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ORIGINAL

Determining the efficiency of different malnutrition tests in septic patients

Determinación de la eficacia de diferentes tests de desnutrición en pacientes sépticos

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Abstract

Background and aims: Malnutrition is frequently detected in septic patients and is important cause of mortality.
Methods: Numerical rating Scale 2002, Nutrition risk in the critically ill score and adductor pollicis thickness measurement are used to determine malnutrition in 287 septic patients.
Results: The mean age was 66,57±16,31 years. The mean APACHE II score was 16,19±8,20 while the mean SOFA score was 5,89±3,49. To NRS 2002 test 171 was accepted as high malnutrition risk while 116 patients was accepted as low malnutrition risk. According to Nutric test, the risk of malnutrition was found to be low in 144 patients and found to be high in 143 patients. The mean APTM was detected as 20,20±2,21 mm. The cutt-off point for APTM was found as ≤ 21 mm.
Conclusions: high risk of malnutrition was frequently observed in patients with sepsis and mortality was higher in high risk patients. Higher sensitivity was achieved when the tests were combined with each other. As a result, we recommend the use of malnutrition screening tests in patients with sepsis and combining the tests with each other.

Key words: Malnutrition, sepsis, mass screening.

Resumen

Antecedentes y objetivos: La desnutrición se detecta con frecuencia en pacientes sépticos y es una importante causa de mortalidad.
Métodos: Escala de calificación numérica 2002 (NRS 2002), riesgo nutricional en la calificación de enfermedad crítica, emplea la medición del grosor del aductor del pulgar para determinar la desnutrición en 287 pacientes sépticos.
Resultados: La edad media fue de 66,57 ± 16,31 años. La puntuación media APACHE II fue 16,19 ± 8,20 mientras que la puntuación SOFA media fue 5,89 ± 3,49. Según NRS 2002, la prueba mostró en 171pacientes alto riesgo de desnutrición, mientras que 116 pacientes se consideraron como bajo riesgo de desnutrición. De acuerdo con la prueba Nutric, se encontró que el riesgo de desnutrición era bajo en 144 pacientes y alto en 143 pacientes. El APTM medio se detectó como 20,20 ± 2,21 mm. El punto de corte para APTM se encontró como ≤ 21 mm.
Conclusiones: se observó con frecuencia alto riesgo de desnutrición en pacientes con sepsis y la mortalidad fue mayor en pacientes de alto riesgo. Se logró una mayor sensibilidad cuando las pruebas se combinaron entre sí. Como resultado, recomendamos el uso de pruebas de detección de desnutrición en pacientes con sepsis y la combinación de las pruebas entre sí.

Palabras clave: Desnutrición, sepsis, tamizaje masivo.

Introduction

Sepsis is a common disease worldwide[1]. Malnutrition is seen in 50% of septic patients in the intensive care unit (ICU) and is the most important cause of mortality associated with organ failure and associated complications[2,3]. Sepsis and malnutrition, is associated with increased duration of ICU stay, morbidity and mortality[4]. Nutritional screening in patients is the first step in establishing a nutritional plan. Nutritional deficiencies should be diagnosed immediately in ICU patients.

Various tests such as Numerical rating Scale 2002 (NRS 2002), Nutrition risk in the critically ill scores (Nutric score) and adductor pollicis thickness measurement (APTM) are used to determine malnutrition in intensive care patients. The NRS 2002 and Nutric scores gives information both on nutrition and disease severity and the effectiveness has been reported in different studies[5-7]. It is recommended to use Nutric test to screen malnutrition in the ASPEN guidelines[5]. The APTM test is used widely and there are

different studies on the use of in ICU patients[8]. Unfortunately, there is currently uncertainty in the literature as to which malnutrition screening test to use in patients with sepsis[3].

The goal of this study was to determine different malnutrition screening tests in septic patients.

Material methods

After the consent of the ethics committee was obtained, 287 patients diagnosed with sepsis and stayed in the ICU more than 24 hours were included in the study. Informed consent was obtained from the patient and their relatives. Patients under 18 years of age, refused to participate in the study, suspicious or diagnosed brain death, pregnant patients and patients staying in intensive care for less than 24 hours were excluded from the study.

The diagnosis of sepsis was made according to the sepsis criteria published by Rhodes et al[1]. Age, gender, weight, APACHE II, SOFA scores were all recorded in all patients from ICU admission.

The NRS 2002 score was calculated by using the following parameters: body muscle index measurement, weight loss, reduced dietary intake and illness severity. Mild: weight loss >5% in last 3 months or 50-75% lower food intake than normal food needs, Moderate: more than 5% weight loss during last 2 months or BMI 18.5-20.5 or taking only 25-60% of the normal food need in the last week, Severe: More than 5% weight loss in 1 month (weight loss >15% in 3 months) or BMI >18.5 worsened general condition or taking only 0-25% of the normal food need in last week[9]. The score ≥ 3 was accepted as high malnutrition risk.

