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CONUT index as a predictor of postoperative complications in patients undergoing intestinal reinstallation

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Introduction: Malnutrition is a serious problem in hospitalized patients, its multiple consequences and relationship with increased morbidity and mortality are widely known, CONUT is a tool for detecting malnutrition, the Clavien-Dindo classification of complications is simple, objective and reproducible, in the evaluation of surgical results.
Objective: To evaluate the use of CONUT as a predictor of postoperative complications according to the Clavien-Dindo classification.
Methods: We conducted an observational, descriptive, retrospective study in patients undergoing intestinal reinstallation at our institution from March 1, 2019 to March 1, 2021, correlating nutritional status with postoperative complications.
Results: We studied 36 patients between 19 and 82 years old, mean albumin 3.8, lymphocytes 1.5, cholesterol 151.9, mean CONUT 2.97. The most frequent complication was Clavien-Dindo 3.1 in 10 patients, grade 2 in 9 patients. CONUT score sensitivity of 52.9% and specificity of 84.2%, positive predictive value of 75% and negative predictive value of 66.7% were found to predict postoperative complications.
Conclusions: We confirmed that the preoperative CONUT score predicted postoperative complications in patients undergoing intestinal anastomosis, we found that Clavien-Dindo is perfectly feasible and reproducible to reflect postoperative complications.

Key words: CONUT, Predictor, Intestinal reinstallation, Complications, Clavien-Dindo.

Introduction

Malnutrition is a problem of great importance in the hospital setting, despite the fact that it still goes unnoticed by many specialists and those responsible for health. There are numerous studies that show that the prevalence of malnutrition in hospitalized patients ranges between 30-55%. There are many studies that have tried to develop filter tools to detect malnutrition early, but none of them is applicable to all hospitalized patients, since their evaluation parameters include some that require expert intervention (doctors, nurses, nutritionists) with each patient individually, either in the anamnesis or in the physical examination, which is not feasible and is a reason for difficulty in collaboration. The Controlling Nutritional Status (CONUT) score is a tool that is based exclusively on laboratory parameters[1], it is calculated based on the level of serum albumin, the concentration of total cholesterol in the blood and the total count of peripheral lymphocytes, and this tool is objective first updated for early detection of hospital malnutrition in 2005[2].

The CONUT system is considered to be associated with the nutritional and immunological status of the host based on these three laboratory parameters[3]. The consequences and repercussions of malnutrition are multiple and of great clinical relevance; affecting the immune system[4], the gastrointestinal tract[5], the endocrine and metabolic systems, and cardiorespiratory function[6]. It also affects the healing and healing processes of wounds[7]. All this is reflected in an increase in the economic cost of hospital care in malnourished patients[8].

CONUT is widely used as a prognostic indicator in cancer patients. Kuroda et al.[9] reported that the CONUT score tended to estimate nutritional status and predict long-term overall survival in gastric cancer patients after surgery. Gómez Candela et al. mentions that CONUT makes it possible to identify

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Variable	Normal	Mild	Moderate	Severe
Serum Albumin (gr/dL)	>3.5	3.0–3.49	2.5-2.9	<2.5
Score	0	2	4	6
Lymphocyte count (cell/mm3)	>1600	1200-1599	800-1199	<800
Score	0	1	2	3
Total Cholesterol (mg/dL)	>180	140-179	100-139	<100
Score	0	1	2	3
	Normal	Mild	Moderate	Severe
Stages of malnutrition.	Score (0-1)	Score (2-4)	Score (5-8)	Score (9-12)

Table 1. The nutritional control scale (CONUT) [15]. Stages of malnutrition.

patients at risk of malnutrition and at risk of presenting complications from admission[10]. Tokunaga et al.[11] showed that CONUT was an independent predictor of serious complications. Early postoperative CONUT score was found to be an independent risk factor for postoperative complications in patients with hepatocellular carcinoma after liver resection[12].

