

Original Article

Neutrophil to Lymphocyte ratio in the diagnosis of adnexal torsion

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Abstract: Adnexal torsion (AT) is a condition in which there is sometimes difficulty in making a preoperative diagnosis since there are no routine laboratory markers and this condition is usually intraoperatively diagnosed. Many of the studies have indicated that the neutrophil-to-lymphocyte ratio (NLR) is a significant inflammatory marker in various diseases. In this study, we aimed to investigate the diagnostic efficacy of the NLR on the diagnosis of AT. Patients surgically treated for AT were analysed retrospectively. A total of 27 AT patients were included in the study (Group 1). Another 30 patients who were surgically treated for a unilateral ovarian mass and did not have torsion or malignancy on the final histopathological examination were assigned to the control group (Group 2). White blood cells (WBCs), neutrophils, lymphocytes and the NLR were compared between groups. The mean WBC values for Groups 1 and 2 were 9.7 ± 1.8 and 7.6 ± 1.5 K/ μ L ($P < 0.001$), respectively. The mean neutrophil values were also significantly higher in Group 1 ($P < 0.001$). However, the mean lymphocyte values were significantly higher in Group 2 ($P < 0.001$). Mean NLR was significantly higher in Group 1 ($P < 0.001$). Sensitivity and specificity of WBC > 8.8 were 83.3% and 74.1%, respectively. Sensitivity and specificity of NLR > 3 were 88.9% and 100%, respectively. Furthermore, the area under the ROC curve (AUC) was 0.933 for the NLR and 0.830 for WBC. With respect to the diagnosis of adnexal torsion, an NLR > 3 was identified as a more sensitive marker than the high WBC count. Therefore, an NLR > 3 seems to be a valuable marker in cases where it is difficult to diagnose AT.

Keywords: Adnexal torsion, neutrophil to lymphocyte ratio, diagnosis

Introduction

Adnexal torsion (AT) occurs when an adnexa totally or partially rotates around its own vascular axis. AT stimulates the venous and lymphatic blockage of ovarian parenchyma and is complicated with massive congestion and haemorrhagic infarction followed by an arterial blockage that causes gangrene and haemorrhagic necrosis [1].

AT is diagnosed in about 2-7% of the patients surgically treated for acute pelvic pain. Torsion may be experienced by women at any age with the highest incidence rate between the ages of 20 and 30 years with lower rates during the prepubertal and postmenopausal periods [2].

Generally, AT is clinically diagnosed based on nonspecific clinical findings that may postpone

the diagnosis such as a stomachache by itself or an adnexal cyst determined through ultrasound. Diagnosis has been confirmed during surgery in only 40% of patients who were diagnosed with AT through preoperative ultrasound [3]. Certain serum markers such as interleukin 6, tumour necrosis factor, D-dimer and C-reactive protein have been used in the diagnosis of AT. However, there are no specific markers that are routinely used for a preoperative diagnosis [4, 5].

White blood cell (WBC) count is a potential indicator for inflammation in the body. The five types of white blood cells are monocytes, lymphocytes, basophils, eosinophils and neutrophils. Studies have concluded that there is an increase in WBC counts in ovarian torsion cases [6].

Table 1. The demographic features and clinical parameters of the subjects

	Torsion (n = 27)	Control (n = 30)	P
Age	27.30 ± 7.17	26.10 ± 6.87	0.523
Gravidity	1.96 ± 1.69	1.57 ± 1.52	0.357
Parity	1.85 ± 1.65	1.57 ± 1.52	0.285
WBC (K/uL)	9758 ± 1828	7632 ± 1514	< 0.001
Neutrophil (K/uL)	7940 ± 1620	4350 ± 1050	< 0.001
Lymphocytes (K/uL)	1470 ± 640	2030 ± 550	< 0.001
NLR	6.44 ± 2.92	2.24 ± 0.63	< 0.001
NLR > 3	24	0	< 0.001
WBC (K/uL) > 8890	20	5	< 0.001

WBC: White blood cell, NLR: Neutrophil to lymphocyte ratio.