The Nutric score was calculated by using the age, APACHE II and SOFA scores, number of comorbidities and days in hospital to ICU admission. Since IL-6 could not be measured in our hospital, IL-6 was not evaluated to the score. The score 5-9 points high malnutrition risk and is associated with poor clinical prognosis. These patients may benefit from aggressive nutritional therapy. The score 0-4 adressed as low malnutrition risk[10].

The adductor pollicis muscle thickness measurement (APTM) was done by using a Lange® skinfold caliper, the caliper was applied along the adductor pollicis muscle, which was placed in the triangle composed by the extended thumb and index finger. The largest of the three assessments was accepted as a measure of APTM (11). There are several studies about APTM cut off values[12].

All malnutrition evaluation tests were performed within the first 2 hours of admission. Patients were followed-up until they were removed from the intensive care unit or until their death. The patients' ICU stay and prognosis were all recorded.

Our first goal in our study is to investigate malnutrition rates in patients with sepsis by using different malnutrition screening tests. Our secondary aim is to investigate the sensitivity and specificity of other tests by accepting the widely used NRS 2002 test as the main test. The other aim of the study is to understand the sensitivity and specificity when the other tests are combined with each other, while the NRS 2002 test is accepted as the main test.

Statistical Analysis

According to reference, the lowest correlation between dominant hands APTM and length was calculated as r = 0.19 and it was calculated that 287 cases should be taken with a probability of 0.05 and 90% power[13]. Statistical analysis was performed using the Statistical Package for Social Sciences (SPSS) version 22.0 (SPSS Inc. Chicago, IL, USA) and MedCalc (v14.12.0). The normal distribution of variables was tested Shapiro Wilk test. All variables were not normally distributed and were described as mean and standard deviations and median (Min-Max) values. Mann Whitney U test and Kruskal Wallis test (Mann Whitney U test with Bonferroni Correction was used for comparison of two pairs) were used comparing groups. The Chi-square test was applied for comparison of kategorical variables. Specificity and sensitivity of the tests to identify malnutrition were tested in comparison to NRS diagnosis due to its widespread use.

Results

The study sample consisted of 287 patients (138 women, 149 men), with a mean age of 66,57±16,31 years and mean weight was 75,59±14,71 kg. The mean APACHE II score was 16,19±8,20 while the mean SOFA score was 5,89±3,49. The mean ICU stay was 19,546±27,05 days. The mortality rate was 66,55%. The origins of the patients were all shown in **table I**.

Malnutrition screening tests were performed in all patients. According to NRS 2002 test 171 was accepted as high malnutrition risk while 116 patients was accepted as low malnutrition risk. To the Nutric test, the risk of malnutrition was found to be low in 144 patients and found to be high in 143 patients. The mean APTM value was detected as 20,20±2,21 mm.

The relationship between NRS score and gender, age, weight, APACHE II, SOFA score, ICU stay and prognosis was shown in **table II**. Statistically difference was detected on age, weight, APACHE II, SOFA score and prognosis (p<0,005).

The relationship between Nutric malnutrition test and gender, age, weight, APACHE II, SOFA score, ICU stay and prognosis was shown in **table III**. There was statistically relevant difference was detected on age, weight, APACHE II, SOFA score and prognosis (p<0,005).

The relationship between the APTM vs gender, age, weight, APACHE II, SOFA score, ICU stay and prognosis shown in **table IV**. There was statistically relevant difference was detected on age, weight, APACHE II, SOFA score and prognosis (p<0,005). The cutt-off point for APTM was found as ≤ 21 mm. In this point the sensitivity was specificity was found as 90,06% (84,6-94,1) and 78,45% (69,9-85,5).

The sensitivity, specivity and AUC values of malnutrition tests was shown in **table V**.

Table VI shows the sensitivity, specificity, PPV and NPV values after combining the tests.

Discussion

In this study, we aimed to compare the efficacy of different malnutrition screening tests in patients with sepsis. We found different malnutrition rates when using different tests. According to the NRS 2002 test the risk of malnutrition was as 59.5%, 49.8% for the Nutric test and 62.36% for the APTM test.

Table I: Sepsis origin.

	n=287
Pulmonary	135
Urinary	9
Soft tissue, wound	23
Abdominal	54
Other*	66

* post-surgery, infective endocarditis, without a defined focus.

Table II: NRS test.

