Original Article

Impact of Prognostic Nutritional Index on Terminal Cancer Patients

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Abstract

Background: In terminal cancer patients (TCPs), one of the most important things is to define the survival to help the main responsible physicians, patients, and main caregivers make decisions, set goals, and work across the end-of-life strategies. **Patients and Methods:** We retrospectively reviewed the medical files of TCPs, who died during September 2011 and December 2017, to recognize the correlation between prognostic nutritional indices (PNIs) and survival in those subtypes of patients. The receiver operating characteristic (ROC) curve was used to identify the cutoff value of PNI. **Results:** A total of 858 TCPs were eligible and included, the median age was 62 years (range: 18–107). The most common primary cancer sites were colorectal cancer in 151 patients (17.6%), hepatobiliary in 129 (15%), lung cancer in 115 (13.4%), breast cancer in 114 (13.3%), and genitourinary in 80 (9.3%). The mean value of PNI for all cancer types was 32.9 ± 6.7. The values showed different levels across cancer types. For patients who lived >2 weeks, PNI was 36.7 compared with that who died within 2 weeks was 29.3, which was a statistically significant ($P < 0.001$). By the ROC curve, the cutoff value of PNI was 32.3 and area under the curve was 0.888. The sensitivity, specificity, positive predictive value, and negative predictive value were 91.28% (95% confidence interval [CI]: 88.2–93.8), 71.09% (95% CI: 66.5–75.4), 76.5% (95% CI: 73.7–79.2), and 88.8% (95% CI: 85.3–91.5), respectively. **Conclusion:** The PNI is an easy and an applicable biomarker to estimate life expectancy in TCPs.

Keywords: Life expectancy, prognostic nutritional index, terminal cancer

Introduction

Nevertheless, some oncologists prescribe anticancer therapy to terminal cancer patients (TCPs) aiming to extend survival, all the same, it is not always a suitable option.[1]

Terminal cancer, also called end-stage cancer, means cancer beyond the cure. While advanced cancer may respond to therapy, terminal cancer usually has no response. Thus, the main rationales in the treatment focus on improving the quality of life and making them more comfortable.[2]

In general, oncologists and palliative care teams depend on clinical factors and nutritional status to determine life expectancy. While the Karnofsky Performance Status, Palliative Prognostic Score (PPS), and Palliative Prognostic Index (PPI) represent the main points used to define life expectancy, they are based on subjective factors affecting their accuracy.[3]

The prognostic nutritional index (PNI) was initially suggested to evaluate the nutritional status in the gastrointestinal operations included malignant tumors in the perioperative setting.[4]

The PNI is based on laboratory indicators which can be simply achieved from routine blood tests. It is calculated as 10 × serum albumin (g/dl) + 0.005 × lymphocyte count.[5]

Seeing the TCPs, a systemic review included eight evaluable published studies, provided ≥1500 predictions survival. The authors had proved that the main responsible physicians (MRPs) usually overestimate the survival in those patients.[6] Thus far, the utilization of PNI as a marker of disease behavior is not fully investigated in those subtypes of patients.

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Consequently, the aim in this work is to yield a realistic estimate about the value of the PNI in life expectancy to help the MRPs, patients, and main caregivers make decisions, set goals, and work across the end-of-life (EOL) strategies.

Patients and Methods

The current retrospective study included 858 TCPs with terminal cancer between September 2011 and December 2017 who died in the Medical Oncology Department, Zagazig University, Egypt, and King Abdullah Medical City in Saudi Arabia. The eligibility criteria included aged ≥18 years old, histopathological confirmed cancer, and the evidence of advanced disease. Patients with hematological malignancy, treatment with adjuvant or curative intent were excluded from the study. Clinicopathological data included primary site, age, sex, complete blood count, and liver function were collected from patients' files and the electronic system.

PNI was calculated as 10 × the serum albumin concentration (g/dL) + 0.005 × the total lymphocyte count (per mm^3), at the last admission before death.

Statistical methods

All statistics were done using the Statistical Package for the Social Sciences 20.0 for Windows (SPSS Inc., Chicago, IL, USA). $P < 0.05$ was considered statistically significant.

Results

A total of 858 TCPs with a median age of62 years (mean age: 60.8 ± 15.5 years) were included in the study. The most common primary sites of cancers were colorectal cancer in 151 patients, hepatobiliary in 129, lung cancer in 115, breast cancer in 114, genitourinary in 80, pancreatic cancer in 49, head-and-neck cancer in 45, gastric cancer in 43, and prostatic cancer in 22.

