

Can preoperative complete blood count parameters be used in the diagnosis of patients with adnexal torsion: a case-control study

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Abstract

Objective: To determine whether there is a relationship between complete blood count parameters at adnexal torsion and to investigate the clinical utility of these parameters in preoperative diagnosis.

Methods: The retrospective, case-control study was conducted at a tertiary care hospital in Turkey and comprised data of patients who underwent adnexal torsion surgery from 2007 to 2017. Medical records of healthy controls who underwent various gynaecological surgeries during the period were used as the control group. Demographic characteristics and preoperative complete blood count parameters were retrieved from the medical records, and factors influencing adnexal torsion diagnosis were evaluated. Data was analysed using SPSS 21.

Results: Of the 296 subjects, 73(24.7%) were adnexal torsion cases and 223(75.3%) were controls. Demographic characteristics did not differ between the groups ($p>0.05$). Leukocytosis was present in 38(52%) cases. Mean white blood cell, neutrophil, and platelet counts and neutrophil-to-lymphocyte and platelet-to-lymphocyte ratios were significantly higher, and mean platelet volume was significantly lower in the cases compared to controls ($p<0.05$). Logistic regression analysis identified an independent association between a low mean platelet volume and adnexal torsion ($p<0.05$). The optimal cutoff value was 10.35fL, with 77.4% sensitivity and 74.2% specificity.

Conclusions: There was found to be a significant relationship between adnexal torsion and certain parameters of the complete blood count. Low mean platelet volume could be considered a useful additional tool for the preoperative diagnosis.

Keywords: Adnexal disease, Blood cell count, Early diagnosis, Mean platelet volume, Torsion.

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Introduction

Adnexal torsion (AT) refers to a gynaecological emergency in which the interruption of blood flow results from twisting a complete turn of the ovary or fallopian tube around its vascular axis, which results in ischaemic changes.¹ In the absence of treatment, ischaemia results in necrosis of the ovary, fallopian tube or the whole adnexal tissue, and may adversely affect fertility in young patients.² In rare instances, AT can cause potentially fatal complications like pelvic thrombophlebitis and peritonitis.¹ The main goal of AT management is to surgically untwist the torsion event as soon as possible to preserve the structure and function of the adnexa. However, the preoperative diagnosis of AT is still challenging for clinicians. Whilst ultrasound and Doppler findings may

be useful in the management of AT, the proportion of patients correctly diagnosed before surgery ranges between 22% and 66%.^{1,3} Currently, there is no reliable method for preoperative diagnosis of AT.

Complete blood count (CBC) parameters are informative and relatively inexpensive diagnostic tools and thus are widely used in daily clinical practice. Recently, increasing evidence suggests that these parameters are useful markers for both diagnosis and prognosis of ischaemic diseases, such as acute coronary syndrome, acute ischaemic stroke, and acute mesenteric ischaemia.⁴⁻⁶ In this respect, the clinical utility of CBC parameters in the preoperative diagnosis of AT has yet to be fully elucidated. With the exception of a few descriptive cohort studies, which observed slight leukocytosis, no further studies have been reported in this field.⁷⁻¹³

The current study was planned to determine whether there is a relationship between CBC parameters and AT,

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and to investigate the clinical utility of CBC parameters in preoperative AT diagnosis.

Patients and Methods

The retrospective, case-control study was conducted at a tertiary care hospital in Turkey and comprised data of patients who underwent adnexal torsion surgery from 2007 to 2017. Approval was obtained from the institutional ethics review board and all the subjects whose data was included had furnished informed consent at the time of their respective surgeries.

Medical records of patients with AT formed the AT group, while the control group comprised data of healthy subjects who had undergone surgery for interval tubal sterilisation, urinary incontinence or vaginal reconstruction. Data excluded related to subjects with malignancy, endometriosis, pelvic inflammatory disease, tubo-ovarian abscess, degenerated/enlarged leiomyoma, acquired or congenital haematological disease, acute or chronic inflammatory disease, pregnancy, the use of any drug that may influence the coagulation cascade, like anticoagulants and hormonal contraceptives, and smoking.

