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ORIGINAL RESEARCH

Assessment of the Prognostic Nutritional Index in patients of Acute Heart Failure

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ABSTRACT

Background: PNI has been described as a simple and objective indicator of negative outcomes not only in chronic conditions like hepatocellular carcinoma, chronic heart failure and various cancer types, but also in acute illnesses like acute coronary syndrome, acute heart failure and stroke. To the best of our knowledge, no research has looked at the potential usefulness of PNI for CCU patients. The aim of the study was to assess the correlation between prognostic nutritional index and short-term clinical outcome in terms of mortality in patients of acute heart failure.

Methods: This prospective observational study was conducted in the department of Medicine, for a duration twenty-four months among patients hospitalized in department of Cardiology diagnosed as acute heart failure. PNI was calculated by using the formula= [10 x serum albumin(g/dl) + 0.005 x Total lymphocyte count(/mm^3)]. The patient was followed up for 28 days after discharge. The results were analysed using descriptive statistics and making comparisons among various groups. The ROC was analysed to find optimum cut off of PNI for prediction of mortality.

Results: In present study 70 patients were enrolled during defined study period. The mean age of the study cases was 55.47±11.05 years. Out of 70 cases, majority 58.6% suffered with type HFmrEF, followed by HFpEF (27.1%) while type HFrEF was diagnosed in 14.3% cases. Out of 70 admitted cases, 67 (95.7%) were survived while 3 (4.3%) were expired. The PNI level was maximum in HFrEF type (48.4±6.4) and minimum in HFmrEF type (45.0±6.0). However no significant difference was found in PNI among various types of heart failure (p=0.214).The ROC analysis to find optimum cut off of PNI for prediction of mortality resulted an optimum cut off as PNI<45.04, which had the sensitivity 100% and specificity 64.18%. It concludes that all the

mortalities had PNI score less than 45.04, however 64.18% (95% CI 52.95% - 75.41%) survived cases had PNI more than 45.04.

Conclusion: Nutritional management, may improve clinical outcomes while reducing hospitalization and medical costs, particularly in older patients with HF. As a result, for risk classification and therapeutic treatment of HF, a clinically meaningful nutritional index is recommended. PNI, which is clinically and easily accessible, was found to be an independent risk factor for cardiovascular death and overall mortality in patients with AHF who had either HFrEF or HFpEF in this investigation.

Keywords: Heart failure, prognosis nutritional index, Critical Cardiac Unit, Geriatric Nutritional Risk Measure Index, ROC analysis

INTRODUCTION

Heart failure (HF) is a complicated clinical illness caused by a functional or anatomical heart problem that prevents ventricular filling or blood ejection into the systemic circulation. It is, by definition, a failure to satisfy circulation's systemic needs. HF is still a common condition with a high morbidity and death rate across the world. It affects an estimated 26 million individuals throughout the world and adds to rising healthcare expenses[1]. According to the Global Health Data Exchange registry, there are 64.34 million cases of CHF in the globe now[2].This amounts to 9.91 million years of life lost due to disability (Years Lived with Disabilities - YLDs) and $346.17 billion in healthcare costs[2]. The age of the patient is a significant factor in the development of HF. The prevalence of heart failure (HF) rises sharply with age, regardless of the etiology or the criterion used to categorize people with HF.

The incidence of HF-related malnutrition is estimated differently depending on the population investigated and the parameters used to define malnutrition. The Controlling Nutritional Status (CONUT) score is a screening tool for identifying undernourished hospitalized patients[3]. Although it was designed to predict acute deterioration in surgical patients, a high CONUT score has been linked to a better prognosis in individuals with chronic heart failure[4,5,6]. The Geriatric Nutritional Risk Measure Index (GNRI) is an aged-specific index that has been suggested to quantify the nutrition-related risk of morbidity and death in hospitalized old patients[7]. The GNRI is also utilized for chronic illness prognosis[8] and it has recently been described as an effective screening tool for predicting prognosis for both chronic and malignant tumors[8,9]. The prognosis nutritional index (PNI), is an introduction index that measures chronic inflammation, immune system, and nutritional state in different individuals and suggests prognostic importance[8].