After a median follow-up of 14 days (range from 0 to 176 days), 49.2% of patients survived ≥2 weeks. The patients' features are illustrated in Table 1.

The mean value of PNI for all types of cancer was 32.9 ± 6.7 at the time of admission. The values showed different levels across cancer types.

For patients who lived >2 weeks, PNI was 36.7 compared with that who died within 2 weeks was 29.3, which was a statistically significant ($P < 0.001$). Table 2 revealed the PNI distribution through the included patients.

By the receiver operating characteristic curve, the cutoff value of PNI was 32.3, according to the Youden index, area under the curve (AUC) was 0.888 [Figure 1]. The sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were 91.28% (95% confidence interval [CI]: 88.2–93.8), 71.09% (95% CI: 66.5–75.4), 76.5% (95% CI: 73.7–79.2), and 88.8% (95% CI: 85.3–91.5), respectively [Table 3].

Table 1: The main patients' features (n=858)

Parameters	All, *n* (%)
Age (years)	
Mean±SD	60.81±15.49
Median (range)	62.0 (18-107)
Sex	
Male	416 (48.5)
Female	422 (51.5)
PNI	
Mean±SD	32.91±6.73
Median (range)	31.20 (23.7-59.3)
Primary cancer sites	
Colorectal	151 (17.6)
Hepatobiliary	129 (15.0)
Lung	115 (13.4)
Breast	114 (13.3)
Genitourinary	80 (9.3)
Pancreas	49 (5.7)
Head and neck	45 (5.2)
Stomach	43 (5.0)
Prostate	22 (2.6)
Others	110 (12.8)
Follow-up (days)	
Mean±SD	21.39±22.99
Median (range)	14.0 (0-176.00)
Overall survival	
>2 weeks	422 (49.2)
≤2 weeks	436 (50.8)

PNI: Prognostic nutritional index, SD: Standard deviation

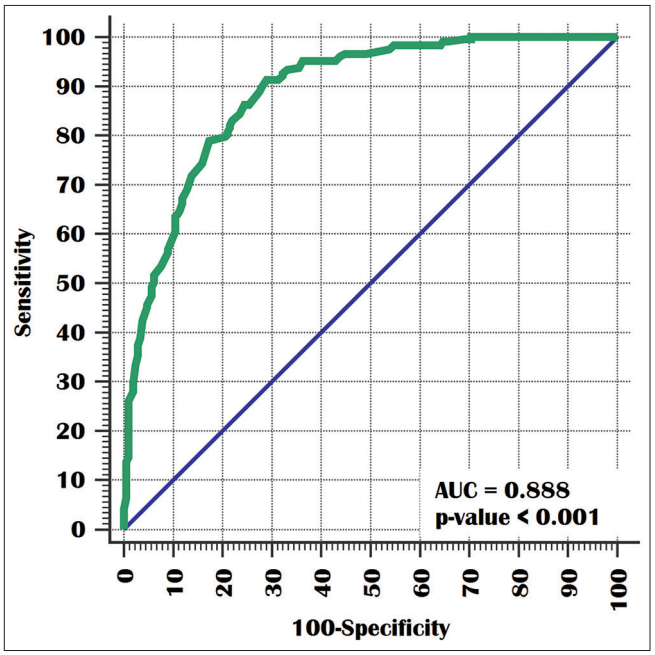

Figure 1: Receiver operating characteristic analysis of prognostic nutritional index

Discussion

In the current study, the AUC of PNI was 0.888, with a sensitivity of 91.28%, specificity of 71.09%, PPV of 76.5%,

Table 2: Prognostic nutritional index distribution through the included patients

Parameters	PNI (mean±SD)	*P*
Age (years)		
<60	33.15±6.89	0.306
≥60	32.69±6.58	
Sex		
Male	32.89±6.73	0.779
Female	32.93±6.74	
Primary cancer sites		
Colorectal	33.27±7.35	0.585
Hepatobiliary	33.40±6.52	
Lung	32.79±6.55	
Breast	32.65±6.06	
Genitourinary	32.86±6.50	
Pancreas	32.28±7.44	
Head and neck	32.25±6.48	
Stomach	32.43±7.82	
Prostate	32.25±6.47	
Others	33.22±7.01	
Total	32.91±6.73	
Overall survival (weeks)		
>2	36.71±7.54	<0.001
≤2	29.24±2.59	

