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Impact of Naples Prognostic Score on the development of surgical reexploration in open heart surgery patients

Mehmet Karaçalılar[1], İrfan Dinler[1], Nurhayat İnci[1], Sinan Göçer[2], Mahir Kuyumcu[3], Mehmet Özbek[4]

1 Department of Cardiovascular Surgery, Faculty of Medicine, Dicle University, Diyarbakır, Turkey

2 Department of Cardiovascular Surgery, Lokman Hekim Hospital, Istanbul, Turkey

3 Department of Anesthesiology And Reanimation, Faculty of Medicine, Dicle University, Diyarbakır, Turkey

4 Department of Cardiology, Faculty of Medicine, Dicle University, Diyarbakır, Turkey

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Abstract

Background: Significant and minor perioperative bleeding is common in patients undergoing open heart surgery. Perioperative bleeding has become an important prognostic indicator. Naples Prognostic Score (NPS); It is an effective tool that can be used to detect malnutrition, calculated according to serum albumin level, total cholesterol amount, neutrophil-lymphocyte ratio (NLR), and lymphocyte-monocyte ratio (LMR). In our study,we were planned to evaluate malnutrition and show its negative effects by using the NPS score in patients undergoing open heart surgery.

Methods and Results: For the study, a total of 2071 patients who underwent open heart surgery were examined in detail randomly, sequentially and retrospectively. A total of 1825 patients were examined in detail after the patients covering the exclusion criteria were removed. It was determined that a total of 73 patients underwent surgical reexploration. In 53 (4.3%) of the patients with coronary artery bypass surgery, in 11 (3%) of the patients with heart valve surgery, in 8 (4.7%) of the patients with heart valve surgery combined with coronary artery bypass surgery, It was determined that surgical reexploration was performed in 1 (2.8%) of the other procedures. Multivariate regression model; showed that being in the high NPS score group, increasing age, and female gender were independent determinants of the need for surgical reexploration. It was determined that the need for reexploration was observed in the group with higher NPS score (median 3.18 vs 2.69, $p<0.001$).

Conclusion: A high NPS score can provide very important prognostic information. Patients in the high NPS score group required surgical reexploration more frequently.

Keyword: Open Heart Surgey, NPS Score, surgical reexploration

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Correspondence / Yazışma Adresi: *Mehmet Karaçalılar, Department of Cardiovascular Surgery, Faculty of Medicine, Dicle University, Diyarbakır, Turkey*
e-mail: m.karacalilar@gmail.com

Açık kalp ameliyatı olan hastalarda NaplesPrognostik Skorunun cerrahi revizyona olan etkisi

Öz

Amaç: Açık kalp ameliyatı geçiren hastalarda önemli ve küçük perioperatif kanamalar yaygındır. Perioperatif kanama önemli bir prognostik gösterge haline gelmiştir. Naples Prognostik Skoru (NPS); Serum albümin düzeyi, toplam kolesterol miktarı, nötrofil-lenfosit oranı (NLR) ve lenfosit-monosit oranına (LMR) göre hesaplanan, malnütrisyonun tespitinde kullanılabilecek etkili bir araçtır. Çalışmamızda açık kalp ameliyatı geçiren hastalarda NPS skoru kullanılarak malnütrisyonun değerlendirilmesi ve olumsuz etkilerinin gösterilmesini planlandık.

Yöntemler ve Sonuçlar: Çalışma için açık kalp ameliyatı geçiren toplam 2071 hasta rastgele, sıralı ve geriye dönük olarak detaylı olarak incelendi. Dışlama kriterlerini karşılayan hastalar çıkarıldıktan sonra toplam 1825 hasta detaylı olarak incelendi. Toplam 73 hastaya cerrahi revizyon uygulandığı belirlendi. Koroner arter bypass ameliyatı olan hastaların 53'ünde (%4,3), kalp kapağı ameliyatı olan hastaların 11'inde (%3), koroner arter bypass ameliyatı ile birlikte kalp kapağı ameliyatı olan hastaların 8'inde (%4,7), diğer işlemlerin 1'inde (%2,8) cerrahi revizyon yapıldığı belirlendi. Çok değişkenli regresyon modeli; yüksek NPS skoru grubunda olmanın, artan yaşın ve kadın cinsiyetin cerrahi revizyon ihtiyacının bağımsız belirleyicileri olduğunu gösterdi. NPS puanı yüksek olan grupta yeniden araştırma ihtiyacının gözlendiği belirlendi (medyan 3,18 vs 2,69, p<0,001).

