

Clinical Research



Nutritional Assessment in Vegetative and Minimally Conscious Patients

OPEN ACCESS

Received: Jul 6, 2017
Revised: Sep 8, 2017
Accepted: Sep 17, 2017

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Highlights

- The vegetative state (VS) and minimal conscious state (MCS) patients in rehabilitation center have normal range of body mass index (BMI) and biochemical parameters, including hemoglobin, lymphocyte, albumin and cholesterol.
- The duration from onset has a positive correlation with BMI, and a negative correlation with cholesterol level.
- This study suggests that regular and properly prescribed enteral feeding in VS and MCS patients would supply stable and appropriate nutrition.

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Nutritional Assessment in Vegetative and Minimally Conscious Patients

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Conflict of Interest

The author has no potential conflicts of interest to disclose.

ABSTRACT

The aim of this study is to investigate the nutritional status in vegetative state (VS) and minimally conscious state (MCS) patients, and to identify correlation between the duration from onset and indices indicating nutritional status. This study included a total of 37 VS and MCS patients. For nutrition assessment, the body mass index (BMI), biochemical parameters such as hemoglobin, total lymphocyte count, albumin and cholesterol levels were measured. The mean BMI was 21.31 ± 2.81 kg/m². Only 4 patients (10.81%) were classified as underweight, 24 patients (64.86%) had normal BMI, 6 patients (16.22%) were overweight, and 3 patients (8.11%) were obese. The partial correlation coefficients showed that duration from onset has a positive correlation with BMI, and a negative correlation with cholesterol level. This study suggests that regular and properly prescribed enteral feeding in VS and MCS patients would supply stable and appropriate nutrition. Further study is needed with additional nutrition assessments reflecting muscle mass.

Keywords: Body Mass Index; Malnutrition; Nutritional Status; Persistent Vegetative State

INTRODUCTION

Malnutrition is a common feature in hospitalized patients. Its prevalence ranges from 25% to 54% in hospital settings [1]. It occurs when nutritional intake fails to meet nutritional requirements [2]. Malnutrition is strongly related to adverse events such as pressure ulcer, aspiration pneumonia, urinary tract infection, and other morbidities, and it also increases the re-admission rates and financial burden of hospital care in terms of length of hospital-stay as well as mortality [3]. On the other hand, proper nutritional supplementation is associated with decreased incidence of pressure sores and other morbidities [4]. The European Society Parenteral and Enteral Nutrition (ESPEN) recommended that nutrition assessments should be carried out in all hospital settings for early detection of malnutrition [5].

Multiple factors have been identified to cause malnutrition in cross-sectional studies. The following factors are associated with increase the risk of malnutrition: functional impairment, cognitive impairment, swallowing problem and receipt of nutritional intervention such as nasogastric tube (NGT) or percutaneous endoscopic gastrostomy (PEG) feeding [3]. The vegetative state (VS) and minimally conscious state (MCS) patients

have several risk factors associated with malnutrition, and would be categorized into the high-risk group of malnutrition. Proper nutritional support is essential to VS and MCS patients for preventing complications. Moreover, as VS and MCS patients have difficulty in reporting their disease status and complications, objective nutrition assessment is more important in these patients.

Patients' history, anthropometric measurements and laboratory data are important parts for evaluating nutrition assessment [6]. Body mass index (BMI) as one of anthropometric measurements is a clinically available and objective variable with a fairly wide-spread use [7]. Biochemical parameters, such as hemoglobin, total lymphocyte count (TLC), albumin and cholesterol levels, are also objective measurements reflecting nutritional status [8]. The history and self-reported questionnaires to evaluate nutrition are not applicable to VS and MCS patients. In this regards, the objective evaluations including BMI and laboratory measurements could be more appropriate in these patients.

There are only few research studies of nutritional status in VS and MCS patients. The aims of this study are to investigate nutritional status in VS and MCS patients in rehabilitation hospital with the objective measurements, and to measure the correlation between the duration from onset and indices reflecting nutritional status in VS and MCS patients.

MATERIALS AND METHODS

Subjects

This study was conducted in chronic VS or MCS patients who had been admitted in this rehabilitation center for 14 months. Inclusion criteria of chronic VS or MCS were as followed: 1) history of severe brain injury (Glasgow coma scale < 8) more than 6 months ago, such as spontaneous hemorrhage, traumatic brain injury, ischemic stroke, and hypoxic brain damage; 2) fulfillment of the clinical diagnostic criteria of VS and MCS patients from onset; patients who had intermittent wakefulness indicated by eye-opening during sleep-wake cycles, patients who showed environment-contingent behavior, for example crying or smiling, but failed to produce any voluntary behavior [9]; and 3) receipt of nutritional support by enteral feeding (NGT or PEG) with standard formulas (containing 14%–18% protein) at regular time. The feeding amount was prescribed according to nutrition assessment, usually 30 kcal/kg/day, after initial nutrition screening [10]. The risk group of malnutrition was consulted to dietitians. The prescribed enteral feeding was supplied at regular schedules. The protocol of this study was approved by the Ethics committee of Ewha Womans University Medical Center (IRB No. 2016-08-001-003).

