Clinical Case Report

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Recovery of malnutrition in a patient with severe brain injury outcomes

A case report

Santina Caliri, BS, Adriana Andaloro, BS*, Francesco Corallo, PSY, Antonina Donato, BS, Silvia Marino, MD, Carmela Mantarro, BS, Aurelio Terranova, MD, Placido Bramanti, MD, Fabrizia Caminiti, MD, Carmela Rifici, MD

Abstract

Rationale: Severe brain injury often induces a state of malnutrition due to insufficient caloric and protein input. If left untreated, it will have a negative impact on rehabilitation. Nutritional therapy provides caloric and the nutritional support necessary to cover the daily needs and help contrast hospital infections. Our hypothesis is that integration of natural foods in the daily diet can enhance the recovery of the state of malnutrition and increase rehabilitation outcomes.

Patient concerns: We present the case of a young man with traumatic brain injury caused by a car accident. Who underwent tracheostomy and percutaneous endoscopic gastrostomy (PEG) procedures, had severe consciousness disorder, was severely malnourished and therefore underweight.

Diagnosis: He was severely underweight, malnourished, with a severe consciousness disorder that necessitated the tracheostomy and the PEG.

Interventions: Our approach included caloric implementation of artificial nutrition and the gradual introduction of semi-liquid natural foods administered through PEG.

Outcomes: The patient was followed for a year during which the metabolic/nutritional pattern and the blood tests improved, normal weight restored, and consciousness regained.

Conclusion: Nutritional intervention integrated with natural foods, has allowed a gradual increase in weight, a better recovery of the lean mass and the stabilization of the metabolic-nutritional framework.

Nutritional approach used has contributed to the reduction of recovery times, making the therapeutic path more effective.

Abbreviations: BIA = bioimpedance analyzer, BMI = body mass index, CRS = coma recovery scale, GCS = Glasgow coma scale, ICU = intensive care unit, LCF = level cognitive function, MNA = mini nutrition assessment, NET = total enteral nutrition, PEG = percutaneous endoscopic gastrostomy, TBI = traumatic brain injury.

Keywords: malnutrition, natural foods, traumatic brain injury

1. Introduction

Etiologically, malnutrition is a multifactorial clinical condition that alters the functional and structural asset of the organism.[1] This leads to an imbalance in morbidity, mortality, and impaired quality of life.[2] Malnutrition is associated with an increase in infectious complications, impaired health, poor wound healing, and prolonged hospitalization.[3,4]

After a serious accident, admission to an intensive care unit (ICU) often causes protein/energy deficits that continue even after discharge from the ward. This has repercussions on the rehabilitation process,[5] thus becoming the primary cause of hospital malnutrition. Nutritional therapy allows to cover the daily energy needs and provide support against metabolic imbalances and infections that occur as a consequence of traumatic brain injury (TBI).[6] Early nutritional intervention provides a greater margin for improvement[7] and helps to contrast hospital infections.[8] The first approach towards a malnourished patient is to identify the causes and adopt the nutritional counseling in order to establish the treatment which aims at developing diets that reflect the metabolic needs of the patient (rationing of meals, modification of the consistency, and use of high-density caloric foods).[9]

In unconscious TBI patients artificial nutrition is used due to the impossibility to deliver a normal diet. The standard diet therapy involves the use of formulas for enteral nutrition in combination with nutritional supplements (fortified foods) especially protein.[10] According to Savino, the special medical products on the market may not contain optimal quantities of

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The study protocol was approved by the Local Ethics Committee according to the Declaration Helsinki.

Informed written consent was obtained from the patient for publication of this case report.

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IRCCS Centro Neurolesi "Bonino-Pulejo," Messina, Italy.

** Correspondence: Adriana Andaloro, IRCCS Centro Neurolesi "Bonino-Pulejo," Messina, Italy (e-mail: ad.andaloro@gmail.com).*

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protein necessary to meet patient needs. It mainly refers to the quality (presence of branched, essential, and nonessential amino acids) and origin of raw materials. In fact, whey proteins are more effective than those of plant origin because they contain all the essential amino acids and are rich in branched-chain amino acid and amino acid sulfur.[11]

Our hypothesis is that the recovery of the state of malnutrition obtained by the integration of natural foods in the daily diet, strengthens and accelerates the results of rehabilitation.

