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Can various complete blood count parameters helpful in preoperative diagnosis of adnexal torsion?

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SUMMARY

OBJECTIVE: Adnexal torsion is an important gynecological emergency due to nonfrequent but possible adverse reproductive outcomes. There is no specific laboratory marker to support the preoperative diagnosis or that can be used clinically. The aim of this study was to investigate the diagnostic values of platelet, neutrophil, lymphocyte, and red cell markers as an early indicator of ovarian torsion.

METHODS: This retrospective study included 28 female patients who were treated surgically for adnexal torsion between August 2010 and July 2020, and 29 control group women. The demographic data and routine hematological values of patients were compared for adnexal torsion prediction.

RESULTS: There were no differences between the groups in terms of the platelet count, platelet distribution width, red cell distribution width, and mean platelet volume values, and there were no differences in the demographic data. Statistical differences were found among white blood cell, hemoglobin, hematocrit, neutrophil and lymphocyte counts, neutrophil/lymphocyte ratio, and platelet/lymphocyte ratio, and 81.5% sensitivity and 82.1% specificity were identified for neutrophil/lymphocyte ratio 2.45 (area under the curve AUC 0.892; 95%CI 0.808–0.975; p<0.001). Odds ratio for neutrophil/lymphocyte ratio was 2.62 (95%CI 0.861–7.940, p=0.029).

CONCLUSION: According to the regression analysis, neutrophil/lymphocyte ratio was found to be the most beneficial among all blood count parameters for the pre-diagnosis of AT.

KEYWORDS: Adnexal torsion. Hemogram parameters, Prediction

INTRODUCTION

Adnexal torsion (AT) is defined as the complete or partial twisting of the suspensory ligament that provides vascular support to the ovary and extends from the pelvic side wall. In case of torsion, low-pressure venous and lymphatic flow is disturbed, initially causing growth and edema in the ovary. As torsion continues, it affects the arterial flow leading to thrombosis, ischemia, and hemorrhagic infarction.

Adnexal torsion is a rare condition, and it can be observed at any age and ranks fifth among all the emergency surgical indications with a rate of 2.7%[1,2]. In contrast, 15% of surgically treated adnexal masses are caused by torsion[3]. AT is diagnosed clinically, and its diagnosis can be supported by imaging methods. Its final preoperative diagnosis is challenging due to the lack of specific symptoms. Various laboratory markers have been used for the preoperative diagnosis; however, a specific marker has yet to be found[4]. Since it is a gynecological emergency showing various levels of inflammatory response and thrombosis due to vascular stasis, increased nonspecific inflammatory markers in local and systemic circulation can be identified which have been used for preoperative AT diagnosis in many studies[4,5]. The first and the simplest test requested for patients who presented with acute abdomen is a complete blood count (CBC). This test can provide us with numerous inflammatory

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markers. The most important ones are the mean platelet volume (MPV), neutrophil/lymphocyte ratio (NLR), red cell distribution width (RDW), platelet distribution width (PDW), and platelet/lymphocyte ratio (PLR)[6-8].

In our study, whether CBC parameters can be used to predict AT, which is a pathology-inducing inflammatory response, is investigated.

METHODS

Hospital information management systems and surgery records were analyzed retrospectively, and 28 women, who were diagnosed with AT and whose diagnosis was confirmed surgically between August 2010 and July 2020, were included in this study. A total of 29 women who were admitted to the hospital during the same period without any condition formed the control group. Ethical approval for the study was received from the Ethics Committee of Adiyaman University.

Inclusion criteria

Women aged between 18–45, who were presented with lower abdominal pain with adnexal mass detected during assessment, who were operated on with a pre-diagnosis of AT, and who had an intraoperative diagnosis, were included.

Exclusion criteria

Women with a history of inflammatory disease, such as systemic lupus erythematosus, familial Mediterranean fever, and rheumatoid arthritis; a positive pregnancy test; renal or hepatic failure; diabetes mellitus; hypertensive disease; hemoglobinopathy; a history of myocardial infarction or thrombosis; detection of acute appendicitis during radiological assessment; or other possible causes, such as urinary tract infection, during laboratory assessment were excluded.

