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RESEARCH

Predictive power of the Geriatric Nutritional Risk Index for mortality in patients over 80 years of age undergoing open heart surgery

Açık kalp cerrahisi geçiren 80 yaş üstü hastalarda Geriatrik Nutrisyonel Risk İndeksinin mortalite oranını tahmin edebilme gücü

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Abstract

Purpose: This retrospective study aimed to determine the predictive power of the geriatric nutritional risk index, calculated using the preoperative albumin value of patients over 80 years old who underwent open-heart surgery, in relation to the postoperative mortality rate.

Materials and Methods: A total of 22 patients (13 males, 9 females; mean age: 82.1±2.4 years; range, 80-88 years) who underwent open elective heart surgery for coronary bypass and heart valve replacement between July 2019 and September 2022 were retrospectively analyzed using the geriatric nutritional risk index. Based on this index, two distinct groups were formed. Values 98 and below were considered risky, and values 99 and above were considered risk-free. There were 6 patients in the risk group. The other 16 patients were in the risk-free group. All patient groups were compared on the basis of surgical procedures, age, gender, body mass index (kg/m2), diabetes, hypertension, atrial fibrillation, smoking, and operative characteristics.

Results: In the study, 6 risky (27.3%) and 16 risk-free (%72.7) patients were examined according to the geriatric nutritional risk index and the mortality rate was found to be high (%66.7) in the risky group. The patients in the risk group had lower body mass index and albumin values (25.0±1.8 and 30.1±2.4) compared with the risk-free group (28.1±2.4 and 36.7±3.1). In addition, the mean extubation values were high (11.2±4.2). No significant difference was found between the other parameters and the presence of risk.

Conclusion: Before undergoing open heart surgery, the Geriatric Nutritional Risk Index can strongly predict postoperative mortality rates.

Keywords:. Geriatric nutritional risk index, octogenarian, albumin, malnutrition

Öz

Amaç: Bu retrospektif çalışmada açık kalp cerrahisi geçiren 80 yaş üstü hastaların operasyon öncesi albümin değeri kullanılarak hesaplanan geriatrik nutrisyonel risk indeksinin, ameliyat sonrası mortalite oranını tahmin edebilme gücü ortaya konulmaya çalışıldı.

Gereç ve Yöntem: Temmuz 2019 – Eylül 2022 tarihleri arasında koroner bypass ve kalp kapağı değişimi nedeniyle açık elektif kalp cerrahisi uygulanan toplam 22 hasta (13 erkek, 9 kadın; ortalama yaş: 82,1±2,4 yıl; dağılım, 80-88 yıl) geriatrik nutrisyonel risk indeksi ile retrospektif olarak incelendi. Bu indekse göre iki grup oluşturuldu. 98 ve altındaki değerler riskli, 99 ve üstündeki değerler risksiz grup olarak belirlendi. Riskli grupta 6 hasta vardı. Diğer 16 hasta risksiz grupta bulunuyordu. Tüm hasta grubu cerrahi işlemler, cinsiyet, yaş, vücut kütle indeksi (kg/m²), atrial fibrilasyon, diyabet, hipertansiyon, sigara içiciliği ve operatif özellikler yönüyle karşılaştırıldı.

Bulgular: Çalışmada geriatrik nutrisyonel risk indeksine göre 6 riskli (%27,3) ve 16 risksiz (%72,7) hasta incelendi ve risk varlığı tespit edilen hastalarda mortalite oranı yüksek (%66,7) bulundu. Risk grubundaki hastalar, risk grubu olmayanlara kıyasla daha düşük vücut kitle indeksi ve albümin değerlerine sahipti (sırasıyla 25,0±1,8 ve 30,1±2,4; 28,1±2,4 ve 36,7±3,1). Ayrıca, ortalama entübasyon değerlerinin yüksek bulunduğu belirlendi (11,2±4,2). Diğer parametreler ile risk varlığı arasında anlamlı bir farklılığa rastlanılmadı.

Sonuç: Açık kalp cerrahisi öncesi değerlendirilen geriatrik nutrisyonel risk indeksi, operasyon sonrası mortalite oranını öngörmede güçlü bir belirleyici olarak kullanılabilir.

