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Risk factors for malnutrition among hospitalized gastroenterological patients

Faktori rizika od pothranjenosti hospitalizivanih gastroenteroloških bolesnika

Branka Roganović*†, Saša Perić*, Stanko Petrović*†, Ana Roganović Sarić‡, Andrija Roganović§

***Military Medical Academy, Clinic for Gastroenterology and Hepatology, Belgrade, Serbia; †University of Defence, Faculty of Medicine of the Military Medical Academy, Belgrade, Serbia; ‡Military Medical Center "Slavija", Belgrade, Serbia; §Clinical Center of Serbia, Clinic for Vascular Surgery, Belgrade, Serbia**

Abstract

Background/Aim. Risk factors for malnutrition of patients during hospitalization have not been precisely determined. The aim of the study was to determine these factors in hospitalized gastroenterological patients. **Methods**. Nutritional status (NS) of 650 gastroenterological patients was assessed at the hospital admission and at discharge by the six parameters: unintentional weight loss, lymphocyte count, serum albumin concentration, body mass index, triceps skinfold thickness, and mid-upper arm muscle circumference. The influence on NS at discharge was tested for ten factors: gender, age, affected organ, the nature, severity, and complications of the disease, the length of hospitalization, mobility worsening during hospitalization, Karnofsky score, and NS on admission. Primary and secondary risk factors were defined among the factors significantly influencing malnutrition. **Results**. Seven factors were found to be the independent predictors for malnutrition in hospitalized gastroenterological patients. NS at admission was considered as a primary risk factor (Forward: Wald multivariate logistic regression analysis, $p < 0.001$ for five applied assessment parameters). The other six factors, obtained in the evaluation according to 1-3 assessment parameters, were considered as secondary risk factors: severe disease activity, malignancy, the existence of complications, male gender, hospitalization > 14 days, and mobility worsening during the hospitalization (Forward: Wald multivariate logistic regression analysis, p from 0.001 to 0.027). **Conclusion**. There are seven risk factors for malnutrition among gastroenterological patients during hospitalization. Timely nutritional support in these patients can prevent the development of intrahospital malnutrition and its negative influence on the clinical outcome.

Key words:
gastrointestinal diseases; hospitalization; malnutrition; nutritional status; risk factors; treatment outcome.

Apstrakt

Uvod/Cilj. Faktori rizika od pothranjenosti bolesnika tokom hospitalizacije nisu precizno definisani. Cilj studije bio je da se determinišu ovi faktori kod hospitalizovanih gastroenteroloških bolesnika. **Metode.** Nutritivni status (NS) 650 gastroentroloških bolesnika bio je procenjivan na prijemu i na otpustu pomoću šest parametara procene: nenamerni gubitak težine, broj limfocita, koncentracija albumina u serumu, indeks telesne mase, debljina kožnog nabora tricepsa i obim sredine nadlaktice. Uticaj na NS na otpustu bio je testiran za deset faktora: pol, starost, oboleli organ, prirodu, težinu i komplikacije bolesti, dužinu hopsitalizacije, pogoršanje pokretnosti tokom hospitalizacije, Karnovski indeks i NS na prijemu. Među faktorima koji su tokom hospitalizacije značajno uticali na pothranjenost, definisani su faktori rizika. **Rezultati.** Za sedam faktora je dobijeno da su nezavisni prediktori pothranjenosti. NS na prijemu je bio primarni faktor rizika (*Forward: Wald* multivarijantna logistička regresiona analiza, $p < 0,001$ za pet primenjenih parametara procene). Ostali faktori, dobijeni procenom prema 1-3 parametra, označeni su kao sekundarni faktori rizika: teška aktivnost bolesti, malignitet, postojanje komplikacija, muški pol, hospitalizacija preko 14 dana i pogoršanje pokretnosti tokom hospitalizacije (*Forward: Wald* multivarijantna logistička regresiona analiza, p od 0,001 do 0,027). **Zaključak.** Postoji sedam faktora rizika za pothranjenost gastroenteroloških bolesnika za vreme hospitalizacije. Pravovremena i adekvatna nutritivna podrška kod ovih bolesnika može da spreči nastanak intrahospitalne pothranjenosti i njen negativan uticaj na klinički ishod.

