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Evaluation of Neutrophil-Lymphocyte Ratios According to Gupta Perioperative Myocardial Infarction or Cardiac Arrest (MICA) Risk Index in Elderly Patients Undergoing Hip Surgery

Kalça Operasyonu Yapılan Yaşlı Hastalarda Gupta Perioperatif Miyokard Enfarktüsü veya Kardiyak Arrest (MICA) Risk İndeksine Göre Nötrofil-Lenfosit Oranlarının Değerlendirilmesi

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Abstract

Aim: Perioperative cardiac events are a leading cause of mortality after surgery. Consequently, risk stratification for perioperative myocardial ischemia and cardiac arrest has gained significant importance before surgery. The Gupta perioperative myocardial infarction or cardiac arrest (MICA) risk index provides a risk estimate for perioperative myocardial infarction or cardiac arrest. This study aimed to investigate the relationship between the MICA risk index and neutrophil-lymphocyte ratios (NLR) in elderly patients undergoing hip surgery.

Material and Method: The medical records of patients operated on for hip fracture surgery between 01.10.2021 and 30.04.2022 were retrospectively analyzed. Demographic data, comorbidities, clinical and laboratory characteristics, NLR, and length of hospital stay were evaluated. Subsequently, MICA scores were computed. According to the MICA score, patients were categorized into two groups: a high-risk group (risk greater than 1%) and a low-risk group, and the preoperative NLR of these two groups was compared.

Results: The study included 83 patients aged 65 and older out of a total of 191 patients who underwent hip fracture surgery. The patients were assessed based on their MICA cardiac risk scores, and they were categorized into two groups: those with a MICA score<1 (n=30) and those with a MICA score≥1 (n=53). Gender and body mass index (BMI) showed no significant differences between the groups. However, there were statistically significant variations observed in terms of age (p<0.001), the American Society of Anaesthesiologists (ASA) classification (p<0.001), and comorbidities (p=0.042). Patients with a MICA score≥1 exhibited significant differences when compared to those with a MICA score<1 in terms of postoperative intensive care unit admission (p=0.003), complication rate (p<0.001), mortality (p=0.004), and length of hospital stay (p=0.025). Furthermore, there was a positive correlation between the MICA score and preoperative NLR (p=0.619, r=0.055), although no significant difference was found between the two groups (p=0.486). While the NLR was higher in patients with adverse outcomes (exitus) compared to those without, this difference did not reach statistical significance (p=0.165).

Conclusion: A comprehensive multidisciplinary approach is crucial for assessing preoperative risk factors and devising appropriate treatment strategies in elderly patients undergoing hip surgery. The MICA score can serve as a valuable tool for predicting perioperative risk in this patient population. Our study revealed no significant association between preoperative NLR and the MICA score.

Keywords: MICA score, hip fracture surgery, NLR, perioperative period, elderly patient

Öz

Amaç: Perioperatif kardiyak olaylar, cerrahi sonrası önde gelen ölüm nedenlerindendir. Bu nedenle, perioperatif miyokard iskemisi ve kardiyak arrest için risk sınıflaması, cerrahi öncesi önemli hale gelmiştir. Gupta perioperatif miyokard enfarktüsü veya kardiyak arrest (MICA) risk indeksi, perioperatif miyokard enfarktüsü veya kalp durması için bir risk tahmini sağlar. Bu çalışmanın amacı, kalça operasyonu geçiren yaşlı hastalarda MICA risk indeksi ve nötrofil lenfosit oranları (NLR) arasındaki ilişkiyi araştırmaktır.

Gereç ve Yöntem: Kalça kırığı nedeniyle 01.10.2021 ve 30.04.2022 tarihleri arasında opere edilen hastaların dosyaları retrospektif olarak tarandı. Hastaların demografik bulguları, komorbiditeleri, klinik ve laboratuvar özellikleri, NLR'i, hastanede kalış süreleri değerlendirildi. MICA skorları hesaplandı. MICA skoruna göre yüksek riskli grup (%1 'in üzeri yüksek risk) ve düşük riskli grup olarak 2 gruba ayrıldı ve bu iki grup hastaların preoperatif NLR'i karşılaştırıldı.