PNI has been described as a simple and objective indicator of negative outcomes not only in chronic conditions like hepatocellular carcinoma, chronic heart failure and various cancer types, but also in acute illnesses like acute coronary syndrome, acute heart failure and stroke [8-13]. Furthermore, among individuals with normal serum creatinine levels who had coronary artery bypass grafting, a prior study found a link between PNI and AKI[14]. To the best of our knowledge, no research has looked at the potential usefulness of PNI for CCU patients. The aim of the study was to assess the correlation between prognostic nutritional index and short-term clinical outcome in terms of mortality (in hospital and 28 days of admission) in patients of acute heart failure.

MATERIALS AND METHODS

This prospective observational study was conducted in the department of Medicine, Era's Lucknow Medical College and Hospital, Lucknow for a duration twenty-four months among patients of any gender above or equal to 18 years of age, hospitalized in department of Cardiology diagnosed as acute heart failure(new onset or acute worsening of pre-existing

chronic heart failure) of any etiology. The Sample size (n=86) was calculated on the basis of hazard ratio of PNI in cases (0.76) and the standard hazard ratio (1.0) [12]. Patients with severe liver cirrhosis (child Pugh's B and C), thyrotoxicosis, severe anaemia, cor-pulmonale, pregnancy, ESRD and sepsis /acute infections were excluded from the study. Eligible patients were enrolled in the study after obtaining informed signed written consent to participate in the same.

The patients who were hospitalized for Acute heart failure were consecutively selected for the study. The venous blood samples in supine position on 1st day of hospitalization, for TLC, albumin, and NT pro BNP; and also,2D echocardiography was done. PNI was calculated by the using formula= [10 x serum albumin(g/dl) + 0.005 x Total lymphocyte count(/mm^3)]. The patient was followed up for 28 days after discharge (on 1week, 2 weeks, and 28th day) and reminded beforehand telephonically about follow up.

DATA ANALYSIS

The results were analysed using descriptive statistics and making comparisons among various groups. Categorical data were summarized as in proportions and percentages (%) while discrete as mean ± SD. The unpaired t-test was used to compare means of various parameters between two groups (survived and expired cases). The ANOVA was used to compare means of various parameters between type of heart failure. Multivariate analysis was used to show simultaneous relationship of PNI with significant parameters of AHF taking age as confounding correlate. The ROC analysis to find optimum cut off of PNI for prediction of mortality. A two-sided (α=2) $p<0.05$ was considered statistically significant. The analysis was done in IBM SPSS version 23.

RESULTS

In present study 70 patients were enrolled during defined study period. The mean age of the study cases was 55.47±11.05 years while the mean age of males was 56.70±10.70 years. On the other hand, the mean age of females was 50.08±11.40 years. Out of 70 cases, 57 (81.4%) cases were males while rest 13 (18.6%) cases were females. Hence males were in majority with male – female ratio 4.4: 1.the mean NT pro BNP of the study cases was 13422.3±5724.1 pg/dL. The mean TLC was calculated to be 10.5814±3.8301 10^9/L, mean Lymphocyte count was 1.6988±0.8745 10^9/L, mean Albumin was 3.7±0.4 mg/dL, mean EF% was 46.8±8.5 and the mean PNI score was 46.1±6.4. Out of 70 cases, majority 58.6% suffered with type HFmrEF, followed by HFpEF (27.1%) while type HFrEF was diagnosed in 14.3% cases. Out of 70 admitted cases, 67 (95.7%) were survived while 3 (4.3%) were expired (Table 1).

Table 1. Baseline characteristics of the patients.