Ključne reči:
gastrointestinalne bolesti; hospitalizacija; pothranjenost; nutritivni status; faktori rizika; lečenje, ishod.

Correspondence to: Branka Roganović, Military Medical Academy, Clinic for Gastroenterology and Hepatology, Crnotravska 17, 11 000 Belgrade, Serbia. E-mail: branka.roganovic1@gmail.com

Introduction

Malnutrition is a serious health problem that affects more than 20% of patients upon hospital admission [1–3]. It significantly contributes to the many adverse outcomes, such as cardiovascular and infective complications, increased morbidity and mortality, prolonged hospitalization, increased hospitalization costs, and increased readmission rates after discharge from the hospital [4–8]. Although these consequences of poor nutritional status (NS) are well known, malnutrition is often undiagnosed on hospital admission. Furthermore, some patients experience deterioration of their nutritional status and become malnourished during hospitalization, regardless of their initial nutritional status. However, this change often remains unrecognized by the medical staff [7, 9, 10]. If we keep in mind that malnutrition can potentially be prevented and treated, identification and definition of risk factors for malnutrition is of particular interest. Many studies investigated the risk factors for malnutrition among the patients on hospital admission [1, 2, 11, 12]. However, there is a lack of data regarding the prevalence and risk factors for malnutrition during hospitalization. Some authors highlight gender, age, malignant tumors, reduced food intake, prolonged therapeutic fasting as factors associated with malnutrition, but the significance of these factors has not been precisely determined [13, 14].

This study presents our experience with risk factors for malnutrition among hospitalized gastroenterological patients. As well, information is presented on how to recognize a risky patient who is a candidate for nutritional intervention.

Methods

Study design and patient population

A prospective study included 650 gastroenterological patients treated in our Clinic for fifteen months. The criteria on inclusion were: 18 years of age or above, Karnofsky score > 40 upon admission, and length of hospital stay for at least seven days. The study protocol was approved by the local Ethics Committee, and each patient gave written informed consent before entering the study.

Assessment of nutritional status

Nutritional status was evaluated at the hospital admission and within 24 hours prior to hospital discharge. We used six NS assessment parameters (NSAPs): unintentional weight loss (WL), lymphocyte count (LYM), serum albumin concentration (ALB), body mass index (BMI), triceps skin-fold thickness (TSF), and mid-upper arm muscle circumference (MAMC). In the patients with hypersplenism and ascites, NS was not evaluated according to LYM and weight loss, respectively.

BMI (kg/m^2) was calculated as weight (kg) divided by the square of the height (m^2). In the case of ascites, BMI was defined using the Powel-Tuck equation [15]. TSF and mid-upper arm circumference (MAC) were determined at the mid-point between the acromion and olecranon processes of the non-dominant side by calipers and tape. MAMC was estimated using the following formula: MAMC (cm) = MAC (cm) – 3.14 x TSF (cm).

According to NS at the admission and at discharge, patients were classified into two groups: non-malnourished (normally nourished, overweight and obese) and malnourished [16].

Factors influencing the NS during hospitalization

The influence on NS was tested for the following ten factors: gender, age, affected organ, the nature and severity of the disease, complications of the disease, the length of hospitalization, mobility worsening during the hospital stay, NS and Karnofsky score at the hospital admission. The Karnofsky score was used as a tool for assessing the functional capacity of the patient.

According to the affected organ, patients were divided into groups with the disease of: esophagus, stomach, and duodenum (ESD); liver and bile ducts (LBD); pancreas; intestine. The biological nature of the disease was defined as benign and malignant. Malignity was confirmed histopathologically and/or by a significant increase of tumor markers in the blood or ascites. The severity of the disease was defined according to the recommendations of the European Society for Clinical Nutrition and Metabolism (ESPEN) as severe, moderate, and mild [17]. Complications included infectious complications (pneumonia, urinary tract infections, sepsis) and organic failure (cardiac, respiratory, and renal failure). According to mobility, patients were classified as mobile (able to carry out usual activities), semi-mobile (need some help of hospital staff, particularly for activities that require leaving the hospital room), and stationary (bedridden).