Bulgular: Kalça kırığı nedeniyle opere edilen 191 hastadan 65 yaş ve üzeri 83 hasta çalışmaya dahil edildi. Hastaların MICA skorları hesaplanarak, MICA skoru<1 olanlar (n=30) ve MICA skoru≥1 olanlar (n=53) olarak 2'ye ayrıldı. Gruplar arasında hastaların cinsiyetleri, vücut kitle indeksleri (VKİ) açısından farklılık gözlenmezken, yaşları (p<0.001), Amerikan Anestezistler Derneği (ASA) sınıflamaları (p<0.001) ve ek hastalık açısından anlamlı farklılık mevcuttu (p=0.042). MICA skoru≥1 olan hastaların MICA skoru<1 olan hastalara göre postoperatif yoğun bakıma çıkış (p=0.003), komplikasyon görülme oranı (p<0.001), mortalite (p=0.004)ve hastane kalış süresi (p=0.025) açısından anlamlı farklılık mevcuttu. Hastaların MICA skoru ile preoperatif NLR arasında (p=0.619, r=0.055) pozitif yönlü korelasyon gözlenirken gruplar arasında anlamlı farklılık gözlenmemiştir (p=0.486). Mortalite açısından baktığımızdan exitus olanlarda NLR, olmayanlara göre daha yüksek çıksa da anlamlı farklılık gözlenmemiştir (p=0.165).

Sonuç: Kalça operasyonu olan yaşlı hastalarda preoperatif risk faktörlerinin belirlenmesi ve bu riske yönelik tedavi planlamasında multidisipliner yaklaşım önemlidir. Bu hastalarda perioperatif riski tahmin etmek için MICA skoru kullanılabilir. Çalışmamızda preoperatif NLR'nın MICA skoru ile ilişkili olmadığı sonucunu bulduk.

Anahtar Kelimeler: MICA skoru, kalça kırığı cerrahisi, NLR, perioperatif dönem, yaşlı hasta

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INTRODUCTION

Due to the potentially severe consequences of hip fractures in elderly populations, such as mortality and inability to perform daily tasks, it becomes crucial to identify high-risk patients preoperatively. Determining preoperative risk can provide valuable insights into the optimal timing of surgery, the requirement for intensive care during treatment, and the overall prognosis for these patients.[1]

The Gupta perioperative myocardial infarction or cardiac arrest (MICA) score derived from the National Surgical Quality Improvement Programme (NSQIP) has become a commonly employed tool for evaluating the risk of experiencing intraoperative or postoperative myocardial infarction and cardiac arrest following non-cardiac surgeries. This score is calculated using parameters including age, preoperative creatinine value (mg/dl), American Society of Anaesthesiologists (ASA) classification, functional status (active mobile-passive mobile-bed-dependent), and surgical site.[2]

The 2014 American College of Cardiology and American Heart Association guidelines on perioperative assessment recommend differentiating low-risk (<1%) and high-risk (≥1%) patients for cardiac complications to guide appropriate preoperative testing. One of the recommended tools for evaluating perioperative risk is the MICA risk calculator. The validity of the MICA score has been established as a predictor for major cardiovascular events, including myocardial infarction and cardiac arrest, occurring within 30 days following orthopedic surgeries.[3]

Neutrophil-to-Lymphocyte Ratio (NLR), a marker of inflammation, is defined as the ratio of neutrophil count to lymphocyte count. It is a low-cost and easily accessible laboratory marker that can be routinely employed in clinical practice. Extensive research has demonstrated that NLR is a valuable tool for predicting the risk of mortality after surgery.[4] In this study, we aimed to investigate whether there is a correlation between MICA score and NLR.

