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The impact of in-hospital nutritional status deterioration on treatment outcome of adult gastroenterological patients

Uticaj intrahospitalnog pogoršanja nutritivnog statusa na ishod lečenja odraslih gastroenteroloških bolesnika

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Abstract

Background/Aim. In the current literature, data on impact of intrahospital changes in patients' nutritional status on the treatment outcome are limited. The aim of this study was to investigate the relationship between nutritional status deterioration and the treatment outcome among hospitalized gastroenterological patients. **Methods.** In 650 adult gastroenterological patients nutritional status on admission and at discharge was evaluated using the 6 nutritional status assessment parameters: body mass index, triceps skinfold thickness, mid-upper arm muscle circumference, serum albumin concentration, lymphocyte count and unintentional weight loss. The influence on treatment outcome was tested for the nutritional status on admission, nutritional status at discharge and intrahospital nutritional status deterioration. **Results.** The incidence of favorable outcome in the non-undernourished and undernourished patients on admission was in the range 93.4–97.3% and 81.2–91.2%, respectively. The incidence of favorable outcome in the non-undernourished and undernourished patients at discharge was in the range 94–97.4% and 80.8–88.1%, respectively. Favorable outcomes were obtained in 95.6–98.9% of the patients without nutritional status deterioration and in 87.1–90.3% of the patients with nutritional status deterioration. Intrahospital nutritional status deterioration significantly influenced the outcome, no matter what assessment parameter had been used ($p < 0.001$ for all the applied parameters). Furthermore, only the deterioration of nutritional status was found to be an independent predictor of treatment outcome (multivariate analysis Forward Wald, $p \leq 0.001$; relative risk (RR) = 0.104–0.350; confidence intervals (CI) = 0.037-0.186/0.297–0.657). **Conclusion.** Deterioration of nutritional status is an independent predictor of adverse outcome.

Key words:
gastrointestinal diseases; nutritional status; hospitalization; treatment outcome; adults.

Apstrakt

Uvod/Cilj. U dostupnoj litearturi postoji malo radova o uticaju promena nutritivnog statusa bolesnika tokom hospitalizacije na ishod lečenja. Cilj studije bio je da se kod hospitalizovanih gastroenteroloških bolesnika ispita odnos između pogoršanja nutritivnog statusa i ishoda lečenja. **Metode.** Kod 650 gastroenteroloških bolesnika procenjivan je nutritivni status pri prijemu i pri otpustu iz bolnice, korišćenjem šest parametara procene: indeks telesne mase, debljina kožnog nabora tricepsa, obim sredine nadlaktice, koncentarcija albumina u serumu, broj limfocita i nenamerni gubitak težine. Uticaj na ishod lečenja testiran je za: nutritivni status pri prijemu, nutritivni status pri otpustu i intrahospitalno pogoršanje nutritivnog statusa. **Rezultati.** Učestalost povoljnog ishoda kod nepothranjenih i pothranjenih bolesnika pri prijemu, iznosila je 93,4–97,3%, odnosno 81,2–91,2%. Učestalost povoljnog ishoda kod nepothranjenih i pothranjenih bolesnika na otpustu, bila je 94%–97,4%, odnosno 80,8–88,1%. Povoljan ishod bolesti dobijen je kod 95,6–98,9% bolesnika bez pogoršanja nutritivnog statusa i kod 87,1–90,3% bolesnika sa pogoršanjem nutritivnog statusa. Intrahospitalno pogoršanje nutritivnog srtatusa značajno je uticalo na ishod lečenja, bez obzira na to koji je parametar procene nutritivnog statusa bio primenjen ($p < 0.001$ za sve primenjene parametre). Osim toga, intrahospitalno pogoršanje nutritivnog statusa bilo je jedini nezavisni prediktor ishoda lečenja (multivarijantna analiza *Forwald Wald*, $p \leq 0{,}001$; relativni rizik (RR) = 0,104–0,350; interval poverenja (IP) = 0,037–0,186/0,297-0,657). **Zaključak.** Pogoršanje nutritivnog statusa je nezavisni prediktor nepovoljnog ishoda lečenja.

Ključne reči:
gastrointestinalne bolesti; nutritivni status; hospitalizacija; lečenje, ishod; odrasle osobe.

