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Prognostic nutritional index associated with a risk of mortality in patients with abdominal sepsis in the intensive care unit

Abstract

Introduction: Sepsis of abdominal origin represents a common cause of morbidity and mortality in the intensive care unit (ICU), it can represent an increase in it when associated with complications such as the development of septic shock and the requirement of a surgical intervention, adding to the poor nutritional status of the patient. Biochemical markers and objective indices can be used to evaluate the nutritional status of this type of pathology. In this study, the Prognostic Nutritional Index (PNI) was used to associate the risk of mortality in this pathology.

General objective: To determine the association between the prognostic nutritional index and mortality in patients with abdominal sepsis in the intensive care unit.

Methodology: A retrospective, longitudinal analytical study was carried out in a second-level hospital of care of patients admitted to the ICU with the diagnosis of abdominal sepsis, determining the value of the prognostic nutritional index at different times, comparing it with the cut-off point reported in the literature (45 points) and associating it with the risk of mortality.

Results: A total of 195 patients who met the inclusion criteria were obtained, 61% were male, at an average age of 45 years, the main cause of abdominal sepsis was peritonitis due to intestinal perforation and 59.5% of the patients developed septic shock. A cut-off value of the prognostic nutritional index was determined in patients with abdominal sepsis less than 30 before admission and at the time of admission and 72 hours, a value of 32 was identified to associate mortality risk with an OR of 3.16 (95% CI 1.48-6.76), 2.9 (95% CI 1.36-6.17) and 2.29 (95% CI 1.08-4.85) respectively. Mortality was 34 patients (17.4%) with a mean hospital stay of 5 days.

Conclusion: In the present study, it was found that PNI at admission under 30 and 72 hours under 32 hours is associated with a risk of mortality in patients with abdominal sepsis in the intensive care unit.

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Introduction

Sepsis continues to be a highly prevalent pathology in intensive care units despite studies, guidelines, and advances in the care of this disease, with an incidence of more than 50%.[1] In the context of sepsis, it has been documented that there is an increase in long-term mortality, patients who have suffered sepsis come to suffer from physiological, physical and psychological deficiencies of all systems and organs.[2] Identifying patients at risk of complications such as the elderly, admission diagnoses that affect the respiratory or circulatory system, abdominal and that cause greater severity of the acute disease, the existence of associated comorbidities such as malnutrition, diabetes mellitus, chronic kidney disease, chronic heart failure, chronic obstructive pulmonary disease can reduce or increase mortality and days of stay in the ICU.[3]

Patients with sepsis have catabolic stress and a systemic inflammatory response; therefore, having an adequate nutritional status impacts the patient's prognosis in terms of survival and adequate outcomes.[4,5] **Patients in critical condition who manage to stay longer than 48 hours in the ICU must be considered to be at risk of malnutrition.** Ideally, in these patients, it is important **to perform a clinical evaluation to determine the risk of malnutrition in the ICU.**[6] For this there are nutritional assessment tools in patients with critical illness, determining nutritional risk such as the NUTRIC score, which is a tool developed to assess nutritional risk in patients admitted to the ICU, the use of this tool can be complemented with a general clinical evaluation including anamnesis, assess if there is an involuntary weight loss or even if there is a decreased physical performance prior to admission to the ICU, physical examination, and general assessment of body composition.

Other tools for the assessment of nutritional status are the nutritional risk index, the 2002 nutritional risk screening, and the subjective global assessment. However, some literature highlight that these tools can be difficult to use in clinical practice, this is due to their complexity for practical and objective application. In addition, some of the parameters used by these tools are not always available, such as weight change, which may be unknown.[7]

Other scores that are used as objective markers for nutritional status are the Prognostic Nutritional Index (PNI) (Bullock 2020), the geriatric nutritional risk index (GNRI) and the Controlling Nutritional Status (CONUT), which are different nutritional scoring systems that together can be related to unfavorable outcomes in different pathologies.[8]

