

Original

The impact of malnutrition on morbidity, mortality and length of hospital stay in trauma patients

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Abstract

Background & aim: To assess the nutritional status of hospitalised trauma patients and the repercussion on the clinical follow up.

Methods: In a prospective way 161 adult patients admitted to the units of Intensive Care (ICU), General Surgery, Maxillofacial Surgery and Orthopedics of the Centro de Emergencias Médicas in Asunción, Paraguay, from March 2002 to March 2004 were evaluated at admission by using the Subjective Global Assessment (SGA). Patients were followed to determine length of hospital stay, complications and in-hospital mortality.

Results: From the trauma patients median age was 27 (14-92) years and 94% were males. Most patients (74%) were from the countryside. The most frequent anatomic sites of trauma were: head 25%, thorax 16.6%, limbs 15.4%, abdomen 14%. The median Injury Severity Score (ISS) was 20 (1-39). From this population of patients, 40% were malnourished or at risk of malnutrition according to the SGA. Multivariate analysis identified as significant risk factors for mortality: malnutrition according to the SGA ($p = 0.04$, RR = 4 (1-15)), and admission to the ICU ($p = 0.0001$, RR 53 (12-234)). Risk factors for complications were malnutrition according to the SGA ($p = 0.003$, RR 2.9 (1.4-5.8)) and ISS over 20 ($p = 0.001$, RR = 8.4 (2.3-29.9)). The risk factors for length of stay were malnutrition according to the Subjective Global Assessment ($p = 0.01$, RR = 2.3 (1.2-4.7)) and Injury Severity Score over 20, $p = 0.03$, RR = 2.8 (1-7.3).

Conclusions: In the conditions of this study, malnutrition is frequent on admission in trauma patients, and is an independent risk factor for morbidity, mortality, and

EL IMPACTO DE LA MALNUTRICIÓN SOBRE LA MORBILIDAD, MORTALIDAD Y DURACIÓN DE LA ESTANCIA HOSPITALARIA EN PACIENTES TRAUMATOLÓGICOS

Resumen

Antecedentes y objetivo: determinar el estado nutricional de pacientes traumatológicos hospitalizados y su repercusión sobre el seguimiento clínico.

Métodos: evaluamos de forma prospectiva a 161 pacientes adultos ingresados en las unidades de cuidados intensivos (UCI), cirugía general, cirugía maxilofacial y traumatología, en el Centro de Emergencias Médicas de Asunción, Paraguay, desde marzo de 2002 a marzo de 2004, a su ingreso, mediante el Subjective Global Assessment (SGA). Se siguió a los pacientes para determinar la duración de la estancia hospitalaria, las complicaciones y la mortalidad intra-hospitalaria.

Resultados: en la unidad traumatológica, la edad media de los pacientes fue 27 años (14-92) y el 94% eran varones. La mayoría era de origen rural (74%). Los sitios anatómicos lesionados con mayor frecuencia fueron: cabeza 25%, tórax 16,6%, miembros 15,4%, abdomen 14%. La puntuación mediana del Injury Severity Score (ISS) fue 20 (1-39). En esta población de pacientes, 40% estaba malnutrida o en riesgo de malnutrición de acuerdo con el SGA. El análisis multivariado identificó los siguientes factores de riesgo de mortalidad: malnutrición según el SGA ($p = 0,04$, RR = 4 (1-15)), y el ingreso en la UCI ($p = 0,0001$, RR = 53 (12-234)). Los factores de riesgo de complicaciones fueron la malnutrición según el SGA ($p = 0,003$, RR = 2,9 (1,4-5,8)) y el ISS mayor de 20 ($p = 0,001$, RR = 8,4 (2,3-29,9)). Los factores de riesgo para la duración de la estancia fueron la malnutrición según el SGA ($p = 0,01$, RR = 2,3 (1,2-4,7)) y el ISS mayor de 20 ($p = 0,03$, RR = 2,8 (1-7,3)).

Conclusiones: en las condiciones de estudio, la malnutrición es frecuente al ingreso de pacientes traumatológicos, y es un factor de riesgo independiente sobre la morbilidad, mortalidad y prolonga la duración de la hospitalización. Se deberían realizar esfuerzos para

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prolongs the length of hospitalisation. Efforts should be made to quickly assess the nutritional status of these patients and early start nutritional intervention.