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Introduction

Malnutrition is highly prevalent among patients on hospital admission [1–4]. Previous studies have indicated that poor nutritional status (NS) in hospitalized patients is associated with many adverse outcomes, including a higher risk of complications, increased morbidity and mortality, prolonged hospital stay and increased hospitalization costs [5–10]. Some authors have determined malnutrition as a risk factor for frequent readmissions and bad outcome in a postdischarge period [11–13]. In spite of that, the problem of intrahospital malnutrition is often underestimated, and unfortunately, likelihood of nutritional depletion increases during hospital stay, even in large hospitals. Compared with the numerous studies on malnutrition prevalence on hospital admission and the impact of malnutrition on the treatment outcome, studies on intrahospital changes in NS and their association with a bad outcome, are in minority [14–18]. In Serbia, there is no data on this problem.

The aim of this study was to investigate the relationship between the nutritional status deterioration (NSD) and treatment outcome among hospitalized gastroenterological patients.

Methods

Study design and patient population

This prospective study on adult patients, admitted to our hospital, was conducted over a 15-month period. The inclusion criteria were: age ≥ 18 years, a Karnofsky score better than 40 on admission, lack of hemiotherapy, hospitalization period longer than 7 days and informed written consent to participation in the study. The patients were continuously included in the study. All the patients underwent both, diagnostic procedures and medical therapy. The ethical aspect of this study was approved by the local Ethics Committee.

Assessment of nutritional status

Nutritional status was assessed within 48 h after admission and at discharge, using the 6 nutritional status assessment parameters (NSAPs): body mass index (BMI), triceps skinfold thickness (TSF), mid-upper arm muscle circumference (MAMC), serum albumin concentration (ALB), lymphocyte counts (LYM), and unintentional weight loss (WL).

BMI was calculated as weight/height^2 (kg/m^2). Weight (nearest 0.1 kg) and height (to the nearest centimetre) were measured while the patient was standing in light clothes and without shoes. Mid-upper arm circumference (MAC) and TSF, were measured using a tape and callipers at the midpoint between olecranon processes and the acromion of the non-dominant side. The mean value of three consecutive measurements was recorded. MAMC was calculated indirectly, on the basis of the TSF and the MAC: MAMC (mm) = 10 [MAC (cm) – 0.314 x TSF (mm)].

On the basis of each of the 6 NSAPs, the patients were classified as being non-undernourished (normally nourished and obese) and undernourished [19].

NS was not assessed according to weight loss and lymphocyte counts if ascites and hypersplenism were presented, respectively. For the patients with ascites, BMI was calculated using the recommended equation [20].

Intrahospital NSD was considered if any decrease of NSAPs was present, regardless of their extent.

Factors influencing the treatment outcome

The influence on treatment outcome was tested for the NS on admission, NS at discharge and intrahospital NSD.

The parameter for the treatment outcome was the patient's objective status at the discharge from the hospital. It was evaluated on the basis of the physical examination of the patients and laboratory analysis, while ultrasound and endoscopic examinations were repeated if it was necessary. Physical examination of the patient at discharge from the hospital, was performed by the same doctor as on admission. It included general observation (state of consciousness, temperature, mobility, appearance of the skin and mucous membranes) and examination by body systems. Laboratory analysis such as erythrocyte sedimentation rate, complete blood count with differential count, blood glucosa, urea, creatinin, protien, albumin, bilirubin holesterol, triglycerides, iron and liver enzimes were measured in all patients, while additional biochemical analyses were performed depending on the underlying disease. Treatment outcome was defined as satisfactory (the patients' clinical status was better than it was on admission), or unsatisfactory (the patients clinical status was worse or the same, as it was on admission).

Statistical analysis

Data processing was performed using SPSS 11.5 for Windows software (SPSS, Inc., Chicago, IL). Average values were presented as mean value ± standard deviation (SD), and p value of < 0.05 (two-sided) was considered to be statistically significant. Characteristics between the two groups were compared by means of the Student's t- test for parametric data and by the Mann-Whitney U-test for categorical data. Binary logistic analysis was performed to test the correlation between two variables, and Forwald: Wald multivariate logistic regression analysis was used for the prediction of clinical outcome. Critical values of some parametric variable for unsatisfactory clinical outcomes were calculated on the basis of the area under the receiver operating characteristic (ROC) curve.

