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Relationship of NLR and PLR with fracture severity in patients with proximal femur fractures

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Abstract

Aim: The aim of this study is to investigate the role of hematological markers in predicting the severity of proximal femur fractures, which is an important mortality and morbidity problem.

Materials and Methods: Patients who applied to our clinic for proximal femur fracture for 2 years between 2017 and 2019 were included in this study. Demographic information, fracture severity, fracture classification and blood values of the patients were recorded. Patients with proximal femoral fractures who were registered in the hospital information operating system and accepted to participate in this study were included in the study, while patients with a concomitant fracture, a history of malignancy, and those who applied for revision surgery were excluded from the study.

Results: A total of 89 patients with proximal femoral fractures, 51 of whom were women (57.3%), with a mean age of 79.2±10.9 (range, 25 to 98) years were included in this study. The patients were divided into two groups as stable and unstable according to the severity of the fracture. When the preoperative hemogram parameters of the patients were examined, it was noted that the neutrophil (p=0.013), lymphocyte (p=0.012), Neutrophil/Lymphocyte ratio (NLR) (p=0.001) and Platelet/Lymphocyte ratio (PLR) (p=0.035) values were statistically significantly different between the groups. NLR and PLR values were found to be higher in the unstable fracture group than in the stable fracture group. It was observed that values of 6.45 and above for NLR and 172.2 and above for PLR were predictive of unstable fracture.

Conclusion: In conclusion, NLR and PLR are useful biomarkers in determining the severity of proximal femur fractures. It can guide us in the management of proximal femur fractures because it can be routinely, inexpensively and easily measured.

Introduction

Proximal femur fractures are an important morbidity and mortality problem in societies. It occurs in two ways. Firstly, proximal femur fractures are increasing as a result of increasing geriatric population due to prolonged lifespan. Another is that as a result of increased interaction, high-energy traumas (traffic accidents, work accidents) are increasing. This situation creates a social and economic burden [1]. Hematological markers are the most important indicators of inflammation. Due to their easy and cheap availability, their relationship with many diseases, especially cancers, has been discussed in the literature [2-6]. Recently, studies investigating the relationship between fracture severity and hematological markers have increased [7]. In the present study, we investigated the role of hematological markers in predicting the severity of proximal femur fractures, which is an important mortality and morbidity problem in the community.

Materials and Methods

Patients who applied to our clinic for proximal femur fracture for 2 years between 2017 and 2019 were included in this study. Demographic information, fracture severity, Evans Jansen fracture classification and blood values of the patients were recorded. Patients with proximal femoral fractures who were registered in the hospital information

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Table 1. Demographic characteristics, laboratory results, and intergroup analysis.

N=89	Total (n=89)	Group 1: Stable(n=38)	Group 2: Unstable(n=51)	p
Age, years				0.425*
Mean ± sd	79.2 ± 10.9	80.3 ± 9.3	78.4 ± 12	
Sex, n (%)				0.324**
Female	51 (57.3)	19 (50)	32 (62.7)	
Male	38 (42.7)	19 (50)	19 (37.3)	
Side, n (%)				0.022**
Left	38 (42.7)	22 (57.9)	16 (31.4)	
Right	51 (57.3)	16 (42.1)	35 (68.6)	
Surgical Technique, n (%)				0.777**
Bipolar	63 (70.8)	28 (73.7)	35 (68.6)	
PFNA	26 (29.2)	10 (26.3)	16 (31.4)	
Hgb, g/dl				0.379***
Median(IQR)	10.7 (9.8-12)	10.6 (9.3-11.9)	10.9 (9.9-12.2)	
WBC, 10^9/L				0.099***
Median(IQR)	9.7 (7.4-11.7)	9.3 (7.3-11.1)	10.8 (7.4-13.5)	
Neutrophil, 10^9/L				0.013***
Median(IQR)	7.5 (5.6-9.4)	6.9 (5.3-8.3)	8 (5.9-11.3)	
Monocyte, 10^9/L				0.852***
Median(IQR)	0.6 (0.4-0.8)	0.6 (0.4-0.8)	0.6 (0.4-0.8)	
Lymphocyte, 10^9/L				0.012***
Median(IQR)	1.2 (0.9-1.6)	1.3 (1.1-1.7)	1.1 (0.8-1.5)	
PLT, 10^9/L				0.934***
Median(IQR)	218 (160.5-275.5)	217 (162.5-283)	220 (156-271)	
MPV				0.259***
Median(IQR)	9.6 (8.8-10.6)	9.6 (8.7-10.1)	10 (8.8-10.8)	
NLR				0.001***
Median(IQR)	6.4 (4.1-9.9)	4.7 (3.2-7.1)	7.2 (5.1-11.4)	
PLR				0.035***
Median(IQR)	172.4 (126.8-270.6)	166.4 (120.4-205.1)	206.8 (127.4-295.7)	
MLR				0.102***
Median(min-max)	0.5 (0.3-0.7)	0.4 (0.3-0.6)	0.5 (0.4-0.8)	
MPV/PLT Ratio				0.980***
Median(min-max)	0.04 (0.03-0.06)	0.04 (0.03-0.06)	0.04 (0.03-0.06)	