Variables	Mean±SD/ Frequency (%)
Age (in years)	55.47±11.05
Gender	
Male	57 (81.4)
Female	13 (18.6)
Laboratory parameters	
NTproBNP (pg/dL)	13422.3±5724.1
TLC (10^9/L)	10581.4±3830.1
Lymphocyte count(10^9/L)	1698.8±874.5
Albumin (mg/dL)	3.7±0.4
EF%	46.8±8.5
PNI	46.1±6.4
Type of HF	
HFmrEF	41 (58.6)

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HFpEF	19 (27.1)
HFrEF	10 (14.3)
Outcome	
Expired	3 (4.3)
Survived	67 (95.7)

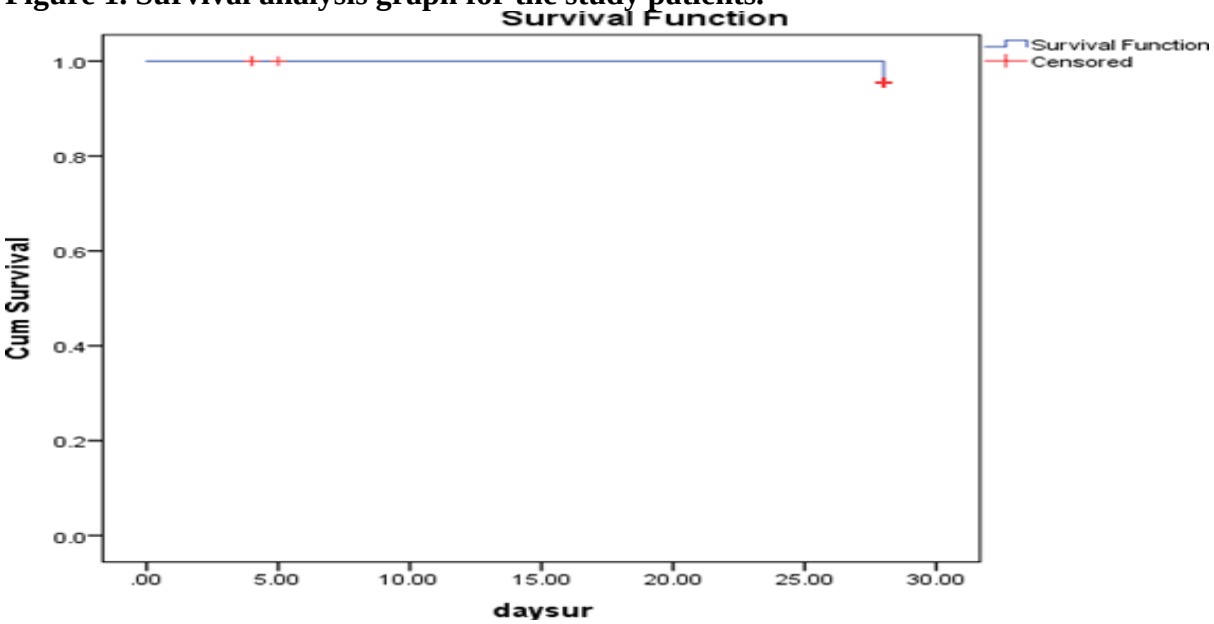
The PNI level was maximum in HFrEF type (48.4±6.4) and minimum in HFmrEF type (45.0±6.0). However no significant difference was found in PNI among various types of heart failure (p=0.214). The NT Pro BNP level was maximum in HFmrEF type (14428.3±5708.7pg/dL) and minimum in HFpEF type (11936.8±6078.1pg/dL). However no significant difference was found in Pro BNP level among various types of heart failure (p=0.218) (Table 2).

Table 2. Comparison of the variables in patients with types of heart failure.

Variables	Type of heart failure (Mean±SD)			Test of significance
	HFmrEF	HFpEF	HFrEF	
PNI	45.0±6.0	47.3±6.8	48.4±6.4	F=1.58, p=0.214
NT pro BNP (pg/dL)	14428.3±5708.7	11936.8±6078.1	12120.0±4617.1	F=1.56, p=0.218

The overall mean survival time during 28 days of follow up was 28.0±0.0 days with 95% CI (28.0-28.0 days) and median too was 28 days. This survival time estimation was limited to 28 days as it was the maximum time of follow up (Figure 1).