Risk factors for malnutrition during hospitalization

Risk factors were determined among the factors that significantly influenced malnutrition during hospitalization. The factors obtained by estimation of NS according to the 4-6 NSAPs were qualified as the primary risk factors, while those obtained by estimation according to the 1-3 NSAPs were qualified as the secondary risk factors.

Statistical analysis

Statistical analysis was performed using SPSS 11.5 for Windows software (SPSS, Inc., Chicago, IL), and a *p*-value of < 0.05 was considered statistically significant. The Student's *t*-test for parametric data and the Mann-Whitney *U*-test for categorical data were performed to compare characteristics between two groups. Correlation between two variables was tested by binary logistic analysis. Prediction of malnutrition at discharge was determined using the Forward: Wald multivariate logistic regression analysis.

Results

Characteristics of the patients

During the study period, 989 consecutive patients were screened. We excluded 339 patients from the study: at screening, 67 patients did not qualify for participation in the study; in 186 patients, the length of hospital stay was shorter than seven days; 42 patients had a lethal outcome in the hospital; 44 patients left the study for their own reasons. The study was completed with 650 patients: 360 males and 290 females. Average values for age, Karnofsky score, and length of hospitalization were: 60.3 ± 16.1 years; 94.8 ± 8.8, and 13.5 ± 6.7 days, respectively. Malignant diseases were diagnosed in 236 (36.30%) patients. The most common were intestinal diseases (40.92%), followed by the LBD (34.46%), pancreatic (14.16%), and ESD diseases (10.46%).

Assessment of nutritional status

On hospital admission, depending on the NSAPs we used, malnutrition was diagnosed in 7.7–31.7% of patients, while 68.3–92.3% of patients were non-malnourished. At discharge, malnutrition was diagnosed in 8.0–38.2% of patients, while 61.8–92% were non-malnourished (Table 1).

Factors influencing the NS during hospitalization

Gender. Malnutrition was significantly more common in males if the NSAPs were MAMC (binary logistic analysis, $p < 0.001$) and ALB (binary logistic analysis, $p = 0.040$).

Age. Regardless of the NSAPs applied, the average age was similar for malnourished and non-malnourished patients at discharge (Student's *t*-test, $p > 0.05$).

Affected organ. Regardless of the NSAPs applied, malnutrition was more common in the patients with intestinal disease and LBD diseases than in the patients with disease of ESD and pancreas. These differences were statistically significant if the assessment parameter was ALB (Binary logistic analysis; $p = 0.035$).

The nature, severity, and complications of the disease. Regardless of the NSAPs applied, malnutrition was significantly more common in the patients with malignant disease (binary logistic analysis, p from < 0.001 to 0.028), with severe disease (binary logistic analysis, p from 0.001 to 0.006), and with complications of the disease (binary logistic analysis, p from < 0.001 to 0.013).

The length of hospitalization. The average length of hospitalization was higher in patients who were malnourished at discharge, but these differences were statistically significant if the assessment parameters were BMI (Student's *t*-test, $p = 0.005$), TSF (Student's *t*-test, $p = 0.020$), or ALB (Student's *t*-test, $p < 0.001$). Furthermore, malnutrition was significantly more common in patients with hospitalization longer than 14 days if the assessment parameters were WL (binary logistic analysis, $p = 0.022$), TSF (binary logistic analysis, $p = 0.030$), or ALB (binary logistic analysis, $p < 0.001$).

Mobility worsening during the hospital stay. Malnutrition at discharge was significantly more common in the patients with mobility worsening during the hospital stay than in the patients without mobility worsening. The differences were not statistically significant only if the assessment parameter was TSF (binary logistic analysis, $p > 0.05$).