		NRS test		p
		high malnutrition risk	low malnutrition risk	
gender*	Female (n / %)	89 / 52,0	49 / 42,2	0,103**
	Male (n / %)	82 / 48,0	67 / 57,8	
Age		71,006±13,85	60,05±17,49	0,000†
Weight		74,48±15,33	77,24±13,66	0,004†
APACHE II score		21,42±6,62	8,49±1,47	0,000†
SOFA score		7,32±3,70	3,80±1,64	0,000†
ICU stay		24,57±27,87	19,91±25,67	0,092†
Prognosis*	Healthy (n / %)	6 (3,5)	91 (78,4)	0,000**
	Exitus (n / %)	165 (96,5)	25 (21,6)	

APACHE II score: Acute Physiology and Chronic Health Evaluation score
SOFA score: Sequential Organ Failure Assessment (SOFA) Score
ICU stay: Intensive care Unit stay
***:** % column, p<0,005 statistically significant
****:** Pearson Chi-Square
†: Kruskal Wallis test
††: Mann Whitney U test with Bonferroni Correction (high malnutrition risk versus low malnutrition risk and moderate malnutrition risk
†††: high malnutrition risk versus low malnutrition risk
††††: moderate malnutrition risk versus low malnutrition risk

Table III: Nutric Score.

		Nutric Score		p
		high malnutrition risk	low malnutrition risk	
gender*	Female (n / %)	73 / 50,3	65 / 45,8	0,438**
	Male (n / %)	72 / 49,7	77 / 54,2	
Age		72,54±14,61	60,49±15,74	0,000†
Weight		72,77±12,09	78,48±16,53	0,000†
APACHE II score		20,42±8,27	11,88±5,44	0,000†
SOFA score		7,26±3,97	4,50±2,18	0,000†
ICU stay		21,80±22,23	23,59±31,27	0,336†
Prognosis*	Healthy (n / %)	17 (11,7)	80 (56,3)	0,000**
	Exitus (n / %)	128 (88,3)	62 (43,7)	

APACHE II score: Acute Physiology and Chronic Health Evaluation score
SOFA score: Sequential Organ Failure Assessment (SOFA) Score
ICU stay: Intensive care Unit stay
***:** % column, p<0,005 statistically significant
****:** Pearson Chi-Square
†: Mann Whitney U test

Table IV: APTM test.

		APTM test		p
		high malnutrition risk (≤ 21 mm)	low malnutrition risk (>21 mm)	
gender*	Female (n / %)	89 / 49,7	49 / 45,4	0,475
	Male (n / %)	90 / 50,3	59 / 54,6	
Age		70,74±13,93	59,68±17,65	0,000
Weight		74,56±15,64	77,32±12,94	0,003
APACHE II score		19,92±7,74	10,03±4,35	0,000
SOFA score		6,91±3,73	4,22±2,25	0,000
ICU stay		26,28±30,46	16,74±18,85	0,008
Prognosis*	Healthy (n / %)	6 / 3,4	91 / 84,3	0,000
	Exitus (n / %)	173 / 96,6	17 / 15,7	

APACHE II score: Acute Physiology and Chronic Health Evaluation score
SOFA score: Sequential Organ Failure Assessment (SOFA) Score
ICU stay: Intensive care Unit stay
***:** % column, p<0,005 statistically significant
****:** Pearson Chi-Square,
†: Kruskal Wallis test,
††: Mann Whitney U test with Bonferroni

Table V: Sensitivity, specificity and AUC values.

	AUC %95 Confidence Interval	Sensitivity Confidence Interval	Specificity Confidence Interval
NRS test	1,000	100,0	100,0
Nutric score	0,802 (0,701-0,846)	70,18 (62,7-76,9)	78,45 (69,9-85,5)
APTM test	0,893 (0,851-0,926)	90,06 (84,6-94,1)	78,45 (69,9-85,5)

NRS test: Numerical rating Scale 2002 test
Nutric score: Nutrition risk in the critically ill score
APTM test: adductor pollicis thickness measurement test
AUC: Area under curve

Table VI: Sensitivity, specificity and AUC values of the combination of the tests.

	Sensitivity	Specificity	PPV	NPV
Nutric test plus APTM test	82,00	91,95	95,91	68,97

Nutric score: Nutrition risk in the critically ill score
APTM test: adductor pollicis thickness measurement test
PPV: positive predictive value
NPV: negative predictive value