Figure 1. Survival analysis graph for the study patients.



The mean NT pro BNP level of the expired cases was 15400±2523.9 pg/dL, while among survived cases the mean NT pro BNP level was 13333.7±5820.3 pg/dL. However, no significant difference was observed in mean NT pro BNP between expired and survived cases (p=0.545). The mean PNI level of the expired cases was 42.9±1.8, while among survived cases the mean PNI level was 46.3±6.4. The significant difference was observed in mean PNI level between expired and survived cases (p=0.046). It showed a decreased level in expired cases (Table 3).

Table 3. Comparison of the variables in patients Acute Heart Failure (Expired vs Survived).

Variables	Outcome (Mean±SD)		Test of significance
	Expired	Survived	
NTproBNP (pg/dL)	15400.0±2523.9	13333.7±5820.3	t=-0.61, p=0.545
TLC (10^9/L)	9333.3±5522.1	10637.3±3786.6	t=0.57, p=0.568

Lymphocyte count (10^9/L)	1576.0±653.4	1704.3±886.5	t=0.25, p=0.806
Albumin (mg/dL)	3.5±0.4	3.8±0.4	t=0.97, p=0.333
EF%	48.3±2.9	46.7±8.7	t=-0.33, p=0.744
PNI	42.9±1.8	46.3±6.4	t=2.63, p=0.046

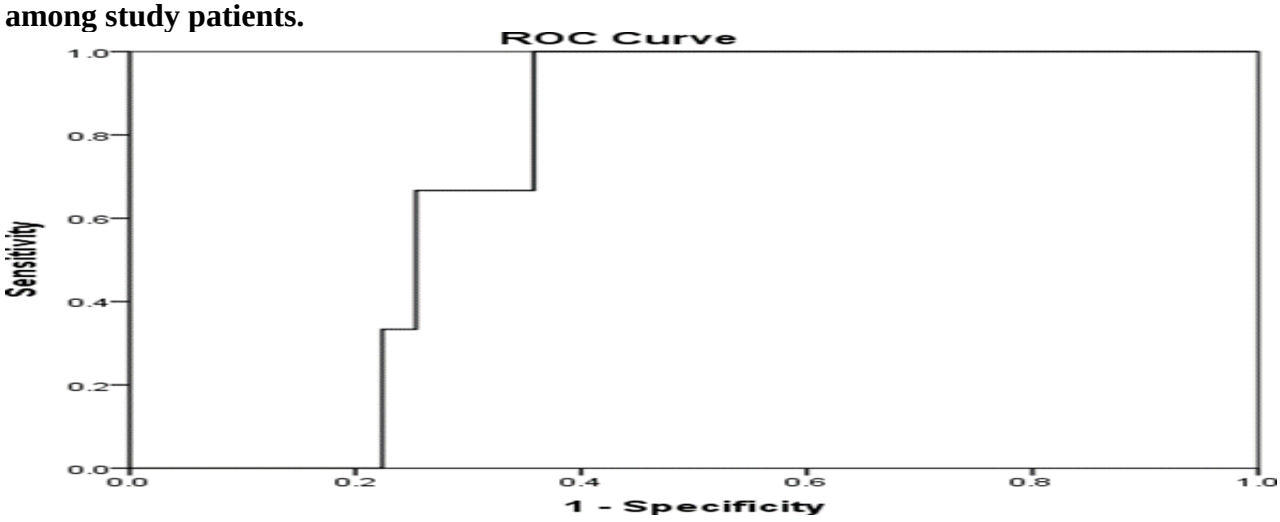
According to the multivariate analysis after taking age as confounding correlate, all the variable studied in AHF were found to be significantly correlated with PNI. Further the maximum impact of PNI was found at NT pro BNP (max effect size ή=0.85), followed by duration (ή=0.66), while minimum effect was observed at Lymphocyte count (ή=0.29) (Table 4).

