ORIGINAL ARTICLE

Effect of prognostic nutritional index on short-term survival after transcatheter aortic valve implantation

Prognostik nütrisyon indeksinin transkateter aortik kapak implantasyonu sonrası kısa dönem sağ kalıma etkisi

Cafer Panç, M.D., Emre Yılmaz, M.D., İsmail Gürbak, M.D., Fatih Uzun, M.D., Mehmet Ertürk, M.D.

Department of Cardiology, İstanbul Health Sciences University, Mehmet Akif Ersoy Cardiovascular and Thoracic Surgery Training and Research Hospital, İstanbul, Turkey

ABSTRACT

Objective: Transcatheter aortic valve implantation (TAVI) is a good alternative to surgical aortic valve replacement (SAVR) in severe aortic stenosis patients who are at intermediate or high risk, or other cases that are considered unsuitable for SAVR. TAVI is most often performed on elderly patients, and although conventional risk scores include a number of comorbidities, they do not take into account functional decline specific to elderly patients. The prognostic nutritional index (PNI), which is a simple and effective parameter for both nutritional and inflammatory status, reflects functional decline in the elderly. The aim of this study was to determine the effect of the PNI on short-term survival after TAVI.

Methods: The PNI values of 302 patients who underwent TAVI were analyzed. The study population was divided into 2 groups according to a PNI cut-off value: PNI >43.37 (n=213; 70%) and PNI <43.37 (n=89; 30%).

Results: Patients with a lower PNI score had a significantly higher mortality rate in the initial 30-day period following the procedure than patients with a higher PNI score (3.3% vs. 31.5%; p<0.001). Major vascular complications and cardiac tamponade were significantly more frequent in the lower PNI group. The cut-off value of the PNI for 30-day survival was 43.37, with 94.3% specificity and 73.4% sensitivity and the negative predictive value of the PNI was 96.7%. The PNI score was found to be an independent risk factor for 30-day mortality after TAVI.

Conclusion: A higher PNI score was associated with short-term survival and fewer post-TAVI complications.

ÖZET

Amaç: Transkateter aort kapak implantasyonu (TAVİ), ciddi aort darlığında orta-yüksek riskli veya cerrahiye uygun olmayan hastalarda, cerrahi aort kapak değişimine iyi bir alternatiftir. TAVİ çoğunlukla yaşlı hastalara uygulanmaktadır. Geleneksel risk faktörleri birçok komorbiditeyi içermesine rağmen yaşlı hastalara özgü fonksiyonel bozuklukları içermemektedir. Nütrisyonel ve enflamatuvar durumların her ikisini içeren basit ve kullanışlı bir parametre olan prognostik nütrisyon indeksi (PNİ), yaşlılardaki bu fonksiyonel bozulmayı yansıtır. Çalışmanın amacı, PNİ'nin TAVİ sonrası kısa dönem sağ kalım üzerine etkisini araştırmaktır.

Yöntemler: TAVİ yapılan 302 hastada PNİ değeri hesaplandı. Çalışma popülasyonu PNİ'nin kestirim değerine göre iki gruba ayrıldı: PNİ >43.37 (n=213; %70) ve PNİ <43.37 (n=89; %30). TAVİ sonrası 30 günlük sağ kalımda PNİ'nin prediktif değerini değerlendirdik.

Bulgular: Düşük PNİ değeri olan hastaların 30 günlük mortalitesi yüksek PNİ değeri olanlara göre daha yüksekti. (%3.3–%31.5; p<0.001). Majör vasküler komplikasyonlar ve kardiyak tamponadın düşük PNİ grubunda daha yüksek olduğu bulundu. 30 günlük sağ kalım için PNİ'nin kestirim değeri olan 43.37'nin özgüllüğü %94.3, duyarlılığı %74.3 ve negatif prediktif değeri %96.7 idi. PNİ, TAVİ sonrası 30 günlük mortalite için bağımsız risk faktörü olarak tespit edildi.

Sonuç: Yüksek PNİ değerleri, kısa dönemde yüksek sağ kalım ve düşük TAVİ sonrası komplikasyonlarla ilişkili olarak bulundu.