Sonuç: Yüksek NPS skoru çok önemli prognostik bilgiler sağlayabilmektedir. Yüksek NPS skoru grubundaki hastalar daha sık cerrahi revizyona ihtiyaç duydu.

Anahtar kelimeler: Açık Kalp Ameliyatı, NPS Skor, surgical reexploration.

INTRODUCTION

Significant and minor perioperative bleeding is common in patients undergoing open heart surgery. Perioperative bleeding has become an important prognostic indicator[1]. Strangely enough, there is no standardized definition for perioperative bleeding. Surgical re-exploration can be performed as a rescue in patients who cannot control bleeding related to the procedure.

Malnutrition is a serious health problem that has a bad effect on all systems and is very common in patients hospitalized for any reason. Malnutrition is also very common in the patient population who are candidates for or have a history of cardiovascular surgery and is associated with adverse postoperative outcomes[2]. It is known that a significant portion of patients undergoing cardiac surgery have defined or undefined levels of malnutrition[3].

Many assessment tools have been previously described to identify nutritional conditions that are of prognostic importance. Evaluation of nutritional status with blood parameters has become the latest tool in recent times. However, in order for these assessment tools to provide objective results, it is important that they provide scores that are simple, easily calculated, and whose results do not vary much from person to person or from measurement to measurement[4]. Some tested scoring systems have been shown to provide data with significant prognostic value in patients with cardiovascular disease[5].

NPS; It is an effective tool that can be used to detect malnutrition, calculated according to serum albumin level, total cholesterol amount, neutrophil-lymphocyte ratio (NLR), and lymphocyte-monocyte ratio (LMR). NPS (Naples prognostic score) is a parameter that shows nutritional status by calculating it with laboratory parameters and has been shown to have an effect on prognosis in many diseases[6].

In this study, it was planned to evaluate malnutrition and show its negative effects by

using the NPS score in patients undergoing open heart surgery.

METHODS

Study Design

In our research, we planned to conduct a single-center, observational study examining patients who underwent open heart surgery for any reason. This study was approved by the Dicle University Faculty of Medicine ethics committeedecision number 22/11/2023-301. Patients who underwent open surgery in our clinic between January 2013 and December 2023 were retrospectively screened without random selection. The patients' clinical epicrisis and surgery notes were examined in detail and laboratory parameters were analyzed in detail and a comparison was made.

Patients

For the study, a total of 2071 patients who underwent open heart surgery were examined in detail randomly, sequentially and retrospectively. Patients were excluded from screening due to the presence of diseases that could affect our study results. According to the design of the study, patients who could be monitored for bleeding for at least 48 hours were included in the study in order to test whether there was any bleeding requiring revision. Patients who exited for any reason before the end of the 48-hour follow-up period and whose blood parameters could not be studied were excluded from the study. A total of 1825 patients were examined in detail after the patients covering the exclusion criteria were removed.

Definitions

Patients whose venous blood samples were routinely taken during hospitalization and those who were followed up were included in the study. A complete blood count (CBC) was performed with an automated system and hematological indices were calculated for each patient. Total cholesterol, high-density lipoprotein (HDL), low-density lipoprotein (LDL), triglyceride and other biochemical levels were measured.

Surgical Reexploration

Surgical reexamination may be performed when blood loss cannot be stopped with surgical tubes or blood transfusions. Surgical reexamination may occur early or late. Surgical reexamination is considered an indicator of severe bleeding. In our study, salvage surgical procedures performed after blood loss could not be controlled with surgical techniques and precautions were grouped as surgical reexploration.

Follow-up and study outcomes

Patients were followed up by looking at epicrisis and surgery reports. We used the occurrence of in-hospital bleeding requiring revision that could be attributed to the operation as the main outcome. We analyzed each revision operation separately.