This study aims to examine how the diet with natural foods has favored the recovery of the state of malnutrition in a severely malnourished patient with severe disorder of consciousness.

2. Case study

We describe the case of a young man (19 years old) who was admitted to the ICU for severe head trauma with multiple craniofacial fractures. Tracheostomy was carried out as well as percutaneous endoscopic gastrostomy (PEG). A few months later he was admitted to our center to undertake intensive neuro-rehabilitation. Total enteral nutrition (NET) of 1500 kcal/d at 50 mL/h was applied.

General evaluation highlighted, in addition to the neurological damage, secondary metabolic alterations such as hormonal changes, brain and systemic inflammation.

Upon admission, in addition to the objective examination, the state of consciousness of the patient was assessed through clinical, neurological and neuropsychological scales. Coma recovery scales (CRS-R 4/23), Glasgow coma scale (GCS 3/15), and level cognitive function (LCF 1/8) have been used to monitor wake-up. These resulted in a severe disorder of consciousness, the patient did not show any contact with people or the environment.

At the same time, drug therapy was adapted in order to modulate the awakening and stimulate the various functional systems: in fact, oxcarbazepine 300 mg 2 times daily (stabilizing antiepileptic) was introduced, baclofen was increased to 25 mg 3 times daily and 10 gtt 3 times daily maximum of diazepam was added. The latter drug was administered to control severe spastic syndrome. Levodopa/bensarazide 100 mg + 25 mg, ½ c 3 times daily was also prescribed.

At the entrance and for the following months, the patient had repeated febrile increases due mainly to infections with central venous catheter, *Staphylococcus hominis* and *Clostridium difficile* (Table 1). Infections were treated with antibiotic therapy and fever with paracetamol. During the first months of hospitalization, the patient also had frequent diarrhoeal episodes.

Previous inadequate nutritional support caused malnutrition which worsened muscle mass loss in the bedridden patient. Thus, an adequate nutritional plan was necessary in order to treat the complications of malnutrition, infections, and recover a normal nutritional state.

The initial evaluation (T0) of the nutritional status was based on the anthropometric analysis revealed that the patient was severely underweight (36 kg for 171 cm), had a body mass index (BMI) of 12.3 kg/m^2, a brachial circumference of 20 cm and a calf circumference of 22 cm. The mini nutritional assessment (MNA) was used as a clinical evaluation scale, gave an initial score of 2. The bioimpedance test (BIA [bioimpedance analyzer] STA/BIA Model by AKERN SRL, Montachiello (PISA), Italy) confirmed the patient's cachectic state, with a value of 358.1 mg 24 h/htm. Data were processed using the BodyGram Plus software.

Table 1

Infectious profile.

Infectious profile	Microbiological load
Klebsiella pneumoniae	High bacterial load
Hbs AB	Positive
Pseudomonas aeuroginosa	High bacterial load
Staphylococcus epidermidis	Low bacterial load
Staphylococcus hominis	High bacterial load
Candida tropicalis	High bacterial load
Providensia stuartii	Positive
Candida parapsilosis	High micotic load
Citomegalovirus IgG	Positive
Clostridium	Positive
Escherichia coli	Positive
Serratia marcescens	High bacterial load
Proteus mirabilis	Positive

The table lists all bacterial, viral and mycotic infections that have been treated during hospitalization in our clinical case.

The evaluation of the nutritional status was based on the clinical and the bio-humoral panel, including total proteins, albuminemia, lymphocyte count, procalcitonin, cholinesterase, and on the calculation of the energetic requirement.

Particularly, albuminemia values were well below the minimum (1.8 g/dL), so human albumin was administered in association with the pharmacological treatment and pasteurized egg whites administered by PEG: 500 mL weekly for 3 consecutive days or until normal range values were obtained.

After 3 months the NET is reformulated with implementation to 2250 kcal/d or 35 kcal/kg ideal body weight/d in order to obtain a BMI value of 22 kg/m^2. Furthermore, the nutritional protein formula was modified from 4 g/100 mL to 6 g/100 mL (90 g protein/d or 1.4 g/kg ideal body weight).