Karnofsky score at admission. The average Karnofsky score on admission and at discharge was always significantly lower in patients who were malnourished at discharge (Mann-Whitney test, $p < 0.001$). Regardless of the NSAPs applied, malnutrition at discharge was significantly more common in the patients with admission Karnofsky score ≤ 80 than in the patients with admission Karnofsky score > 80 (binary logistic analysis, $p < 0.001$).

Nutritional status at admission. Malnutrition at discharge was more common in the patients who had been malnourished at the hospital admission than in patients who had been non-malnourished at admission. These differences were not statistically significant only if the assessment parameter was WL (binary logistic analysis, $p > 0.05$).

Risk factors for malnutrition during hospitalization

There were 9 factors that could influence NS during hospitalization (Table 2). Six of them influenced NS according to the evaluation of NS with 5 or all 6 parameters: nutritional status at admission, mobility worsening during the hospital stay, Karnofsky score at admission, the nature, severity, and complications of the disease. The remaining

Table 1

Nutritional status according to different NSAPs

NSAP	Patients, n	Admission, n (%)		Discharge, n (%)	
		non-malnourished	malnourished	non-malnourished	malnourished
WL	620[1]	496 (80.0)	124 (20.0)	486 (78.4)	134 (21.6)
BMI	650	600 (92.3)	50 (7.7)	598 (92.0)	52 (8.0)
TSF	650	578 (88.9)	72 (11.1)	568 (87.4)	82 (12.6)
MAMC	650	457 (70.3)	193 (29.7)	458 (70.5)	192 (29.5)
ALB	650	444 (68.3)	206 (31.7)	402 (61.8)	248 (38.2)
LYM	636[2]	474 (74.5)	162 (25.5)	468 (73.6)	168 (26.4)

NSAP – nutritional status assessment parameter; WL – weight loss; BMI – body mass index; TSF – triceps skinfold thickness; MAMC – mid-upper arm muscle circumference; ALB – serum albumin concentration; LYM – lymphocyte count.
[1]Thirty patients with ascites were not analyzed; [2]Fourteen patients with hypersplenism were not analyzed.

three factors influenced NS under certain conditions: gender, affected organ, and the length of hospitalization.

Seven factors were found (Forward: Wald multivariate logistic regression analysis) to be the independent predictors for malnutrition during hospitalization. Only NS at admission was obtained in the evaluation according to more than half of NSAPs. Therefore, it was considered a primary risk factor. The other six factors: severe disease activity, malignant disease, the existence of complications, male gender, the length of hospitalization > 14 days, and mobility worsening during the hospital stay, were obtained in the evaluation according to 1–3 NSAPs. Therefore, they were considered secondary risk factors (Table 3).

Table 2

Factors significantly influencing the nutritional status (NS) at discharge (binary logistic analysis)

Factors	WL	BMI	TSF	MAMC	ALB	LYM
	p	*p*	*p*	*p*	*p*	*p*
Gender	-	-	-	0.001	0.040	-
Affected organ	-	-	-	-	0.035	-
The nature of the disease	0.001	0.007	0.013	0.028	0.001	0.001
Severity of the disease	0.004	0.001	0.002	0.003	0.001	0.001
Complications of the disease	0.001	0.001	0.001	0.001	0.001	0.013
Karnofsky (admission) ≤ 80	0.001	0.001	0.001	0.001	0.001	0.001
Hospitalization >14 days	0.022	-	0.030	-	0.001	-
Mobility worsening	0.003	0.007	-	0.001	0.001	0.024
NS on admission	-	0.001	0.001	0.001	0.001	0.001

WL – weight loss at discharge; BMI – body mass index; TSF – triceps skinfold thickness; MAMC – mid-upper arm muscle circumference; ALB – serum albumin concentration; LYM – lymphocyte count.

Table 3

Risk factors for malnutrition at discharge

Factors	WL	BMI	TSF	MAMC	ALB	LYM
	p	*p*	*p*	*p*	*p*	*p*
Gender	-	-	-	0.001	-	-
The nature of the disease	0.026	-	-	-	-	-
Severity of the disease	-	-	-	0.001	0.002	0.021
Complications of the disease	0.001	-	-	0.027	0.001	-
Hospitalization >14 days	-	-	-	-	0.016	-
Mobility worsening	-	-	-	0.001	-	0.014
Nutrition status on admission	-	0.001	0.001	0.001	0.001	0.001

WL – weight loss at discharge; BMI – body mass index; TSF – triceps skinfold thickness; MAMC – mid-upper arm muscle circumference; ALB – serum albumin concentration; LYM – lymphocyte count.