P<0.05 is considered statistically significant. PNI: Prognostic nutritional index, SD: Standard deviation

Table 3: Sensitivity and specificity with prognostic nutritional index cutoff value of 32.3

	Percentage	95% CI
Sensitivity	91.28	88.2-93.8
Specificity	71.09	66.5-75.4
PPV	76.5	73.7-79.2
NPV	88.8	85.3-91.5

PPV: Positive predictive value, NPV: Negative predictive value, CI: Confidence interval

and NPV of 88.8%. This finding did not match with a previous study done by Nakamura *et al*. who showed that the sensitivity, specificity, PPV, and NPV were 74.8%, 62.2%, 68.1%, and 69.6%, respectively.[3] This deviation between the two studies may be referred to differences in sample size and primary cancer sites (in Nakamura *et al*. study, 278 patients and approximately half of the patients had colorectal and gastric cancers).

In other studies, the results were ranged from 0.648% to 0.732%, 59.6% to 82.3%, and 57.9% to 65.3% for the AUC, sensitivity, and specificity, retrospectively. However, the patients in these studies were not with terminal cancer.[7-15]

Notably, in the present study, we observed that patients with high PNI level experienced better survival compared with those with low PNI (patients lived >2 weeks, PNI was 36.7 compared with that who died within 2 weeks was 29.3, which was a statistically significant; $P < 0.001$).

This significant observation is matched with that presented previously with Nakamura *et al*., Abe *et al*., and Koyama *et al*.[3,16,17]

A systematically structured review involved 30 articles demonstrated that lymphocyte count and serum albumin are grade A evidence in estimating the life expectancy in TCPs.[18]

The survival estimation is a decisive factor for MRPs and patients in any grave illness. In TCPs, the increased significance as the goal of handling may be shifted from cancer-directed therapy to palliative care. Despite the magnitude of life expectancy in that subgroup of patients, it is almost always imperfect.[19]

The oncologists usually estimate the survival based on their clinical experience and anticipation. It is constantly optimistic and incorrect. They believed that patients should live more than they really do. A systemic review included 12 articles on clinical predictions of survival (CPS), and 19 prognostic factors reported that the clinical prediction alone is weak and incorrect.[20]

A prospective study included 343 physicians to estimate their prognostic accuracy for 468 patients with terminal illness at the hospice referral in Chicago. Only20% of physicians were accurate, and the survival overestimated by a 5.3 factor.[21]

Furthermore, through a multicenter prospective study carried out in 58, the Japanese palliative care centers involved 2036 patients to assess the accuracy of CPS and evaluate its relationship with actual survival in patients with advanced cancer into four groups (home health-care palliative team, hospital palliative teams, palliative care units, and also those receiving chemotherapy). The CPS was 35% (95%: CI 33%–37%), the pessimistic CPS was 20% (95% CI: 18%–22%), and the optimistic CPS was 45% (95% CI: 43%–47%), in the whole sample.[22]

Moreover, Gripp *et al*. conducted a prospective study on 216 patients to assess the life expectancy showed that physicians' survival estimates were uncertain, mostly in patients about death.[23]

In addition, numerous studies had reported that many TCPs continue to receive anticancer therapy they may not need it and even associated with both bad qualities of life and poor outcomes.[1,24-27] This is possibly due to a deficiency of an easy, accurate, and applicable tools for a more rigorous identification of the life expectancy in that subtype of patients.

At the EOL, patients would not prefer chemotherapy if they recognized that they held a poor prognosis. To overcome these drawbacks and improve the accuracy of the prognostication, the investigators tried to develop an index based mainly on simple laboratory tests.

PNI is different from other indices used in estimation of life expectancy as KPS, PPS, and PPI. Being based on an objective data, it can be easily incorporated into a computerized system

as well as the possibility of use as common screening index with vital signs in TCPs.

Limitations

The retrospective studies are most always accused of bias, as the data depend on the file documentations. The study did not include all types of cancers. Moreover, most of the patients used corticosteroids, as they have significances in the palliative treatment. Furthermore, the steroid hormone can induce apoptosis in lymphocytes, so PNI may be changed by the steroid effect.

Conclusion

The PNI is an easy and an applicable biomarker and can be added to routine evaluation with vital signs to estimate life expectancy in TCPs.

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Conflicts of interest

There are no conflicts of interest.

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