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Correspondence: Dr. Cafer Panç. İstanbul Sağlık Bilimleri Üniversitesi, Mehmet Akif Ersoy Göğüs, Kalp ve Damar Cerrahisi Eğitim ve Araştırma Hastanesi, İstanbul, Turkey.
Tel: +90 212 - 692 20 01 e-mail: caferpanc@gmail.com

Aortic stenosis (AS) is the most common acquired aortic valve disorder in developed countries, with an increasing prevalence as age advances.[1] For years, surgical aortic valve replacement (SAVR) was the only effective treatment for symptomatic and severe AS. Since the mortality and morbidity risk of SAVR increases with age and comorbidities, SAVR was long considered contraindicated for elderly patients with multiple comorbidities.[2] The development of transcatheter aortic valve implantation (TAVI) in 2002 was an important breakthrough for high-risk patients.[3] Initially, TAVI was only performed in patients who were not suitable candidates for surgery due to high-risk features determined by the assessment of the heart team based on an individual risk profile and anatomical features. Following the development of new technologies, TAVI is now also performed in intermediate- and high-risk patients based on their risk scores. TAVI is most often performed on elderly patients, and although conventional risk scores, such as the Society of Thoracic Surgeons (STS) score and the European System for Cardiac Operative Risk Evaluation (EuroSCORE), include a number of comorbidities, they do not take into account functional decline specific to elderly patients. New parameters have been developed to close this gap, such as frailty, which has been associated with increased early and late mortality in several studies.[4,5] Nutritional problems caused by malnutrition and lack of energy are among the important components of frailty.

It is also known that inflammation plays an important role in the pathogenesis of AS.[6] The prognostic nutritional index (PNI) score is a simple and effective parameter based on the serum albumin level and lymphocyte count that includes both nutritional and inflammatory status. It has been demonstrated that the PNI value predicted mortality in several cardiovascular diseases.[7–9] This simple tool could provide more information for risk stratification and patient selection for TAVI. The objective of this study was to determine the effect of the PNI score on 30-day survival after TAVI.

METHODS

Study population

A total of 302 consecutive patients who underwent TAVI at a single center between October 2010 and December 2018 were included in the study. Clinical data, patient characteristics, laboratory data, echocardiography data, procedural variables, and details of the length of hospital stay were collected from hospital medical records. The local ethics committee approved the study (date: 21.11.2017, no: 2017-24).

Abbreviations:

AKI	*Acute kidney injury*
AS	*Aortic stenosis*
CI	*Confidence interval*
EuroSCORE	*European System for Cardiac Operative Risk Evaluation*
OR	*Odds ratio*
PNI	*Prognostic nutritional index*
ROC	*Receiver operating characteristic*
SAVR	*Surgical aortic valve replacement*
STS	*Society of Thoracic Surgeons*
TAVI	*Transcatheter aortic valve implantation*
TF	*Transfemoral*

Patient selection

Echocardiography was performed on all of the patients to evaluate the degree of AS. Severe AS was defined as a mean pressure gradient of >40 mmHg, jet velocity of >4.0 m/sec with aortic valve area of <1.0 cm^2, or a low flow, and low-gradient AS was defined on the basis of both a stroke volume index value of <35 mL/m^2 and a mean aortic gradient of <40 mmHg. The patients were evaluated for the suitability of intervention by the heart team, which includes at least 1 cardiologist and 1 cardiovascular surgeon. The decision between SAVR and TAVI in patients who are at increased surgical risk (STS score or EuroSCORE II ≥4% or logistic EuroSCORE I ≥10% or other risk factors not included in these scores, such as frailty, porcelain aorta, sequelae of chest radiotherapy) was made according to individual patient characteristics. TAVI was performed as has been previously described.[10] The transfemoral (TF) approach was preferred. Non-TF approaches, such as through the iliac artery, apical, subclavian, or direct aortic routes, were considered if the TF approach was inappropriate. Procedural complications, such as acute kidney injury (AKI), vascular complications, bleeding, and so forth were defined according to the Valve Academic Research Consortium-2 criteria.[11]

Follow-up

The primary endpoint was all-cause mortality within 30 days of the procedure. This was based on the surgical literature description, in which procedural mortality consists of all-cause mortality within 30 days or during hospitalization for the procedure. Clinical follow-up of the patients was performed in person when possible, or by telephone. If no information was available, the national death notification system was examined. No patient in this study was lost during follow-up.