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Key words: *Nutritional Assessment. Malnutrition. Trauma. Mortality. Outcome.*

Introduction

Malnutrition is frequent in hospitalized patients, and is not always recognized by health care professionals' team. The relationship between nutritional status and postoperative mortality was first described in 1939¹. The nutritional status at hospital admission is compounded by primary malnutrition mainly reflecting poor social-economic condition, and secondary malnutrition reflecting, usually, the impact of degenerative and chronic diseases. Systematic surveys of hospital malnutrition have found a prevalence from 30 to 70%²⁻⁶.

In the last years trauma is assuming a leading cause of hospital admission of young people and associated to high rates of morbidity and mortality. Paraguay is a country with a population of 6,036,900 inhabitants with an average age of 26 years and a *per capita* product of US\$ 4,200. An important part of the population (39.9%) lives in rural areas with poor access to health care. Approximately 2.8% of health care is carried on by the State⁷.

A recent study of hospital malnutrition done in adults have identified in Paraguay approximately 40% of undernutrition assessed through the SGA⁸.

There are few reports about the incidence of malnutrition in trauma patients, specially when coming from rural areas and its repercussion on mortality and morbidity⁹⁻¹⁴.

It is therefore interesting to study the nutritional risk in trauma patients and the specific impact of this risk on in-hospital clinical course. In the present prospective study the nutritional status in trauma patients was assessed within 72 hours of admission. A multinomial logistic regression model was used to study the correlation between nutritional status and the incidence of complications, mortality and length of hospital stay.

Materials and methods

Patient selection

This prospective, analytical cohort study included 161 consecutive trauma patients admitted to the Centro de Emergencias Médicas in Asunción, Paraguay from March 2002 to March 2004. Inclusion criteria were: nutritional assessment done within 72 hours of

valorar rápidamente el estado nutricional de estos pacientes y comenzar una intervención nutricional de forma precoz.

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Palabras clave: *Evaluación nutricional. Malnutrición. Traumatismo. Mortalidad. Pronóstico.*

hospital admission, trauma patients admitted to general surgery, maxillofacial surgery, orthopaedics or the intensive care unit (ICU) of a major trauma reference center, and age over 13 years. Exclusion criteria were: pregnant women, patients with chronic illnesses referred from other hospitals, elective surgical patients, non-trauma patients and those receiving out-patient treatment. Sampling was non-probabilistic, including consecutive cases fulfilling inclusion criteria. The research protocol was approved by the hospital research and ethical committee.

Nutritional evaluation

The Subjective Global Assessment (SGA)¹⁵ was used to determine the prevalence of malnutrition and to divide patients into two cohorts: well nourished and malnourished (including moderately malnourished or at risk of malnutrition, and severely malnourished) (table I).

Complications, mortality and length of hospital stay

Complications were defined to be the appearance of a disease condition or accident in addition to the pre-existing condition which motivated hospital admission, without a specific relationship between the two. Complications can be infectious or non-infectious in nature. Length of hospital stay was measured in days, from the day of admission to hospital to the time of release or death. Data were collected prospectively to determine length of hospital stay, rate of complications and mortality.

Statistical analysis

Data were collected in a pre-encoded research form and processed with EPIINFO 2004 (version 3.2.2, CDC, Atlanta). Multivariate analysis was done with the SPSS 11.5 software. Descriptive statistics were used to characterize the population. Continuous variable (length of hospital stay, age) were reported as average \pm standard deviation, or median for variables without a normal distribution. Dichotomous variables, total complications (infectious and non-infectious), and mortality were expressed as percentages.

The Student or Wilcoxon tests were used to compare the two cohorts' length of hospital stay, with

Table I
Subjective global assessment

A) Clinical history

1. Body Weight. Loss in the last 6 months: Total: Percentage: Variations in the last 2 weeks: #Gain #No changes #Loss
2. Changes in the oral intake. No Yes. Duration weeks. Tipe: *Insufficient solid oral diet *Hypocaloric liquid oral diet *Exclusive liquid oral diet *Fast
3. More than 2 weeks Gastrointestinal Symptoms#None #Dysphagia #Nauseas #Abdominal pain #Vomits #Anorexia #Diarrhoea
4. Functional Capacity *Complete *Dysfunction Tipe: -Limited capacity -Ambulatory -In bed
5. Illness and its relation with de nutritional requirements: Primary Diagnosis: Metabolic Stress:
 - No stress
 - Low stress
 - Moderated stress
 - High stress