The PNI was devised in 1984 as a risk score that relates postoperative complications to baseline nutrition, using albumin and lymphocyte counts.[9] This index was initially developed to assess preoperative nutritional status and predict postoperative complications in patients undergoing gastrointestinal cancer surgery. For its determination, the PNI is calculated using the serum albumin concentration and the peripheral blood lymphocyte count. Their calculation is easily reproducible, using the following equation: [(10

× serum albumin (g/dL)) + (0.005 × total lymphocyte count)] and initially cut-off points <40 and <45 were suggested to predict the risk of surgical complications.[10]

PNI has been used as a predictor of preoperative morbidity and mortality in different pathologies such as acute heart failure and cardiomyopathies.[11] Therefore, determining the value of the prognostic nutritional index will help us to identify patients with abdominal sepsis who have a high risk of mortality.

Material and methods

An analytical, longitudinal and retrospective observational study was carried out in the Intensive Care Unit of the Villa General Hospital, where 195 patients with the diagnosis of abdominal sepsis were admitted during the period from January 2019 to July 2024, the sample size was calculated using the Epi-info program using a 95% confidence interval, an absolute accuracy of 7% and a frequency of 58% with a total of 195 patients, which included men and women over 18 years of age, with the use of vasopressors (norepinephrine) with a standard dose of less than 0.3 mcg/kg/min, who had results of albumin and lymphocyte count. Pregnant patients, with pathologies that caused immunosuppression such as HIV or hematological diseases, as well as those who had liver diseases and who died within 72 hours in the ICU were excluded.

The PNI was calculated before admission to the intensive care unit, at admission and 72 hours of stay in the ICU, comorbidities, causes of abdominal sepsis, as well as days of stay and mortality were identified.

The study was approved by the ethics and research committee with registration number 2060103724.

Statistical analysis

Quantitative variables (age, PNI, days of mechanical ventilation and days of hospital stay) were identified according to their distribution, expressed in means and standard deviation for those of normal and median distribution, and interquartile ranges for those of free distribution. Qualitative variables (gender, comorbidities, sources of abdominal sepsis, origin of sepsis, complications, presence of septic shock, low and high PNI, mortality, presence of mechanical ventilation) were expressed in frequencies and percentages.

Analytical statistics: A cut-off point of PNI for mortality was identified three times, prior to admission, during their stay and 72 hours after, they were converted into dichotomous qualitative variables low risk or high risk and compared with PNIs with a cut-off point of 45 points as mentioned in international articles. Nonparametric U Mann Whitney tests and parametric T student tests were used for quantitative variables, as well as Chi-square tests for qualitative variables to identify the difference between mortality with PNI and patient characteristics. The odds ratio (OR) and its association with mortality were identified (.)

All statistical analyses were performed with SPSS 24.0 and values of $p < 0.05$ were considered statistically significant.

Results

Of the 195 patients, a median age of 45 was found (IQR 33; 45), 61 % were men and 39 % were women, the most frequent comorbidity in the group was type 2 diabetes in 28.2 %. The main cause of peritonitis was intestinal perforation in 26.2%. Sepsis associated with community-acquired infections occurred in 91.8% of the total population. PNI was used for nutritional assessment; a PNI of less than 45 was obtained before admission to the ICU in 67.2% of patients, at admission it was found in 67.7% of them and at 72 hours in 64.6%. Mortality was 17.4% of all patients with abdominal sepsis (Table 1). The cut-off points were identified using a ROC curve of the PNI for mortality, finding a cut-off point of 30 in the pre-admission determination, which presents an area under the curve of 0.629 95% CI: (0.523-0.736). A sensitivity of 55%, and a specificity of 71% were determined with a positive predictive value of 24% and a negative predictive value of 88%, with a positive likelihood ratio of 1.8 and a negative likelihood ratio of 0.6 (Figure 1a). The cut-off point for the PNI at admission was 30, presenting an area under the curve of 0.629 with a CI of 95%: (0.530-0.740), finding a sensitivity of 52 % and a specificity of 72 %, with a positive predictive value of 28 % and a negative predictive value of 87 %, with a positive likelihood ratio of 1.8 and a negative likelihood ratio of 0.6 (Figure Ib). Regarding the value of the PNI at 72 hours, it had a cut-off point of 32, which represents an area under the curve of 0.626 95% CI: (0.528-0.723), with a sensitivity of 52 % and a specificity of 67 %, with a positive predictive value of 25% and a negative predictive value of 87%, with a positive likelihood ratio of 1.5 and a negative likelihood ratio of 1.3 (Figure Ic).