Anahtar kelimeler: Geriatrik nutrisyonel risk indeksi, oktogenarian, albümin, malnütrisyon

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INTRODUCTION

The patient group aged eighty years and above (octogenarians) endures a higher number of major surgeries per day. Individuals in this age group are generally at higher risk due to their comorbidities and limited exercise capacity[1]. Preoperative evaluation of patients and early detection of postoperative complication risks, especially in terms of major operations such as cardiac surgery, come to the fore in octogenarians. Although many risk scoring systems are used today, European Cardiac Operative Risk Evaluation System II (EUROSCORE II) and Society of Thoracic Surgery (STS) risk score are widely used scoring systems all over the world[2]. Although these scoring systems, which are guiding in cardiac surgery, provide satisfactory results, their ability to predict perioperative outcomes is thought to be limited, especially in elderly patient groups. Unfortunately, there are no guidelines for the perioperative management of elderly patients who are candidates for open heart surgery or risks specific to the elderly. In recent years, nutritional status, frailty and comorbidities are emerging as better predictors of mortality and morbidity than chronological age[3]. Indeed, over time, the complexity of older patients has been shown to increase, mainly related to comorbidities and frailty. A sound definition and assessment of nutritional status may facilitate the discussion of whether octogenarians are good candidates for major surgery, so that appropriate operative and perioperative management can be implemented.

Malnutrition is a prevalent issue in frail individuals, amplifying the susceptibility to complications and mortality during surgical procedures. With the progressive rise in the elderly population over time, there has been a concurrent increase in the prevalence of frailty, further accentuating the manifestation of malnutrition[4]. Patients identified as frail face an increased susceptibility to complications and require intensified postoperative attention following cardiac surgery. In this study, the Geriatric Nutritional Risk Index (GNRI) was chosen as the assessment tool for evaluating malnutrition. GNRI is a quantitative measure derived from a straightforward formula involving body weight and serum albumin levels. A GNRI value of 98 or below is indicative of malnutrition, as stipulated by the defined threshold[5].

Our assumption was that individuals experiencing malnutrition would exhibit an increased incidence of postoperative complications. To verify the validity of this hypothesis, we conducted a retrospective study, using the GNRI and additional preoperative parameters that might contribute to the development of comorbidities. We believe that this article, being one of the first to calculate mortality rates using GNRI values in the field of open-heart surgery, will bring a unique perspective to the literature. Considering this, we raised the question of how accurate the GNRI is in predicting the mortality of patients aged 80 and above undergoing open-heart surgery. With the aim of confirming this hypothesis and contributing to the literature, we conducted this study.

MATERIALS AND METHODS

Study design

This single-center, retrospective study was conducted in Adana City Training and Research Hospital, Cardiovascular Surgery Clinic, Data were collected from, 22 patients who underwent open elective heart surgery due to coronary bypass or heart valve replacement between July 2019 and September 2022.

Sample

The research was conducted in a tertiary level training and research hospital and has a high volume in terms of open heart surgery. Due to the retrospective nature of the designed study, the data were obtained from the hospital electronic data. Patients aged eighty years and above, who had undergone an elective open heart surgery procedure with cardiopulmonary bypass, and whose data we could access before, during, and after the operation were included in the study. 62 patients were identified between July 2019 and September 2022. Exclusions from the study comprised emergency cases and those involving additional procedures beyond open-heart surgery. Under elective circumstances, the study included only 22 patients who underwent coronary bypass or heart valve replacement.

Procedure

The open-heart surgeries of these 22 patients were performed by expert surgeons working in the same clinic. 22 patients (13 males, 9 females; mean age: 82.1±2.4 years; range, 80-88 years) were retrospectively analyzed using the geriatric nutritional risk index. We used the formula: GNRI = 14.89 x

serum albumin (g/dl) + 41.7 x (preoperative body weight [kg]/ideal body weight [kg]). Lorentz formula for ideal weight (for men: w = (height [cm]− 100) − ((height − 150)/4); for women: w = (height − 100) − ((height − 150)/2) calculated. When the GNRI was 98 or lower, patients were deemed high risk and compared postoperatively. Preoperative factors were evaluated in terms of age, gender, albumin level, body mass index, atrial fibrillation, diabetes, hypertension, ejection fraction, NYHA class, chronic obstructive pulmonary disease, chronic renal failure, smoking, and previous operation. Intraoperative factors were assessed on the basis of cross-clamp and cardiopulmonary bypass duration. Postoperative factors were evaluated in terms of extubation time and, length of stay in the intensive care unit and hospital.

The study protocol was approved by the Adana City Training and Research Hospital Ethics Committee (Date: 24.03.2022, No: 1845). This study was conducted in accordance with the principles of the Declaration of Helsinki.