Demographic characteristics, like age, gravidity and parity, and preoperative CBC parameters white blood cell (WBC), neutrophil, lymphocyte, and platelet counts, haemoglobin (Hb) levels, mean corpuscular volume (MCV), mean platelet volume (MPV), platelet distribution width (PDW), plateletcrit levels, neutrophil-to-lymphocyte ratio (NLR) and platelet-to-lymphocyte ratio (PLR) were obtained from the medical records.

Blood samples had been collected while patients were admitted to the hospital and before receiving any medications. Specimens had been analysed within 2 hours using a Sysmex XE-2100 Automated CBC Analyzer (Sysmex Europe, Germany). Leukocytosis was defined as WBC count of $>11 \times 10^3/\mu\text{L}$, according to the recommendations of the Haematology Department of the institution. The groups were compared in terms of the examined CBC parameters. Once CBC parameters significantly associated with AT were determined, the clinical utility of those parameters in the preoperative diagnosis of AT was investigated.

Power analysis of the study was conducted using G*Power3.0 software (Germany), revealing 95% power using type I error (α)=0.05, effect size=0.5, and a two-sided t test. Data was analysed using SPSS 21. Kolmogorov-Smirnov test was used to assess the normality

of the data. Normally distributed data was expressed as means and standard deviations. Nonparametric data was expressed as medians and interquartile ranges (IQRs). The groups were compared using independent sample t-tests and Mann-Whitney U tests. Variables with $p < 0.05$ were included in the binary logistic regression analysis and the influence of each factor on the preoperative diagnosis of AT was evaluated. Receiver operating characteristic (ROC) curve analysis was used to determine the cut-off values of serum MPV for diagnosing AT. Odds ratios (ORs) and 95% confidence intervals (CIs) were determined. $P < 0.05$ was considered statistically significant.

Results

Of the 83 AT patients, data of 10(12%) was excluded. Likewise, of the 329 controls, data of 106(32%) was excluded. Of the 296 subjects in the final study sample, 73(24.7%) were AT cases and 223(75.3%) were controls. The demographic characteristics did not differ significantly between the groups ($p > 0.05$).

Leukocytosis was present in 38(52%) cases. Mean WBC, neutrophil count, platelet count, NLR and PLR were significantly higher (respectively < 0.05) and the MPV was significantly lower ($p < 0.05$) in the cases than the controls. The mean lymphocyte count, Hb and haematocrit levels, MCV, PDW, and plateletcrit levels did not differ significantly between the groups ($p > 0.05$) (Table 1).

Table-1: Demographic characteristics and complete blood count (CBC) parameters of patients in the Adnexal Torsion (AT) and control groups.

Variable	AT (n = 73; 24.7%)	Control (n = 223; 75.3%)	p-value
Demographic characteristic			
Age (years), mean \pm SD	30.2 \pm 9.7	29.3 \pm 5.4	0.056
Gravidity, median (IQR)	2 (2)	2 (2)	0.054
Parity, median (IQR)	1 (2)	1 (1)	0.098
CBC parameter^a			
WBC count ($\times 10^3/\mu\text{L}$)	10.7 \pm 3.4	10.0 \pm 2.2	0.035*
Neutrophil count ($\times 10^3/\mu\text{L}$)	8.3 \pm 3.3	7.3 \pm 2.1	0.030*
Lymphocyte count ($\times 10^3/\mu\text{L}$)	1.8 \pm 0.9	1.9 \pm 0.7	0.263
Haemoglobin (g/dL)	12.1 \pm 1.6	11.8 \pm 1.5	0.105
Haematocrit (%)	36.6 \pm 3.6	34.4 \pm 4.1	0.293
MCV (fL)	84.3 \pm 7.4	85.0 \pm 5.6	0.075
Platelet count ($\times 10^3/\mu\text{L}$)	263.2 \pm 60.6	238.5 \pm 70.6	0.008*
MPV (fL)	9.6 \pm 1.3	10.9 \pm 1.1	$< 0.001^*$
PDW (fL)	13.1 \pm 2.8	13.5 \pm 2.4	0.257
Plateletcrit (%)	0.3 \pm 0.1	0.3 \pm 0.1	0.652
NLR (%)	6.7 \pm 6.6	4.9 \pm 5.3	0.016*
PLR (%)	192.3 \pm 145.9	139.7 \pm 74.0	$< 0.001^*$