A meta-analysis showed that the CONUT score was useful in predicting which patients with gastrointestinal and hepatopancreatobiliary cancers have a higher risk of mortality and postoperative complications[13]. Another study was able to evaluate the relationship between the CONUT score and postoperative complications and also serve as a reliable and simple indicator that reflects the immunological-nutritional status[14]. In a study by García Vázquez et al. That malnutrition evaluated using the CONUT method was significantly related to complications, the ROC curves for all the methods evaluated showed that CONUT is the best tool[15]. The CONUT score is determined by serum albumin concentration, total cholesterol concentration, and total lymphocyte count (Table 1). Serum albumin concentration will be affected by nutritional status, infection, inflammatory response, and fluid retention status[16]. Hubner, M. et al. reported that hypoalbuminemia is a risk factor for complications after gastrointestinal surgery[17]. Galata et al. They reported that a preoperative albumin level greater than 3.26 g/dL was associated with a reduced risk of complications, and hypoalbuminemia was the only independent risk factor for major postoperative complications in patients undergoing colorectal surgery[18].

The total peripheral lymphocyte count, a necessary component of the CONUT score, indicates the immunological status of the patient[19]. Various studies have indicated that T lymphocytes affected by the systemic inflammatory response play an important role in the depression of cellular immunity[20]. It is suggested that a lower concentration of cholesterol has a detrimental effect on postoperative results by affecting the reserve of antioxidants and the inflammatory response[21]. Takagi et al. reported that a low cholesterol level was associated with postoperative complications in patients undergoing gastrointestinal and hepatopancreatobiliary surgery[22].

The serum cholesterol level also plays an important role in the poor prognosis of cancer patients, because the fluidity of the cell membrane is influenced by hypocholesterolemia, which is related to the mobility of cell surface receptors and the ability to transmit transmembrane signals[23]. In 1992, Clavien described a classification of surgical complications based on the treatment necessary to correct them[24]. However, in 2004 and together with Dindo, they redefined the categories into five grades[25]. Subsequently revised and validated in 2009, with the first multicenter study in which they verified and evaluated the efficacy of the classification to register and compare the surgical complications of different surgical techniques and medical centers, the Clavien and Dindo classification emerged as we know [26] (Table 2).

It is concluded that the proposed morbidity scale based on the therapeutic consequences of complications constitutes a simple, objective and reproducible approach for the comprehensive evaluation of surgical results. This classification

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Grade	Grade definition	Therapy mode
Grade I	Any deviation from the normal postoperative course	Does not require surgical, pharmacological, radiological or endoscopic treatment Acceptable therapeutic regimens are antiemetic drugs, antipyretics, analgesics, diuretics, electrolytes, and physical therapy Surgical site infection or small abscesses requiring a bed incision fall into this category
Grade II	Altered normal course	Pharmacological management different than in grade I Includes blood transfusions and parenteral nutrition
Grade III	Complications requiring intervention	Subclassification IIIa Complications requiring intervention performed under regional anesthesia IIIb Interventions requiring general
Grade IV	Complications that threaten the life of patients	Subclassification IVa Organ dysfunction IVb Multi-organ dysfunction
Grade V	Patient death	

Table 2. Clavien-Dindo classification[26].

appears to be applicable in most parts of the world and can even be used by less experienced surgeons. The wide implementation of this classification in the surgical literature can facilitate the evaluation and comparison of surgical results between different surgeons, centers and therapies[27].

The committee of European experts, in its resolution on feeding and nutritional care in hospitals, recommends the implementation of rapid, easy-to-use and evidence-based screening methods that allow malnourished patients to be detected, the report insists on the importance of screening for malnutrition during the first 24-48 hours of admission, it should be a quick and easy-to-use filter method, based on reliable, cheap and easy to obtain measures and procedures, which allow covering almost the entire hospitalized population[28]. Analytical methods are indicators of risk and nutritional prognosis, and they are simpler, more reliable, more versatile and more efficient[29].