*Independent Sample T test **Chi-Square Test ***Mann-Whitney U test NLR: Neutrophil/Lymphocyte ratio PLR: Platelet/Lymphocyte ratio MLR: Monocyte/ Lymphocyte ratio.

Table 2. Statistical parameters of various diagnostic approaches for the predictive value of preoperative PLT, MPV and MPV/PLT Ratio.

N=89	AUC (95%CI)	p	Cut-off	Sensitivity (%)	Specificity(%)	+LHR	PPV(%)	NPV(%)	Max Youden Index	DOR
NLR	0.700 (0.590-0.809)	0.001	≥6.45	64.7	71.1	2.24	75	60	0.358	4.5 (1.8- 11.2)
PLR	0.631 (0.514- 0.748)	0.035	≥172. 2	62.7	65.8	1.83	71.1	56.8	0.285	3.2 (1.3-7.8)

+LHR: Positive Likelihood Ratio, PPV: Positive Predictive Value, NPV: Negative Predictive Value, DOR: Diagnostic Odds Ratio, NLR: Neutrophil/Lymphocyte ratio,PLR: Platelet/Lymphocyte ratio.

operating system and accepted to participate in this study were included in the study, while patients with a concomitant fracture, a history of malignancy, and those who applied for revision surgery were excluded from the study. This study was planned with ethical approval from the ethics committee of our hospital (2021-07/1296). All procedures were performed in accordance with the Declaration of Helsinki and ethical standards. Informed consent was

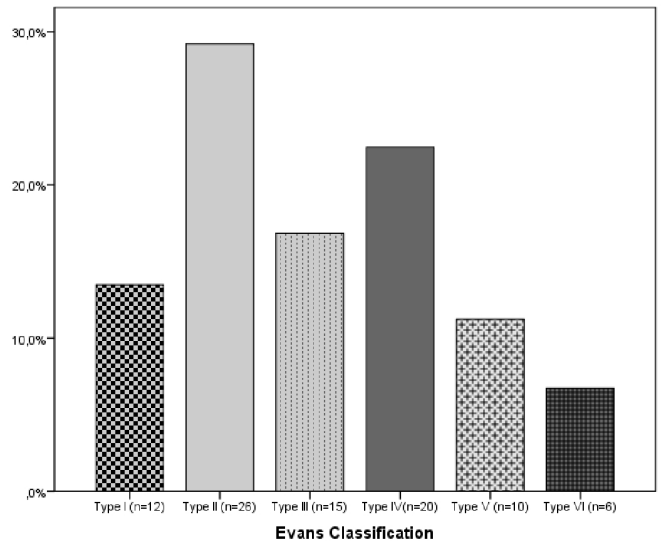

Figure 1. Distribution of fracture according to Evans-Jansen classification.

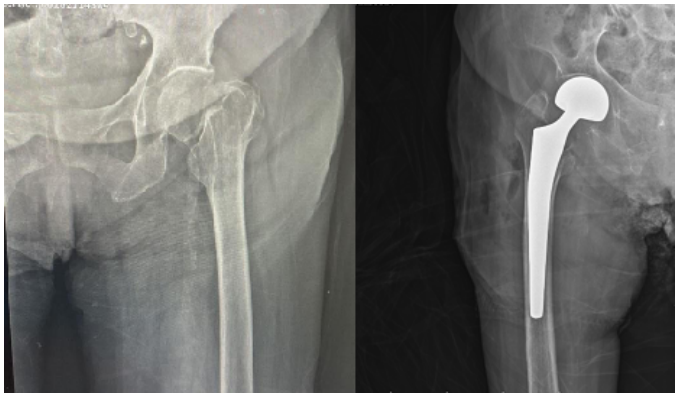

Figure 2. Partial hip arthroplasty direct radiography image.

obtained from all participants or family members participating in the study.