^aCBC parameters are presented as the mean \pm SD; * $p < 0.05$; IQR: Interquartile Range; MCV: Mean Corpuscular Volume; MPV: Mean Platelet Volume; NLR: Neutrophil-to-Lymphocyte Ratio; PDW: Platelet Distribution Width; PLR: Platelet-to-Lymphocyte Ratio; SD: Standard Deviation; WBC: White Blood Cell.

Table-2: Binary logistic regression analysis of complete blood count (CBC) variables with respect to early diagnosis of adnexal torsion.

Variable	OR	95.0% CI	p-value
WBC count	1.24	0.493 - 1.321	0.395
Neutrophil count	1.30	0.809 - 2.093	0.278
Platelet count	1.00	0.991 - 1.008	0.924
MPV	2.79	0.262 - 0.489	<0.001*
NLR	0.93	0.729 - 1.193	0.580
PLR	1.00	0.992 - 1.017	0.496

* $p < 0.05$; CI: Confidence interval; MPV: Mean platelet volume; NLR: Neutrophil-to-lymphocyte ratio; OR: Odds ratio; PLR: Platelet-to-lymphocyte ratio; WBC: White blood cell.

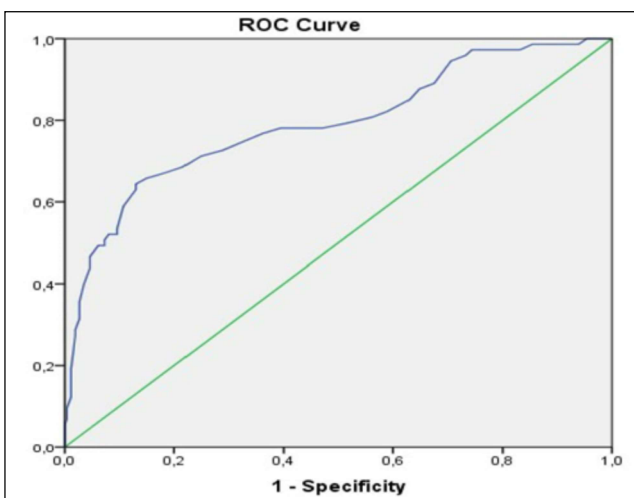


Figure: Receiver operating characteristic (ROC) curve of serum mean platelet volume for discriminating patients with adnexal torsion from healthy controls (area under curve [AUC]: 0.791, standard error [SE]: 0.033).

Binary logistic regression analysis revealed that only low MPV was independently associated with AT (Table 2). ROC curve analysis revealed that the optimal cut-off value of serum MPV for predicting AT was 10.35 fL with 77.4% sensitivity and 74.2% specificity (Figure).

Discussion

To the best of our knowledge, the current study is the first to widely investigate the clinical utility of CBC parameters for preoperative At diagnosis.