Factors, such as age, patient complaints, parity, body mass index (BMI), CBC parameters (hemoglobin [Hgb] and hematocrit [Hct]), leukocyte count (%), lymphocyte count, platelet count, MPV, PDW, RDW, NLR, and PLR, were taken into consideration for assessment. Surgical consent was taken from all patients before the procedure.

Early diagnosis of AT was based on the findings of a physical examination, and ultrasonography (USG) was used as a supportive evaluation. In ultrasound imaging, isolated ovarian growth, a cyst or solid ovarian mass, presence of fluid in pouch of Douglas, or lack of blood flow in ovarian parenchyma were interpreted as possible AT. Following the early diagnosis, diagnostic laparoscopy was performed on patients depending on their medical condition and the technical equipment of the operating room. Patients with ovarian torsion were evaluated for this study. All pathological materials collected from patients were sent for examination.

Blood samples

All assessments were initiated 1 h after blood collection. Venous blood samples taken from the antecubital region with the vacutainer system (BD, Becton, Dickinson and Co., Franklin Lakes, NJ, USA) and placed into ethylenediaminetetraacetic acid (EDTA) anticoagulant-containing tubes (BD Vacutainer®, K2E 5.4 mg; BD, Plymouth, UK) were analyzed using the Cell-Dyn Ruby (Abbott Park, IL, USA) hematology analyzer.

Statistical analysis

Statistical analysis of data was performed using SPSS for Windows 23.0 (IBM Corp., Chicago, IL, USA). The Mann-Whitney U test was performed to compare the continuous variables of the two groups. The χ^2 test was performed to compare categorical data. Data were presented as mean±standard deviation. $p<0.05$ was considered statistically significant.

RESULTS

When 28 women in the AT group were compared with 29 women in the control group, no difference was identified in terms of age, BMI, and parity. Preoperative color Doppler ultrasound revealed loss of ovarian parenchyma blood flow in 18 patients (75%). In terms of CBC, platelet count, MCV, RDW, PDW, and MPV were similar in both the groups ($p>0.05$; Table 1). Compared with the control group, white blood cell, neutrophil count (%), NLR, and PLR of the AT group were higher. However, Hgb, Hct, lymphocyte count, eosinophil count, and basophil count were lower in the AT group.

In the logistic regression analysis performed to predict AT, only NLR was able to predict AT ($p<0.001$, Nagelkerke R square: 0.637). Odds ratio for NLR was 2.62 (95%CI 0.861–7.940, $p=0.029$). In the receiver operator characteristics (ROC) curve analysis performed (Figure 1), it was identified that NLR could be used to predict AT with 81.5% sensitivity and 82.1% specificity when the cutoff value is 2.45 (AUC 0.892; 95%CI 0.808–0.975, $p<0.001$).

DISCUSSION

Adnexal torsion is a very rare cause of acute pelvic pain when compared with other gynecological emergencies such as pelvic inflammatory disease and hemorrhagic ovarian cyst, and there are many contradictions to its diagnosis[2,9]. Diagnosis is often made with detailed medical history, physical examination followed by suspicion, and ultrasound findings that support the

diagnosis. It is most commonly seen in the reproductive age group but it can also occur during prepubertal and postmenopausal periods. Clinical findings are nonspecific. In 85% of the cases, pelvic pain is accompanied by nausea, vomiting, low-grade pyrexia, and sinus tachycardia[10,11]. However, in rupture cases accompanied by torsion, intra-abdominal hemorrhage may occur with severe clinical findings. AT mostly presents itself as an acute event on top of a chronic condition (dermoid tumor or ovarian hypertrophy like in polycystic ovary syndrome [PCOS])[12]. In this study, to support the diagnosis and to identify risk groups, a strong correlation was identified with an ovarian cyst larger than 5 cm, which was included in the scoring system[13]. The other four parameters are based on clinical findings.

The traditional approach to AT is surgery. The most common surgical approach is partial or complete oophorectomy or salpingo-oophorectomy, but in some cases, detorsion or oophoropexy can also be performed. A very rare procedure is the shortening of the utero-ovarian ligament[14,15]. It is quite a rare procedure due to expectant management and possible dangers due to a conservative approach. Especially in intermittent torsion, delayed diagnosis or misdiagnosis can lead to a decrease in or the loss of the reproductive capacity of the ovary[10].