Table 4. Multivariate analysis showing simultaneous relationship of PNI with significant parameters of AHF taking age as confounding correlate.

Dependent Variable		B	SE	t- value	p- value	Effect Size
NT pro BNP (pg/dL)	Intercept	51134.71	2811.23	18.19	**<0.001**	0.838
	age	12.71	25.55	0.50	0.621	0.004
	PNI	-831.75	43.76	- 19.01	**<0.001**	0.850
Lymphocyte count (109/L)	Intercept	-815.55	910.71	-0.90	0.374	0.012
	age	-15.61	8.28	-1.89	0.064	0.053
	PNI	73.01	14.18	5.15	**<0.001**	0.293
Albumin (mg/dL)	Intercept	1.31	0.42	3.11	**0.003**	0.131
	age	0.00	0.00	0.80	0.427	0.010
	PNI	0.05	0.01	7.51	**<0.001**	0.468
NYHA_28 day	Intercept	4.11	0.44	9.27	**<0.001**	0.573
	age	0.00	0.00	-0.27	0.787	0.001
	PNI	-0.06	0.01	-8.24	**<0.001**	0.515
Duration	Intercept	12.32	0.72	17.12	**<0.001**	0.821
	age	0.01	0.01	1.41	0.163	0.030
	PNI	-0.12	0.01	- 11.16	**<0.001**	0.660

The ROC analysis to find optimum cut off of PNI for prediction of mortality resulted an optimum cut off as PNI<45.04, which had the sensitivity 100% and specificity 64.18%. It concludes that all the mortalities had PNI score less than 45.04, however 64.18% (95% CI 52.95% - 75.41%) survived cases had PNI more than 45.04. The positive predictive value, negative predictive value and diagnostic accuracy of the PNI cut off level was 11.11%, 100% and 65.71% respectively (Figure 2).

Figure 2. ROC analysis showing optimum cut off of PNI for prediction of mortality among study patients.



DISCUSSION

In present study, the mean age of the study cases was 55.47±11.05 years. In a study conducted by Shukkoor et al., found results almost similar to our study where he found the mean age (SD) of the study cohort was 59.9±13.3 years [15]. However, our results were found contrasting in a study done by Cheng et al., who conducted his study over 1673 patients where mean age was observed as 76±13 years [16]. It seems that HF in Indian population is relatively at low age compared to China.

In our study, out of 70 cases, 57 (81.4%) cases were males while rest 13 (18.6%) cases were females. Shukkoor et al., also found that the majority of the patients were more likely to be males (65.9%) [15]. Ho et al., conducted a study regarding the epidemiology of heart failure which revealed that heart failure remains highly lethal, with a median survival time of 1.7 years in men and 3.2 years in women and a 5-year survival rate of 25% in men and 38% in women [17].

Analysis of various other parameters of acute heart failure was also done through this study. According to this the mean NT pro BNP level of the expired cases was 15400±2523.9 pg/dL. Another study conducted by Shobhitendu et al., found similar results where mean NT-pro BNP levels at time of admission who died within six months of follow-up was18,554 pg/dL (p=0.001) [18].

The mean TLC was calculated to be 10.5814±3.830110^9/L, mean lymphocyte count was 1.6988±0.8745 10^9/L, mean albumin was 3.7±0.4 g/dL, mean EF% was 46.8±8.5 and the mean PNI score was 46.1±6.4. When comparing our results to with the Cheng et al., study, it must be pointed out that they found the parameters as follows lymphocyte count was 1.3±0.7 10^9/L, albumin was 3.6±0.5 g/dL, mean EF% was 50±20 and Narumi et al., found that lymphocyte count was 4.3 ± 2.4×1000/μL, albumin(IQR) was 3.6 g/dL (3.0–4.0 g/dL), and PNI score (IQR) was 36.8 (31.8–40.9) [16,19].

