

# Absolute White Blood Cell Count and Neutrophil-Lymphocyte Ratio May Predict the Need for Double- J Stent Insertion in Ureteral Stones in Children: A Comparative Study

## Çocuklarda Mutlak Beyaz Kan Hücresi Sayısı ve Nötrofil-Lenfosit Oranı, Üreter Taşlarında Double- J Kateter Yerleştirilmesi İhtiyacını Öngörebilir: Karşılaştırmalı Bir Çalışma

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### Abstract

**Objective:** Our goal was to determine whether or not a double-J (DJ) stent insertion is required in cases of ureteral stones based on the absolute white blood cell (WBC) counts, neutrophil-lymphocyte ratio (NLR), absolute monocyte counts, and other laboratory markers.

**Materials and Methods:** The patients were divided into two groups as those who did (Group 1), and did not (Group 2) need DJ stent insertion. The age, symptoms, diagnosis, hemogram parameters, and treatment results of the patients were evaluated.

**Results:** Forty-nine percent (n=44) of the patients were female and 51% (n=46) were male. The groups did not differ in terms of age and gender (p>0.05). A higher incidence of hematuria was observed in Group 1 (p<0.05). WBC (p<0.05), NLR (p<0.05), and monocyte counts (p<0.05) were found to be higher in Group 1. In the ROC analysis; WBC and NLR were found to be two predictive markers for the need for DJ stent insertion. At a cut-off value of 12.6 x 10<sup>9</sup>/L, WBC had 37% sensitivity, and 81% specificity (AUC: 0.67; 95% CI: 0.54-0.80), and at a cut-off value of 3.8, NLR had 65% sensitivity, and 76% specificity (AUC: 0.70; 95%CI: 0.57-0.82) in predicting the need for a DJ stent insertion. Reoperation was not required in any case.

**Conclusion:** In cases of ureteral stones, the absolute WBC count and NLR may help determine the requirement (if any) for a DJ stent insertion.

**Keywords:** double-J catheter, neutrophil-lymphocyte ratio, ureteral stone, white blood cell count

### Öz

**Amaç:** Amacımız, mutlak beyaz kan hücresi (WBC) sayısı, nötrofil-lenfosit oranı (NLO), mutlak monosit sayıları ve diğer laboratuvar belirteçlerine dayalı olarak üreter taşı vakalarında double-J (DJ) kateter yerleştirilmesinin gerekli olup olmadığını belirlemektir.

**Gereçler ve Yöntemler:** Hastalar DJ stent takılanlar (Grup 1) ve takılmayanlar (Grup 2) olarak iki gruba ayrıldı. Hastaların yaşı, semptomları, tanıları, hemogram parametreleri ve tedavi sonuçları değerlendirildi.

**Bulgular:** Hastaların %49'u (n=44) kadın, %51'i (n=46) erkekti. Gruplar yaş ve cinsiyet açısından farklılık göstermedi (p>0,05). Grup 1'de daha yüksek hematüri insidansı gözlemlendi (p<0,05). WBC (p<0,05), NLO (p<0,05) ve monosit sayısı (p<0,05) Grup 1'de yüksek bulundu. ROC analizinde; WBC ve NLO'nun DJ kateter yerleştirilmesi ihtiyacını öngören iki prediktif belirteç olduğu saptandı. DJ stent yerleştirme ihtiyacını tahmin etmede 12,6 x 10<sup>9</sup>/L eşik değerinde WBC %37 duyarlılığa ve %81 özgüllüğe (EAA: 0,67; %95 GA: 0,54-0,80), 3,8 eşik değerinde NLR %65 duyarlılık ve %76 özgüllük değerine (AUC: 0,70; %95CI: 0,57-0,82) sahipti. Hiçbir durumda reoperasyon gerekmedi.

**Sonuç:** Üreter taşı vakalarında, mutlak WBC sayısı ve NLO, double-J kateter yerleştirilmesinin gerekli olup olmadığını belirlemeye yardımcı olabilir.