Table 1 General characteristics of patients with abdominal sepsis

Variable	N= 195	
Age (years) IQR	45	33; 56
Male (%)	119	61
Female (%)	76	39
Comorbidities		
Type 2 diabetes mellitus (%)	55	28.2
High blood pressure (%)	51	26.2
Chronic Kidney Disease (%)	10	5.1
Causes of Abdominal Sepsis		
Peptic ulcer (%)	9	4.6
Intestinal perforation (%)	51	26.2
Anastomosis dehiscence	6	3.1
Traumatic injuries (%)	41	21
Tertiary peritonitis (%)	17	8.7
Appendicitis (%)	22	11.3
Cholangitis (%)	31	15.9
Pancreatitis (%)	31	15.9
Liver abscess (%)	3	1.5
Types of sepsis		
Community-acquired abdominal sepsis (%)	179	91.8
Healthcare-associated sepsis (%)	16	8.2
Prognostic Nutritional Index PNI		
Pre-entry (points) IQR	35	22; 49
ICU admission (points) IQR	38	23; 48
At 72 hours of admission to the ICU (points) IQR	38	25; 50
Complications		
Postoperative complications (%)	50	25.6
Infectious complications. (%)	77	39.5
Septic shock (%)	116	59.5
Mechanical ventilation (%)	164	84.1
Days of Intra-Hospital Stay	5	3; 7
Mortality (%)	34	17.4

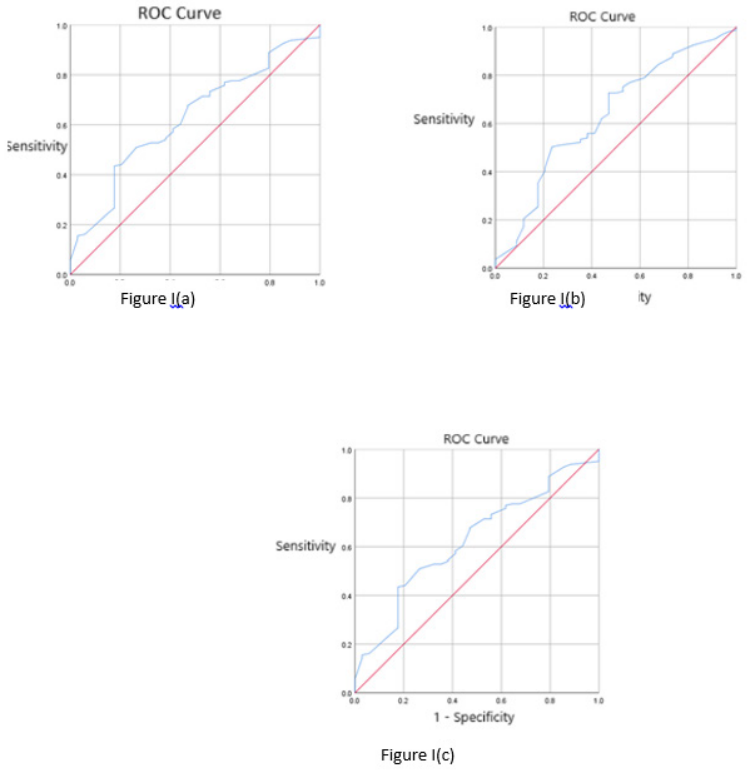

Figure 1 Cut-off points of the Nutritional Index Prognosis.

