

Does the preoperative prognostic nutritional index predict postoperative complications in patients with colorectal cancer who underwent curative resection?



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Does the preoperative prognostic nutritional index predict postoperative complications in patients with colorectal cancer who underwent curative resection?

AIM: Malnutrition is a common and very important issue in colorectal cancer patients. The immunological and nutritional status of these patients have been reported to be correlated with the postoperative complications. The prognostic nutritional index (PNI) is an effective and simple parameter, initially created to evaluate preoperative surgical risks. The aim of this study was to evaluate the predictive value of PNI in patients with colorectal cancer who underwent surgery.

METHODS: One hundred eighty patients who underwent curative colorectal resections for colorectal cancer were included in this retrospective study. Demographic characteristics of the patients, biochemical parameters, intra-operative findings, operation type, postoperative surgical complications, and PNI values were collected. **Results:** The median PNI value was 44.4 (range 19-60.5). Receiver Operating Characteristics demonstrated that a value below 39.75 was the optimal cut-off value for the prediction of major complications. The median PNI values were significantly lower in patients with major complications (Clavien-Dindo grade 3 to 5).

CONCLUSION: The PNI can predict severe complications in patients with colorectal cancer who are undergoing primary tumor resection. Investigation of the nutritional status by using the PNI could be a useful approach for clinical follow-up.

KEY WORDS: Colorectal, Nutritional index, Postoperative complications

Introduction

Colorectal cancer is a major health concern with presenting with second cause of mortality world-wide ¹. Surgical resection is still the main stay of treatment for colorectal cancer. But, such major surgery leads to significant postoperative complications and morbidity in colorectal cancer patients ². Postoperative complications can be

defined as separation from the normal postoperative process ³. Recent studies about colorectal resections showed that one or more complications were observed in 20-30% of cases. Complications classification accepted in 1992 by Clavien and Dindo is based on the type of therapy needed to correct the complication. The classification is basic and valid. ⁴ The importance of certain risk factors such as age, nutritional status of the patient and experience of the surgeon are becoming more accepted ⁵.

The preoperative immunological and nutritional status has been reported to be correlated with long term survival in patients with colorectal cancer. Malnutrition is a common and very important issue in colorectal cancer when compared to other common cancers, and serves as a significant preoperative and postoperative risk factor ⁶⁻¹¹. The prognostic nutritional index (PNI) is an effective and simple parameter, initially created to evaluate preoperative surgical risks ¹². Markers of the nutritional status, such as the serum albumin

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concentration and PNI were reported to have prognostic value ¹³. Preoperative nutritional status correlates with the incidence of postoperative complications. The aim of this study was to clarify the impact of the PNI, which simply accounts for immunological and nutritional conditions, on major complications in patients with colorectal cancer who underwent curative resection.

Methods

We included 180 patients who underwent curative colorectal resections for colorectal cancer between January 2014 and December 2015 at Ankara Numune Education and Research Hospital. Demographic characteristics of the patients, complete blood count, biochemical parameters, intra-operative findings, type of operation, post-operative surgical complications, and PNI values were collected retrospectively from patients' medical records. PNI was calculated using the formula of: $10 \times \text{serum albumin concentration (g/dl)} + 0,005 \times \text{lymphocyte counts (number/mm}^3\text{)}$ in peripheral blood ¹¹.

Postoperative 30 day mortality, morbidities, and overall complications were selected as the postoperative outcomes. The complications were, leakage, surgical site infections, urinary tract infection, pneumonia, acute renal failure, pulmonary embolism, intra abdominal abscess and ileus. We examined the incidence of postoperative complications and correlation of the preoperative PNI value with postoperative major complications. We categorized all complications using the modified Clavien-Dindo (CD) system for grading and weighting postoperative mortality and morbidities (Table I) ². Complications that occurred within the first 30 days after surgery were classified using the CD system, for which grades 3 to 5 were considered as the major complication group. CD grade 1 and 2 were considered as the minor complication group.