MATERIAL AND METHOD

This study was conducted retrospectively between November 2021 and March 2022. The study was carried out with the permission of Afyonkarahisar Health Sciences University Faculty of Medicine Clinical Researches Ethics Committee (Date: 03.06.2022, Decision No: 2022/7). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki. The study included all patients ≤ 65 years of age who underwent hip operations. However, certain criteria were used to exclude specific patient groups, including those whose medical records could not be accessed from the hospital's medulla system, cancer patients, patients with active infections, patients with severe hepatic and renal failure, those diagnosed with hematological diseases, and patients undergoing immunosuppressive therapy.

In this study, demographic data, comorbidities, clinical and laboratory characteristics, preoperative NLR, postoperative complications and length of hospital stay were evaluated, and MICA scores were computed for each patient. Based on the MICA cardiac risk score, the patients were categorized into two groups: the high-risk group (with a risk greater than 1%) and the low-risk group. Subsequently, a comparison was made between the NLR values of these two groups. Postoperative mortality of the patients was also evaluated.

Statistical Analysis

Statistical analysis was performed using IBM SPSS Statistics version 20. The data were presented as percentages (%), median, interquartile range (IQR), and mean ± standard deviation. The conformity of the variables to normal distribution was determined by visual (histogram) and analytical methods (Kolmogorov-Smirnov test). Student T or Mann-Whitney U test was used to compare continuous variables, and the Chi-square test was used to compare categorical variables. Correlation coefficients were calculated to assess the relationships between variables where at least one of the variables was either not normally distributed or ordinal, and statistical significance was calculated by the Spearman test. P<0.05 values were considered statistically significant.

RESULTS

The study comprised 83 patients aged 65 and older out of the total 191 patients who were operated on for hip fractures between November 2021 and March 2022. Based on their MICA cardiac risk scoring, patients were categorized into two groups: MICA score<1 (n=30) and MICA score≥1 (n=53) (**Figure 1**). Among the participants, 63.4% were female, and 36.6% were male, with no statistically significant difference observed in terms of gender between the two groups (p=0.991, **Table 1**). The median age of patients with MICA score<1 was 72 years, while the median age of the group with MICA score≥1 was 81 years, indicating a statistically significant difference between both groups in terms of age (p<0.001, **Table 1**).

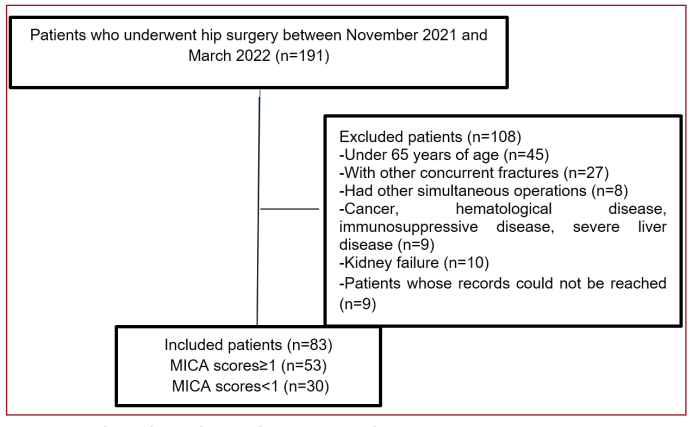

Figure 1. Flow chart shows the patient selection process

The body mass indexes (BMI) of the patients in both groups did not exhibit a statistically significant difference (p=0.183, **Table 1**). However, a significant difference was observed between the ASA distributions of the patients (p<0.001, **Table 1**). Among the patients, 84.1% had comorbidities, while 15.9% did not. Nevertheless, there was no significant difference in the distribution of comorbidities between the two groups (p=0.042). Regarding anesthesia type, 54.9% of the patients underwent surgery under general anesthesia, and 45.1% underwent regional anesthesia (p=0.831, **Table 1**).