AT can occur in women of any age. However, it most frequently occurs during the early reproductive years.^{1,3} A population-based study from South Korea reported that the mean age of patients with AT was 33.8 years.¹⁴ In our study, the mean age of AT patients was 30.2 years. Although it was not examined in the present study, this condition may be associated with benign ovarian and paratubal cysts, which occur more frequently during reproductive ages, as emphasised in a study.¹

In daily practice, clinicians frequently use CBC parameters as the first step of laboratory investigations to determine the pathogenesis and severity of the inflammatory process. Among these parameters, leukocytosis is one of the most frequently observed responses to these processes, including ischaemic diseases.⁴⁻⁶ Furthermore, it has been reported that the WBC response to ischaemic disease is associated with increased neutrophil counts, while stress-based steroid exposure causes a concomitant decrease in lymphocyte counts.^{5,6,15-17} Previous descriptive cohort studies on AT reported that 26.7% to 64% patients had leukocytosis, without performing leukocyte differentiation analysis.⁷⁻¹² In the present study, although the WBC count was significantly higher in the AT group than in the control group, 52% AT patients had leukocytosis, which is consistent with previous reports.⁷⁻¹² Similar to other ischaemic diseases, our study revealed that AT was associated with increased neutrophil counts and decreased lymphocyte counts.^{5,6,15,16} To our knowledge, the current study is also the first to report on the analysis of leukocyte differentiation in At patients.

Platelets are dynamic blood particles whose primary function is haemostasis. Platelets are also known to play a role in the inflammatory process.¹⁸ The well-known responses of platelets to the acute inflammatory process by way of inflammatory mediators include increases in the number of circulating particles and changes in particle shape and size. Studies investigating the clinical utility of platelet indices, like platelet counts, MPV, PDW, and plateletcrit levels, revealed that these indices were useful diagnostic and prognostic markers of ischaemic disease.^{4,6,19-21} The present study observed significant associations between AT and higher platelet counts and a lower MPV. However, our results were in contrast with a recently published study in which AT was associated with lower platelet counts and a higher MPV, although these differences were not significant.¹³ The discrepancies between the two sets of results may be due to methodological differences or unknown factors, like using different commercial CBC analysers, determining different inclusion and exclusion criteria, and the time interval of AT.

Recently, the NLR and PLR, which can be derived easily from CBCs, have been studied as novel markers of ischaemic disease. Investigators reported that the data is useful and could be used a diagnostic and prognostic marker of various ischaemic diseases.⁴⁻⁶ Furthermore, a

recent study reported that a higher NLR may be associated with AT.¹³ Similarly, the present study found that both higher NLR and PLR were significantly associated with AT. We believe that this may be related to the inflammatory response to ischaemia, which results in a significant increase in both neutrophil and platelet counts, and a decrease in lymphocyte counts.

Numerous studies have reported associations between changes in MPV and various inflammatory processes.^{4,19,22} However, MPV may act as a negative or positive acute phase reactant in different inflammatory conditions. Besides the severity of the inflammatory process, acute or chronic conditions can also influence the MPV. Studies of several ischaemic diseases have shown that increased MPV, which can be detected in the early stages of disease onset, may be used for early diagnosis of these diseases.^{4,6,23,24} Similarly, the present study found that MPV was an independent predictor of preoperative At diagnosis and determined an optimal cut-off value of 10.35fL, with 77.4% sensitivity and 74.2% specificity. However, low MPV in At patients seems inconsistent with other ischaemic diseases. We believe that this may be the result of a long-time interval between the onset of a torsion event and hospital admission for many At patients. Subsequently, it has been shown that the intense consumption of large, hyperactive platelets at sites of ongoing thrombus formation, injury and inflammation results in a reduction in the MPV in ongoing ischaemic processes.²⁵ However, in none of these studies has the time interval between the onset of the complaint and blood sample collection been investigated. This can be considered a limitation of the above-mentioned studies, and requires further investigation for validation. The current study itself was limited by its retrospective single-centre design with a small sample size, Further descriptive and comparative studies are needed to determine the clinical utility of CBC parameters, especially serum MPV, in preoperative At diagnosis.

Conclusion

There was a significant relationship between certain CBC parameters and AT. MPV <10.35 fL may be useful in preoperative AT diagnosis.

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