nutritional Risk Screening-2002
MNA-SF: Mini Nutritional Assessment- Short Form

and 4.6% of the obese patients had malnutrition (p>0.05) (Table 3).

In Table 4, the correlation between MNA-SF and NRS-2002 scores and anthropometric measurements of patients has been presented. A positive significant relationship was observed between the NRS-2002 score and waist circumference and waist/hip ratio in female patients, and waist/hip ratio in the total study population (p<0.05).

When the NRS-2002 was considered as a reference, the sensitivity and selectivity of the MNA-SF form were 86% and 60.1%, respectively. There was significant and poor consistence between the two scales (kappa=0.308) (Table 5).

Discussion

Overweight and obesity pose a high risk for various chronic diseases and may cause malnutrition via deterioration of nutritional status (2, 10). Malnutrition should also be examined in terms of overweight and obesity due to overnutrition (11). Therefore, it is important to perform nutritional status screening of overweight and obese hospitalized patients using appropriate screening tools (12).

Table 4. Correlation of the NRS-2002 and MNA-SF scores with anthropometric measurements

Anthropometric Measurements		Male		Female		Total	
		MNA-SF	NRS	MNA-SF	NRS	MNA-SF	NRS
Body Weight	r	0.047	−0.096	0.107	0.079	0.079	0.000
	p	0.614	0.442	0.245	0.533	0.222	0.998
Body Mass Index	r	0.071	−0.066	0.084	0.126	0.050	0.016
	p	0.449	0.596	0.358	0.317	0.445	0.856
Waist Circumference	r	0.000	0.041	0.052	0.299	0.042	0.179
	p	1.000	0.760	0.604	0.031*	0.554	0.061
Hip Circumference	r	0.096	−0.124	−0.081	0.189	0.021	0.026
	p	0.343	0.354	0.417	0.175	0.766	0.783
Waist-to-Hip Ratio	r	−0.113	0.210	0.176	0.345	0.035	0.206
	p	0.267	0.113	0.077	0.012*	0.619	0.031*

*p < 0.05
NRS-2002: Nutritional Risk Screening-2002
MNA-SF: Mini Nutritional Assessment- Short Form

Table 5. The consistence of MNA-SF with NRS-2002

	Sensitivity (%)	Selectivity (%)	Positive prediction value (%)	Negative prediction value (%)	Kappa
MNA-SF	86	60.1	34.6	94.2	0.308

NRS-2002: Nutritional Risk Screening-2002
MNA-SF: Mini Nutritional Assessment- Short Form

In a relevant study, the nutritional status of overweight and obese patients who were newly hospitalized was screened using the NRS-2002; 23.2% of the overweight patients and 24.8% of the obese patients were at risk of malnutrition (13). Another study that used the MNA for screening overweight and obese oncology patients showed that 50% of them were at risk of malnutrition and 12% were malnourished (4). In our study, we used two different screening tools were employed to screen the nutritional status of overweight and obese patients. As per the NRS-2002, 18.8% of overweight patients and 21.1% of obese patients were at risk of malnutrition. As per the MNA-SF, the risk of malnutrition was 20.6% in overweight patients and 21.8% in obese patients. Based on the MNA-SF form, 2.5% of the overweight patients and 4.6% of the obese patients were malnourished ($p > 0.05$) (Table 3). Our findings are consistent with previous reports (4, 13), and the indicated ratios show the importance of nutritional status screening in overweight and obese patients.

In the present study, we examined the correlation between the NRS-2002 and MNA-SF scores and the anthropometric measurements of the patients. The NRS-2002 score increased with an increase in the waist circumference and waist/hip ratio in female patients; the waist/hip ratio was positively related to the NRS-2002 score in all the patients ($p<0.05$). This result is attributed to the high-energy but low-quality diet consumed by the patients. To our knowledge, no previous study has assessed the correlation between these scores and anthropometric measurements.