Assessment

The nutrition assessment was performed, using BMI and biochemical measurements. BMI was calculated as weight (kg) divided by height squared (m^2). Body weight was measured with a calibrated lift scale in the morning, with the subjects lightly dressed. Height was measured from heel to top of head.

Venous blood was sampled and analyzed in the morning. Biochemical parameters, including hemoglobin, TLC, albumin, and cholesterol levels were also recorded [7]. Characteristics such as age, gender, duration from the onset and presence of sore at admission were also collected.

Statistical analysis

Statistical analyses were performed with SPSS for Windows, SPSS® version 18.0 (SPSS Inc., Chicago, IL, USA).

The partial correlation coefficient was calculated between duration from onset and indices reflecting nutritional status such as BMI and biochemical analysis adjusted by age and gender [9]. Statistical significance was defined as p value less than 0.05.

RESULTS

Characteristics of the patients

A total of 37 chronic VS and MCS patients were included (males 23, females 14) in this study. The mean age was 58.14 ± 15.95 years, and the mean duration from onset was 29.59 months. Among the participants, 15 patients (40.54%) reported history of a spontaneous hemorrhage, 5 patients (13.51%) had a traumatic brain injury, 5 patients (13.51%) had an ischemic stroke, and 12 patients (32.43%) had a hypoxic brain damage. Only 3 patients (8.11%) had a sore with grade II or below at admission. All patients had received enteral nutrition; 16 patients (43.24%) had a NGT feeding, and 21 patients (56.76%) had placed a PEG for enteral nutrition (Table 1).

BMI and biochemical parameters

Table 2 shows the mean values of BMI, hemoglobin, TLC, albumin and cholesterol levels in chronic VS and MCS patients. The mean BMI was 21.31 ± 2.81 kg/m², which is included

Table 1. Demographic data of patients

Characteristic	Value	Percent (%)
Age (yr)	58.14 ± 15.95	-
Gender		
Male	23	62.16
Female	14	37.84
Diagnosis		
Spontaneous hemorrhage	15	40.54
Traumatic brain injury	5	13.51
Ischemic stroke	5	13.51
Hypoxic brain damage	12	32.43
Feeding type		
NGT	16	43.24
PEG	21	56.76
Sore		
Presence	3	8.11
Absence	34	91.89
Duration from onset (mon)	29.59 ± 20.17	-

Values are presented as mean \pm standard deviation or number.

NGT, nasogastric tube; PEG, percutaneous gastrostomy.

Table 2. BMI and biochemical data of patients

Characteristic	Value	Normal range
BMI (kg/m ²)	21.31 ± 2.81	18.5–22.9
Hemoglobin (g/dL)	13.21 ± 1.44	12.0–16.0
TLC (cells/mm ³)	$1,725.70 \pm 518.72$	1,500–4,000
Cholesterol (mg/dL)	159.08 ± 25.67	130–240
Albumin (g/dL)	3.78 ± 0.33	3.5–5.1

Values are presented as mean \pm standard deviation or number.

BMI, body mass index; TLC, total lymphocyte count.

within normal range. According to BMI value, only 4 patients (10.81%) were classified as underweight (lower than 18.5 kg/m²), 24 patients (64.86%) were considered as normal (18.5 to 22.9 kg/m²), 6 patients (16.22%) were overweight (23 to 24.9 kg/m²), and 3 patients (8.11%) were obese (higher than 25 kg/m²).

The mean values of biochemical parameters were within normal range of general population; hemoglobin 13.21 ± 1.44 g/dL, TLC 1,725.70 ± 518.72 cells/mm³, albumin 3.78 ± 0.33 g/dL, and cholesterol 159.08 ± 25.67 mg/dL on average. According to hemoglobin level, only 4 patients (10.81%) were considered as low level (lower than 12 g/dL). In TLC level, 12 patients (32.43%) had lower level than normal range (lower than 1,500 cells/mm³). Five patients (13.51%) in albumin level (lower than 3.5 g/dL) and 4 patients (10.81%) in cholesterol level (lower than 130 mg/dL) had lower values in each.