Statistical analysis

Statistical analysis was performed using SPSS 26.0 (IBM Corp., Armonk, NY, USA) software. Categorical data are expressed as numbers and percentages, while continuous data were represented as mean and standard deviation (median and range, if applicable). Statistical tests were conducted to analyze the data. Categorical expressions were compared using the chi-square test. The normal distribution of the parameters was determined using the Shapiro-Wilk test. Parameters that did not show normal distribution were analyzed using the Mann-Whitney U test. A p-value of less than 0.05 was considered statistically significant.

RESULTS

We had 6 patients in the risk group of the two groups created according to GNRI. The other 16 patients were in the risk-free group. The analyzed data of all patients are shown in Table 1. There were no significant differences in preoperative factors between the two groups, including age, gender, atrial fibrillation, diabetes, hypertension, ejection fraction, NYHA class, chronic obstructive pulmonary disease, chronic renal failure, smoking, and previous operations. Table 2 presents a comparison of other data based on their GNRI values.

Table 1. Baseline characteristics and postoperative outcomes of octogenarian patients who underwent open heart surgery

Parameter	n	%
AF	2	9.1
DM	13	59.1
NYHA Class		
1	7	31.8
2	12	54.5
3	3	13.6
HT	12	54.5
COPD	15	68.2
Dialysis	1	4.5
Gender		
Male	13	59.1
Female	9	40.9
Smoking	11	50.0
Operation		
CABG	17	77.3
MVR	3	13.6
AVR	1	4.5
AVR+MVR	1	4.5
GNRI		
Risk	6	27.3
Risk free	16	72.7
Pneumonia	4	18.2
Mortality	4	18.2
	Mean±Ss	Med (Min-Max)
EF	44.6±7.1	45 (35-60)
Age	82.1±2.4	81 (80-88)
BMI	27.3±2.6	27.1 (22.8-32.8)
Albumin	34.9±4.2	34.2 (26.1-42.3)
GNRI	103.1±9.2	103.5 (81-120)
X clamp	74.6±11.4	72.5 (63-115)
CBP-time	108.2±10.1	106 (95-137)
Extubation	8.59±2.7	8 (6-17)
ICU stay	3.23±1.5	3 (1-6)
Hospital stay	10.5±3.0	9.5 (7-19)

AF: atrial fibrillation, DM: diabetes mellitus, NYHA: New York Heart Association, HT: hypertension, COPD: chronic obstructive pulmonary disease, CABG: coronary artery bypass graft, AVR: aortic valve replacement, MVR: mitral valve replacement, GNRI: geriatric nutritional risk index, EF: ejection fraction, BMI: body-mass index, CBP: cardiopulmonary bypass, ICU: intensive care unit

In terms of preoperative factors, patients in the GNRI risk group had a higher mortality rate ($p<0.001$). Additionally, patients in the risk group had lower body mass index and albumin values compared with patients without GNRI risk ($p=0.012$; $p=0.001$, respectively). No statistically significant difference was found in cross-clamp and cardiopulmonary bypass time ($p=0.553$ and $p=0.530$, respectively) during intraoperative analysis. It was discovered during the postoperative examination that

the extubation time was considerably longer (p=0.012). No statistically significant differences were found in the data on intensive care and hospital stays (p=0.428; p=0.654, respectively).

Table 2. Octogenarian patients who had elective open heart surgery were grouped according to GNRI value and association with other values

Parameter	Risk (n=6) n (%)	Risk free (n=16) n (%)	p
AF	-	2 (12.5)	0.364
DM	5 (83.3)	8 (50.0)	0.157
NYHA Class			
1	1 (16.7)	6 (37.5)	0.226
2	3 (50.0)	9 (56.3)	
3	2 (33.3)	1 (6.3)	
HT	3 (50)	9 (56.3)	0.793
COPD	4 (66.7)	11 (68.8)	0.926
Dialysis	-	1 (6.3)	0.531
Gender			
Male	4 (66.7)	9 (56.3)	0.658
Female	2 (33.3)	7 (43.8)	
Smoking	4 (66.7)	7 (43.8)	0.338
Operation			
CABG	5 (83.3)	12 (75)	0.839
MVR	1 (16.7)	2 (12.5)	
AVR	-	1 (6.3)	
AVR+MVR	-	1 (6.3)	
Pneumonia	2 (33.3)	2 (12.5)	0.259
Mortality	4 (66.7)	-	<0.001**
	Mean±Ss	Mean±Ss	p
EF	40.0±6.3	46.3±6.7	0.065
Age	82.3±2.2	82.1±2.5	0.597
BMI	25.0±1.8	28.1±2.4	0.012*
Albumin	30.1±2.4	36.7±3.1	0.001**
X clamp	73.3±3.6	75.1±13.3	0.553
CBP-time	108.5±5.6	108.1±11.5	0.530
Extubation	11.2±4.2	7.62±0.9	0.012*
ICU stay	3.67±1.6	3.06±1.5	0.428
Hospital stay	12.3±5.0	9.81±0.6	0.654