B) Physic exam

(For each option specify: 0 = normal; 1 = low; 2 = moderated; 3 = severe)
 Loss of subcutaneous fat mass (triceps, thorax): _____
 Malleolar Oedemas: _____
 Loss of muscular mass (cuadriceps, deltoides): _____
 Sacrum oedemas: _____

C) SGA estimation

- a) Welnourished. (The patient has gained weight, without oedema, or better appetite.)
- b) Moderately malnourished. (The patient has weight loss, poor diet, moderate loss of subcutaneous tissue)
- c) Severely malnourished. (The patient has obvious signs of malnutrition: severe loss of subcutaneous tissue, loss of muscular mass).

$p < 0.05$ defined as the alpha value. The chi square test ($p < 0.05$) was used to compare mortality and complications of the two cohorts, with the Yates correction as needed. The power of association between the variables was calculated as relative risk (RR) with a 95% confidence interval. Variables considered to be risk factors for morbidity and mortality (risk of malnutrition according to SGA, age, injury severity score (ISS)¹⁶, surgery, admission to ICU, hypoalbuminemia, anemia, sex) and length of hospital stay were analyzed using a multinomial logistic regression model.

Sample size was calculated using a pre-test, for an expected difference of 40% of mortality, two-tailed alpha of 0.05 and beta 0.20. Hulley's table 13B (1993)¹⁷ showed a sample size of 23 patients per cohort.

Table II
Patients' characteristics obtained by the subjective global assessment

Clinical history

<i>Factor</i>	<i>Patients</i>
Weight loss	5
Changes in the oral intake	
Insufficient solid oral diet	14
Exclusive liquid oral diet	2
Hypocaloric liquid oral diet	11
Fast	14
More than 2 weeks GI Symptoms	
Dysphagia	2
Nauseas	1
Vomits	1
Abdominal pain	6
Anorexia	4
Diarrhoea	
Functional Capacity	
Limited capacity	1
Ambulatory	
In bed	4
Metabolic Stress	
Low stress	10
Moderated stress	43
High stress	10

Physic exam

	<i>Low</i>	<i>Moderated</i>	<i>Severe</i>
Loss of subcutaneous fat mass (triceps, thorax)	19		
Malleolar Oedemas	3		
Loss of muscular mass (cuadriceps, deltoides)	16	3	
Sacrum oedemas	1		

Results

A total of 161 patients were evaluated, 94% of which were male. Median age was 27 (range 14-92), with 13% of patients aged over 50. Most patients, 74%, were from rural areas. A total of 37% of patients were admitted to general surgery, 17% to maxillofacial surgery, 22% to orthopaedics and 24% to the ICU.

The most frequent mechanisms of trauma were stab wounds (in 25% of patients), motor vehicle accidents (20%), gunshot wounds (18%), free falls (8%) and electrical injuries (5%). The most frequent anatomic sites of injury were head trauma (25%), thoracic trauma (16.6%), limb injuries (15.4%), abdominal injuries (14%), and polytrauma (4%). Median of injury severity score (ISS) was 20 (range 1-39).

Table III
Mortality and risk factors. Univariate analysis (n = 161)

Risk factor	Mortality n (%)	Survival n (%)	RR	95% CI
Albumin < 3.4 g/dl	11 (20)	43 (80)	2.1	1.4-81*
≥ 3.4 g/dl	10 (9)	97 (91)		
Risk of malnutrition	10 (15)	55 (85)	1.3	0.6-2.9
Well nourished	11 (11)	85 (89)		
Admission to ICU@	18 (46)	21 (54)	18.7	5.8-60.3*
Other services	3 (2)	119 (98)		
Male	20 (13)	131 (87)	1.32	0.2-8.9
Female	1 (10)	9 (90)		
ISS [§] > 20	7 (27)	19 (73)	2.6	1.2-5.8*
≤ 20	14 (10)	121 (90)		
Hemoglobin < 12 g/dl	1 (7)	13 (93)	0.5	0.08-3.62
≥ 12 g/dl	20 (14)	127 (86)		
Surgical treatment	7 (8)	82 (92)	0.4	0.1-0.9
Medical treatment	14 (19)	58 (81)		
Age > 50 years	3 (14)	18 (86)	1.2	0.4-3.9
≤ 50 years	16 (12)	122 (88)		

* p < 0.05. @ICU = Intensive Care Unit. [§] ISS = Injury Severity Score.