The preoperative NLR values were found to be higher in the group with a MICA score≥1; however, this difference was not statistically significant (p=0.486, **Table 2**). In the Spearman correlation analysis, a positive correlation was observed between the calculated MICA score of the patients and the entry NLR (p=0.619, r=0.055) (2). When analyzing the NLR values according to the mortality status of the patients, it was observed that the median NLR values in the patients with exitus (10.95; 8.80) were higher compared to the NLR values in the living patients (7.07; 7.06). However, this difference did not reach statistical significance (p=0.165, **Table 2**).

Postoperatively, 51.8% of the patients were transferred to the ward, while 48.2% were transferred to the intensive care unit. Patients with MICA score≥1 had a significantly higher rate of postoperative intensive care unit visits than patients with MICA score<1(60.4%, 26.7%, p=0.003, **Table 3**, respectively). While the duration of surgery was similar in both groups, the median length of hospital stay was significantly higher in patients with MICA score≥1 (p=0.025, **Table 3**). The 30-day mortality rate was 20.5% in all patients. Mortality was significantly higher in patients with MICA score≥1 than in patients with MICA score<1 (p=0.004, **Table 3**). Postoperative complications were observed in 30.5% of the patients, with pneumonia being the most common complication, occurring at a rate of 24%, and there was a significant difference between the groups in terms of complications (p<0.001, **Table 3**). A positive correlation was observed between the MICA score and preoperative NLR values (p=0.619, r=0.055); however, no significant difference was detected between the groups (p=0.486). Upon analyzing the NLR values in terms of mortality, it was observed that NLR values were higher in patients with exitus compared to those without; however, this difference did not reach statistical significance (p=0.165).

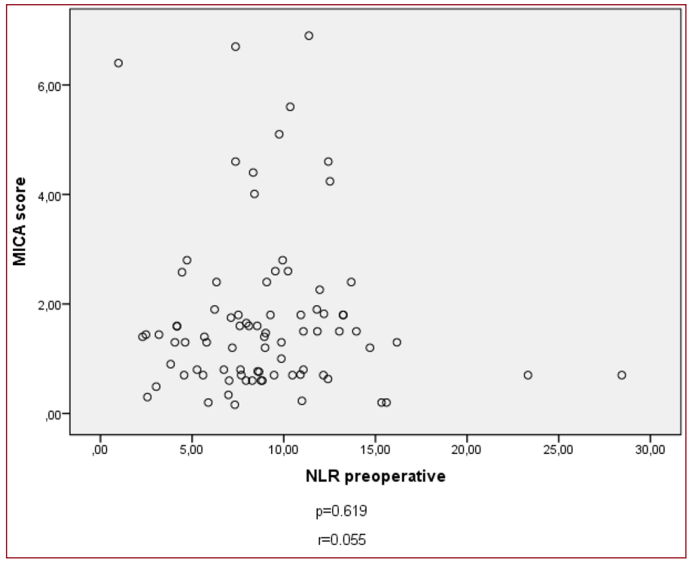

Figure 2. Correlation analysis between MICA score and entry admission NLR

Table 1. Comparison of patients' demographic data and anesthesia methods

	MICA score<1 (n=30)	MICA score≥1 (n= 53)	Total (n=83)	p
Gender, F/M, n (%)	19 (63.3) / 11 (36.7)	33 (63.5)/ 19 (36.5)	52 (63.4)/ 30 (36.6)	0.991*
Age, year Median; IQR	72; 9	81; 12	77; 14	<0.001#
BMI, median; IQR	29.34; 7.58	26.26; 12.38	28,40; 10.38	0.183#
ASA, n (%) II III IV	10 (33.3)/ 20 (66.7)/ 0	2 (3.8)/ 41 (78.8)/ 9 (17.3)	12 (14.6)/ 61 (74.4)/ 9 (11)	<0.001*
Co-morbidity, yes/no, n (%)	22 (73.3)/ 8 (26.7)	47 (90.4)/ 5 (9.6)	69 (84.1)/ 13 (15.9)	0.042*
Co-morbidity type Co-morbidity, n (%) Hypertension COPD More than 1 co-morbidity Heart disease Other	7 (31.8) 0 9 (40.9) 4 (18.2) 2 (9.1)	6 (12.8) 1 (2.1) 26 (55.3) 9 (19.1) 5 (10.6)	13 (18.8) 1 (1.4) 35 (50.7) 13 (13.8) 7 (10.1)	0.160*
Form of anesthesia, general/regional, n (%)	16 (53.3)/ 14 (46.7)	29 (55.8)/ 23 (44.2)	45 (54.9)/ 37 (45.1)	0.831*