**Anahtar kelimeler:** double-J kateter, nötrofil-lenfosit oranı, üreter taşı, beyaz kan hücre sayımı

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## Introduction

The incidence of urolithiasis in children has increased, ranging from 0.1 to 5% [1]. There are a variety of metabolic, environmental, and dietary variables that may lead to the formation of urinary stones in children [2,3]. While hematuria, dysuria, and discomfort are the usual symptoms of urolithiasis in older children, younger children may have nonspecific symptoms including irritability [3].

Often the best treatment alternative for urolithiasis is chosen depending on the size, location, composition of the stone and anatomy of the urinary system. Along with the advancement of endoscopic technology, the primary surgical approach for the management of urinary stones has also changed over time, moving from open surgery to less invasive techniques [4,5]. In extracorporeal shock wave lithotripsy (ESWL), external shock waves are focused directly on the stone. Both kidney and ureteral stones may be treated using this approach. On the other hand, many ureterorenoscopy-guided (URS) contact lithotripsy methods, including laser, ultrasound, and pneumatic lithotripsy may be used for this purpose. When imaging fails to facilitate the procedure or cannot be done during ESWL in children with stones larger than 4 mm, DJ stent insertion is primarily employed [6,7].

The use of DJ stents after URS therapy is still debatable. In this research, we have aimed to investigate whether the absolute WBC, neutrophil-lymphocyte ratio (NLR), absolute monocyte counts, and other laboratory markers may help determine the need for double-J stent insertion in cases of ureteral stones.

## Materials and Methods

### Patients and Groups

The patients who were diagnosed and treated in our clinic between January 1, 2018 and December 30, 2022 were included in the study. Patients (total n=90) who did (n =50), and did not need, (n = 40) a DJ stent insertion were included in the study. The data of the patients were retrospectively scanned. The patients were divided into two groups as those that did (Group 1) and did not (Group 2) need DJ stent insertion. The age, symptoms, diagnoses, hemogram parameters, and treatment results of the patients were evaluated. Ethical approval was obtained from the local ethics committee of Dicle University Medical Faculty (approval date and number: 28.02.2023/60).

### Surgical Procedure

All patients who presented to the emergency department with flank pain underwent physical, ultrasonographic, and radiological examinations, and their CRP values and hemogram parameters were evaluated. Among them, patients with ureteral stones were hospitalized. After adequate hydration, patients with persistent stones detected in the control ultrasonography underwent URS. After URS, DJ stent was inserted in patients with proper indications (patients who developed edema or excessive edema due to large stones). No additional procedure was applied to the patients who did not need DJ stent insertion.

## Inclusion Criteria

Among patients aged 0-18 years with complete retrospective medical data and diagnosed, and treated in our clinic, those who had undergone surgery for ureteral stones were included in the study.

## Exclusion Criteria

Patients aged >18 years with comorbidity and/or urinary extravasation and inconsistent retrospective data were excluded from the study.

## Statistical Analysis

Statistical analyzes including descriptive statistics, frequencies, and other statistical methods were performed for all patient data. Continuous data were expressed as mean  $\pm$  standard deviation. Continuous variables were analyzed with the Shapiro-Wilk and Kolmogorov-Smirnov tests to determine whether the data had a normal distribution. Continuous and normally distributed variables were compared using Student's T-test. Non-parametric tests were used for the data that did not fit the normal distribution. In case of need, categorical variables were evaluated with a chi-square test and some other data with Fisher's exact test. Correlation between data was checked with Pearson and Spearman correlation tests. Binary logistic regression tests were used for the analysis of risk factors and indications for DJ-stent insertion. Analyzes were performed using SPSS Statistics for Windows, Version 26.0 (IBM Corp., Armonk, NY, USA).