Adnexal torsion may present different images in the ultrasound. Ovarian growth (the most common finding), mass,

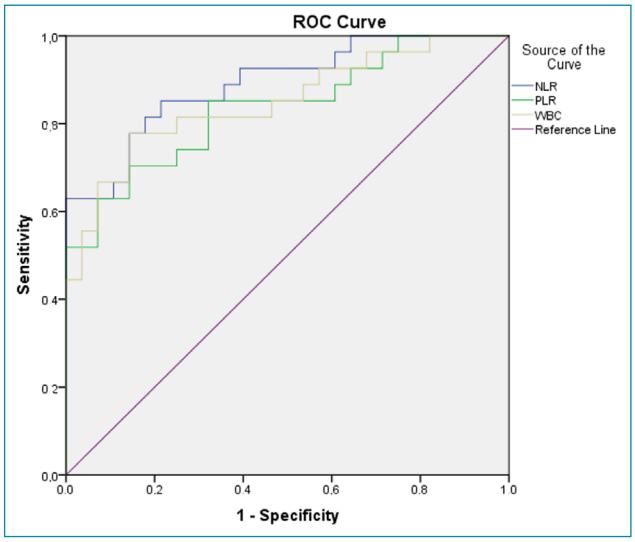

Figure 1. The receiver operator characteristics (ROC) curve analysis.

Table 1. Demographic data and laboratory results of the groups.

	Torsion	Control	p-value
	n=28	n=29	
Age (year; mean±SD)	30.2±11.7	33.1±11.2	0.295
BMI (kg/m^2; mean±SD)	26.2±6.1	25.7±4.1	0.911
Parity (mean±SD)	3.9±2.5	2.8±1.5	0.094
WBC (×10^3/μL; mean±SD)	12.7±8.9	7.4±1.6	<0.001
Hemoglobin (g/L; mean±SD)	11.9±2.1	13.5±1.4	0.002
Hematocrit (%; mean±SD)	35.8±6.1	40.6±4.1	0.002
Platelet count (×10^3/μL; mean±SD)	249.4±62.5	277.3±57.3	0.057
MCV (fL; mean±SD)	82.5±7.9	86.7±6.4	0.122
MCHC (g/L; mean±SD)	33.8±5.1	32.5±1.4	0.219
RDW (%; mean±SD)	12.8±2.0	12.6±1.3	0.861
MPV (fL; mean±SD)	8.5±1.5	8.4±1.4	0.955
PDW (fL; mean±SD)	19.6±1.9	19.4±1.6	0.350
Neutrophil (%; mean±SD)	76.5±12.1	58.4±7.5	<0.001
Lymphocyte (%; mean±SD)	17.4±9.6	33.2±7.2	<0.001
Eosinophil (%; mean±SD)	0.44±0.65	0.86±0.89	0.004
Basophil (%; mean±SD)	0.70±0.49	0.97±0.33	0.001
NLR (mean±SD)	7.13±5.89	1.91±0.69	<0.001
PLR (mean±SD)	19.8±13.0	8.8±2.6	<0.001

n: number of patients; BMI: body mass index; WBC: white blood cells; MCV: mean corpuscular volume; MCHC: mean corpuscular hemoglobin concentration; RDW: red cell distribution width; MPV: mean platelet volume; PDW: platelet distribution width; NLR: neutrophil–lymphocyte ratio; PLR: platelet–lymphocyte ratio.

free fluid in the pouch of Douglas, peripheral follicles in the enlarged ovary, and curling in the vascular pedicle in gray-scale ultrasound, a solid mass with hypo–hyperechoic areas are the findings that suggest torsion[16,17]. Ovarian growth can be defined as the diameter of the ovary being >4 cm (or >20 cm^3)[16]. The vortex-like appearance of blood flow in the curled ovarian vascular pedicle in color Doppler ultrasound is called the "whirlpool sign." Even though its presence is almost pathognomonic for AT, it occurs in 13–80% of cases[18]. Another important color Doppler ultrasound finding is blood flow loss in the ovarian parenchyma; various studies detected this condition in 60–100% of cases[5,17]. Computed tomography (CT) and magnetic resonance imaging (MRI) can also offer useful information of AT[19]. However, their use has been limited due to high costs and because they do not offer any additional information compared with USG. For this reason, we did not use CT or MRI for diagnosis in any patient.