Correlation between duration from onset and nutritional status

The partial correlation coefficient was calculated between duration from onset and indices reflecting nutritional status controlled with age and gender. With age and gender adjusted, duration from onset had a positive correlation with BMI, and a negative correlation with cholesterol level (Table 3; Fig. 1). The partial correlation coefficient was 0.34 for duration from onset and BMI and -0.37 for duration from onset and cholesterol level in VS and MCS patients. On the other hand, the levels of hemoglobin, TLC and albumin did not have a significant correlation with duration from onset.

Table 3. Partial correlation coefficients of duration from onset and nutritional indices in MCS and VS patients with age and gender adjusted

Characteristic	BMI	Hemoglobin	TLC	Albumin	Cholesterol
Duration	0.34*	0.01	0.46	0.02	-0.37*

Values are presented as mean ± standard deviation.

MCS, minimally conscious state; VS, vegetative state; Duration, duration from onset; BMI, body mass index; TLC, total lymphocyte count.

*p < 0.05.

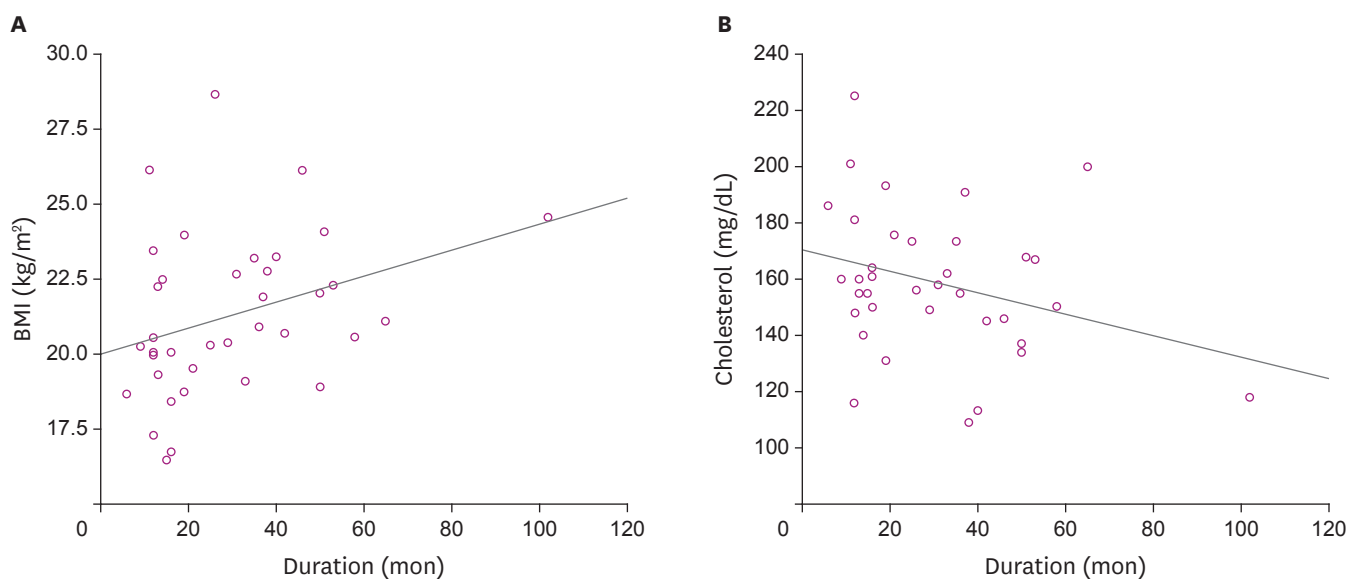


Fig. 1. Scatter plot of duration from onset and index reflecting nutritional status. (A) BMI, (B) cholesterol level. BMI, body mass index.

DISCUSSION

We measured the subjects' BMI and biochemical parameters indicating nutritional status in VS and MCS patients. We found that BMI values of 64.86% VS and MCS patients were considered as normal. Only 4 patients (10.81%) were considered as underweight, 6 patients (16.22%) were overweight, and 3 patients (8.11%) were obese according to BMI.

In biochemical parameters, the mean values of biochemical parameters were within normal range of general population. Four patients had lower levels in hemoglobin and cholesterol levels, 5 patients in albumin level, and 12 patients in TLC level.

In this study, the NGT or PEG feeding with appropriate prescription and regular schedule could be considered as tolerable way to supply proper nutrition and energy intake in chronic VS or MCS patients. This result is consistent with the previous study in Italy by Montalcini et al. [11]. They reported that mean values of BMI ($20 \pm 3 \text{ kg/m}^2$), hemoglobin ($12 \pm 2 \text{ g/dL}$), and albumin ($3.3 \pm 0.4 \text{ g/dL}$) in chronic VS and MCS patients in Italy were within normal range of general population.