Results

Characteristics of the patient

A total of 989 patients were assessed for eligibility over the study period. Three hundred and 39 patients were excluded from the study: 67 patients did not meet inclusion criteria on screening, 186 patients were hospitalized for less than 7 days, 42 patients died in hospital and 44 patients were excluded for other reasons. The data were analyzed for 650

patients. The hospitalization length ranged from 7 to 45 days (13.5 ± 6.7 days, on the average). Other baseline characteristics of the series are presented in Table 1.

Influence of admission nutritional status on treatment outcome

Depending on the NSAPs applied, 68.3–92.3% of the patients on admission were non-undernourished, while 7.7–31.7% were malnourished. The incidence of favorable outcome in non-undernourished and malnourished patients on admission was 93.4–97.3% and 81.2–91.2%, respectively. Regardless of the NSAP applied on admission, the tretment outcome was always better in the patients with better NS on admission. These differences were statistically significant if the assessment parameters were WL ($p < 0.001$), BMI ($p = 0.010$), MAMC ($p < 0.001$) or albumin ($p < 0.001$), but were not if the assessment parameters were TSF and lymphocyte counts (binary logistic analysis; $p > 0.05$).

Influence of discharge nutritional status on treatment outcome

Depending on the NSAPs applied, 61.8–92% of the patients at discharge were non-undernourished, while 8–38.2% were malnourished. The incidence of favorable outcome in non-undernourished and malnourished patients at discharge was in the range of 94%–97.4% and 80.8–88.1%, respectively. Regardless of the NSAP administered at discharge, the treatment outcome was always significantly better in the patients with better nutritional status at discharge (binary logistic analysis; $p < 0.001$ for WL, BMI, MAMC, albumin; $p = 0.041$ for TSF; $p = 0.004$ for LYM).

Influence of nutritional status deterioration on treatment outcome

Depending on the NSAPs applied, NSD during hospital stay ranged from 29.1% to 57.9% in all the patients. Favorable outcomes were obtained in 95.6–98.9% of the patients without NSD and in 87.1–90.3% of the patients with NSD. Deterioration of NS during hospitalization significantly influenced the outcome, no matter of the assessment parameter used (Table 2). Among admission NS, discharge NS and NSD during hospitalization, only NSD was found to be an independent predictor of outcome, regardless of the assessment parameter applied (multivariate analysis Forwald Wald, $p \leq 0.001$; relative risk (RR) = 0.104–0.350; confidence intervals (CI) = 0.037–0.186/0.297–0.657).

The patients with favorable and unfavorable outcome of treatment had similar mean declinings of TSF, MAMC, and lymphocytes (paired-samples Student's *t*-test; $p > 0.05$), while the average declinings of body weight, BMI and albumin were significantly higher in the those with an unfavorable outcome, compared to those with a favorable outcome (paired-samples Student's *t*-test, Table 3). Reducing the body weight of 1.2 kg, or 1.4% in relation to weight at admission, reducing the BMI of 0.55 kg/m^2, and reducing the level of albumin for 2.5 g/L were critical for the occurrence of an adverse outcome (ROC curve; Table 3).

Table 1

Baseline characteristic of the patients

Patient's characteristics	OSD	HBT	Pancreas	Intestine	Total
The organ involved, n	68	224	92	266	650
Gender (men/women), n	34 / 34	114 /110	62/30	150 / 116	360 / 290
Average age (years), $\bar{x}$ ± SD	67.9 ± 12.9	59.8 ± 16.5	59.7 ± 15.4	59.2 ± 16.3	60.3 ± 16.1
Average body weight (kg), $\bar{x}$ ± SD	67.7 ± 15.2	74.3 ± 13.9	70.9 ± 11.1	72.3 ± 15.1	72.3 ± 14.3
Disease nature (malignant / benignant), n	26 / 42	42 / 182	64 / 28	104 / 162	236 / 414
Average Karnofsky score, $\bar{x}$ ± SD	92.9 ± 9.0	95.4 ± 8.9	90.7 ± 9.7	90.7 ± 9.7	94.8 ± 8.8
Average length of hospitaliz. (days), $\bar{x}$ ± SD	14.2 ± 7.1	14.5 ± 7.1	13.6 ± 5.4	12.5 ± 6.6	13.5 ± 6.7

OSD – oesophagus, stomach and duodenum; HBT – hepatobilliary tract; $\bar{x}$ – mean; SD –standard deviation.