STATISTICAL ANALYSIS

Numerical data are expressed as mean $\pm$ standard deviation (SD) or median (with minimum–maximum range), depending on normal distribution (Shapiro–Wilk test). Categorical variables were expressed as proportions or percentages. Unpaired Student's t-tests and Chi-square tests or Mann-Whitney U test were used for comparisons of continuous and categorical variables, respectively. A Pearson's correlation coefficient was used to determine the relation between the each PNI and other variables. The discriminatory accuracy of the PNI was estimated by constructing receiver operating characteristics (ROC) curves and measuring Area Under Curve (AUC). A *p*-value $< 0,05$ was considered statistically significant. Analyses were performed using SPSS 18.0 (SPSS Inc., Chicago, IL).

Results

One 100 (55.6%) patients were male, 80 (44.4%) were female. The median age of the patients was 62 (min: 27, max: 89). When patients were classified according to tumor localization; 68 (38%) cases had rectal and 112 (62%) cases had colonic site of location. Performed operations were; 54 (30%) right hemicolectomy, 52 (28.8%) low anterior resection, 23 (12.8%) left hemicolectomy, 20 (11.1%) anterior resection, 16 (8.9%) APR, 15 (8.3%) total proctocolectomy (Table II). 52 (28.9%) operations were laparoscopic and 128 (81.1%) were open surgery. 12 (6.7%) patients died during early postoperative stage due to causes other than cancer

TABLE I - *Modified Clavien Dindo System*

- 1 Any deviation from the normal postoperative course without the need for pharmacological treatment or surgical, endoscopic and radiological interventions.
- 2 Requiring pharmacological treatment with drugs other than such allowed for grade I complications. Blood transfusions and total parenteral nutrition are also included.
- 3 Requiring surgical, endoscopic or radiological intervention
 - 3a Intervention not under general anesthesia
 - 3b Intervention under general anesthesia
- 4 Life-threatening complication (including CNS complications) requiring IC/ICU-management
 - 4a Single organ dysfunction (including dialysis)
 - 4b Multi organ dysfunction
- 5 Death of patient

TABLE II - *Kinds of interventions*

	Open	Laparoscopic	Total
Right hemicolectomy	45	9	54 (%30)
Low anterior resection	31	21	52 (%28,9)
Left hemicolectomy	20	3	23 (%12,8)
Anterior resection	13	7	20 (%11,1)
APR	7	9	16 (%8,9)
Total proctocolectomy	12	3	15 (%8,3)
Total	128	52	130 (%100)

TABLE III - *CD grade 3 to 5*

Exitus	12 (%6,7)
Surgical site infections	10 (%5,6)
Leakage	9 (%5)
Ileus	3 (%1,7)
Acute renal failure	2 (%1,1)
Intra abdominal abscess	2 (%1,1)
Pulmonary embolism	2 (%1,1)
Total	40 (%22,3)

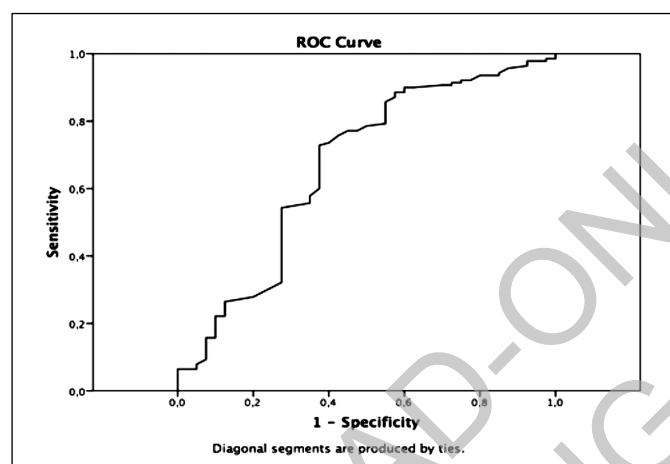
TABLE IV - Relationship with major complications between laparoscopic and open procedure groups.

	Open	Laparoscopic
CD 1 to 2	94 (%73,4)	46 (%88,5)
CD 3 to 5	34 (%26,6)	6 (%11,5)
Total	128 (%100)	52 (%100)

TABLE V - Relationship with CD and PNI

Clavien Dindo Grade	PNI median	%25	%75
CD grade 1-2	47	41,5	50,5
CD grade 3-5	39,75	33,03	49,5

TABLE VI - ROC curve analysis of PNI cut-off value (39,75)



(cardiac arrest, pulmonary insufficiency etc.). In 40 (22.2%) patients major complications (CD grade 3 to 5) were observed (Table III). Surgical complications greater than CD grade 3 were significantly decreased in the laparoscopic group versus the open procedure group (%11.5-%26.6) ($p=0.018$) (Table IV). The median PNI value was 44.4 (range 19-60.5). ROC curves and measuring AUC demonstrated that 39,75 was the optimal cut-off value.