PNI

The PNI score was calculated using the following formula: 10 X serum albumin value (g/dL) + 0.005 X total lymphocyte count in the peripheral blood (per mm^3).[12] The optimal cut-off value for a continuous PNI was calculated by applying receiver operating curve (ROC) analysis to test all possible cut-offs that would predict 30-day survival. A PNI value of 43.36 was identified through ROC analysis as the optimal value to predict 30-day survival (Fig. 1).

Statistical analysis

Analyses were performed using IBM SPSS Statistics for Windows, Version 21.0 software (IBM Corp., Armonk, NY, USA). Categorical variables were expressed as percentages (%) and Fisher's exact test or Pearson's chi-square or continuity correction tests were used for categorical variables, as appropriate. The Kolmogorov-Smirnov test was used to assess the distribution of the variables. Variables with abnormal distribution were expressed as the median (25^{th}-75^{th} percentiles), while variables with normal distribution were expressed as mean±SD. The Mann-Whitney U test was used for continuous variables without normal distribution, while Student's t-test was used for variables with normal distribution. A cut-off value for the PNI was determined using ROC curve analysis, and patients were divided into 2 groups according to that cut-off value. The sensitivity and specificity of the PNI value with the highest intersection point was used to determine the mortality prediction threshold. The 30-day survival according to PNI was determined using Kaplan-Meier analysis, and statistical significance was compared using the log-rank test. Subsequently, a predictive value of PNI for 30-day mortality after TAVI was investigated with univariate and multivariate logistic regression analyses. Variables with statistical significance in univariate analysis were used in the multivariate logistic regression analysis. The Hosmer-Lemeshow test was used to test goodness-of-fit. The results of the model were reported as an odds ratio (OR), 95% confidence interval (CI), and p value. A p value of <0.05 was accepted as statistically significant.

RESULTS

The mean age of the 302 patients was 79.14±7.60 years, and 187 (61.9%) members of the group were women. The median STS score was 10.3 (range: 8.9–11.8) and the median EuroSCORE was 18 (range: 6.8–41.6). The baseline demographic and procedur-

Table 1. Baseline patient characteristics

Characteristics	All (n=302)	PNI >43.37 (n=213)	PNI <43.37 (n=89)	*p*-value
Age, years, mean±SD	79.14±7.6	78.27±8.07	80.02±7.14	0.077
Female, n (%)	187 (61.9)	130 (61.0)	57 (64.0)	0.623
EuroSCORE, %	18 (6.8–41.6)	30.0 (7.0–45.56)	17.0 (6.1–38.0)	0.698
STS score, %	10.3 (8.9–11.8)	10.3 (8.0–11.8)	10.10 (9.0–14.0)	0.051
Coronary artery disease, n (%)	188 (62.3)	134 (62.9)	54 (60.7)	0.715
Chronic obstructive pulmonary disease, n (%)	177 (58.6)	117 (54.9)	60 (67.4)	0.045
Diabetes mellitus, n (%)	122 (40.3)	80 (37.5)	42 (47.1)	0.120
Chronic kidney disease, n (%)	90 (29.8)	59 (27.6)	31 (34.8)	0.217
Hypertension, n (%)	216 (71.5)	150 (70.4)	66 (74.2)	0.606
Coronary artery bypass surgery, n (%)	66 (21.9)	53 (24.9)	13 (14.6)	0.069
Pulmonary hypertension, n (%)	171 (56.6)	115 (53.9)	56 (62.9)	0.153
Peripheral artery disease, n (%)	101 (33.4)	69 (32.3)	32 (35.9)	0.550
Cerebrovascular disease, n (%)	8 (2.6)	6 (2.8)	2 (2.2)	0.565
Atrial fibrillation, n (%)	53 (17.5)	35 (16.4)	18 (20.2)	0.533
Permanent pacemaker, n (%)	17 (5.6)	12 (5.6)	5 (5.6)	0.434

EuroSCORE: European System for Cardiac Operative Risk Evaluation; PNI: Prognostic nutritional index; STS: Society of Thoracic Surgeons.