Table 2

Favorable and unfavorable treatment outcome in patients with and without deterioration of nutritional status (NS) (binary logistic analysis)

Assessment parameter for NSD	Deterioration of NS (present)		Deterioration of NS (absent)		Statistical parameters		
	Favorable outcome	Unfavorable outcome	Favorable outcome	Unfavorable outcome	*p*	RR	CI
WL	324	35	258	3	< 0.001	0.150	0.052–0.428
BMI^d	302	40	304	4	< 0.001	0.101	0.036–0.285
TSF^d	272	36	334	8	< 0.001	0.181	0.083–0.396
MAMC^d	180	26	426	18	< 0,001	0.293	0.156–0.547
ALB^d	272	38	334	6	< 0,001	0.130	0.054–0.313
LYM^d	162	24	434	20	< 0.001	0.311	0.167–0.578

NSD – nutritional status deterioration; WL – weight loss at discharge; BMI^d – body mass index declining; TSF^d – triceps skinfold thickness declining; MAMC^d – mid-upper arm muscle circumference declining; ALB^d – albumin concentration declining; LYM^d – lymphocyte counts declining; *p* – probability; RR – relative risk, CI – confidence interval.

Table 3

Average parameters reduction during hospitalization and treatment outcome

Treatment outcome	Average parameter declining during hospitalization						
	WL (kg)	WL **(%)**	BMI[d] kg/m^2	TSF[d] mm	MAMC[d] mm	ALB[d] g/L	LYM[d] $\times 10^3$/mm^3
Favorable, x ± SD	1.0 ± 1.0	1.4 ± 1.4	0.4 ± 0.4	1.4 ± 2.0	9.8 ± 13.3	2.6 ± 2.4	0.3 ± 0.3
Unfavorable, x ± SD	2.1 ± 2.2	3.2 ± 3.4	0.8 ± 0.7	1.1 ± 0.9	9.3 ± 6.7	5.6 ± 3.1	0.4 ± 0.5
p	**< 0.001**[†]	**< 0.001**[‡]	**< 0.001**[†]	> 0.05[†]	> 0.05[†]	**< 0.001**[†]	> 0.05[†]
t	-5.730	-5.730	-5.203	-	-	-7.015	-
Critical declining[§]	**1.2**	**1.4**	**0.55**	-	-	**2.5**	-
p	< 0.001	< 0.001	< 0.001	-	-	< 0.001	-
sensitivity (%)	67.7 %	67.0 %	60.0 %	-	-	73.3 %	-
specificity (%)	65.8 %	64.1 %	71.2 %	-	-	67.5 %	-
CI	0.630–0.808	0.621–0.795	0.612–0.800	-	-	0.649–0.843	-

WL – weight loss at discharge, BMI[d] – body mass index declining; TSF[d] – triceps skinfold thickness declining; MAMC[d] – mid-upper arm muscle circumference declining; ALB[d] – serum albumin concentration declining; LYM[d] – lymphocyte counts declining; *p* – probability; CI – confidence interval;
[†]Paired-samples – Student's *t*-test; [‡]Mann Whitney test (*U* = 8136; z = -4.322); [§]Receiver operating characteristic (ROC) curve.

Discussion

The first study on the impact of malnutrition on disease outcome was published in 1978 by Mullen et al. [21]. They found that the recent loss of 10–15% of body weight increased the perioperative risk and prolonged recovery. Weight loss of 20–25% endangers a patient who is planning to go to surgery, while the loss of 30% to 35% is a sign of severe cachexia and ends lethally, if a vigorous nutritional therapy is not applied [21]. Studies carried out on the following years demonstrated that malnutrition increases morbidity, prolongs recovery period after illness and surgery and reduces the response to chemotherapy in patients with malignant diseases [22, 23]. Furthermore, malnourished hospitalized patients have a higher mortality rate (10–40%), in relation to well-nourished patients [5, 24–26].