Evans Jansen classification

Type I: Non-displaced two-part fracture

Type II: Displaced two-part fractures

Type III: Three-part fractures without posterolateral support due to a major trochanter fracture

Type IV: Three-part fractures without posteromedial support due to fracture of the trochanter minor

Type V: Four-part fractures without posteromedial and posterolateral support

Type VI-R: Reverse oblique fractures.

Statistical analysis

Study data Statistical analyzes were performed using IBM SPSS Statistics for Windows, version 22.0 (IBM Corp., Armonk, N.Y., USA). Quantitative data in the study are age and hemogram parameters, while qualitative data are gender, side and surgical technique. NLR and PLR values were categorized as high or low according to the determined cut-off value. Normal distribution for continuous variables were assessed with visual (histograms and probability graphics) and analytic methods (Kolmogorov-Smirnov and Shapiro-Wilk's test). Whether there was a difference between stable and unstable bone fracture groups in terms of demographic, clinical and laboratory parameters was evaluated with parametric or nonparametric tests.While the independent sample t-test was used for normally distributed data, the Mann-Whitney U test was used for comparison analysis between two independent groups in non-normally distributed data. Comparison analyzes between independent groups for categorical variables were performed with the chi-square test.. NLR and PLR values were evaluated by receiver operating curve (ROC) analysis whether NLR and PLR values predicted unstable fracture The area under the ROC curve (AUC) results were considered excellent for AUC values between 0.9-1, good for AUC values between 0.8-0.9, fair for AUC values between 0.7-0.8, poor for AUC values between 0.6-0.7 and failed for AUC values between 0.5-0.6 (1,2). Results following ROC analysis; area under curve (AUC) and cut-off values, sensitivity and specificity of these cut-offs values, likelihood ratio PPD and NPD are presented. Youden index and Positive Likelihood Ratio were used to decide the cut-off point [the Youden Index was calculated as max (sensitivity + specificity − 1)]. Logistic regression analysis was used to calculate the Diagnostic Odds Ratio and 95% CI. A value of $p < 0.05$ was accepted as statistically significant [8,9].

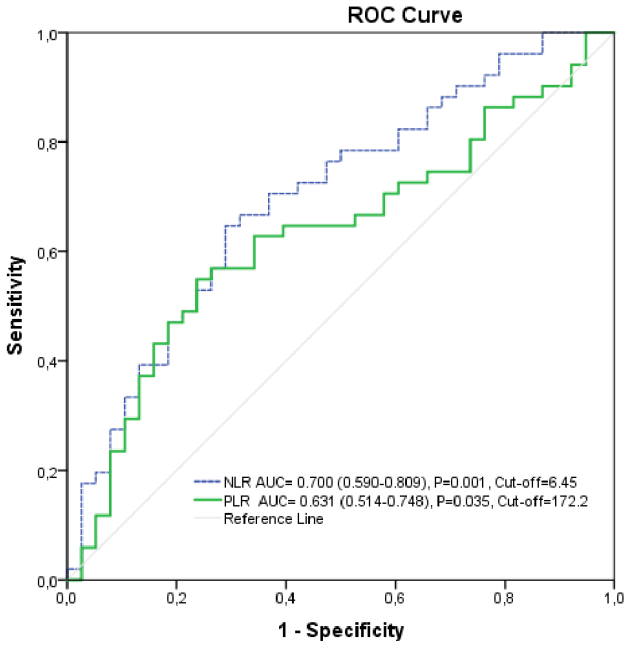

Figure 3. Receiver operating characteristic (ROC) curves for the NLR and PLR (*Larger results of NLR and PLR indicates more diagnostic positive test for unstable fractures.*)