al characteristics of the PNI groups are presented in Table 1. The patient characteristics were similar with regard to hypertension, diabetes mellitus, previous myocardial infarction, previous coronary artery bypass graft surgery, chronic kidney disease, cerebrovascular disease, atrial fibrillation, and peripheral arterial disease. The baseline echocardiographic and laboratory parameters did not reveal any significant differences between the 2 groups, with the exceptions of albumin level and lymphocyte count. The mean PNI value was 48.6±1.6. The laboratory parameters of the groups were similar with regard to the glucose, C-reactive protein, and hemoglobin values; the glomerular filtration rate; and the platelet count. The baseline echocardiographic and laboratory parameters are presented in Table 2. The TF approach was used in 93.4% of the patients. An Edwards Sapien valve (Edwards Lifesciences Corp., Irvine, CA, USA) was implanted in 80.1% of the patients. The puncture area was most often (63.9%) closed with a Prostar closure device (Abbott Laboratories, Lake Bluff, IL, USA). The mean contrast medium volume was 163.6±92.74 mL (Table 3).

A total of 35 patients (11.6%) with all-cause death were identified during the follow-up period. All-cause death occurred in 3.3% in the higher PNI group and 31.5% in the lower PNI group. The difference between

Table 2. Baseline echocardiographic and laboratory parameters

Parameters	All (n=302)	PNI >43.37 (n=213)	PNI <43.37 (n=89)	*p*-value
Aortic valve area (cm^2)	0.76 (0.6–0.88)	0.79 (0.60–0.9)	0.70 (0.6–0.82)	0.481
Peak gradient (mmHg)	78 (67.5–92)	79 (68–92)	76 (66–90)	0.896
Mean gradient (mmHg)	48 (42–57)	48 (42–57)	49 (42–57)	0.846
Left ventricular EF, %	60 (50–60)	60 (50–60)	60 (50–60)	0.428
Glucose (mg/dL)	178±97	159±79	171±94	0.063
Creatinine (mg/dL)	1.0 (0.8–1.2)	1.0 (0.8–1.2)	1.0 (0.9–1.2)	0.209
eGFR (mL/min)	64.3 (50.4–84.3)	64.6 (50.9–85.7)	61.6 (45.6–71.9)	0.142
C-reactive protein (mg/L)	10±7	8±3	10±4	0.156
Hemoglobin (g/dL)	11 (10–12.4)	11.2 (10.1–12.6)	10.5 (9.4–12.0)	0.065
Platelet count (cells/µL)	245±71	251±70	241±64	0.098
Albumin (g/dL)	4.0±0.3	4.2±0.4	3.2±0.3	<0.001
Lymphocyte count (cells/µL)	2.0±0.7	3.0±1.1	1.5±0.6	<0.001

EF: Ejection fraction; eGFR: Estimated glomerular filtration rate; PNI: Prognostic nutritional index.

Table 3. Procedural details

Parameters	All (n=302)	PNI >43.37 (n=213)	PNI <43.37 (n=89)	*p*-value
Transfemoral approach, n (%)	282 (93.4)	198 (93.0)	84 (94.4)	
Transapical and other approaches, n (%)	20 (6.6)	15 (7.0)	5 (5.6)	0.841
Edwards Sapien valve, n (%)	241(80.1)	175 (82.2)	66 (75.0)	
Medtronic CoreValve or Abbott Laboratories Portico, n (%)	60 (19.9)	38 (17.8)	22 (25.0)	0.209
Abbott Laboratories Prostar closure device, n (%)	193 (63.9)	130 (61.0)	63 (70.8)	0.108
Cutdown with surgery, n (%)	108 (35.8)	78 (36.6)	30 (33.7)	0.630
Operation duration (min)	83.16 ± 98.53	59.20±93.49	107.12±103.58	0.207
Contrast medium volume (mL)	163.6±92.74	166.20±115.09	161±70.39	0.924
Valve size (mm)	26 (23–29)	26 (25–27)	26 (23–29)	0.792

EuroSCORE: European System for Cardiac Operative Risk Evaluation; PNI: Prognostic nutritional index; STS: Society of Thoracic Surgeons.

the 2 groups was statistically significant (p<0.001). The stroke rate was 1.7% in the whole group and was higher in the lower PNI group (range: 1.4%–2.2%; p=0.461). AKI was detected in 18.5% of the patients. Major and minor vascular complications were detected in 6.0% and 10.3% of the patients, respectively. A permanent pacemaker was implanted in 14.6% of the patients after TAVI. The incidence of AKI, major vascular complications, and cardiac tamponade was significantly higher in the lower PNI group. No significant difference was observed between the 2 PNI groups in the complications of permanent pacemaker requirement, coronary occlusion, stroke, minor vascular complication, bleeding, or valve-in-valve requirement. The postoperative complication data are shown in Table 4. The mortality rate was significantly higher in the lower PNI group when the 2 groups were compared with and without all-cause death. Lower albumin levels and higher rates of coronary occlusion, major vascular complications, and cardiac tamponade were seen in patients with mortality (Table 5).