The benefit of early and adequate nutrition support was well known [12]. Lee et al. [13] suggested that early enteral feeding is important predictor of outcome in acute severe brain injured patients. Enteral feeding in acute critically ill patients could provide the appropriate doses of macro- and micronutrients to meet the measured needs and modulate the inflammatory response [14]. However, there are few studies about the impact of enteral feeding in chronic severe brain injured patients. This study showed that long-term enteral feeding could be a tolerable nutritional support in chronic VS and MCS patients. Each patient was received enteral feeding, with determining individual nutritional needs. Monitoring the adequacy of nutrient provision is important for preventing malnutrition, as individual patients' nutritional need vary with current and past nutritional state. The VS and MCS patients may have a possible perception of suffering [11] but lack of expression, monitoring the adequacy of nutritional status is markedly needed in these patients.

Anthropometric measurements such as lean body mass, body fat and height, and the BMI are affected by the age and gender [15]. In addition, the biochemical parameters also affected by these factors. Aging process can cause decline of serum albumin level and increase of cholesterol level [7]. The increased level of cholesterol is greater in men than women [7]. The mean value of hemoglobin is different depending on the gender [16]. We used partial correlation coefficient adjusted by age and gender.

The partial correlation coefficient showed that BMI had a statistically significant positive correlation with duration from onset. The longer the duration of enteral feeding is, the higher weight patients get, but not obese. The weight gain could be associated with lack of active exercise and increase of body fat mass. Previous studies reported that BMI may underestimate adiposity [17], and it could be an imprecise indicator of fat-free mass depletion [18]. The VS and MCS patients might have severe loss of muscle mass [19]. The mid-arm circumference and calf circumference, known to be associated with the nutritional status in the general population [20,21], would be helpful analysis tools to consider muscle mass depletion and adiposity with BMI. Future study is needed to investigate more anthropometric parameters including mid-arm circumference and calf circumferences in VS and MCS patients.

There was also a significant negative correlation between duration from onset and cholesterol levels controlled with age and gender. Hypcholesterolemia has been also considered a reflection of low lipoprotein and thus of low visceral protein [7]. Decreased cholesterol levels has been associated with more complications such as nosocomial infection, in addition slightly increased in mortality [7,22]. In this study, these patients had normal range of serum cholesterol level with negative correlation between duration from onset. It would be explained that balanced enteral feeding after severe brain injury decreased cholesterol levels and back to normal level. Further study is needed to verify that hypcholesterolemia occurs or cholesterol level stays within normal range after long-term enteral feeding.

This study has some limitations. First, the sample size was small. There was difficulty for generalizability, as 37 patients with the rarity of this clinical condition were included and all patients were recruited in a rehabilitation center. Second, there was gender imbalance; the ratio of males to females was 1.64 to 1. Third, in this study, other anthropometric parameters, such as mid-arm circumference and calf circumference, were not measured. If the mid-arm circumference and calf circumference had been measured, it would have been more helpful in expecting muscle mass change with long-term enteral feeding.

CONCLUSION

In this study, we found that the mean values of BMI, hemoglobin, TLC, albumin, and cholesterol levels are within normal ranges in VS and MCS patients. In addition, the duration from onset has a positive correlation with BMI, and a negative correlation with cholesterol level. This result suggests that regular and properly prescribed enteral nutrition could supply stable and appropriate nutrition for VS and MCS patients.

REFERENCES

1. Malone A. Malnutrition: our time is now! JPEN J Parenter Enteral Nutr 2015;39:63-72.
[PUBMED](#) | [CROSSREF](#)
2. Shakersain B, Santoni G, Faxén-Irving G, Rizzuto D, Fratiglioni L, Xu W. Nutritional status and survival among old adults: an 11-year population-based longitudinal study. Eur J Clin Nutr 2016;70:320-325.
[PUBMED](#) | [CROSSREF](#)
3. Bell CL, Lee AS, Tamura BK. Malnutrition in the nursing home. Curr Opin Clin Nutr Metab Care 2015;18:17-23.
[PUBMED](#) | [CROSSREF](#)
4. Geeganage C, Beavan J, Ellender S, Bath PM. Interventions for dysphagia and nutritional support in acute and subacute stroke. Cochrane Database Syst Rev 2012;10:CD000323.
[PUBMED](#)
5. Lambert C, Nüssler A, Biesalski HK, Freude T, Bahrs C, Ochs G, et al. Age-dependent risk factors for malnutrition in traumatology and orthopedic patients. Nutrition 2017;37:60-67.
[PUBMED](#) | [CROSSREF](#)
6. Seiler WO. Clinical pictures of malnutrition in ill elderly subjects. Nutrition 2001;17:496-498.
[PUBMED](#) | [CROSSREF](#)
7. Omran ML, Morley JE. Assessment of protein energy malnutrition in older persons, part II: laboratory evaluation. Nutrition 2000;16:131-140.
[PUBMED](#) | [CROSSREF](#)
8. Bharadwaj S, Ginoya S, Tandon P, Gohel TD, Guirguis J, Vallabh H, et al. Malnutrition: laboratory markers vs nutritional assessment. Gastroenterol Rep (Oxf) 2016;4:272-280.
[PUBMED](#)