Forward: Wald multivariate logistic regression analysis: relative risks (RR) and 95% confidence intervals (CI) are: for Gender (RR = 0.335; 95% CI = 0.177–0.634); for The nature of the disease (RR = 1.594; 95% CI = 1.058–2.402); for Severity of the disease (RR = 1.717–2.249; 95% CI = 1.085–1.369/ 2.550–3.696); for Complications of the disease (RR = 3.887–4.830; 95% CI = 1.752-2.722 /8.572–8.621); for Hospitalization > 14 days (RR = 1.778; 95% CI = 1.111–2.844); for Mobility worsening (RR = 0.103–0,245; 95% CI= 0.028–0.079/ 0.372–0.756); for Nutrition status at admission (RR = 35.976–139.059; 95% CI = 21.404–69.462/ 60.471–278.385).

Discussion

Although interest and awareness of the clinical significance of NS have existed for over forty years, malnutrition is a problem that is still present, even in large hospitals. Previous studies have shown that the prevalence of malnutrition on hospital admission is in the range from 22% to 73% [1–3]. In our study, depending on the NSAPs we used, malnutrition on hospital admission was diagnosed in 7.7–31.7% of patients, which is partly in accordance with the results of the other authors. Probably, a lower percentage of malnutrition could be explained by the specificity of our series, which only included gastroenterological patients. The percentage of malnourished patients at discharge was higher by 0.7–6.5%, and malnutrition existed in 8.0–38.2% of our patients. Compared to values at admission, 0.616% of patients had a deterioration in NS at discharge. Similar results have been published by some other authors who reported a significant decrease in MAMC, fat-free mass, albumin level, weight, and BMI during hospitalization [7, 9, 10]. In our study, there was a decrease in the values of all NSAPs, except LYM.

Gender and age. According to our results, the male gender is a secondary risk factor for malnutrition during hospitalization. This is in accordance with the results obtained by the other authors [13, 18, 19]. The result of our study could be explained by the higher prevalence of malignancies among men and greater weight loss in men than in women during hospitalization. Although malnutrition often accompanies older age and older patients are at increased

risk for malnutrition at both admission and discharge [8, 20–22], the average age for malnourished and non-malnourished patients at discharge in our patients was similar. In the study of Kang et al. [2], malnutrition was higher in the patients over 70 years, while Zhu et al. [3] showed that malnutrition at discharge was significantly higher at the age of 65 and above. The difference in results between our and the other studies is probably related to the specificity of our series, which consisted of gastroenterological patients only, while most other studies included patients with various internal and neurological diseases.

Affected organ. Generally, in the patients with gastroenterological diseases, the prevalence and the risk of hospital malnutrition is higher than in patients with other diseases due to impaired digestion and absorption, loss of appetite, prolonged therapeutic fasting, and increased nutritional requirements [23–26]. Following the changes in the NS of their patients, Cui et al. [14] found a significant reduction in body weight and calf circumference in the patients with benign digestive tract disease at the discharge from the hospital. In our study, malnutrition was more common in the patients with the intestinal disease and LBD disease, probably due to the higher prevalence of malignant diseases in these patients, but they were not found to be independent predictors for malnutrition during hospitalization. This result is similar to the results of some other studies [27–29].