A CBC is performed on all patients admitted to the emergency room with acute pelvic pain for infection, inflammation, and anemia diagnosis. In addition, there is no single or combined marker that can be used for preoperative diagnosis in cases suspected of AT. The most commonly used markers are C-reactive protein (CRP), interleukin-6 (IL-6), interleukin-8 (IL-8), and tumor necrosis factor-α (TNF-α). However, they have low sensitivity and specificity for use by themselves in diagnosis[4,5,20].

Adnexal torsion causes various degrees of inflammation and inflammatory responses, and the idea that these would be reflected in laboratory assessments is the basis of our study. Routine CBC has caused interest due to easy obtainability of inflammatory markers that require no additional cost. No significant difference was found between AT and control groups in terms of MPV, PDW, and RDW values. This result is in parallel with some studies in the literature while contradicting with others[21,22]. This contradiction may be caused by three issues:

I. lack of laboratory standardization,
II. natural changes to parameters investigated during torsion/detorsion, and
III. normal morphological changes to existing cells during the period between torsion and diagnosis.

Conversely, in line with the literature, leukocyte count was found to be high in the AT group as it is an inflammatory condition. Low counts of Hgb and Hct in the patients in our study were caused by intra-abdominal hemorrhage, which are identified during surgery in the majority of patients, as evidenced from patient files.

The ratios such as NLR and PLR are important inflammatory markers[23]. Our study investigated possible changes to these parameters as AT causes various levels of inflammatory processes. Study data reveal that both NLR and PLR increase significantly in torsion cases. In the inflammatory process, there is an increase in neutrophil and platelet levels in the blood which serve as mediators in the cellular battle and recovery; lymphocytes gather on the ischemic tissue surface, and their levels decrease in the blood to limit inflammation and improve recovery, leading to relative lymphopenia. We considered that these cellular changes are the reasons why NLR and PLR increase. Detailed assessment describes us that for AT cases, the critical level is 2.45, and the risk of AT increased by 2.6-fold above 2.45. At the same time, 81.5% sensitivity and 82.2% specificity were identified for values above 2.45 (Figure 1). We considered that these values can be used by a clinician to support the pre-diagnosis of AT in suspected cases following physical examination and imaging.

As a result, it has been shown in our study that NLR can be used as inflammatory markers for routine AT assessment in laboratories. Studies involving more cases will be able to offer more information.

AUTHORS' CONTRIBUTIONS

DK: Data curation, Investigation, Methodology, Writing – original draft, Writing – review & editing. **MB:** Data curation, Investigation, Methodology, Writing – review & editing. **GO:** Data curation. **MK:** Methodology, Project Administration, Resources, Writing – original draft.

REFERENCES

1. McWilliams GD, Hill MJ, Dietrich CS 3rd. Gynecologic emergencies. Surg Clin North Am. 2008;88(2):265-83,vi. https://doi.org/10.1016/j.suc.2007.12.007
2. Hibbard LT. Adnexal torsion. Am J Obstet Gynecol. 1985;152(4):456-61. https://doi.org/10.1016/s0002-9378(85)80157-5
3. Bouguizane S, Bibi H, Farhat Y, Dhifallah S, Darraji F, Hidar S, et al. Adnexal torsion: a report of 135 cases. J Gynecol Obstet Biol Reprod (Paris). 2003;32(6):535-40. PMID: 14593299
4. Daponte A, Pournaras S, Hadjichristodoulou C, Lialios G, Kallitsaris A, Maniatis AN, et al. Novel serum inflammatory markers in patients with adnexal mass who had surgery for ovarian torsion. Fertil Steril. 2006;85(5):1469-72. https://doi.org/10.1016/j.fertnstert.2005.10.056
5. Shadinger LL, Andreotti RF, Kurian RL. Preoperative sonographic and clinical characteristics as predictors of ovarian torsion. J Ultrasound Med. 2008;27(1):7-13. https://doi.org/10.7863/jum.2008.27.1.7