In a study of patients who were candidates for esophagectomy, logistic regression analysis suggested that moderate or severe malnutrition previously assessed by the CONUT was an independent risk factor for any morbidity and for severe morbidity[30]. The recent work of García Vázquez et al, studies the predictive validity of CONUT in polypathological patients, demonstrates its validity in the detection of complications, and mortality, according to its results CONUT can be considered, in addition to a simple tool for detecting the risk of malnutrition, a predictor of morbidity and mortality, it allows early screening to be carried out in a simple, cost-effective, evidence-based and universal way[15].

There are multiple studies that correlate malnutrition with an increased rate of anastomosis dehiscence, suboptimal response to healing, and infectious complications [31-32]. Gutiérrez Rangel et al, evaluated the nutritional status and the impact in post-operated intestinal anastomosis patients, showed in their study that there was a higher prevalence of anastomosis dehiscence in their group of malnourished patients compared to the well-nourished group[33]. The objective of the present study was to evaluate the potential use of the CONUT scale as a method to predict post-surgical complications according to the Clavien-Dindo classification.

Methods

We conducted an observational, descriptive, retrospective study with patients aged 18 to 80 years who underwent scheduled intestinal reinstallation at our institution in the period from March 1, 2019 to March 1, 2021. Data on nutritional status, epidemiology and complications of patients undergoing intestinal reinstallation surgery were collected. The patients were divided into 4 groups depending on the preoperative CONUT in normal, mild, moderate and severe, then we calculate the association of the patient's CONUT and postoperative complications, patients with CONUT $\geq$ 2 were considered malnourished. The CONUT cut-off point was established > 3 to separate the patients into 2 groups to measure their association with the Clavien-Dindo scale. The Clavien-Dindo classification method was used to classify postoperative complications and avoid bias, we analyzed the correlations of nutritional status with postoperative complications. Mild complications included those classified as grades I to II according to the Clavien-Dindo system, and major complications included those classified as grades III to IV.

This study was approved by the research ethics committee of our institution, which adheres to the research treaties and regulations applicable in Mexico.

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		Frequency	Percentage
Grade	0	5	13.9 %
	1.0	5	13.9 %
	2.0	9	25.0 %
	3.1	10	27.8 %
	3.2	2	5.6 %
	4.1	2	5.6 %
	4.2	2	5.6 %
	5.0	1	2.8 %
	Total	36	100 %

Table 3. Frequency of complications according to Clavien Dindo.

STATISTIC ANALYSIS

Statistical analysis was performed with SPSS 25.0 (Armonk, NY: IBM Corp). The mean ± SD or median (range) is used to represent continuous data, while categorical data is presented as numbers (%). Student's t-test was performed for continuous variables depending on the normality of the data distribution, and Pearson's 2-test was obtained to analyze categorical variables, as appropriate. Significant associations were assessed from univariate analyzes and identified independent predictors of complications were then analyzed using linkage analysis. A value of p <0.05 is estimated to be statistically significant.

Results

Study population and basic characteristics.

It was found that, of a total of 38 patients, 36 patients were included in the study, 2 patients were excluded for not having the necessary laboratory data to perform the CONUT score (Figure 1); 36 patients aged between 19 and 82 years were included, with an arithmetic mean of 43.3 and standard deviation. ± 17.4 Their distribution by gender was 24 males (66.7%) and 12 (33.3%) females. With a mean age for female patients of 54.58 SD ± 13.7, for male patients 37.7 years SD ± 16.5.

Regarding albumin levels, a mean of 3.8028, SD 0.63559, lymphocyte levels mean 1.5542, SD 0.70714, cholesterol levels mean 151.9, SD 32.4. Presenting a mean CONUT score of 2.97, median 2.00, mode 1, SD 2.7, minimum 0, maximum 9. After surgery, 5 patients (13.9%) recovered without incident, 14 patients (38.9%) presented minor postoperative complications, and 17 patients (47.2%) had major postoperative complications.