Parameter Assessment

NLR was calculated as the neutrophil count/lymphocyte count ratio. LMR was calculated as lymphocyte count/monocyte count. While calculating the NPS score; If the albumin value was ≥4.0 g/dL, 0 point was given, and if <4.0 g/dL, 1 point was given. While calculating the NPS score; If the total cholesterol value was >180 mg/dL, 0 points were given, and if it was ≤180 g/dL, 1 point was given. While calculating the NPS score; If the NLR value was ≤2.96, 0 point was given, and if >2.96 g/dL, 1 point was given. While calculating the NPS score; If the LMR value was >4.44, 0 point was given, and if it was ≤4.44 g/dL, 1 point was given. The total score was calculated and a comparison was made based on the total score.

Statistical Analysis

We analyzed our data in SPSS for Windows version 25.0. First, we analyzed the normality of

the distribution. For normally distributed data, they were compared using the Student-t test, and for non-normally distributed data, the Mann-Whitney U test was used. Abnormally distributed variables were expressed as median IQR (interquartile range). We calculated the categorical variables we created as percentages (%) and compared them using the Chi-square test/Fischer's Exact. When the number of groups was large, comparison was made using one-way analysis of variance (ANOVA) or the Kruskal-Wallis test, as appropriate. P value <0.05 was considered significant.

RESULTS

Baseline Characteristics

The data of 1825 patients were evaluated retrospectively to examine the determined points. Figure 1 shows the flow chart showing the patient acceptance and distribution of our study. The majority of our cases consist of coronary artery bypass surgery. It was determined that a total of 73 patients underwent surgical reexploration. In 53 (4.3%) of the patients with coronary artery bypass surgery, in 11 (3%) of the patients with heart valve surgery, in 8 (4.7%) of the patients with heart valve surgery combined with coronary artery bypass surgery, It was determined that surgical re-examination was performed in 1 (2.8%) of the other procedures.

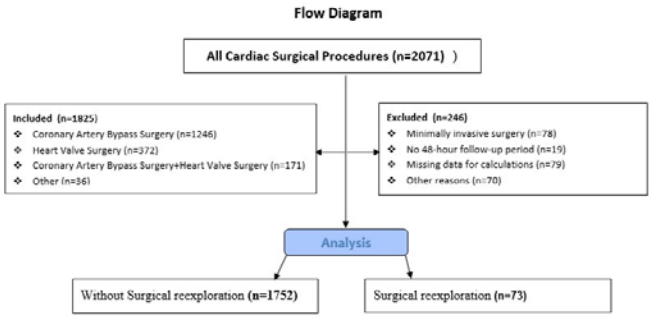

Figure 1. Flow Chart of Trial design and distribution of surgical procedures

Associations between surgical reexploration and clinical variables

Demographic and laboratory parameter variables of patients who underwent and did not undergo surgical reexploration after open heart surgery are given in Table 1.

Table I: General demographic and laboratory characteristics of the patients

Variables	WithoutSurgical Exploration (n=1752)	SurgicalReexploration (n=73)	*p*value
Age (years)	60.1±11.8	64.7±9.7	***0.001***
Femalegender, n (%)	512(29)	39(53)	***<0.001***
Hypertension, n (%)	729(42)	41(56)	***0.014***
Diabetesmellitus, n (%)	509(29)	29(40)	0.050
Smoking, n (%)	563(32)	13(18)	***0.010***
STS score(IQR)	4.20(4.40)	4.32(5.18)	0.796
Euro score(IQR)	17.11 (17.8)	18.95 (22.2)	0.285
LVEF (%)	52.2±6.7	51.5±7.0	0.358
GlomerularFiltration Rate (ml/min)	82.9±23.1	76.4±25	***0.032***
Hemoglobin (g/dl)	13.4±2	12.8±2	***0.014***
Leukocyte (× 10^3 µL)	11.097±5.066	11.213±4.356	*0.825*
Lymphocyte (× 10^3 µL)	2016±1131	1623±765	***<0.001***
Monocytes (× 10^3 µL) (IQR)	687(707)	813(911)	***0.014***
Neutrophil (× 10^3 µL)	8394±4828	8776±4129	*0.444*
Platelet (× 10^3 µL)	250±68	257±71	0.465
Glucose (mg/dl)	154±71	163±60	*0.286*
Serum albumin (g/dl)	3.68±0.48	3.46±0.44	***<0.001***
Total cholesterol (mg/dl)	181±47	174±44	0.201
Triglyceride (mg/dl) (IQR)	153(158)	136(161)	0.186
High DensityLipoprotein (mg/dl)	39±11.4	39±9.3	0.659
LowDensityLipoprotein (mg/dl)	113±38	108±37	0.309
NLR (IQR)	5.64(5.88)	7.64(9.20)	***0.013***
LMR(IQR)	3.53(3.70)	2.37(2.70)	***0.008***
Total NaplesScore (IQR)	2.69(2.74)	3.18(3.37)	***<0.001***