PNI correlated with all postoperative complications. The median PNI values were significantly lower in patients with major complications (CD grade 3 to 5) ($p<0.001$) (Table 5-6).

Discussion

Nutritional status is influenced by the physiological and pathological status^{15,16}. It is well-known that malnutrition is a factor that is closely associated with the incidence of postoperative complications, length of hospital

stay, quality of life and increased mortality of malignant tumors^{17,18}. The PNI is a basic and helpful systemic inflammation based prognostic score and is calculated based on laboratory evaluation of total lymphocyte count and serum albumin level and can be a sign of the pretreated host immunological and nutritional condition^{19,20}. Low PNI was first found to be a predictor of a high risk of short-term postoperative complications in the gastrointestinal tract²¹⁻²³. In this retrospective study, we demonstrated that low PNI was associated with high risk of postoperative complications in colorectal cancer. In previous studies, some authors set the PNI cut-off value at 40 for patients with colorectal cancer²⁴⁻²⁶. In our study the optimal cut-off value for PNI was 39,75 according to the ROC curve analysis. Ikeya et al²⁷ found the optimal cut off value for PNI to be 44.5 according to the ROC curve analysis. In our study the PNI values were significantly lower in patients with major complications (CD grade 3 to 5). Mohri et al²⁸ reported that PNI was an independent predictor of postoperative complications in patients with colorectal cancer, and some studies have shown that perioperative immunonutrition significantly reduces the postoperative complications and length of hospital stay^{29,30}. However, for other kinds of malignant tumors, most studies usually set the cutoff value of PNI at 45, because PNI<45 was regarded as malnutrition and was accompanied by a high risk of postoperative complications¹⁹.

Our results suggest that postoperative complications occurred more frequently in the PNI-low group than in the PNI-high group. Also the analysis demonstrated that preoperative PNI, which is easily measurable before surgery, may be used clinically to identify patients at increased risk for postoperative complications. These results are consistent with several previous studies evaluating the predictive role of PNI in malignancies^{21,23,24}. The PNI can predict severe complications in patients with colorectal cancer who are undergoing primary tumor resection but PNI needed to be modified in patients who underwent laparoscopic resection. Laparoscopic surgery is decreasing the morbidity rate in patients. Also in our study we establish although low PNI score, patients with laparoscopic surgery have low morbidity rate.

Conclusions

From this retrospective study, we can conclude that PNI is a simple and effective marker for predicting the major complications in patients with colorectal cancer and it is important to inform the patients.

Riassunto

La malnutrizione è un elemento frequente e molto importante nei pazienti affetti da cancro colo-rettale, per-

chè lo stato immunologico e nutrizionale di questi pazienti è stato messo in relazione con l'incidenza delle complicanze postoperatorie.

L'indice nutrizionale prognostico (PNI) rappresenta un parametro semplice ed efficace creato inizialmente per valutare preoperatoriamente il rischio chirurgico.

Lo scopo di questo studio è stato quello di valutare il valore predittivo del PNI in pazienti con cancro coloretale sottoposti a trattamento chirurgico includendo retrospettivamente nello studio 180 pazienti sottoposti a resezione coloretale curativa per cancro coloretale.

Sono state raccolte le caratteristiche demografiche dei pazienti, i parametri biochimici, i reperti intraoperatori, il tipo di interventi chirurgici, le complicazioni postoperatorie ed i valori del PNI.

Il valore medio del PNI è stato di 44,4 con intervallo tra 19 e 60,5. Le caratteristiche operatorie hanno dimostrato che il valore al di sotto di 39,7 era il confine ottimale predittivo delle complicanze maggiori. I valori mediani del PNI sono risultati significativamente inferiori nei pazienti che avevano avuto le maggiori complicazioni (grado da 3 a 5 Clavien-Dindo).

In conclusione il PNI può essere predittivo di complicazioni gravi nei pazienti con cancro coloretale sottoposti a resezione primaria del tumore. Le ricerche dello stato nutrizionale con l'uso del PNI potrebbe essere un utile elemento per il follow-up clinico.

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