The cut-off value of PNI determined for 30-day survival was 43.37, with 94.3% specificity and 73.4% sensitivity (Fig. 1). The area under the curve was 0.861, with a 95% CI of 0.816–0.906 (p<0.001). When the higher and lower PNI groups were compared in terms of 30-day survival, the higher PNI group demonstrated a statistically significantly higher rate (higher PNI survival rate: 96.71%; lower PNI survival rate: 68.53%; p<0.001). The negative predictive value and positive predictive value for the PNI was 96.7% and 31.4%, respectively.

Kaplan-Meier survival analysis was used to evaluate the higher and lower PNI groups in terms of 30-day mortality. The log-rank chi-square value was 49.92 (p<0.001). The higher PNI group demonstrated a better survival rate (Fig. 2).

Demographic and clinical data that may affect 30-day mortality after TAVI were analyzed using univariate analysis. Variables with p value of <0.1 were modeled and analyzed using logistic regression analysis with multivariate digits. The PNI value was found to be an independent risk factor for 30-day mortality after TAVI (Table 6). Short-term survival was associated with a higher PNI level.

DISCUSSION

The main findings of our study are 1) a 43.4 PNI cut-off value demonstrated 94.3% specificity and 73.4% sensitivity to predict 30-day survival, 2) higher PNI levels were associated with a higher rate of 30-day survival, and 3) the PNI score was found to be an independent risk factor for 30-day mortality.

Inflammation plays an important role in the pathogenesis of AS.[6] Pro-inflammatory process is observed in calcific AS at the same time.[13] TAVI is most often performed in high-risk patients, and traditional risk scores for TAVI (e.g., STS, EuroSCORE) do not include some important parameters (e.g., nutritional status, frailty, inflammation). New risk scores are currently being examined in order to overcome the limitations of traditional risk scores. In 1 study, the frailty index was used for this purpose to supplement the Eu-

Table 4. Postprocedural complications

Characteristics	All (n=302)	PNI >43.37 (n=213)	PNI <43.37 (n=89)	*p*-value
Mortality, n (%)	35 (11.6)	7 (3.3)	28 (31.5)	<0.001
New permanent pacemaker implantation, n (%)	44 (14.6)	33 (15.5)	11 (12.4)	0.600
Coronary occlusion, n (%)	2 (0.7)	1 (0.5)	1 (1.1)	0.503
Stroke, n (%)	5 (1.7)	3 (1.4)	2 (2.2)	0.461
Acute kidney injury (Stage 2 or 3), n (%)	56 (18.5)	34 (16)	22 (24.7)	0.105
Major vascular complication, n (%)	18 (6.0)	8 (3.8)	10 (11.2)	0.025
Minor vascular complication, n (%)	31 (10.3)	26 (12.2)	5 (5.6)	0.131
Bleeding, n (%)	65 (21.5)	45 (21.1)	20 (22.5)	0.916
Cardiac tamponade, n (%)	7 (2.3)	2 (0.9)	5 (5.6)	0.025
Valve-in-valve requirement, n (%)	3 (1.0)	2 (0.9)	1 (1.1)	0.651

PNI: Prognostic nutritional index.

Table 5. **Comparison of the 30-day survival rate of subgroups according to the PNI cut-off value of 43.37**