6. Aukrust P, Halvorsen B, Ueland T, Michelsen AE, Skjelland M, Gullestad L, et al. Activated platelets and atherosclerosis. Expert Rev Cardiovasc Ther. 2010;8(9):1297-307. https://doi.org/10.1586/erc.10.92
7. Tozkoparan E, Deniz O, Ucar E, Bilgic H, Ekiz K. Changes in platelet count and indices in pulmonary tuberculosis. Clin Chem Lab Med. 2007;45(8):1009-13. https://doi.org/10.1515/CCLM.2007.194
8. Ye GL, Chen Q, Chen X, Liu YY, Yin TT, Meng QH, et al. The prognostic role of platelet-to-lymphocyte ratio in patients with acute heart failure: a cohort study. Sci Rep. 2019;9(1):10639. https://doi.org/10.1038/s41598-019-47143-2
9. Anteby SO, Schenker JG, Polishuk WZ. The value of laparoscopy in acute pelvic pain. Ann Surg. 1975;181(4):484-6. https://doi.org/10.1097/00000658-197504000-00022
10. Damigos E, Johns J, Ross J. An update on the diagnosis and management of ovarian torsion. Obstet Gynaecol. 2012;14(4):229-36. https://doi.org/10.1111/j.1744-4667.2012.00131.x
11. Oelsner G, Shashar D. Adnexal torsion. Clin Obstet Gynecol. 2006;49(3):459-63. https://doi.org/10.1097/00003081-200609000-00006
12. Huchon C, Fauconnier A. Adnexal torsion: a literature review. Eur J Obstet Gynecol Reprod Biol. 2010;150(1):8-12. https://doi.org/10.1016/j.ejogrb.2010.02.006
13. Huchon C, Staraci S, Fauconnier A. Adnexal torsion: a predictive score for pre-operative diagnosis. Hum Reprod. 2010;25(9):2276-80. https://doi.org/10.1093/humrep/deq173
14. Akkar OB, Karakus S, Yildiz C, Yenicesu AGI, Cetin M. Recurrent ovarian torsion: a case report. Basic Clin Sci. 2013[cited on Aug 17, 2021];2(4):174-6. Available from: https://dergipark.org.tr/tr/pub/bcs/issue/3445/47019
15. Weitzman VN, DiLuigi AJ, Maier DB, Nulsen JC. Prevention of recurrent adnexal torsion. Fertil Steril. 2008;90(5):2018.e1-3. https://doi.org/10.1016/j.fertnstert.2008.02.144
16. Chang HC, Bhatt S, Dogra V. Pearls and pitfalls in diagnosis of ovarian torsion. Radiographics. 2008;28(5):1355-68. https://doi.org/10.1148/rg.285075130
17. Peña JE, Ufberg D, Cooney N, Denis AL. Usefulness of Doppler sonography in the diagnosis of ovarian torsion. Fertil Steril. 2000;73(5):1047-50. https://doi.org/10.1016/s0015-0282(00)00487-8
18. Vijayaraghavan SB. Sonographic whirlpool sign in ovarian torsion. J Ultrasound Med. 2004;23(12):1643-9;quiz1650-1. https://doi.org/10.7863/jum.2004.23.12.1643
19. Rha SE, Byun JY, Jung SE, Jung JI, Choi BG, Kim BS, et al. CT and MR imaging features of adnexal torsion. Radiographics. 2002;22(2):283-94. https://doi.org/10.1148/radiographics.22.2.g02mr02283
20. Bakacak M, Köstü B, Ercan O, Bostancı MS, Kıran G, Aral M, et al. High-sensitivity C-reactive protein as a novel marker in early diagnosis of ovarian torsion: an experimental study. Arch Gynecol Obstet. 2015;291(1):99-104. https://doi.org/10.1007/s00404-014-3400-8
21. Köleli I. Mean platelet volume in early diagnosis of adnexal torsion. Balkan Med J. 2015;32(4):410-3. https://doi.org/10.5152/balkanmedj.2015.151092
22. Yilmaz M, Cimilli G, Saritemur M, Demircan F, Isaoglu U, Kisaoglu A, et al. Diagnostic accuracy of neutrophil/lymphocyte ratio, red cell distribution width and platelet distribution width in ovarian torsion. J Obstet Gynaecol. 2016;36(2):218-22. https://doi.org/10.3109/01443615.2015.1049989
23. Cho U, Park HS, Im SY, Yoo CY, Jung JH, Suh YJ, et al. Prognostic value of systemic inflammatory markers and development of a nomogram in breast cancer. PLoS One. 2018;13(7):e0200936. https://doi.org/10.1371/journal.pone.0200936