Despite this, no appreciable improvement was observed and diarrhoeal discharges continued. After 2 months of use it was therefore decided to replace the NET with homogenised natural foods (milk, semolina, homogenised meat, smoothed vegetables, olive oil, and fruit pulp) with integration of protein powder for a daily caloric quantity of about 2200 kcal/d and 95 g/die of protein, to be administered via PEG.

After 6 months from the entry (T1) there has been a reduction in diarrhoeal discharges and increases in fever, thus interrupting antibiotic therapy. This led to an increase in body weight, an increase in muscle mass, and a slight improvement in hematochemical values, and improvement was also demonstrated by BIA (Table 2).

This was followed also by the awakening with the recovery of the state of consciousness, with the appearance of specific nonconstant neurological responses to visual, auditory, and nociceptive stimuli (CRS-R 11/23, GCS 12/15, LCF 3/8). This awakening allowed speech therapy rehabilitation and weaning with a gradual introduction of foods of homogeneous consistency administered by os until a whole meal was administered and PEG was removed.

At the follow-up at 12 months (T2) the patient presented a clear recovery of the state of malnutrition with restoration of normal weight and normal muscle mass (Table 2). The final MNA test had a value of 24 and the BIA a value of 799.6 mg 24 h/htm (Fig. 1). The hematochemical values were also within the normal range (Table 3).

Table 2

Variations of anthropometric and nutritional values.

	T0	T1	T2	
Weight	36.5	43.5	64	kg
BMI	12.5	14.9	21.9	kg/m^2
Brachial circumference	20	22	28	cm
Calf circumference	22	25	31	cm
BMR	1092.2	1348.1	1514	kcal
FFM	31.5	38.8	48.8	kg
FM	5	5.1	15.2	kg
TBW	23	25,3	35,5	L
ECW	14.1	11.6	16.1	L
Nutrition	358.1	626	799.6	mg 24 h/htm
Hydration	73.1	65.8	72.8	%

BMI = body mass index, BMR = basal metabolic ratio, ECW = extracellular water, FFM = fat-free mass, FM = fat mass, TBW = total body water.

At the final neuropsychological evaluation, the patient was vigilant, partially cooperative, communicating through verbal and nonverbal channels. He paid attention and started a rehabilitation program aimed at the recovery of the upper cognitive functions (CRS-R 21/23, GCS 14/15, LCF 6/8).

3. Discussion

TBIs in young adults are the most common cause of long-term disability and death.[12] These bedridden patients, hospitalized for long periods of time, are exposed to a major number of infections. If inadequately treated these influence the nutritional and metabolic status of the patient. In our study, the patient's initial clinical picture was serious. It had a severe disorder of consciousness and a state of severe malnutrition.

It is essential for a critical patient in intensive care to receive nutritional support, especially enteral. The administration of enteral nutrition formulas within 24 hours of the injury has been shown to reduce the incidence of infections, especially pneumonia.[13]

The nutritional treatment carried out with enteral formulations only, has not brought significant improvements by prolonging the cachettic state of the patient. The latter has also developed several infections during the early stages of hospitalization, increasingly worsening the clinical profile.

The onset of sepsis influences the poor state of nutrition and cachexia. Mobilization of protein deposits from the skeletal muscle masses towards the processes of protein synthesis and turnover are induced by long periods of fasting.[14] This induces a

Figure 1. Nutritional graph: the arrow on the left column demonstrates the nutritional level of the patient before nutritional supplement and the arrow on the right column demonstrates the nutritional level after nutritional supplement with natural foods.

Table 3

Variations in serum blood levels.

Variations in serum blood levels	T0	T1	T2	Range
Total protein, g/dL	4.8	6	7,1	6.4–8.2
Albuminemia, g/dL	1.8	2,3	3,8	3.5–5.2
Cholinesterase, U/L	4807	9566	14842	7000–19000
Lymphocytes, U/L	1.50	1.90	3.50	0.8–4.50 $\times$ 10^3
Hemoglobin, g/dL	11.9	14.1	13.5	13–17

decrease in serum proteins and causes alterations in nutritional indices, weight loss, and loss of muscle mass.[15]

The nutritional support, in this phase, has been characterized by the introduction of natural foods of semi-liquid consistency to be administered through PEG (Table 4).