	Survival (n=267)	Death (n=35)	*p*-value
Age, years	79±8	78±9	0.377
Female, n (%)	166 (62.2)	21 (60)	0.949
EuroSCORE, %	18 (7.8–41.64)	17 (3.80–39.0)	0.698
STS score, %	10.1 (8.5–11.8)	12.4 (9.0–15.3)	0.051
Coronary artery disease, n (%)	168 (62.9)	20 (57.1)	0.633
Chronic obstructive pulmonary disease, n (%)	151 (56.6)	26 (74.3)	0.045
Diabetes mellitus, n (%)	103 (38.6)	19 (54.3)	0.110
Chronic kidney disease, n (%)	79 (29.6)	11 (31.4)	0.978
Hypertension, n (%)	193 (72.3)	23 (65.7)	0.541
Coronary artery bypass surgery, n (%)	60 (22.7)	6 (17.1)	0.617
Pulmonary hypertension, n (%)	148 (55.4)	23 (65.7)	0.331
Peripheral artery disease, n (%)	88 (33.0)	13 (37.1)	0.762
Cerebrovascular disease, n (%)	8 (3)	0 (0)	0.369
Atrial fibrillation, n (%)	45 (17.0)	7 (23.3)	0.866
Permanent pacemaker, n (%)	13 (4.9)	0 (0)	0.195
Left ventricular EF, %	60 (50–60)	60 (45–60)	0.428
C-reactive protein (mg/L)	372 (149–872)	325 (85–872)	0.703
Hemoglobin (g/dL)	11.0 (10.0–12.5)	10.7 (9.1–12.0)	0.065
Albumin (g/dL)	3.73±0.46	3.44±0.53	0.002
Lymphocyte count (cells/µL 10^9)	1.74±0.66	1.56±0.78	0.139
PNI	45.97±5.63	38.57±4.03	<0.001
PNI group			
PNI <43.37	61 (22.8)	28 (80)	<0.001
PNI >43.37	206 (77.2)	7 (20)	
Coronary occlusion, n (%)	0 (0)	2 (5.7)	0.013
Stroke, n (%)	5 (1.9)	0 (0)	0.538
Acute kidney injury (Stage 2 or 3), n (%)	50 (18.7)	6 (17.1)	1.000
Major vascular complication, n (%)	11 (4.1)	7 (20)	0.002
Minor vascular complication, n (%)	29 (10.9)	2 (5.7)	0.272
Bleeding, n (%)	57 (21.3)	8 (22.9)	1.000
Cardiac tamponade, n (%)	3 (1.1)	4 (11.4)	0.004
Valve-in-valve requirement, n (%)	1 (0.4)	2 (5.7)	0.036

EF: Ejection fraction; EuroSCORE: European System for Cardiac Operative Risk Evaluation; PNI: Prognostic nutritional index; STS: Society of Thoracic Surgeons.

roSCORE and STS scores and accounted for 58.2% and 77.6% of the predictive information.[14] Moreover, it has been suggested that frailty was associated with poorer short- and long-term results in TAVI patients.[4]

Hypoalbuminemia, which is an important aspect of frailty, has been associated with higher mortality rates after TAVI.[15] Based on these findings regarding hypoalbuminemia, it has been considered that several nutritional parameters may be related to TAVI mortality. Okuno et al.[16] showed that patients with a lower PNI and a higher Controlling Nutritional Status score had a significantly higher 1-year mortality rate and composite outcomes of mortality as well as re-hospitalization due to heart failure. The PNI, which includes both nutritional and inflammatory status based on the

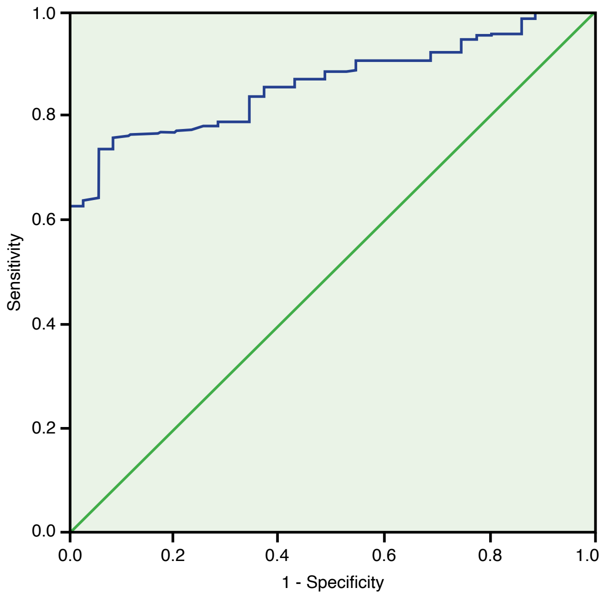

Figure 1. The ROC curve predictive cut-off value of PNI for 30-day survival. Area under the curve: 0.861, 95% confidence interval: 0.816–0.906 (p<0.001), cut-off value: 43.37 with 73.4% sensitivity and 94.3% specificity. PNI: Prognostic nutritional index; ROC: Receiver operating characteristic.