PNI cut-off point for mortality found a cut-off point of 30 in the pre-admission determination, which presents an area under the curve of 0.629 95% CI: (0.523-0.736).(Ia); The cut-off point for the PNI at admission was 30, presenting an area under the curve of 0.629 with a CI of 95%: (0.530-0.740) (Ib); The 72-hour PNI with a cut-off point of 32 which represents an area under the curve of 0.626 95% CI: (0.528-0.723) (Ic).

Univariate and bivariate analyses were performed, finding an association between PNI values and mortality; a PNI < 30 pre-admission to the ICU has 2.16 times more risk than those with a higher score, likewise, a PNI on admission to the ICU < 30 has 1.9 times the risk of dying and finally patients with PNI < 32 at 72 hours of admission to the ICU have 1.29 times the risk of mortality (Table 2). A multivariate analysis was performed adjusting the variables of PNI, comorbidities and mechanical ventilation to mortality, finding that the only one that does not lose its significance is the PNI before admission to the ICU < 30, with an OR 2.44 95% CI (1.08-5.51) *p* 0.032.

Table 2 Association of mortality with nutritional and clinical characteristics of patients with abdominal sepsis

Variables	**Univariate Analysis**			**Bivariate Analysis**	
	Mortality n= 34	Survival n=161	*p*	OR (95% CI)	*p*
Age (years)*	55(33.7; 65.0)	45 (32; 56)	0.018		
Pre-entry PNI < 30**	19 (55.9 %)	46 (28.6 %)	0.002	3.16 (1.48-6.76)	0.002
Pre-entry PNI > 30**	15 (44.1%)	115 (71.4%)	0.002		
PNI income < 30**	18 (52.9%)	45 (28%)	0.005	2.90 (1.36-6.17)	0.0046
PNI income > 30**	16 (47.1%)	116 (72%)	0.005		
PNI at 72 hrs < 32 **	18 (52.9%)	53 (32.9%)	0.027	2.29 (1.08-4.85)	0.027
PNI at 72 hrs >32**	16 (47.1%)	108 (67.1%)	0.027		
Septic shock**	32 (94.1%)	84 (52.2%)	0.001	14.6 (3.4-63.25)	<0.001
Tertiary peritonitis***	2 (5.9%)	15 (9.3%)	0.520		
Type 2 diabetes**	17 (50%)	38 (26.6%)	0.002	3.23 (1.50-6.95)	0.0031
High blood pressure**	13 (38.2)	38 (26.6%)	0.078	2.0 (0.91-4.37)	0.088
Mechanical ventilation**	33 (97.1%)	133 (82.6%)	0.032	6.94(1.22-147.7)	0.003

*Expressed in means and IQR, U Mann Whitney

**Expressed in frequencies and percentages, X2 statistical test

***Expressed in frequencies and percentages, X2 test linear association by linear

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Discussion

Since the eighties, when the usefulness of PNI was determined as a risk marker related to complications in patients undergoing gastrointestinal cancer surgery, several studies have subsequently been developed where its usefulness is not only limited to the oncological field, but has also been possible to associate this marker that evaluates the immunological and nutritional status, managing to predict mortality in different pathologies even as a risk factor for diseases In 2017, Cheng et al. reported in China the association of the PNI with a value of less than 45 to predict the risk of mortality greater than 50% in patients with acute heart failure; another study with a follow-up of more than 4 years identical to the presence of a PNI greater than 48 was associated with greater survival from cardiovascular causes.

In our study, a cut-off point of the PNI of 30 and 32 points is reported, compared to what was described by Wu et al. in 2022 who carried out a retrospective analysis of 2 669 patients diagnosed with sepsis where it was identified that a PNI, whose cut-off point was less than 29.3, as a predictive prognostic factor associated with a mortality of 26% at 30 days in patients over 66 years of age predominantly male gender with impaired liver and kidney function.