The mean age was significantly higher in the surgical reexploration group (64.7±9.7vs. 60.1±11.8, p=0.001). The need for surgical reexploration was significantly more common in women (53% vs 29%, p<0.001).

It was determined that the history of hypertension was higher in the surgical reexploration group (56% vs. 42%, p = 0.014). Additionally, surgical reexploration revealed less frequent smoking addiction ((18% vs 32%, p=0.010).

GFR, lymphocyte count, albumin level and hemoglobin values were found to be significantly lower in the surgical reexploration group. On the contrary, the number of monocytes was observed to be significantly higher.

In terms of our study hypothesis, it was determined that the need for reexploration was observed in the group with higher NPS score (median 3.18 vs 2.69, p<0.001).

Associations between NPS and clinical variables

The NPS score of the patients was analyzed with the receiver operating characteristic (ROC) to predict the need for surgical reexploration (Figure2). The optimum NPS score cut-off value was determined to be >2.5.

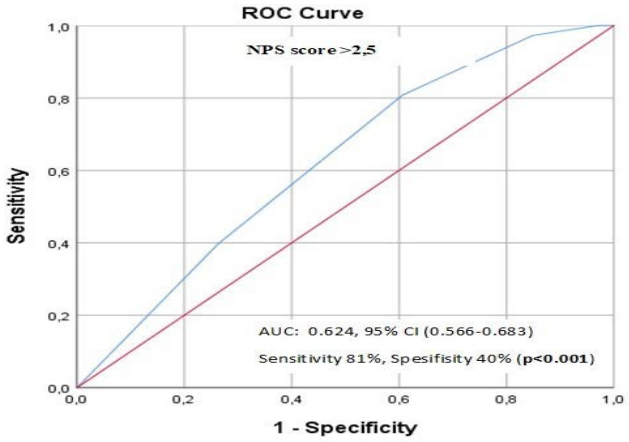

Figure 2. Analysis of NPS score with receiver operating characteristic (ROC) to predict the need for surgical reexploration.

Comparison of clinical and laboratory data when our patients are grouped as those with a score above or below 2.5 according to the NPS score is given in Table 2.

Table II: General demographic and laboratory characteristics of patients according to NPS score group

Variables	NPS score<2,5 (n=703)	NPS score>2,5 (n=1122)	*p*value
Age (years)	58.5±11.4	61.3±11.8	***<0.001***
Femalegender, n (%)	206(29)	345(31)	0.513
Hypertension, n (%)	281(40)	489(44)	0.128
Diabetesmellitus, n (%)	210(30)	328(29)	0.771
Smoking, n (%)	218(31)	358(32)	0.658
LVEF (%)	53±6.9	51.7±6.5	***<0.001***
GlomerularFiltration Rate (ml/min)	85.1±21.5	81.1±24	***<0.001***
Hemoglobin (g/dl)	13.7±1.9	13.1±2.0	***<0.001***
Platelet (× 10^3 µL)	255±63	248±71	***0.025***
Glucose (mg/dl)	156±78	155±66	0.745
SurgicalReexploration, n (%)	14(2)	59(5)	***0.001***

It was observed that the average age was higher in the group with a higher NPS score. In addition, it was observed that glomerular filtration rate, hemoglobin level and platelet level were significantly lower in the group with high NPS score.

There was a significantly higher rate of reexploration requirement in the group with a high NPS score (5% vs. 2% p=0.001).

Prognostic value of NPS

They were evaluated with multivariate regression analyzes in terms of predictors of surgical reexploration in Table 3.