AF: atrial fibrillation, DM: diabetes mellitus, NYHA: New York Heart Association, HT: hypertension, COPD: chronic obstructive pulmonary disease, CABG: coronary artery bypass graft, AVR: aortic valve replacement, MVR: mitral valve replacement, GNRI: geriatric nutritional risk index, EF: ejection fraction, BMI: body-mass index, CBP: cardiopulmonary bypass, ICU: intensive care unit

In total, four deaths were observed during the operation, all of which occurred in the high-risk group. No deaths were reported in the low-risk group. Before surgery, the GNRI value calculated using albumin and body mass index data can affect mortality and extubation time. However, intraoperative data did not have a direct impact on preoperative malnutrition status.

DISCUSSION

While Euroscore and STS scores are commonly used today, they fail to incorporate the aspect of malnutrition. As an alternative to this situation, the GNRI index can be utilized to predict postoperative mortality in cardiovascular surgery for patients aged over eighty, considering the albumin value that reflects their nutritional status. This approach can offer more advantageous information to patients and their families before surgery and can contribute as an additional criterion for the surgeon's planning. With the development of new surgical techniques and technologies, it has become increasingly important to determine prognostic factors more clearly.

Among the innovations introduced with the developing techniques, it has been revealed that advanced age is riskier in operations in malnourished patients due to cellular aging[6]. Although we have reached some results with the data, we based this study on, studies written in areas other than cardiac surgery and using different evaluation systems. With the advancement of technology, the aging of the patient population and the consequent increasing comorbidity are among the points that need to be evaluated, and the GNRI calculation increases its importance. Physical rehabilitation is also a condition affected by malnutrition, and one of the studies reported by Ogawa et al[7] showed that preoperative malnutrition, as assessed by the GNRI, appears to be an important risk factor for poor physical function and delayed postoperative rehabilitation in patients undergoing cardiac surgery. It should be considered that mentioning physical rehabilitation and function in this study may have contributed to prolonged extubation time.

Malnutrition triggers sarcopenia and muscle weakness, diminishing vitality, and contributing to the deterioration of physical function and activity. This decline results in reduced energy consumption and appetite, fostering the advancement of malnutrition, thereby initiating what is recognized as the frailty cycle[8]. In the context of this study, we emphasize malnutrition because of its significant role in driving the progression of frailty.

GNRI has been a subject of examination in several prior studies focusing on postoperative complications. Shoji et al[9] conducted an assessment of the nutritional status of elderly patients undergoing lung cancer surgery and found that a low GNRI was associated with poorer survival outcomes. The applicability of GNRI extends to predicting outcomes in patients with cardiovascular disease. Shibata et al[10] reported that a low GNRI was a risk factor for medium-term mortality after transcatheter aortic valve replacement. Furthermore, the GNRI demonstrated significant correlations with walking speed, grip strength, Clinical Frailty Scale, and STS score according to the findings of Shibata et al.

In this study, we focused on the GNRI value as a predictor of physical indulgence. Protein-energy malnutrition is commonly known as marasmus and kwashiorkor[11]. It appears useful to assess any type of malnutrition or mixed categories by calculating the GNRI using a simple formula based on albumin and body weight. In marasmus, there is a deficiency of both protein and calories, leading to hypoalbuminemia due to the suppression of catabolism and protein synthesis during acute and subacute periods of physical stress. Kwashiorkor has a lack of pure protein due to chronic malnutrition, which results in the breakdown of fat stores and muscle along with weight loss[12]. It is important to evaluate the malnutrition status and physical rehabilitation assistance of patients undergoing cardiac surgery during their hospital admission. In addition, treatment processes that increase the GNRI value can be applied in cooperation with the nutrition unit, particularly in cases of elective surgery. Thus, cardiac surgery mortality can be reduced, especially in octogenarian patients who are inclined to malnutrition, as this study indicates.