Civardi et al show how human milk has a powerful protective effect against infections and inflammations, contributing to immune maturation.[16] By analogy with Civardi's study we started the administration of natural foods with the aim of increasing the immune response.

In order to reduce the risk of complications related to the nature of the administered food, the American Society for Parenteral and Enteral Nutrition guidelines recommend to use a probe of adequate diameter, that proper hygiene be followed[17] and that the caregiver be trained in hygiene rules in both food preparation and storage, so as to reduce the risk of contamination.[18]

After verifying that the introduction of natural foods has not caused any gastrointestinal problems, it was decided to use them exclusively. The diet consisting of natural foods has guaranteed the satisfaction of the energy protein requirements.

The introduction of natural foods has allowed a better tolerance of enteral nutrition, reducing diarrhoeal episodes, while allowing a general clinical recovery, this concerned the reduction of hospital infections, increased basal metabolism and metabolically active mass associated with the restoration of optimal nutritional status and increased muscle mass.

Table 4

Daily dietary plan.

Dietary plan
Energy 2200 kcal – Carbs 53% – Proteins – 17% Fats 30%
Breakfast
250 mL semi-skimmed milk
50 g granulated cookie
Snack
150 g homogenized fruit (apple or pear)
Lunch
80 g semolina
160 g homogenised meat (chicken or turkey or beef)
150 g vegetable puree (carrots or peas or spinach)
30 g extra virgin olive oil
Snack
150 g homogenized fruit (apple or pear)
Dinner
80 g semolina
160 g homogenized fish (cod or plaice)
150 g vegetable puree (carrots or peas or spinach)
30 g extra virgin olive oil

The weight increase associated with the establishment of the nutritional metabolic structure has contributed to the improvement of the cognitive state thus allowing to implement collaboration during the rehabilitation process.

Recent studies showed the addition of bioactive nutrients including antioxidants, essential fatty acids, probiotics, and prebiotics co-audiano the recovery of an optimal state of health.[19,20]

Past literature supporting our work approached theme of natural foods in different ways. The first is a 2017 review by Martin et al showing the possibility of including natural foods only in nonimmunocompromised people in order to benefit from phytonutrients, fiber, and prebiotics. The same study shows how the increase in allergies and intolerances to nutritional formulas has led to the use of natural foods in domestic enteral nutrition therapy.[21]

The second study, from by Schmidt et al, compare 2 groups of neurological patients with diarrhea fed by enteral nutrition. The first group was fed with commercial products based on real foods (milk, meat, vegetables), while the second group only with enteral formulas. The results obtained after 1 month of observation showed that the use of natural foods is an effective prophylaxis to reduce the incidence of diarrhea.[22] Our study differs from Schimidt's in the use of daily food with modified consistency administered by probe. In accordance with Schmidt's study, the substitution of enteral nutrition formula with natural foods administered through PEG reduced the episodes of diarrhea until they were stopped.

Our work has been based on providing adequate amounts of nutrients in terms of daily kcal, especially protein supplements whenever a reduction in serum levels of protein and albuminemia was observed.

For this reason, it is essential that patients are followed during hospitalization in order to reduce problems related to nutritional deficiencies and consequently hospital readmission.

Our work, based on nutritional intervention integrated with natural foods, has allowed a gradual increase in weight, a better recovery of the lean mass and the stabilization of the metabolic-nutritional framework. Therefore, on the basis of our observations, we can state that the nutritional approach used has contributed to the reduction of recovery times, making the therapeutic path more effective.

Author contributions

Conceptualization: Santina Caliri, Adriana Andaloro.
Data curation: Antonina Donato, Carmela Mantarro.
Investigation: Francesco Corallo, Silvia Marino.
Methodology: Aurelio Terranova, Placido Bramanti, Fabrizia Caminiti.
Writing – original draft: Adriana Andaloro.
Writing – review & editing: Carmela Rifici.
Adriana Andaloro orcid: 0000-0001-9241-8575.

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