The most frequent complication in our hospital was grade 3.1 in 10 patients (6 patients seroma drainage, 4 patients surgical cleaning under anesthesia) (27.8%), grade 2 in 9 patients (5 patients with parenteral nutrition, 4 blood transfusion) (25 %), 5 patients (13.9%) with surgical site infection treated with antibiotics, 2 patients were reoperated for intra-abdominal abscess (5.6%), 2 patients with anastomosis dehiscence in addition to acute kidney injury (5.6%), 2 patients with anastomosis dehiscence also acute respiratory failure and acute kidney injury (5.6%), 1 patient with anastomosis dehiscence with Clavien Dindo V (2.8%) (Table 3). The mean number of days of stay was 6.14 days, SD 2.38, minimum 4, maximum 13 days.

Factors associated with postoperative complications

Univariate and multivariate analyzes were performed to identify factors associated with complications. With a CONUT score sensitivity of 52.9% and specificity of 84.2%, positive predictive value (PPV) of 75% and negative predictive value (NPV) of 66.7% to predict postoperative complications. A contingency table of the CONUT and Clavien Dindo score is shown, a Pearson Chi-square P = 0.003 was obtained (Table 4).

Univariate analysis showed that preoperative albumin, bleeding, and CONUT score were associated with complications. The Spearman's Rho, Pearson's Chi-square correlation analysis identified albumin, bleeding and the CONUT score as independent risk factors associated with postoperative complications according to the Clavien Dindo scale (P=0.002, P less than 0.000, P = 0.003).

Discussion

CONUT was first proposed as a comprehensive scoring system to assess the nutritional and immunological status of a patient[34]. In addition to its usefulness in evaluating nutrition, CONUT has been reported to be a prognostic factor[35-36].

In patients undergoing intestinal reinstallation, malnutrition plays an important role as a risk factor for postoperative complications. CONUT has been reported to have a prognostic impact on survival in hospitalized patients [37]. In the present study, our results related high CONUT scores in patients undergoing intestinal reinstallation with poor postoperative outcomes. On the other hand, the CONUT score was found to be an independent risk factor for postoperative complications in patients undergoing intestinal anastomosis.

Regarding the three CONUT components, the serum albumin value has twice the weight of the other parameters. Serum albumin is a strong marker of the host's nutritional status, is closely correlated with the degree of malnutrition, and correlates with prognosis[38].

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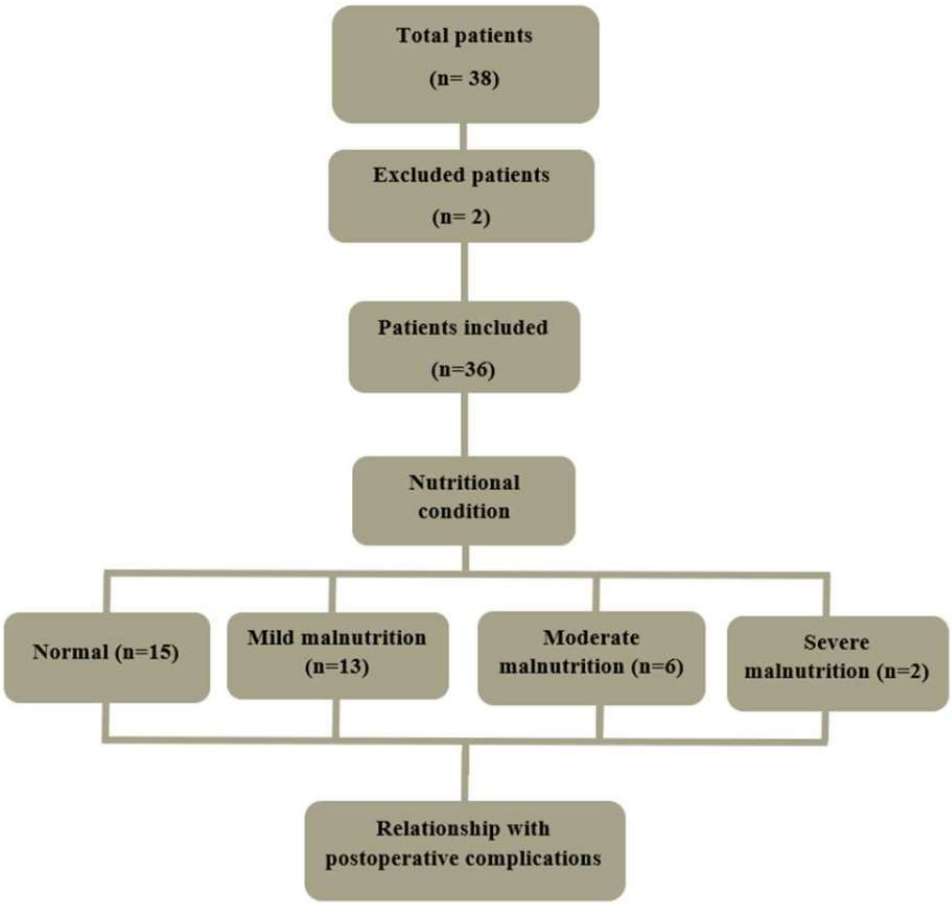