In this study, although no significant effect was observed between postoperative pneumonia and low preoperative GNRI values, there are studies that reported that pneumonia, chronic renal failure, and diabetes mellitus were more common in patients with malnutrition[13].

To the best of our knowledge, this is the only study in the literature using GNRI for octogenarian patients who underwent open heart surgery, and it stands out as an alternative to scoring systems that can be used for preoperative risk assessment in cardiac surgery, as a simple and quickly calculable index.

This study was limited by its retrospective design and small patient sample size in a single center. Therefore, large-scale prospective multicenter studies are required to confirm our findings.

Assessing the nutritional status of patients before cardiac surgery through the calculation of GNRI can help predict and reduce postoperative complications. This is particularly important because malnutrition has been associated with a higher risk of complications. Therefore, providing appropriate nutritional intervention to elective patients with poor nutritional status can help improve their outcomes following cardiac surgery.

Consequently, we have submitted our article to the literature, with the aim of highlighting, the significance of nutritional status in open-heart surgery. We believe that our contribution will foster the broader adoption of this index and predictive mortality calculations in the future. The widespread use of any scoring system, aiding surgeons in conveying crucial information to patients and their families while assisting operators in anticipating case progression, will undoubtedly simplify our efforts on both fronts.

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REFERENCES

1. Volk L, Chao J, Dombrovskiy V, Ikegami H, Russo MJ, Lemaire A et al. Impact of risk factors on in-hospital mortality for octogenarians undergoing cardiac surgery. J Card Surg. 2021;36:2400-6.
2. Barili F, Pacini D, Capo A, Rasovic O, Grossi C, Alamanni F et al. Does EuroSCORE II perform better than its original versions? A multicentre validation study. Eur Heart J. 2013;34:22-9.
3. Vetta F, Locorotondo G, Vetta G, Mignano M, Bracchitta S. Prognostic impact of frailty in elderly cardiac surgery patients. Monaldi Arch Chest Dis. 2017;87:855.
4. Gill TM, Gahbauer EA, Allore HG, Han L. Transitions between frailty states among community-living older persons. Arch Intern Med. 2006;166:418-23.

5. Chen Y, Yang X, Zhu Y, Zhang X, Ni J, Li Y. Malnutrition defined by geriatric nutritional risk index predicts outcomes in severe stroke patients: a propensity score-matched analysis. Nutrients. 2022;14:4786.
6. Norman K, Haß U, Pirlich M. Malnutrition in older adults-recent advances and remaining challenges. Nutrients. 2021;13:2764.
7. Ogawa M, Izawa KP, Satomi-Kobayashi S, Kitamura A, Tsuboi Y, Komaki K et al. Preoperative exercise capacity is associated with the prevalence of postoperative delirium in elective cardiac surgery. Aging Clin Exp Res. 2018;30:27-34.
8. Unosawa S, Taoka M, Osaka S, Yuji D, Kitazumi Y, Suzuki K et al. Is malnutrition associated with postoperative complications after cardiac surgery? J Card Surg. 2019;34:908-12.
9. Shoji F, Miura N, Matsubara T, Akamine T, Kozuma Y, Haratake N et al. Prognostic significance of immune-nutritional parameters for surgically resected elderly lung cancer patients: a multicenter retrospective study. Interact Cardiovasc Thorac Surg. 2018;26:389-94.
10. Shibata K, Yamamoto M, Kano S, Koyama Y, Shimura T, Kagase A et al. Importance of geriatric nutritional risk index assessment in patients undergoing transcatheter aortic valve replacement. Am Heart J. 2018;202:68-75.
11. Marinangeli CPF, Curran J, Barr SI, Slavin J, Puri S, Swaminathan S et al. Enhancing nutrition with pulses: defining a recommended serving size for adults. Nutr Rev. 2017;75:990-1006.
12. Arthur SS, Nyide B, Soura AB, Kahn K, Weston M, Sankoh O. Tackling malnutrition: a systematic review of 15-year research evidence from indepth health and demographic surveillance systems. Glob Health Action. 2015;8:282-98.
13. Heilmann C, Stahl R, Schneider C, Sukhodolya T, Siepe M, Olschewski M et al. Wound complications after median sternotomy: a single-center study. Interact Cardiovasc Thorac Surg. 2013;16:643-8.