*Chi-Square, #Mann Whitney U. Values number, median; It is given as the Interquartile Range (IQR). F/M; Female/Male, BMI; body mass index, ASA: American Society of Anesthesiologists
COPD: chronic obstructive pulmonary disease, Other; dementia, cerebrovascular disease

Table 2. Comparison of NLR values according to patients' MICA scores and mortality status

	MICA score<1 (n=30)	MICA score≥1 (n=53)	Total (n=83)	p#
NLR preoperative	6.70;7.39	8.02;6.73	7.38;7.02	0.486
	Mortality yes (n=17)	Mortality no (n=66)		
NLR preoperative	10.95;8.80	7.07;7.06	7.38;7.02	0.165

#Mann Whitney U. Values are median; It is given as the Interquartile Range (IQR). NLR; Neutrophil Lymphocyte Ratio

Table 3. Comparison of patients' postoperative discharge, length of stay, mortality, and complications

	MICA score<1 (n= 30)	MICA score≥1 (n= 53)	Total (n=83)	p
Postoperative discharge, n (%)				
Service	22 (73.3)/	21 (39.6)/	43 (51.8)/	0.003*
ICU	8 (26.7)	32 (60.4)	40 (48.2)	
Operation time, min, median; IQR	115;64	120;43	120;60	0.868#
Length of hospital stay, days	7;2	8;8	7;6	0.025#
Mortality is 30 days, n (%)				
Yes	1 (3.3)/	16 (30.2)/	17 (20.5)/	0.004*
No	29 (96.7)	37 (69.8)	66 (79.5)	
Complication, n (%)				
Yes	2 (6.7)/	23 (44.2)/	25 (30.5)/	<0.001#
No	28 (93.3)	29 (55.8)	57 (69.5)	
Type of complication, n(%)				
Kidney injury	0	3 (13)	3 (12)	
Pneumonia	0	6 (26.1)	6 (24)	
DVT	1 (50)	0	1 (4)	
MI	0	2 (8.7)	2 (8)	
Embolism	0	4 (17.4)	4 (16)	0.068*
SVO	0	1 (4.3)	1 (4)	
Wound site infection	1(50)	2 (8.7)	3 (12)	
Kidney injury + infection	0	1 (4.3)	1 (4)	
Sepsis, ARDS	0	3 (13)	3 (12)	
Other	0	1 (4.3)	1 (4)	

*Chi-Square, #Mann Whitney U. Values number (%), median; Interquartile Range (IQR). YB; intensive care, MI; myocardial infarction, SVO; cerebrovascular event, Renal failure; kidney failure, DVT; deep vein thrombosis, inf; infection, ARDS; acute respiratory distress syndrome

DISCUSSION

There are many studies on the use of NLR in orthopedic surgery.[8,17,18] While there are studies on the use of the MICA score in perioperative risk prediction in different surgeries.[19-21] We identified a research gap in the literature regarding the use of the MICA score in the context of orthopedic hip fractures. Consequently, our study evaluated the effectiveness of the MICA score in hip surgery and investigated its potential relationship with NLR.

A meta-analysis including 1563 hip fracture patients over 65 years of age found that high pre- and postoperative NLR was associated with long-term (1-year) mortality risk after hip fracture surgery.[14] Another study reported that an NLR value >5 on the fifth postoperative day following hip fracture surgery was associated with a high mortality risk.[8] Again, in a study in which patients over 60 years of age with acute coronary syndrome were followed up, it was concluded that there was a correlation between NLR measured at the time of hospital admission and the length of hospital stay.[15] Fisher et al.[16] found that preoperative high NLR was an important risk factor for postoperative myocardial damage, high inflammatory response, and in-hospital mortality. Our study did not reveal a significant association between preoperative NLR and mortality. However, it is important to consider that different results may emerge when patients are followed up over the long term.