According to the SGA, 40% (n = 65) of patients had moderate malnutrition or were at risk of malnutrition (table II) and there were no severely malnourished patients.

Of all patients studied, 58.4% (n = 94) had complications. Overall mortality was 13% (n = 21) and the median length of hospital stay was 17 days (range 1-139 days).

Univariate analysis showed a significant correlation between increase in mortality, and admission to ICU (46% vs 3%) and ISS > 20 (27% vs 10%). Surgery was associated with greater survival. No significant correlation was found between mortality, age over 50 years or risk of malnutrition according to SGA (table III). Multivariate analysis showed that risk of malnutrition according to SGA and admission to ICU were significant risk factors for mortality (table IV).

According to univariate analysis, complications were significantly more frequent among those at risk of malnutrition than among the well nourished (71% vs 50%) and among those with ISS > 20 than among those with ISS ≤ 20 (88% vs 53%). There was no significant relation between rate of complications and admission to ICU, or surgery (table V). Multivariate analysis showed a significant correlation between

complications, risk of malnutrition and ISS > 20 (table VI).

Length of hospital stay of over 14 days had a significant correlation with risk of malnutrition (63% vs 47%). Surgery was correlated with a hospital stay of less than 14 days (table VII). Multinomial logistic regression showed a significant correlation between risk of malnutrition, ISS > 20 and length of hospital stay (table VIII).

Discussion

In the present study in trauma patients at hospital admission, it was found a high prevalence of moderately malnutrition or risk of malnutrition. This observa-

Table IV
Significant risk factors for mortality. Multivariate analysis

Risk factor	p	RR	95% CI
Risk of malnutrition	0.04	4	(1-15)
Admission to ICU*	0.0001	53	(12-234)

*ICU = Intensive Care Unit.

Table V
Complications and risk factors. Univariate analysis *n* = 161

<i>Risk factor</i>	<i>Patients with Complications n (%)</i>	<i>Patients with no complications n (%)</i>	<i>RR</i>	<i>95% CI</i>
Albumin < 3.4 g/dl	36 (67)	18 (33)	1.23	0.9-1.5
≥ 3.4 g/dl	58 (54)	49 (46)		
Risk of malnutrition	46 (71)	19 (29)	1.4	1.1-1.8*
Well nourished	48 (50)	48 (50)		
Admission to ICU®	24 (62)	15 (38)	1	0.8-1.4
Other services	70 (57)	52 (43)		
Male	87 (63)	64 (37)	0.8	0.5-1.2
Female	7 (70)	3 (30)		
ISS [§] > 20	23 (88)	3 (12)	1.7	1.4-2*
≤ 20	14 (10)	121 (90)		
Hemoglobin < 12 g/dl	11 (79)	3 (21)	1.4	1-1.9
≥ 12 g/dl	83 (56)	64 (44)		
Surgical treatment	52 (58)	37 (42)	1	0.7-1.3
Medical treatment	42 (58)	30 (42)		
Age > 50 years	14 (67)	7 (33)	1.2	0.8-1.6
≤ 50 years	80 (59)	58 (41)		

* *p* < 0.05 . ®ICU = Intensive Care Unit. §ISS = Injury Severity Score.

tion calls attention because the patients were primarily young workers in rural areas. The frequency of malnutrition found by us is similar to that found in other medical or surgical adult patient populations^{18,19} who generally are older and have chronic diseases which are expected to be at greater nutritional risk than acute trauma.

Although previous studies have shown the impact of nutritional status on morbidity, mortality and length of hospital stay^{20,21}, there is little information about the clinical course of trauma patients in relation to their nutritional status²²⁻²⁵. Therein lies the importance of the present work, in which we demonstrate that young trauma

patients at risk of malnutrition had a significantly higher rate of overall complications (71% vs 50%) and an increase in length of hospital stay (63% of those at risk of malnutrition had a hospital stay of over 14 days vs 47% of those who were well nourished).