## Results

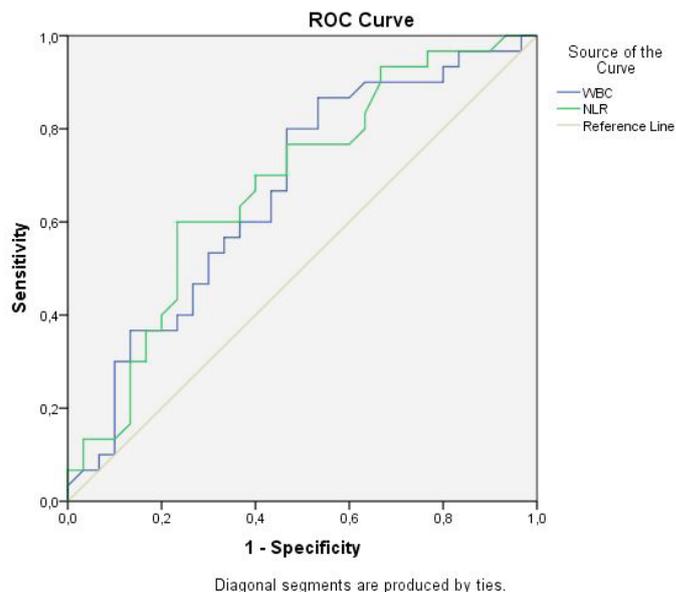
Forty-nine percent (n=44) of the patients were female and 51% (n=46) were male. The mean ages of the patients were 5.8 $\pm$ 3.4 years in Group 1 and 5.5 $\pm$ 4.7 years in Group 2. Age and gender of the patients did not differ significantly between both groups (p>0.05). Twenty-seven percent (n=27) of the patients had hematuria at presentation. The average duration of symptoms was approximately 36 $\pm$ 12.7 hrs in Group 1, and 39 $\pm$ 11.3 hrs in Group 2 (p>0.05). In addition to symptom duration, we also examined the presence of comorbidities in both groups. Remarkably, the average comorbidity score was found to be 1 for both groups. Again, the computed p-value exceeded 0.05, signifying that the difference in comorbidity scores between the two groups lacks statistical significance. A higher incidence of hematuria was observed in Group 1 (p<0.05). Two patients had an acute renal failure at admission (p>0.05). While there was no difference between the groups in terms of laterality of the stone (p>0.05), the mean stone size, WBC, NLR, and monocyte counts were significantly higher in Group 1 (for all p<0.05) (**Table 1**).

In the ROC analysis; WBC and NLR were found to be the predictive markers for the need for DJ stent insertion (**Figure 1**). At a cut-off value of 12.6 x 10<sup>9</sup>/L WBC had 37% sensitivity, and 81% specificity (AUC: 0.67; 95% CI: 0.54-0.80), and a cut-off value of 3.8, NLR had 65% sensitivity, and 76% specificity (AUC: 0.70; 95%CI: 0.57-0.82) in foreseeing the need for DJ stent insertion (**Table 2**).

Any correlation could not be found between stone size and NLR or WBC (p>0.05). Reoperation was not required in any case.

**Table 1.** Analysis of the patients and characteristics

	Group 1 (n=50)	Group 2 (n=40)	P value
Age (Mean±SD, year)	5.8±3.4	5.5±4.7	>0.05
Gender			>0.05
Male	33	13	
Female	27	17	
Hematuria	20	4	<0.05
Symptom duration (hour)	36±12.7	39±11.3	>0.05
Comorbidity	1	1	>0.05
Acute renal failure	1	1	>0.05
Stone size (Mean±SD, mm)	11.83±5.07	9.42±3.01	<0.05
Stone side			>0.05
Right	33	14	
Left	27	16	
Reoperation	0	0	>0.05
WBC	14.67±2.87	11.22±2.91	<0.05
NEU	8.48±2.18	7.35±2.96	>0.05
LYM	2.63±1.37	2.51±1.49	>0.05
MONO	1.01±1.31	0.61±0.28	<0.05
PLT	382.6±122.1	351.8±88.6	>0.05
CRP	1.31±2.05	1.27±3.9	>0.05
UREA	27.11±8.57	29.53±11.13	>0.05
CRE	0.78±0.37	0.73±0.51	>0.05
NLR	4.34±0.87	3.2±1.42	<0.05



**Figure 1.** ROC analysis

**Discussion**

Hematological parameters including NLR, platelet-lymphocyte ratio (PLR), and absolute monocyte counts (AMCs) have gained prominence in recent years because of their strong diagnostic predictive values, particularly in inflammatory conditions like acute appendicitis [8]. Similar studies have been conducted on NLR, monocyte-lymphocyte ratio (MLR), PLR, red blood cell distribution width (RDW), monocyte counts, and pentraxin-3 as predictors of survival in various cancers [9-12]. The use and usefulness of monocytes and WBC in youngsters have been restricted despite all investigations favoring their predictive values.