Hip fractures pose significant morbidity and mortality risks, particularly in elderly individuals.[5] In most studies, age is identified as a prominent risk factor for mortality in hip fracture patients.[6] For instance, a study investigating the mortality rates of hip fracture patients reported a 30-day mortality of 19%.[7] Moreover, the 1-year mortality rate among individuals aged 65 years and older who underwent hip fracture surgery varied from 8.4% to 36%, as reported in other studies.[8] In our study, we observed a 30-day mortality rate of 30.2% in the high-risk group with a MICA score≥1, while the low-cardiac-risk group with a MICA score<1 had a significantly lower 30-day mortality rate of 3.3%. The higher mortality rate in the high-risk group may be attributed to the fact that our patients had traumatic fractures, and there might have been concomitant injuries to other organs. The fact that other traumas accompanying hip fractures were not analyzed is one of the limitations of our study.

It is believed that the application of risk models such as the Revised Cardiac Risk Index (RCRI) or NSQIP MICA in the preoperative period may reduce unnecessary cardiac tests and preoperative cardiology referrals in patients.[22]

ASA scoring is widely recognized as the most valid and widely accepted system for assessing the overall health status of surgical patients.[9] Studies have shown a substantial association between ASA scores and mortality rates following hip fractures.[10] In our study, we also

observed that patients in the high-risk group with a MICA score≥1 had higher ASA scores.

BMI>30 kg/m² is associated with prolonged surgical time, cardiac complications, and mortality risk.[11,12] However, our study did not identify a statistically significant difference in BMI among high cardiac-risk patients with a MICA score≥1. This may be due to sarcopenia and weight loss, which are commonly observed in frail elderly individuals

According to the findings of Forget et al.[8] several factors have been identified as significant predictors of mortality, cardiovascular morbidity, and infections in the early and late postoperative period of hip fracture surgery patients. These factors include advanced age, comorbidities, fifth-day (NLR), and male gender. Temiz et al.[23] showed that the NLR value at presentation could be used to determine the mortality risk in elderly patients with hip fracture.

Cardiac and infectious complications are common after hip fracture surgery.[17] Existing studies have established a link between NLR and postoperative complications after hip fracture surgery.[8,16] Our study found no correlation between postoperative complications and preoperative NLR. However, postoperative complications were higher in patients with a MICA score≥1.

A multicentre study investigating the relationship between comorbidity and mortality in hip fracture patients found that diabetes and cognitive impairment were linked to higher early and late mortality rates among geriatric patients who underwent hip fracture surgery. Our study results revealed no significant relationship between comorbidity and mortality. Additionally, no significant difference was observed between the groups with and without high cardiac risk concerning the presence of comorbidities.[13]

The limitations of our study encompass its retrospective nature, the exclusion of NLR measurement in the postoperative period, and the absence of long-term follow-up for the patients. Prospective studies in larger patient groups with long-term follow-up of patients can be planned.

CONCLUSION

Numerous parameters can be utilized to predict the risk in patients during this procedure. One of these parameters is the NLR and the MICA risk score, which is employed to predict cardiac risk and complications in patients. Our study revealed a positive correlation between the MICA score and preoperative NLR values; however, no statistically significant difference was observed between the groups. Nonetheless, we firmly believe that prospective large-scale studies are imperative, encompassing both parameters to predict mortality and assess risk effectively.

ETHICAL DECLARATIONS

Ethics Committee Approval: The study was carried out with the permission of Afyonkarahisar Health Sciences University Faculty of Medicine Clinical Researches Ethics Committee (Date: 03.06.2022, Decision No: 2022/7).

Informed Consent: Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

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