In our study, NRS-2002, recommended for use in hospitalized patients, and MNA-SF forms, recommended for use in elderly by the ESPEN guidelines, were used for nutritional status screening of the patients (3, 5). The evaluation showed that 39.9% of the patients were at risk of malnutrition as per the NRS-2002 form; as per the MNA-SF form, 42.4% of the patients were at risk of malnutrition and 7.1% were malnourished. Mobility and the presence of neuropsychological problems, as assessed using the MNA-SF form could change with age; therefore, it was considered that the malnutrition ratio obtained using this scale was high-

er (average age 65.02±12.18 y). When the NRS-2002 form was considered as a reference, the sensitivity and selectivity of the MNA-SF form were 80.6% and 60.1%, respectively; further, there was significant and poor consistence between the two scales (kappa=0.308). In a study on elderly patients who had undergone surgery for hip fracture, both, NRS-2002 and MNA-SF form were sufficient for evaluating the parameters of malnutrition; however, the MNA-SF form was more effective for mortality prediction (14). In another study, it was emphasized that the MNA-SF form was a useful tool for assessing the nutritional status of elderly hospitalized patients (15). Raslan et al. (16) reported that NRS-2002 and MNA-SF forms obtained similar results in terms of determination of the nutritional status in elderly patients. Considering previous findings and our results, the MNA-SF form in addition to NRS-2002 appears useful for nutritional status screening of hospitalized elderly patients.

Our results highlight the importance of screening for the risk of malnutrition in overweight and obese patients. Thus, nutrition screening should be performed for all hospitalized patients by expert dieticians using appropriate screening tools, and the required nutritional interventions should be administered in patients who are identified as being at risk of malnutrition.

Study limitations

The study population only included overweight and obese patients with cardiovascular diseases. In future studies, the results of general population can be obtained by evaluating all overweight and obese patients.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Erciyes University (Date: 21.11.2018, Decision No: 2018/599).

Informed Consent: Written informed consent was obtained from patients who participated in this study.

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Malnutrition, rehabilitation, and family or caregiver awareness regarding interaction in a patient with cerebral palsy

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ABSTRACT

Cerebral palsy (CP) is a common motor disorder observed during childhood. Malnutrition and dysphagia are common in children with CP. Overdose of medication and seizures may cause aspiration via its influence on the conscious swallowing movement. Some children may experience aspiration because of gastro esophageal reflux. Management of patients with swallowing problems requires the coordinated efforts of healthcare professionals. Patients with CP require appropriate nutritional education and nutritional support. Focusing on improving the nutrition of children with CP in early life offers families and caregivers an opportunity to provide effective intervention that may improve patient outcomes. Family-centered biopsychosocial interventions, rather than technical and short-term rehabilitation interventions that focus only on the pediatric patient, are important for ensuring the rehabilitation of the patient and improving and maintaining his/her health. In the present case, attention was drawn to the influence of caregiver practices on the nutritional status and health of the patient and the importance of family or caregiver rehabilitation.

Keywords: Cerebral palsy, family education, malnutrition, patient rehabilitation

Introduction

Cerebral palsy (CP) is a motor disorder that occurs in the early stages of life; is characterized by abnormal muscle tone, posture, and movement; and is mostly observed during childhood (1). Sensation, perception, cognition, communication, behavioral disorders, epilepsy, and secondary musculoskeletal problems accompany the motor disorders caused by CP. This condition decreases movement coordination, balance, and walking ability, limiting the activities of the affected individual (2, 3).

Drooling, dysphagia, and feeding problems are common in CP patients. In these patients, dysphagia is often characterized by problems in both, voluntary oral movements and the reflexive pharyngeal phase of swallowing (4). Patient care becomes challenging in undernourished and malnourished patients (5). Moreover, there is an increased risk of dehydration and aspiration pneumonia, compromising the patient's quality of life (6). In addition to all these physiological problems, the psychological and physical health of the caregivers is very important for fulfilling the practical daily needs of the patients and ensuring effective rehabilitation (7). It is important to initiate nutritional rehabilitation at the right time for patients and individuals who care for the patient to improve the nutritional status of patients, improve their life quality, and prevent nutritional complications. In the presented case, aspiration pneumonia developed in the patient owing to the family's refusal to implement the recommended nutritional support treatment. The effect of caregivers' practices on the nutritional status and health of the patient was recognized, and the importance of family or caregiver rehabilitation was emphasized.