9. Giacino JT. The vegetative and minimally conscious states: consensus-based criteria for establishing diagnosis and prognosis. *NeuroRehabilitation* 2004;19:293-298.
[PUBMED](#)
10. Stroud M, Duncan H, Nightingale J British Society of Gastroenterology. Guidelines for enteral feeding in adult hospital patients. *Gut* 2003;52 Suppl 7:viii1-viii12.
[PUBMED](#) | [CROSSREF](#)
11. Montalcini T, Moraca M, Ferro Y, Romeo S, Serra S, Raso MG, et al. Nutritional parameters predicting pressure ulcers and short-term mortality in patients with minimal conscious state as a result of traumatic and non-traumatic acquired brain injury. *J Transl Med* 2015;13:305.
12. Klodell CT, Carroll M, Carrillo EH, Spain DA. Routine intragastric feeding following traumatic brain injury is safe and well tolerated. *Am J Surg* 2000;179:168-171.
[PUBMED](#) | [CROSSREF](#)
13. Lee JS, Jwa CS, Yi HJ, Chun HJ. Impact of early enteral nutrition on in-hospital mortality in patients with hypertensive intracerebral hemorrhage. *J Korean Neurosurg Soc* 2010;48:99-104.
[PUBMED](#) | [CROSSREF](#)
14. Seron-Arbeloa C, Zamora-Elson M, Labarta-Monzon L, Mallor-Bonet T. Enteral nutrition in critical care. *J Clin Med Res* 2013;5:1-11.
[PUBMED](#)
15. Omran ML, Morley JE. Assessment of protein energy malnutrition in older persons, part I: history, examination, body composition, and screening tools. *Nutrition* 2000;16:50-63.
[PUBMED](#) | [CROSSREF](#)
16. Murphy WG. The sex difference in haemoglobin levels in adults - mechanisms, causes, and consequences. *Blood Rev* 2014;28:41-47.
[PUBMED](#) | [CROSSREF](#)
17. Jones LM, Legge M, Goulding A. Healthy body mass index values often underestimate body fat in men with spinal cord injury. *Arch Phys Med Rehabil* 2003;84:1068-1071.
[PUBMED](#) | [CROSSREF](#)
18. Stratton RJ, Hackston A, Longmore D, Dixon R, Price S, Stroud M, et al. Malnutrition in hospital outpatients and inpatients: prevalence, concurrent validity and ease of use of the 'malnutrition universal screening tool' ('MUST') for adults. *Br J Nutr* 2004;92:799-808.
[PUBMED](#) | [CROSSREF](#)
19. Herttroijs D, Wijnen C, Leistra E, Visser M, van der Heijden E, Kruijenga H. Rehabilitation patients: undernourished and obese? *J Rehabil Med* 2012;44:696-701.
[PUBMED](#) | [CROSSREF](#)
20. Collins J, Porter J, Truby H, Huggins CE. How does nutritional state change during a subacute admission? Findings and implications for practice. *Eur J Clin Nutr* 2016;70:607-612.
[PUBMED](#) | [CROSSREF](#)
21. Tsai AC, Chang TL, Wang YC, Liao CY. Population-specific short-form mini nutritional assessment with body mass index or calf circumference can predict risk of malnutrition in community-living or institutionalized elderly people in taiwan. *J Am Diet Assoc* 2010;110:1328-1334.
[PUBMED](#) | [CROSSREF](#)
22. Vyroubal P, Chiarla C, Giovannini I, Hyspler R, Ticha A, Hrnčiarikova D, et al. Hypcholesterolemia in clinically serious conditions--review. *Biomed Pap Med Fac Univ Palacky Olomouc Czech Repub* 2008;152:181-189.
[PUBMED](#) | [CROSSREF](#)