Many of the recent studies have indicated that the neutrophil-to-lymphocyte ratio (NLR) is a significant inflammatory marker in various diseases [7]. NLR is also an inexpensive inflammatory marker that responds quickly in emergency cases. In this study, we aimed to evaluate NLR as a timesaving medical examination that could provide for faster AT diagnosis.

Materials and methods

We retrospectively scanned files of patients who were surgically treated for AT between January 2012 and December 2014 at Kahramanmaraş Sütçü İmam University, School of Medicine, Gynecology and Obstetrics Clinic.

A total of 32 patients with preoperative suspicion of AT and confirmed intraoperative diagnosis were evaluated. We excluded one patient with hyperthyroidism, one patient with diabetes mellitus and three patients with a body mass index (BMI) > 30 kg/m²; the remaining 27 patients were considered as the study group (Group 1).

Another 30 patients who were surgically treated for a unilateral ovarian mass with no torsion or malignancy, as seen on the final histopathological examination, were assigned as the control group (Group 2).

WBC, neutrophil and lymphocyte values of all patients, as well as their ages, gravidity, parity and BMI were identified. Blood samples collected from the patients immediately before the operation were used for NLR analysis. NLR was calculated for all groups to determine if there were any significant differences.

Furthermore, elevated levels of WBC and NLR were considered indicators of inflammation. Within the statistical analysis, a receiver operating characteristic (ROC) curve resulted in a cut-off value of 8.8 for WBC and 3 for NLR. The number of patients with high WBC counts and those with NLR > 3 was compared in both groups. Finally, sensitivity, specificity and the area under the curve (AUC) values were calculated for WBC > 8.8 and NLR > 3.

Statistical analyses were performed with SPSS 20.0 (SPSS, Version 20.0; Chicago, IL, USA) statistics software.

During the data analysis, we determined mean, frequency and standard deviation values. Appropriateness of the variables to a normal distribution was analysed through the Kolmogorov-Smirnov test. Chi-square, student-*t* and Mann-Whitney U tests were used to identify differences between the two groups.

With respect to the determination of the most important risk factor among the categorical significant risk factors, an odds ratio (OR) was used. The relationship between the real classification and the classification made according to the cut off value calculated based on the variables of treatment and control groups was presented through the analysis on ROC in terms of their sensitivity and specificity. Statistically, *P* < 0.05 was deemed as significant.

This study was approved by the local research ethics committee at Kahramanmaraş Sütçü İmam University School of Medicine.

Results

A total of 27 surgically-treated AT patients were included in the study. Among these, 21 (77.7%) had a laparoscopy and 6 (22.3%) had a laparotomy. During surgery, 23 (85.1%) patients had a cystectomy with utero-ovarian ligament plication, while the other 4 (14.9%) received a salpingo-oophorectomy.

Among Groups 1 and 2, the mean ages were 27.3 ± 7.1 and 26.1 ± 6.8 years (*P* = 0.523), the mean gravidity was 1.9 ± 1.6 and 1.5 ± 1.5 (*P* = 0.357), and the mean parity was 1.8 ± 1.6 and 1.5 ± 1.5 (*P* = 0.285), respectively for each measure. Mean BMI values were 23.6 ± 3.89

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Table 2. The diagnostic values of WBC and NLR

Variables (Cut off)	Sensitivity	Specificity	AUC \pm Se	Odds ratio (95% C.I.)	P value
NLR (> 3)	88.9%	100%	0.933 \pm 0.039	*	< 0.001
WBC (> 8.8) (K/uL)	74.1%	83.3%	0.830 \pm 0.055	14.3 (3.9-51.9)	< 0.001

AUC: Area under the ROC curve, Se: Standart Error, C. I: Confidence Interval, Roc Curve Analysis (Youdenindex J-Honley & McNeil), WBC: White blood cell, NLR: Neutrophil to lymphocyte ratio. *: The odds ratio couldn't be calculated because of NLR isn't > 3 in control group. If this value was even in one person odds ratio would be 295. So the true odds ratio must be greater than this value.