In the literature, malnutrition rates for ICU vary between 29-100 % depending on the screening tool used[4,14,15]. Inflammation, hypermetabolism and hypercatabolism caused by critical diseases pose a risk for malnutrition[16]. In addition, enteral or parenteral nutrition is frequently applied in ICU patients, but it takes time to reach a full dose and feeding is frequently discontinued becouse of planned medical or surgical procedures[15,16]. This is the most important obstacle to the patient to get enough energy, minerals and vitamins[4]. In 2003 ESPEN recommended the use of the NRS 2002 test in all adult patients including ICU septic patients[11]. There are different studies on the use of NRS-2002 test in ICU patients[4,17,18]. The first study is a multicenter study that includes 1655 intensive care patients and determines that 52% of patients are undernourished[17]. The second study is an international study involving ICU patients from four centers. According to NRS-2002, the prevalence of malnutrition was reported to be 87, 93, 97 and 100% in four centers, respectively[18]. In another study made by Blanckenberg et al.[4] the authors investigated the efficacy of different malnutrition screening tests in patients staying > 48 hours in surgical intensive care for an eight-month period. The researchers used NRS 2002 test similar to our study and it was found that 72.8% of the patients were seriously malnourished according to the NRS-2002 test. The authors suggested that different outcomes should be attributed to patient heterogeneity. In our study, the malnutrition risk values found by the NRS 2002 test was 59.5%, respectively. We think that this difference may be due to different patient populations.

Kalaiselvan et al[19]. investigated the Nutric test on 678 intensive care patients receiving mechanical ventilator therapy. The researchers considered the Nutric score ≥5 as a risk of malnutrition. They found malnutrition in 42.5% of patients. As a result, the researchers found that patients with high Nutric scores had longer ICU stay and increased mortality. Lee et al.[20] in more than half of the 203 patients (55.8%) while high malnutrition was found, similar values were found in Mendes et al. (48%),[21] and Rosa et al (46%),[22]. In a review by Reis et al[23], 12 studies reported that the Nutric score is closely related to clinical outcomes and is suitable for use in intensive care patients. Although the patients included in this review were not separated as sepsis, all of them were receiving MV treatment. In our study according to Nutric test, the risk of malnutrition was as 49.8% in septic patients. The results was similar to other studies.

The APTM can be used in service and intensive care units because it is non-invasive, low cost, easy to perform, and a fast method. Its effectiveness has been reported in different studies[9,12,13,24,25]. In a study, the malnutrition status of 59 surgical intensive care patients was determined using the subjective global assessment (SGA) test, and the relationship between SGA and APTM was found to be medium-weak[9]. Gonzales and colleagues[13] in their study of 361 surgical patients measured the APTM. Comparing this value with SGA test, they found low sensitivity and high specificity and reported that APTM is a simple and useful parameter in the diagnosis of malnutrition. In another study, the APTM was measured in 151 surgical patients, and in this study it was found that muscle measurement may be important in identifying malnutrition in surgical patients[24]. Caporossi and colleagues[25] in 246 ICU patients found that there was a significant relationship between malnutrition and adductor muscle measurement values. The authors found 17.2±5.4 cm measurement as nourished patients while, 12,9±5,3 cm for malnourished patients. In our study we also used the TAPM test for detecting malnutrition and the mean APTM value was detected as 20,20±2,21 mm. The cutt-off point for APTM was found as ≤ 21 mm. When we looked at our results, we found that the sensitivity and specificity of APTM measurements were higher than Nutric test. In a review it was reported that this measurement was affected by different parameters and further studies were needed[12]. The authors also reported that TAPM value is important in the evaluation of mortality in intensive care patients. In our study similar to this study we found higher mortality rates with lower APT measurement values.

Different studies have demonstrated that there are differences in complications between patients with and without malnutrition[17,26]. In Sorensen study[18] the authors concluded that incerasead complications and increased mortality was more commonly seen in patients at risk of malnutrition than patients not at risk of malnutrition. To Blackenberg study[4] the ICU stay and the complications were higher in patients who diagnosed as high risk malnutrition. In our study, mortality was found to be different in patients diagnosed with malnutrition using NRS 2002, Nutric Score and APTM test.

Velasco et al.[27] found the sensitivity and specificity to be 74.4% and 87.2% for the NRS 2002 test. In our study, since we accepted this test as the gold standard, we determined the sensitivity and specificity as 100% for NRS 2002 test. The sensitivity for the Nutric score was 70.18 % and the specificity was 78.45 %, whereas for the APTM were 90.06 and 78.45%. While Velasco et al. did their studies on hospitalized patients, our difference in intensive care patients may explain this difference.

In our study, after the combined use of tests, whereas an increase in sensitivity was found, while a decrease in specificity was detected. This suggests that more test use may be more beneficial for the diagnosis of malnutrition, although we did not look at the test times in our study, we think that the use of more than one test may lead to an increase in time.

The weak side of this study is that, the study was only in one center. It is clear that different results can be obtained in multicentre studies. Another weakness in our study is the comparison of other tests according to the NRS

2002 test, as this test is widely used, we have accepted this test as the main test.

In conclusion, we found that the prognosis was worse in patients with high risk of malnutrition. We found that higher sensitivity was achieved when the tests were combined with each other. As a result, we recommend the use of malnutrition screening tests in patients with sepsis and combining the tests with each other, although it causes prolongation in calculation time.

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