Influence of admission and discharge nutritional status on treatment outcome

The outcome of our patients has been significantly influenced by the admission and discharge NS. Regardless of the NSAPs administered, the frequency of favorable outcome was always higher in well-nourished than in malnourished patients. This is in accordance with the results of certain other studies [27–29]. These authors demonstrated that malnutrition at admission was an independent risk factor for poor rehabilitation outcome, morbidity and mortality of hospitalized patients [27–29]. In the study by Merli et al. [30] the presence of pretransplant malnutrition was the only independent risk factor for the length of stay in the ICU after liver transplantation. Similar results were published by Yosry et al. [31]. However, none of the cited authors, investigated the dynamics of NS from admission to discharge and its impact on treatment outcome.

Influence of nutritional status deterioration on treatment outcome

In our study the frequency of favorable outcome was always higher in patients without NSD, than in patients with NSD during hospital stay. Although the outcome of our patients was significantly influenced by all the three aspects of nutritional status: NS at admission, NS at discharge and NS deterioration during hospitalization, only the deterioration of NS was an independent predictor of the treatment outcome. This result is consistent with the results published by some other authors [14, 15, 22]. Donini et al. [22] found that deterioration of NS was the main independent predictor of mortality and occurrence of adverse events in the population of geriatric rehabilitation patients. Even a mild deterioration of NS could cause an increase in the incidence of adverse events and in mortality in these patients. In the study by Hill et al. [15] deterioration in NS during radiotherapy could be associated with bad treatment outcomes in the patients with gastroenterological cancer. Braunschweig et al. [14] pointed out that patients whose nutritional status worsened during hospitalization regardless of their nutritional status at admission, had significantly higher hospital charges and a higher likelihood of complications. Accordingly, it is reasonable for physicians to pay more attention to intrahospital changes in NS, even if the patient is well-nourished on admission.

In our patients, intrahospital decrease was noticed for the values of all NSAPs, except for the LYM. This result is mostly in concordance with the results of some other studies [17, 32]. There is a slight disagreement concerning the lymphocytes values between our results and the resultes obtained in the studies of Beghetto et al. [18] and Assensio et al. [5]. Those studies demonstrated that, compared to values on admission, lymphocytes were deteriorated as well as the other NSAPs. Furthermore**,** Asensio et al. [5] found that the decrease in lymphocyte count was an independent prognostic factor for in-hospital mortality.

Affected parameter depends on the patient's age. Farré Rovira et al. [33] concluded that in patients over 40 years, the values of all NSAPs decrease during hospital stay, whereas in younger patients hospitalization changes the values of albumin, weight and BMI only. The results obtained by Fettes et al. [34] pointed to possible gender differences in the intrahospital changes in NSAPs: in their study weight loss during hospitalization was bigger in males, than in females. In addition, male lost muscle mass, while females lost subcutaneous fat.

In our study critical values of the reduction in body weight, BMI and albumin level, for the occurence of adverse outcomes, were 1.2 kg, or 1.4% in relation to weight at admission, 0.55 kg/m^2 and 2.5 g/L respectively. De Hollander et al. [35] reported that a decrease in weight, equal or more than 3.2 kg, was significantly associated with mortality risk in older hospitalized adults. In the same study, they also found a significant association between waist circumference and MUMC reduction and increased mortality risk [35]. In the study of de Luis et al. [36], each decrease of 1 g/dl of albumin caused an increase of 3.1 days in hospital stay.

There are more works reporting on the values of certain assessment parameters on admission which are significant for development of an adverse outcomes: TSF [22, 31, 37], level of transferrin and the number of lymphocytes [5], weight loss [38], and BMI [37].

Critical values of body weight reduction for the occurence of adverse outcomes, expressed in kg and in precentages, which were obtained in our study have similar sensitivity and specificity. Interestingly, the critical values of BMI reduction have the highest sensitivity, but low specificity compared with the reduction of body weight and albumin values. The best combination of sensitivity and specificity was obtained for the decrease in albumin level, but, in general, this results in clinical practice should be used with great caution. Therefore, future prospective studies, which will comprise a homogenous groups of patients, are certainly needed to test the results of the present study.

Conclusion

This study is the first one in Serbia on the impact of in-hospital nutritional status deterioration on treatment outcome of gastroenterological patients. The results point to the significance of monitoring of patients' nutritional status during hospitalization, regardless of their nutritional status at admission. Reducing the deterioration of the nutritional status we should be able to reduce its negative effects on the treatment outcome.

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