Figure 1. Flowchart of the CONUT score in the study.

Low serum albumin levels may be caused by proinflammatory cytokines such as interleukin-6 or tumor necrosis factor alpha, which modulate albumin synthesis by hepatocytes[39]. Serum albumin values are also affected by liver function and changes in body fluid volume[40]. Hypoalbuminemia is the only independent risk factor for major postoperative complications, preoperative nutritional optimization is recommended in patients with low albumin levels to minimize postoperative complications[41]. Hypoalbuminemia is often related to poor tissue healing, reduced collagen synthesis at anastomoses, and impaired cell-mediated immune responses such as macrophage activation, surgical site infection is commonly seen in hypoalbuminemic patients[42-43].

Our results are consistent with previous findings. Our study revealed that patients undergoing intestinal anastomosis with postoperative complications have significantly lower albumin concentrations.

It is suggested that a lower concentration of cholesterol has a detrimental effect on postoperative results by affecting the antioxidant reserve and the inflammatory response[44]. Studies suggest that a low level of serum cholesterol was correlated with morbidity and mortality after gastroenterological surgery, a decrease in the level of cholesterol implies not only a deficiency of calories, but also that the cells are deprived of an essential nutrient necessary to

		Correlation CONUT- Clavien Dindo Clavien Dindo					Total
		Grade I	Grade II	Grade III	Grade IV	Grade V	
Nutritional condition According to CONUT	Normal	8	4	2	1	0	15
	Mild Malnutrition	2	4	6	0	1	13
	Moderate Malnutrition	0	1	4	1	0	6
	Severe malnutrition	0	0	0	2	0	2
Total		10	9	12	4	1	36

Table 4. Correlation between nutritional status CONUT and Clavien Dindo. $P < 0.003$.

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maintain metabolic and hormonal balance and membrane integrity[45]. The fragility of the tissue may explain why cholesterol is associated with postoperative complications. Total lymphocyte count is also an important marker of nutrition and immunity, lymphopenia caused by systemic inflammatory response is characterized by significant depression of innate cellular immunity [46]. A meta-analysis showed that intervention with immune-enhancing nutrition increased total lymphocyte count and reduced postoperative complications [47].

Therefore, a higher CONUT score, including low cholesterol and lymphopenia, predicted poor outcomes in patients undergoing bowel anastomoses.

The current study has several limitations to acknowledge. First, this was a single center, retrospective observational analysis, the sample size was small. A multicenter prospective observational study is warranted, because the results may be influenced by our experience.

Conclusions

In conclusion, the current study confirmed that the preoperative CONUT score predicted postoperative complications in patients undergoing bowel anastomoses. Patients with a moderate CONUT score should be intensively monitored so that postoperative complications can be detected early. It may be that modifying a patient's CONUT score reduces the incidence of postoperative complications. Evaluation of the preoperative CONUT score could help clinicians in making decisions regarding surgical implications.

The Clavien-Dindo classification is increasingly used as a way to unify criteria for surgical complications. We found that it is perfectly feasible and reproducible to reflect the postoperative complications of the surgical procedure.

Conflicts of interests

The authors have no conflicts of interest to declare.

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