Table III: Determinants of the need for surgical reexploration in multivariate regression analysis

	Multivariateregression		
	OR	**95% CI**	***pvalue***
Age (years)	1.028	1.003-1.053	***0.025***
Femalegender, (%)	2.765	1.692-4.517	***<0.001***
Hypertension,(%)	1.234	0.744-2.047	0.415
Diabetesmellitus, (%)	1.321	0.745-2.344	0.341
Smoking, (%)	1.402	0.737-2.670	0.303
LVEF (%)	0.990	0.955-1.026	0.569
GlomerularFiltration Rate	0.994	0.985-1.004	0.259
Hemoglobin	0.928	0.818-1.054	0.252
Glucose	1.001	0.997-1.005	0.542
High NPS scoregroup	2.222	1.212-4.072	***0.010***

Multivariate regression model; showed that being in the high NPS score group, increasing age, and female gender were independent determinants of the need for surgical reexploration.

DISCUSSION

It is known that low albumin value increases all-cause mortality and the risk of complications in the population undergoing cardiac surgery[7]. In our study, the low albumin value in the group that developed surgical reexploration once again reveals the prognostic importance of albumin. The prognostic importance of low lymphocyte count in patients undergoing cardiovascular intervention has been shown in previous studies[8]. One of the important results of our study is the strong relationship between low lymphocyte count and surgical reexploration. Considering its inflammatory and nutritional importance, the fact that lymphocyte count provides meaningful prognostic data is also important in terms of the power of the NPS score, which is affected by the lymphocyte count, which we examined in our study. A recent study showed that nutritional and inflammatory scoring has prognostic importance in patients undergoing cardiovascular intervention[9]. NPS scoring has been shown in a previous study to provide prognostic prediction after thoracic surgery[10]. Our study is the first to show that NPS scoring provides prognostic information after open heart surgery. The fact that low cholesterol value, one of the NPS score variables, does not provide strong prognostic data in our study is confusing regarding its importance as a nutritional indicator in cardiovascular diseases.

It is known that the prognosis after cardiac surgery is worse in women[11]. Our study shows that female gender is still associated with poor outcome. Considering the average age of our patients, a worse prognosis is expected in female gender in terms of all endpoints in longer follow-up.

Although the average age in our study was relatively young, showing that the frequency of complications increases with age gave a result consistent with the data in the literature[12]. This shows that the passing years not only have a negative impact on human health, but also the benefit of treatment is negatively affected by age.

The importance of renal functions in cardiovascular diseases and patients undergoing open heart surgery has been shown by numerous studies[13]. The relationship between low GFR level and the development of surgical reexploration in our own patient population shows how important preoperative renal function evaluation is.

In a previous study have paradoxically shown that, contrary to expectations, bleeding complications are less common in cardiovascular interventions in smokers[14]. In our study, the demonstration that there is a decrease in the need for surgical reexploration in the smoker population proves that smoking has a positive effect on bleeding parameters.

We reached very important results in our retrospective study involving a large patient population: 1) We found that the frequency of surgical reexploration, which has a very valuable prognostic importance in patients undergoing open heart surgery, is a significant rate, 2) It has been shown that a high NPS score is predictive of the need for surgical reexploration, 3) The need for surgical reexploration has been shown to be more common in women, 4) Low GFR, low hemoglobin and advanced age have been shown to be important determinants for the development of this surgical complication.

Limitations

This study had some limitations. Since the patients could not be followed prospectively, patients who required surgical reexploration but died before the procedure could be performed may have been excluded from the study. Since the number of patients who underwent surgical reexploration is small, more meaningful results may be obtained in a larger group.

CONCLUSION

The need for surgical reexploration is an important prognostic condition. All causes that increase the frequency of encounters can be considered as indirect or direct indicators of morbidity and mortality. It is known that variables such as low albumin value, low lymphocyte count, high monocyte and neutrophil count, which indicate the nutritional and inflammatory status of the patients at the time of admission, already have prognostic importance. The high NPS score, which is formed by the contribution of these at certain rates, can also provide very important prognostic information. Patients in the high NPS score group required surgical reexploration more frequently. In future studies, it may be seen that the frequency of endpoints may decrease after the follow-up NPS values are examined and correction is made.

Ethics Committee Approval: This study was approved by the Dicle University Faculty of Medicine ethics committee decision number 22/11/2023-301.

Conflict of Interest: The authors declared no conflicts of interest.

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