Severe disease activity and malignant disease. In our series, severe disease activity and malignancy were secondary risk factors for malnutrition among hospitalized patients. Severe disease activity is thought to cause increased nutritional requirements due to stress metabolism [30, 31]. Therefore, many authors agree that the risk of intrahospital malnutrition correlates with the severity of the disease and that malnutrition is more pronounced in advanced stages of the disease [12, 28, 32, 33]. There is no doubt regarding the association between malignant disease and NS. It is known that numerous metabolic disorders and negative energy balance in malignancies lead to malnutrition and cachexia [34, 35]. According to the results of other studies, the prevalence of hospital malnutrition is high in oncology patients [21, 36, 37]. Pirlich et al. [38] pointed to malignancy as one of three independent predictors of malnutrition at hospital admission. However, in the current literature, the association between malignant disease and malnutrition during hospitalization has been less studied. We found that malignancy is a risk factor for malnutrition during hospitalization. Similar results were published by some other authors [14, 39]. An interesting result of Pañella et al. [40] is that NS is not associated with the stage of malignancy.

Complications of the disease. In our patients, the presence of complications was a secondary risk factor for malnutrition during hospitalization. There is evidence in the literature that most of these conditions are characterized by hypermetabolism due to the action of proinflammatory cytokines [41, 42]. Unlike many clinical and epidemiological studies that define malnutrition as a risk factor for infection and poor outcome [43–45], studies that define clinical complications as a risk factor for malnutrition are rare. Pinchcofsky and Kaminski [46] and Kinyoki et al. [47] considered persistent fever a risk factor for deteriorating NS of adult hospitalized patients and children under 5 years of age, respectively. The results of some studies indicate that the presence of infection adversely affects NS in surgical and nonsurgical patients [13, 36, 48].

The length of hospitalization. Most authors agree that prolonging hospitalization increases the risk of malnutrition [48–50]. In their study, Pinchcofsky and Kaminski [46] found significant decreases in nutritional parameters after three weeks of hospitalization. Weinsier et al. [51] demonstrated that hospitalization longer than 14 days was critical for the onset of malnutrition. This is the result obtained in our series as well. The authors consider that patients during hospitalization have higher nutrient needs and lower appetite due to inflammatory processes associated with the disease, as reported by Correia [52].

Mobility worsening during the hospital stay. Although recommended in various tests for initial NS screening, mobility worsening has been less discussed in studies to date. According to our results, mobility worsening was a risk factor for hospital malnutrition. This result is in line with the results of some other studies [24, 36, 53]. It is not surprising since mobility is a component of a patient's functional ability, substantial for performing daily activities independently.

Karnofsky score at admission. In our study, malnutrition at discharge was significantly more common in the patients with admission Karnofsky score ≤ 80, but we did not find that it was an independent predictor for malnutrition. Although the results of some other studies show that malnutrition is associated with a lower Karnofsky score, none of them pointed to this score as a risk factor for malnutrition [54–57]. In these studies, a low Karnofsky score could be a consequence rather than a cause of malnutrition.

Nutritional status at admission. According to our results, NS at admission was the only primary risk factor for malnutrition at hospital discharge. Doctors must be aware that patients may already be malnourished at admission and that 35–70% of hospitalized patients do not consume enough calories to meet their nutritional needs. In the study by McWhirter and Pennington [58], patients who were severely malnourished at admission had the greatest weight loss at discharge. Similar results have been published by some other authors [5, 14, 16, 59].

Limitation of the study

This paper has limitations that we want to mention. First of all, only patients from one gastroenterology clinic were included, therefore, the results might be different if the study had been conducted in multiple centers, including gastroenterology departments outside university clinics. Second, according to the inclusion criteria, patients who participated in the study had Karnofsky score over 40. As the Karnofsky score indicates the functional capacity of the patients, the inclusion of patients with a lower score might increase the percentage of malnourished patients on admission. Considering these limitations, the next study

should certainly be designed as a multicenter one and include a wider patient population.

Conclusion

There are seven risk factors for malnutrition of gastroenterological patients during hospitalization, one primary and six secondary. The primary risk factor is NS at the hospital admission, while severe disease activity, malignancy, the existence of complications, male gender, hospitalization > 14 days, and mobility worsening during the hospitalization are secondary risk factors. Clinicians should pay more attention to the identification and continuous monitoring of these factors and patients' NS during hospitalization. Only in this way it will be possible to provide timely and adequate nutritional support and prevent/treat malnutrition and its negative influence on clinical outcomes.

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