Case Presentation

We present the case of an 18-year-old male patient with CP who was admitted to the hospital emergency service with 39°C body temperature, chills, shivering, and fainting episodes that had persisted for 2 d. Dysuria was not questioned in the patient who did not have nausea, vomiting, cough, sputum, diarrhea, or constipation during admission to the emergency department. The general condition

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of the patient was moderate to poor; he was conscious, non-oriented, non-cooperative, had lower extremities without chewing reflex due to undeveloped mastication muscles, had bilateral atrophic and scoliosis, was evaluated with thorax computed tomography and antibiotherapy (Sefaperazone 2x1, Clarithromycin 2x500 mg IV) was started with the diagnosis of aspiration pneumonia by the chest diseases department. The clinical nutrition unit was consulted for evaluation of the nutritional status of the patient who was followed up for aspiration pneumonia; the patient could take oral intake and did not have a chewing reflex; nutritional support therapy was initiated. Detailed medical history of the patient was recorded by the nutrition unit; he had no family history of the disease. Both, the mother and father were healthy and at the age of 40 y. Parents are second-degree relatives. Three of the 4 children in the family were healthy, and 1 had CP. It was noted that the patient who was born with a birth weight of 3000 g via normal, spontaneous vaginal delivery did not cry immediately at birth and developed cyanosis and hypoxia; further, motor and mental development retardation was identified. It was reported that the patient did not have a sucking reflex after birth; the mother expressed her milk to the child and started supplementary food in the sixth month after birth.

One and a half years before the patient's admission to the hospital, the patient was diagnosed with aspiration pneumonia and was treated at Gazi University Hospital after which, he was recommended to be fed by percutaneous endoscopic gastrostomy. However, the family did not consent for the implementation of this feeding method because of their concern about the development of infection. They continued to feed the patient orally with liquid foods after his post-treatment discharge.

In the first evaluation of the patient by our unit, his body temperature was 37°C, and blood pressure was 129/82 mmHg. The gross motor function assessment showed level 5; he had no independent mobility and had to be carried. He had contractures that affected his height measurement. The Nutritional Risk Screening (NRS 2002) tool was used to assess his nutritional status; NRS 2002 score was 5. The following anthropometric measurements of the patient were recorded: height 115 cm, body weight 14 kg, body mass index 10.5 kg/m^2, upper middle arm circumference 13 cm, calf circumference 16 cm, stroke width 58 cm, knee length 31 cm, wrist circumference 10 cm, and head circumference 41 cm. It was determined that the height and body weight of the patient were below the 5th percentile as per his age. Moreover, the patient had a cachexic appearance and was at risk of malnutrition; thus, nutritional support needed to be started immediately.

His mother was interviewed to obtain detailed history with respect to his nutritional status. The patient was reported to be able to consume foods orally, and his mother gave him pudding-like liquid foods orally; however, the patient aspirated the food.

Due to the absence of chewing reflex, aspiration history, and aspiration recurrence risk, the patient was recommended to be fed via percutaneous endoscopic jejunostomy (PEJ); however, the patient's family did not consent to PEJ feeding owing to the risk of infection. The relatives of the patients were informed about the PEJ, and daily routine interviews were conducted to relieve their concerns about the method and give them detailed information about the complications that could arise from oral nutrition and the practices recommended for improving the patient's health. However, the patient's family members strongly refused the use of the PEJ method during the treatment and after discharge.

Energy, protein, and other nutrient requirements were determined at the time of the patient's discharge. The risks of oral feeding of the patient were communicated again to the family, and the use of a thickener powder product was recommended to reduce the aspiration risk. The clinical dietitian was contacted, and the patient's family was provided diet training after discharge.

The active ingredients of the drugs used by the patient during the hospitalization were as follows: valproic acid, clonazepam, clarithromycin, cefoperazone + sulbactam, carbamazepine, enoxaparin sodium, lansoprazole, paracetamol, and baclofen.