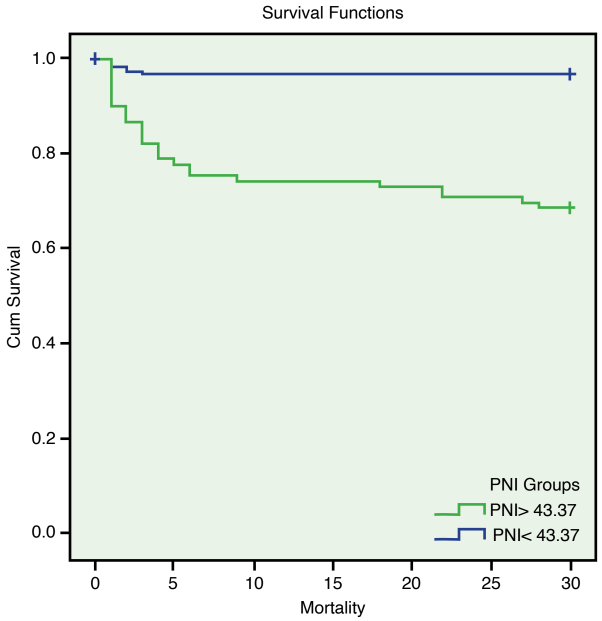

Figure 2. Graphical presentation of the 30-day survival rate of the higher and lower PNI groups. Kaplan-Meier survival analysis, log-rank chi-square: 49.92 (p<0.001). PNI: Prognostic nutritional index.

serum albumin level and lymphocyte count, is a simple and effective parameter for additional prognostic information. The PNI was first used to evaluate the relationship between preoperative nutritional status and surgical risk for some cancers.[12,17–19] The prognostic value of the PNI has also been studied in several cardiovascular diseases. Keskin et al.[8,20] observed that lower PNI levels were associated with higher mortality rates in ST-elevation myocardial infarction patients and those who underwent coronary artery bypass grafting. Shirakabe et al.[21] found that the PNI was a rapid evaluation tool that predicted long-term prognosis in acute heart failure. Narumi et al.[22] reported that a higher incidence of cardiovascular events was seen

Table 6. **Logistic regression analysis evaluation of independent risk factors that may affect 30-day mortality after TAVI**

	Univariate analysis			Multivariate analysis		
	Odds ratio	95% CI (Lower-Upper)	*p*	Odds ratio	95% CI (Lower-Upper)	*p*
COPD	2.219	1.001–4.918	0.050	1.022	0.306–3.411	0.972
Albumin	0.295	0.133–0.653	0.003	0.860	0.189–3.909	0.845
PNI	13.508	5.625–32.441	<0.001	11.013	1.967–61.661	0.006
Cardiac tamponade	11.355	2.428–53.098	0.002	670652221.8	0.000	1.000
Major vascular complications	5.818	2.088–16.212	0.001	0.000	0.000	1.000
STS score	1.099	1.010–1.196	0.029	1.113	0.992–1.248	0.067
Hemoglobin	0.810	0.654–1.005	0.055	0.801	0.545–1.178	0.260
Coronary occlusion	0.000	0.000	0.999			
Valve-in-valve requirement	16.121	1.423–182.672	0.025	6161608104.151	0.000	1.000

CI: Confidence interval; COPD: Chronic obstructive pulmonary disease; PNI: Prognostic nutritional index; STS: Society of Thoracic Surgeons; TAVI: Transcatheter aortic valve implantation.

in patients with lower PNI values. Similarly, we found that immunonutritional status as indicated by the PNI score was associated with short-term survival in TAVI patients. Therefore, this simple tool may be useful for identifying vulnerable TAVI patients.

Study limitations

This study has several limitations. First, this is a retrospective analysis of prospective cohort registry data. We did not have further mortality data to analyze the long-term prognosis. In addition, this is a single-center, nonrandomized trial. Finally, the small sample size is the most significant limitation of this study.

Conclusion

To conclude, the PNI is a simple and useful tool for assessing short-term survival after TAVI. However, the effect of the PNI score on long-term prognosis should be further investigated.

Ethical statement: The study was approved by the Local Ethics Committee (date: 21.11.2017, no: 2017-24).

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