Results

A total of 89 patients with proximal (pertrochanteric) femur fractures, 51 of whom were women (57.3%), with a mean age of 79.2 ± 10.9 (range, 25 to 98) years were included in this study. 57.3% of the fractures are located on the right side (Table 1). When the distribution of fractures according to the Evans – Jansen classification is examined; 12 are type 1, 26 are type 2, 15 are type 3, 20 are type 4, 10 are type 5 and 6 are type 6 (R: reverse) (Figure 1). Type 1 and 2 class of fractures were grouped as stable (n=38), type 3, type 4, type 5 and type 6 fractures were grouped as unstable (n=51). The mean age (p=0.425) and gender distribution (0.324) of both groups were similar. Partial hip arthroplasty (Figure 2) was performed in 70.8% of the patients and there was no difference between the fracture groups in terms of surgical technique (p=0.777). When the preoperative hemogram parameters of the patients were examined, it was noted that the neutrophil (p=0.013), lymphocyte (p=0.012), Neutrophil/Lymphocyte ratio (NLR) (p=0.001) and Platelet/Lymphocyte ratio (PLR) (p=0.035) values were statistically significantly different between the groups (Table 1). NLR and PLR values were found to be higher in the unstable fracture group than in the stable fracture group (Table 2). We evaluated the predictive power of NLR and PLR ratios for unstable fracture with ROC analyzes (Figure 3). According to Table 2, it was observed that the AUC value obtained for NLR (AUC=0.700) was higher than the AUC value of PLR (AUC=0.631) (Table 2). When the cut- off values obtained for both parameters as a result of the analyzes and the sensitivity, specificity, Positive Likelihood Ratio (+LHR), Positive Predictive Value (PPV) and Negative Predictive Value (NPV) values of these cut-off values were examined, it was observed that values of 6.45 and above for NLR and values of 172.2 and above for PLR were predictive of unstable fracture (Table 2). NLR and PLR were found to be parameters with predictive value associated with unstable fractures. Diagnostic Odds Ratio 4.5 for NLR cut-off and diagnostic Odds Ratio 3.2 for PLR were found.

Discussion

Human life; It is increasing thanks to early diagnosis, knowledge of healthy life and medical treatments, and the increasing elderly population is confronted with more elderly proximal femur fractures as a result of low-energy traumas. In addition, young proximal femur fractures are also very common due to high-energy traumas (traffic accidents, work accidents). Therefore, these fractures need to be managed well. The most important finding of this study is that NLR and PLR are useful biomarkers in determining the severity of proximal femur fractures. Radiographic fracture classification systems designed to group fractures with similar characteristics in mechanism and fracture pattern have almost always been the hallmark of the severity assessment of orthopedic injuries. Evans-Jansen and AO fracture classifications are the most commonly used classifications for proximal femur fractures [10]. Of the patients participating in this study, 38 (43%) had stable fractures, while 51 (57%) had unstable fractures. In recent years, the literature has defined hematological biomarkers as a systemic inflammatory-immunological parameter. There are many studies investigating the relationships between these biomarkers and cancer, disease, fracture, trauma because they are easy, inexpensive and routinely measured. NLR at the time of admission before treatment; It has been reported as a biomarker that predicts the outcome and severity of cardiovascular disease, acute intracerebral hemorrhage, elderly hip fractures, malignancy, knee joint osteoarthritis, and multiple trauma [5,7,11,12]. In our study, we found NLR and PLR as biomarkers that predict the severity of proximal femur fractures. Wang et al.7 examined the relationship between fracture severity and NLR in tibial plateau fractures and found that NLR was significantly higher in unstable fracture patients. The results of Fisher et al.11 indicated that an admission NLR $\geq$ 5.1 was an independent determinant of hip fractures. In this study, the cut-off value for NLR was 6.45. NLR $\geq$ 6.45 values were found to be predictive for unstable fractures. There are some limitations in our study. Comorbidities that may affect hematological biomarkers were not included in the study, and no comparison was made with post-operative or post- discharge. Also, we cannot explain the mechanism behind NLR elevation, nor its impact on measures of outcome. Despite this, this study is valuable as it is the first study to investigate the relationship between the severity of proximal femoral fractures and hematological biomarkers. It is likely that multicenter and prospective studies to be conducted in the coming years will illuminate this mechanism. In conclusion, NLR and PLR are useful biomarkers in determining the severity of proximal femur fractures. It can guide us in the management of proximal femur fractures because it can be routinely, inexpensively and easily measured.

Ethics approval

Approval for this study was obtained from the Health Sciences University Dr.Abdurrahman Yurtaslan Oncology Health Application and Research Center Clinical Research Ethics Committee.

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