Discussion

A clear understanding of the mechanisms that cause CP and their effects play an important role in the development of treatment and prevention methods (3). The oral motor function, nutritional problems, and nutritional status of children with CP should be evaluated comprehensively, and rehabilitation and nutritional interventions should be initiated as early as possible (8). Accurate measurement of anthropometric parameters is crucial for accurate interpretation of the causes of malnutrition and the nutritional status in children with CP to enable the development of appropriate nutritional intervention strategies. Contractures generally develop in the muscles of children with CP, and ankle contractures are common. The range of joint range of motion is limited, and the muscles appear func-

tionally short. Ultrasonography is the most common tool that is used to describe the basic muscle structural changes, such as fiber length and tissue thickness. Therefore, anthropometric measurements recorded by measuring the knee length in patients may be misleading (9).

Children with CP have a compromised ability to absorb, chew, and swallow foods. The severity of swallowing problems may vary, depending on the extent of sensorimotor impairment, motor limitations, and cognitive and communication deficits. Dysphagia is common in CP patients with severe motor impairment and may cause nutrition disorders and malnutrition (10, 11). In a meta-analysis of 42 studies, the prevalence of drooling, swallowing, and feeding problems was 44.0%, 50.4%, and 53.5%, respectively (12).

As in our case, insistently feeding a patient with oral motor impairment and dysphagia who cannot protect the respiratory tract leads to pulmonary aspiration and disrupts the nutrition and hydration status (11). Aspiration could cause respiratory failure or death (13). In a study that followed up 3185 CP patients to evaluate survival and mortality, 436 (75.2%) patients died. The primary cause of death in 349 patients for whom death cause data were available was respiratory problems (56.8%). The main cause of respiratory problems was pneumonia (82%), and 45% of the pneumonias occurred due to aspiration (14).

Post-pylorus nasojejunal, percutaneous gastrojejunostomy, or PEJ feeding is recommended to reduce aspiration and should be placed when long-term home enteral nutrition is required (13). In one study, the height and body weight of CP patients who were fed using gastrostomy tubes were higher than those in the control group; another study showed higher mortality risk and hospital stay in children with CP who were fed via gastrostomy tubes than those who were fed orally (15, 16). Although feeding via gastrostomy or jejunostomy tube can facilitate feeding in children with CP, as in our case, most caregivers have difficulty in accepting this intervention emotionally and thus reject it (10). In our case, the family believes that the patient has no nutritional problem, and the patient who has a history of aspiration and signs of cachexia continue to be fed orally despite several warnings. Gangil et al. (17) reported similar findings and showed that the parents of CP patients had low awareness regarding the nutritional problems experienced by their children; the parents were under the impression that their malnourished children were actually healthy. The study also showed that families were pessimistic about the possibility of overcoming and improving the nutritional problems of the patients. Nutritional rehabilitation was given to the patients and their family members. After rehabilitation, nutritional problems, oral motor dysfunction, and nutritional status reduced (17).

Owing to the influence of caregiver practices on patient health, effective nutrition interventions for management of children with CP as well as rehabilitation of the patient, family, and/or caregivers are required. One study that evaluated the nutritional status and caregiver welfare of children with CP reported that the quality of life of caregivers affected the nutritional problems experienced by the children; further, pediatric CP patients who were cared for by caregivers with low quality of life experienced nutritional problems (18). Another trial showed that the family directly affected the health of the patient and influenced the patient's self-perception, social support, and stress management. Empowering the parents of CP patients with cognitive and behavioral strategies to help them manage their children's behavior has the potential to change the health outcomes of caregivers and patients (7).

Thus, there is no gold standard nutrition protocol for CP patients. The primary goal of nutritional support is to prevent the patient from entering the catabolic process, to improve the current metabolic state, and to protect and maintain the integrity of the gastrointestinal system. Swallowing difficulties, gastroesophageal reflux, and constipation symptoms in individuals with CP are associated with different food consumption habits. Therefore, nutritional intervention should be planned, considering the gastrointestinal symptoms and nutritional status (19). A nutrition team that supports the intervention of dieticians and swallowing therapists to evaluate the nutritional status and efficiency of CP patients to determine the optimal nutrition method, reduce the risk of malnutrition, enable early detection of malnutrition, and implement prevention and recovery strategies to improve the nutritional and functional status of these children, is indispensable in CP management (20).

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