This study also summarized the estimators of survival analysis. The overall mean survival time of the study cases was 28.0±0.0 days. As the duration was recorded only for the last follow up (28 days). So, the actual survival time was much more than this estimation. Out of 70 cases 3 patient died during hospitalization which results to mortality of 4.28%. Similar study conducted by Farmakis et al., observed prognosis of acute heart failure to be poor, with in-hospital mortality ranging from 4% to 7%; 60 to 90-day mortality ranging from 7% to 11% with median length of hospital stay ranged from 4 days to 11 days [20].Similar study conducted by Fermann et al., observed mortality has persistently been 5% to 10% at 30 days after hospital discharge and 20% to 40%, 6 to 12 months after hospital discharge [21].

In our study, the mean PNI level of the expired cases was 42.9±1.8, while among survived cases the mean PNI level was 46.3±6.4 and significant difference was observed between expired and survived cases. Our results were in line with the similar study done by Cheng et al., who found a high significant association between the PNI for total mortality [15].

The ROC Analysis to Find Optimum Cut off of PNI for Prediction of Mortality resulted an optimum cut off as PNI<45.04, which had the sensitivity 100% and specificity 64.18%. It concludes that all the mortalities had PNI score less than 45.04, however 64.18% (95% CI 52.95% - 75.41%) survived cases had PNI more than 45.04.Xue et al., through his findings revealed that the cutoff value of PNI was set as 46.91 as 298 patients (47.6%) had PNI <46.91 [22].

LIMITATIONS OF THE STUDY

The study was limited to a small finite sample size and the study not involved healthy subjects as control. So, the results were not compared with normal population parameters.

CONCLUSION

Nutritional management, may improve clinical outcomes while reducing hospitalization and medical costs, particularly in older patients with HF. As a result, for risk classification and therapeutic treatment of HF, a clinically meaningful nutritional index is recommended. PNI, which is clinically and easily accessible, was found to be an independent risk factor for cardiovascular death and overall mortality in patients with AHF who had either HFrEF or HFpEF in this study. According to the multivariate analysis after taking age as confounding correlate, all the parameters of AHF were found to be significantly correlated with PNI. Further the maximum impact of PNI was found at NTproBNP (max effect size), followed by duration, while minimum effect was observed at Lymphocyte count. PNI a simple index calculated from routine biochemistry and hemogram tests, has the potential to become a convenient tool for risk assessment and nutritional support in patients with HF.