On the other hand, Shimoyama et al. in 2021, evaluated the association of presepsin, a biomarker of usefulness in sepsis, with prognostic scores of inflammation in 83 patients in ICU, within these scores the usefulness of the PNI as a tool to evaluate mortality at 28 days was highlighted and predictors of mortality were identified and a mean age of 74 years was reported as general characteristics. In males, an association of comorbidities where cancer and arterial hypertension stood out, an overall survival of 31%, development of shock in 57.8% of patients, and a PNI value of 26.6 was demonstrated. Within the analysis of this study, it is identified that the PNI has a sensitivity of 70% and a specificity of 80% to predict mortality at 28 days, it could even be used as an independent predictor of mortality in clinical settings where it does not have the possibility of determining the levels of presepsin and other markers of systemic inflammation. In our study, a sensitivity of more than 50% and a sensitivity of more than 70% were found at different times.

It should be noted that the values of the PNI are identified in the Mexican population with a diagnosis of abdominal sepsis, considering that nutrition in other countries may be better than in Mexico and that therefore the PNI is lower and is independent of mortality together with other variables.

PNI is an easy, reproducible, economical and useful tool in daily clinical practice and settings with limited resources.

Conclusion

The Prognostic Nutritional Index is a variable independent of mortality that can be combined to predict the prognosis of patients with abdominal sepsis with greater accuracy, having cut-off points < 30 with a sensitivity and specificity of 50% and 70% respectively. More studies with larger samples are needed to identify variables that may be useful for the construction of new prognostic scales in sepsis employing multivariate models.

References

1. Szakmany T, Walters AM, Pugh R, et al. Risk factors for 1–year mortality and hospital utilization patterns in critical care survivors: a retrospective, observational, population–based data linkage study. *Crit Care Med.* 2019;47(1):15–22.
2. Rahmel T, Schmitz S, Nowak H, et al. Long–term mortality and outcome in hospital survivors of septic shock, sepsis, and severe infections: the importance of aftercare. *PLoS One.* 2020;15(2):e0228952.
3. Papathanakos G, Blot S, Ho MH. Main determinants of mortality in patients with severe infection or sepsis. *Intensive Crit Care Nurs.* 2024;81:103614.
4. Compher C, Bingham AL, McCall M, et al. Guidelines for the provision of nutrition support therapy in the adult critically ill patient: The American Society for Parenteral and Enteral Nutrition. *JPEN J Parenter Enteral Nutr.* 2022;46(1):12–41.
5. Servia–Goixart L, Lopez–Delgado JC, Grau–Carmona T, et al. ENPIC Study Investigators. Evaluation of nutritional practices in the critical care patient (The ENPIC study): Does nutrition really affect ICU mortality? *Clin Nutr ESPEN.* 2022;47:325–332.
6. Singer P, Blaser AR, Berger MM, et al. ESPEN guideline on clinical nutrition in the intensive care unit. *Clin Nutr.* 2019;38(1):48–79.
7. Schuetz P, Fehr R, Baechli V, et al. Individualized nutritional support in medical inpatients at nutritional risk: a randomized clinical trial. *Lancet.* 2019;393(10188):2312–2321.
8. Shao Y, Lai QC, Duan Q, Ge P, Ye L. Nutritional indices at admission are associated with mortality rates of patients in the intensive care unit. *Eur J Clin Nutr.* 2022;76(4):557–563.
9. Buzby GP, Mullen JL, Matthews DC, et al. Prognostic nutritional index in gastrointestinal surgery. *Am J Surg.* 1980;139(1):160–167.
10. Lee JY, Kim HI, Kim YN, et al. Clinical significance of the prognostic nutritional index for predicting short– and long–term surgical outcomes after gastrectomy: a retrospective study. *Medicine (Baltimore).* 2016;95(18):e3539.
11. Cheng YL, Sung SH, Cheng HM, et al. Prognostic nutritional index and the risk of mortality in patients with acute heart failure. *J Am Heart Assoc.* 2017;6(6):e004876.

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