A multinomial logistic regression model was used to determine the effect of malnutrition as an independent variable on clinical course in trauma patients, as other factors, such as injury severity, admission to ICU, surgery and others may be confounding variables. Our results show that previous malnutrition is an independent predictive factor for mortality, morbidity and an increase in length of hospital stay in trauma patients. It is interesting that surgery initially appeared as a protective factor against mortality and length of hospital stay, but this did not stand the test of multivariate analysis, possibly because we included 25% of patients with head trauma whose prognosis was more severe and who were not surgical candidates.

Based on these results, it can be concluded that for trauma patients, the risk of malnutrition is one of several factors, including admission to the ICU and injury severity, associated with an unfavourable clinical course.

Table VI
Significant risk factors for complications on multivariate analysis

<i>Risk factor</i>	<i>p</i>	<i>RR</i>	<i>95% CI</i>
Risk of malnutrition	0.003	2.9	(1.4-5.8)
ISS [§] > 20	0.001	8.4	(2.3-29.9)

§ISS = Injury Severity Score.

Table VII
Prolonged hospital stay and risk factors. Univariate analysis (n = 161)

Risk factor	Stay > 14 days n (%)	Stay ≤ 14 days n (%)	RR	95% CI
Albumin < 3.4 g/dl	30 (56)	24 (44)	1	0.8-1.4
≥ 3.4 g/dl	56 (52)	51 (48)		
Risk of malnutrition	41 (63)	24 (37)	1.4	1.1-1.8*
Well nourished	45 (47)	51 (53)		
Admission to ICU®	19 (49)	20 (51)	0.9	0.6-1.3
Other services	67 (55)	55 (45)		
Male	80 (53)	71 (47)	0.9	0.5-1.5
Female	6 (60)	4 (40)		
ISS [§] > 20	17 (65)	9 (35)	1.3	0.9-1.7
≤ 20	69 (51)	66 (49)		
Hemoglobin < 12 g/dl	10 (71)	4 (29)	1.4	1-1.9
≥ 12 g/dl	76 (52)	71 (48)		
Surgical treatment	39 (44)	50 (56)	0.7	0.5-1.9
Medical treatment	47 (65)	25 (35)		
Age > 50 years	14 (67)	7 (33)	1.3	0.9-1.8
≤ 50 years	71 (51)	67 (49)		

* p < 0.05 . ®ICU = Intensive Care Unit. §ISS = Injury Severity Score.

It has been shown²⁶⁻²⁸ that an adequate intervention can prevent hospital malnutrition and that early detection of malnutrition with a nutritional evaluation can decrease complications, length of hospital stay, and hospital costs.

Future studies should evaluate the effect of malnutrition on subgroups of trauma patients with similar diagnoses, and the effects of nutritional treatment, which was not evaluated in this work. It should be remarked that, in nutrition, scientific discoveries can be based on deduction of hypotheses, as it is not ethical

to randomize a group of patients for feeding and another group for fasting. Large reviews have been published on the negative effects of malnutrition on the immune system, gastrointestinal tract, skin, and loss of muscle mass and consequently the deleterious effects on clinical course²⁹, and yet not all health care professionals are aware of the need of adequate nutritional support.

Epidemiologists define a “common disease” as one with a prevalence of 10%³⁰. Malnutrition can therefore be termed as a very common disease in hospitalized patients. Therefore, it is wise to treat the disease and feed the patient. In trauma, efforts had been done in order to evaluate the most effective type of formula³¹, the need for early enteral nutrition, the best route for the administration of nutrients and the potential advantages of immunomodulatory diets³².

Nutritional therapy use in the clinical course of patients who cannot eat during their disease may be compared to that of mechanical respiratory assistance in patients with respiratory failure. If malnutrition can also determine the trauma patient’s clinical course,

Table VIII
Significant risk factors for hospital stay greater than 14 days. Multivariate analysis

Risk factor	p	RR	CI
Risk of malnutrition	0.01	2.3	(1.2-4.7)
ISS [§] > 20	0.03	2.8	(1-7.3)

§ISS = Injury Severity Score.

health care teams should take note and evaluate the nutritional status at admission, to detect patients at risk of malnutrition. Optimal nutritional assessment could then be employed in the attempt to decrease the rate of complications.

Conclusion

In the conditions of the present observations it can be concluded that the risk of malnutrition is frequent in adult trauma patients on admission in Paraguay. It must be diagnosed early on, as it is an independent risk factor for morbidity and mortality, and prolongs the length of hospital stay.

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