REFERENCES

1. Savarese G, Lund LH. Global Public Health Burden of Heart Failure. Card Fail Rev. 2017;3(1):7-11.
2. Virani SS, Alonso A, Benjamin EJ, Bittencourt MS, Callaway CW, et al. Heart Disease and Stroke Statistics-2020 Update: A Report From the American Heart Association. Circulation. 2020;141(9):e139-e596.
3. Narumi T, Arimoto T, Funayama A, Kadowaki S, Otaki Y, Nishiyama S, et al. Prognostic importance of objective nutritional indexes in patients with chronic heart failure. J Cardiol. 2013;62(5):307-13.
4. Nakagomi A, Kohashi K, Morisawa T, Kosugi M, Endoh I, Kusama Y, et al. Nutritional Status is Associated with Inflammation and Predicts a Poor Outcome in Patients with Chronic Heart Failure. J Atheroscler Thromb. 2016;23(6):713-27.
5. Sun X, Luo L, Zhao X, Ye P. Controlling Nutritional Status (CONUT) score as a predictor of all-cause mortality in elderly hypertensive patients: a prospective follow-up study. BMJ Open. 2017;7(9):e015649.
6. Li L, Wang H, Yang J, Jiang L, Yang J, Wu H, et al. Geriatric nutritional risk index predicts prognosis after hepatectomy in elderly patients with hepatitis B virus-related hepatocellular carcinoma. Sci Rep. 2018;8(1):12561.
7. Bo Y, Wang K, Liu Y, You J, Cui H, Zhu Y, et al. The Geriatric Nutritional Risk Index Predicts Survival in Elderly Esophageal Squamous Cell Carcinoma Patients with Radiotherapy. PLoS One. 2016;11(5):e0155903.
8. Miyake H, Tei H, Fujisawa M. Geriatric Nutrition Risk Index is an Important Predictor of Cancer-Specific Survival, but not Recurrence-Free Survival, in Patients Undergoing Surgical Resection for Non-Metastatic Renal Cell Carcinoma. Curr Urol. 2017;10(1):26-31.
9. Wang D, Hu X, Xiao L, Long G, Yao L, Wang Z, et al. Prognostic Nutritional Index and Systemic Immune-Inflammation Index Predict the Prognosis of Patients with HCC. J Gastrointest Surg. 2021;25(2):421-427.
10. Salati M, Filippi R, Vivaldi C, Caputo F, Leone F, Salani F, et al. The prognostic nutritional index predicts survival and response to first-line chemotherapy in advanced biliary cancer. Liver Int. 2020;40(3):704-711.
11. Cheng Y, Li H, Li D, Liang L, Jia Y, Zou L, et al. Prognostic nutritional index may not be a good prognostic indicator for acute myocardial infarction. Sci Rep.;9(1):14717.
12. Cheng YL, Sung SH, Cheng HM, Hsu PF, Guo CY, Yu WC, et al. Prognostic Nutritional Index and the Risk of Mortality in Patients with Acute Heart Failure. J Am Heart Assoc. 2017;6(6):e004876.

13. Scrutinio D, Lanzillo B, Guida P, Passantino A, Spaccavento S, Battista P. Association Between Malnutrition and Outcomes in Patients with Severe Ischemic Stroke Undergoing Rehabilitation. Arch Phys Med Rehabil. 2020;101(5):852-860.
14. Dolapoglu A, Avci E, Kiris T, Bugra O. The predictive value of the prognostic nutritional index for postoperative acute kidney injury in patients undergoing on-pump coronary bypass surgery. J Cardiothorac Surg. 2019;14(1):74.
15. Shukkoor AA, George NE, Radhakrishnan S, Velusamy S, Gopalan R, Kaliappan T, et al. Clinical characteristics and outcomes of patients admitted with acute heart failure: insights from a single-center heart failure registry in South India. Egypt Heart J. 2021;73(1):38.
16. Cheng YL, Sung SH, Cheng HM, Hsu PF, Guo CY, Yu WC, et al. Prognostic Nutritional Index and the Risk of Mortality in Patients with Acute Heart Failure. J Am Heart Assoc. 2017;6(6):e004876.
17. Ho KK, Pinsky JL, Kannel WB, Levy D. The epidemiology of heart failure: the Framingham Study. J Am Coll Cardiol. 1993;22(4 Suppl A):6A-13A.
18. Kabi S, Dalai SP, Jena KK, Samal AK, Panda BN, Dhar SK. Prognostic Significance of First Week NT-ProBNP Levels in Heart Failure. Alcohol. 2018;30(18.75):8825.
19. Narumi T, Arimoto T, Funayama A, Kadowaki S, Otaki Y, Nishiyama S, et al. Prognostic importance of objective nutritional indexes in patients with chronic heart failure. J Cardiol. 2013;62(5):307-313.
20. Farmakis D, Parissis J, Lekakis J, Filippatos G. Acute heart failure: Epidemiology, risk factors, and prevention. Rev Esp Cardiol (Engl Ed). 2015;68(3):245-248.
21. Fermann GJ, Collins SP. Initial management of patients with acute heart failure. Heart Fail Clin. 2013;9(3):291-296.
22. Xue W, Tan P, Xu H, Yang L, Wei Q. Impact of the preoperative prognostic nutritional index on survival outcomes in upper tract urothelial carcinomas. Cancer Med. 2019;8(6):2971-2978.