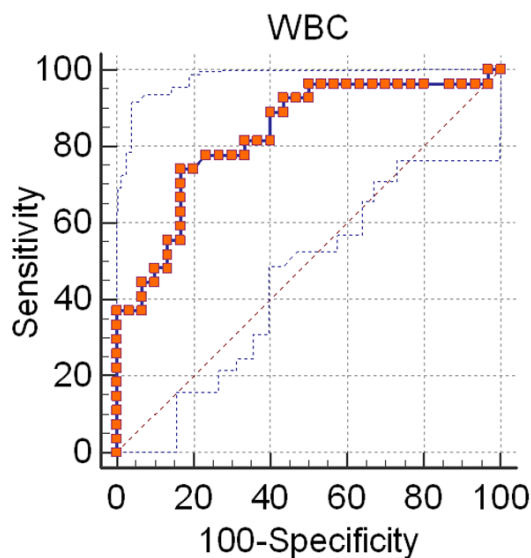


Figure 1. The sensitivity and specificity of the WBC curve.

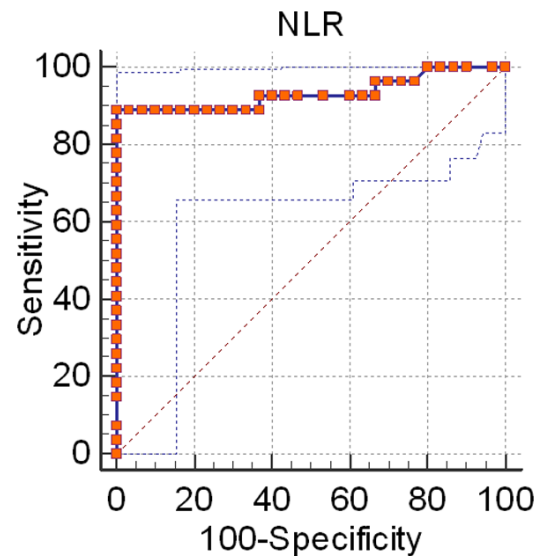


Figure 2. The sensitivity and specificity curves of the NLR.

kg/m² in Group 1 and 24.5 ± 4.15 kg/m² in Group 2 ($P = 0.829$). Mean WBC values were 9.7 ± 1.8 and 7.6 ± 1.5 K/ μ L ($P < 0.001$), while the mean neutrophil values were 7.9 ± 1.6 and 4.3 ± 1.0 K/ μ L ($P < 0.001$), respectively. Mean lymphocyte values were 1.4 ± 0.6 and 2.0 ± 0.5 , respectively ($P = 0.001$). Mean NLR was 6.44 ± 2.92 and 2.24 ± 0.63 , respectively ($P < 0.001$) (Table 1).

High WBC counts (> 8.8 K/ μ L) were identified in 20 patients (74.1%) in Group 1 and in five patients (16.7%) in Group 2 ($P < 0.001$). A high NLR (> 3) was identified in 24 patients (88.9%) in Group 1 and in no patients in Group 2 ($P < 0.001$) (Table 1).

The sensitivity of the NLR > 3 was 88.9%, while its specificity was 100%. Since there was no high NLR count identified in the control group, thus, the OR was not calculated. In the event that one person was identified with a high NLR count, the OR would have been 295. Normally,

the real OR for an NLR > 3 should be higher than this value. The sensitivity of WBC > 8.8 K/ μ L was 74.1%, and its specificity was 83.3%. The OR (95% confidence interval) was 14.3 (3.9-51.9) (Table 2). Furthermore, the AUC ROC was 0.933 for NLR and 0.830 for WBC (Figures 1 and 2).

Discussion

Adnexal torsion is one of the few gynaecological emergency cases. An inaccurate diagnosis or late intervention could cause permanent problems including a loss of the ovaries, which could affect fertility as well as producing peritonitis and even death [8].

Torsion of the uterus adnexa is an important reason for an acute stomachache in women that requires urgent intervention. The main organ that causes torsion is the ovary; however, torsions of the fallopian tubes, subserosal myoma, paratubal cysts and even the uterine body have been reported [9].

Clinical symptoms are nonspecific (aches, nausea, vomiting, low-grade fever); therefore, it is difficult for clinicians to diagnose and differentiate among other aetiologies. In terms of its diagnosis, it should be differentiated from an ovary cyst rupture, ectopic pregnancy, adnexitis, acute appendicitis, gastroenteritis and renal colic [10].