Inflammatory responses have been recently linked to kidney and ureter stones. Biomarkers for inflammatory diseases include C-reactive protein (CRP) and the erythrocyte sedimentation rate (ESR). Immune cells play an important role in the inflammatory process throughout the human body. Multiple studies have pointed to the NLR as a significant indicator of kidney stone formation. The spontaneous passage of a ureteral stone was correlated negatively with both NLR and PLR. However a recent research disproved the hypothesis suggesting that inflammatory biomarkers like NLR and PLR are linked to the spontaneous passage of ureteral stones [13].

As is shown in various research studies, diseases progressing with inflammation had higher total WBC, NEU, and monocyte

**Table 2.** Suggested cut-off values and diagnostic value

Variable	Suggested cut-off value	AUC	P value	95% CI Lower bound	95% CI Upper bound	Sensitivity	Specificity
WBC	12.6	0.67	0.009	0.54	0.80	37%	81%
Monocyte	3.8	0.70	0.003	0.57	0.82	65%	76%

counts [14]. According to Halaseh et al., NLR, LMR, and monocyte counts should be taken into consideration as diagnostic parameters in patients with suspected complex appendicitis [15]. According to Kriplani et al., NLR, PLR, and LMR may be independent, accessible, and cheap predictors for early detection of SIRS/sepsis following percutaneous nephrolithotomy (PNL) [16].

Considering the literature data cited so far, predictive value of the NLR and the absolute WBC count for the need for DJ stent insertion in pediatric patients with urolithiasis has been investigated for the first time in our study.

In the present study, we have found higher WBC ( $p < 0.05$ ) and monocyte counts ( $p < 0.05$ ) in Group 1. However, any correlation could not be found between stone size and NLR or WBC ( $p > 0.05$ ). As a result; in the ROC analysis; WBC and NLR were found to be two predictive markers for the need for a DJ stent insertion after URS in pediatric patients. For WBC, a cut-off value of  $12.6 \times 10^9/L$  had 37% sensitivity, and 81% specificity (AUC: 0.67; 95% CI: 0.54-0.80), and for NLR, a cut-off value of 3.8 had 65% sensitivity, and 76% specificity, (AUC: 0.70; 95% CI: 0.57-0.82) as predictive markers for the need for a DJ stent insertion after ureterolithotomy in pediatric patients.

Limited number of patients included in our study, and retrospective analysis of only the data of the patients who applied to the pediatric surgery service of Dicle University Medical Faculty Hospital were the most important limitations of our study.

## Conclusion

In cases of ureteral stones, the absolute WBC count and NLR may help determine whether or not a DJ stent should be inserted.

**Ethics Committee Approval:** The study protocol was reviewed and approved by the Institutional Review Board of Dicle University Medical Faculty (approval date and number: 28.02.2023/60).

**Informed Consent:** An informed consent was obtained from all the patients.

**Publication:** The results of the study were not published in full or in part in form of abstracts.

**Peer-review:** Externally peer-reviewed.

**Authorship Contributions:** Any contribution was not made by any individual not listed as an author. Concept – S.A., M.A., T.O.K.; Design – S.A., M.A., T.O.K.; Supervision – S.A., M.A., T.O.K.; Resources – E.B., B.A., M.H.O., M.K.; Materials – E.B., B.A., M.H.O., M.K.; Data Collection and/or Processing – E.B., B.A., M.H.O., M.K.; Analysis and/or Interpretation – S.A., M.A., T.O.K.; Literature Search – E.B., B.A., M.H.O., M.K.; Writing Manuscript – S.A., M.A., T.O.K.; Critical Review – S.A., M.A., A.Ö.

**Conflict of Interest:** The authors declare that they have no conflicts of interest.

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