Ultrasonography is the most frequently used screening method with respect to the diagnosis of adnexal torsion. Ultrasonography findings of adnexal torsion include abnormal ovary positions, ovarian expansion with fluid retention, ovarian or adnexal cysts and free liquid in a cul-de-sac. In the study by Oltmann et al., in 46% of children with ovarian torsion, the preoperative ultrasound findings were interpreted as normal [11].

With respect to an AT diagnosis, decreased or absent Doppler flow in the ovary could be seen in Doppler ultrasonography. Although it is widely used in practice, the diagnostic contribution of colour Doppler ultrasonography is still a matter of debate [12]. Despite the existence of torsion in the ovaries, Doppler ultrasonography provides normal results in 60% of the cases due to the dual blood supply nature [13]. The absence of any specific clinical findings could cause diagnostic issues and poor preoperative accuracy [14].

Recently, NLR has been widely used in identifying the degree of inflammation in cardiovascular diseases, malignancy, diabetes mellitus, hypertension and auto inflammatory diseases. NLR has also been studied frequently in gynaecology and obstetrical diseases. It has been reported to be a positive marker for a series of diseases including endometriosis, endometrial cancer, pelvic inflammatory disease, preterm birth, ovarian cancer, cervical cancer, gestational trophoblastic disease, ovarian hyperstimulation syndrome (OHSS), endometrial hyperplasia, gestational diabetes, preeclampsia and uterine sarcoma [15-25].

In this study, both WBC and neutrophil values were increased in AT patients when compared to the control group. However, the lymphocyte levels were lower than those of the control group. Accordingly, the NLR was significantly higher in the AT group. This indicates that NLR

could function as a significant marker in the diagnosis of torsion.

With respect to inflammatory cases, WBC levels are frequently examined. In this study, we further compared WBC levels and NLR and found that the sensitivity and specificity of NLR was higher in AT cases when compared to those of the WBC. Furthermore, NLR was again higher in AUC values (**Figures 1 and 2**). These results indicate that NLR is more sensitive than WBC in AT diagnosis.

NLR is a parameter that has been popular in recent years. Various studies have indicated that the NLR is superior to WBC in estimation of undesired outcomes within the inflammatory process and surgical conditions [26]. However, no studies have been found regarding NLR in ovarian torsion cases. The first publications concerning NLR were made on myocardial ischemia by cardiologists. There are a number of studies on this matter and NLR has been reported to increase in cases of myocardial ischemia. Moreover, this increased ratio is more significant in acute cases [27]. This study was conducted based on the hypothesis that NLR would be significantly higher due to the ischemic nature of AT. The elevated NLR finding from this study is in line with the studies on myocardial ischemia.

No cut-off value was determined for the highest value of NLR. However, a study on coronary arterial diseases found that obstructive cases were experienced more frequently in patients with an NLR greater than 3 [7]. In this study, the cut-off value for ROC curve analysis was 3, while it was determined as 8.8 K/ μ L for WBC. Based on this WBC value, OR (95% confidence interval) was calculated as 14.3 (3.9-51.9). Since no one was identified with an NLR > 3 in the control group, OR was not calculated (**Table 2**). In the event that even one person was identified with an NLR > 3 in the control group, the OR would have been calculated as 295. The real OR of NLR > 3 should have been greater than this value. As a result, with respect to the diagnosis of AT, an OR of NLR > 3 is expected to be significantly higher than the WBC. Furthermore, a high WBC count is accepted as > 11 K/ μ L in current practice. When this value is considered as the cut-off value, the sensitivity significantly decreases to 25.9%.

The limitations of our study include the relatively small size of our series and the fact that our study design was retrospective.

In conclusion, the NLR seems to be a useful parameter in the diagnosis of AT. Furthermore, its diagnostic value is a lot higher than that of WBC values. Therefore, an NLR > 3 should be considered with respect to the diagnosis of this disease. However, further studies should still be performed on this matter.

Disclosure of conflict of interest

None.

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