ORIGINAL ARTICLE

An effective and reliable marker in gradıng the severity of acute cholecystitis: Increased immature granulocyte percentage

Yılmaz Ünal, M.D.,[1] Salih Tuncal, M.D.,[1] Berkay Küçük, M.D.,[2] Aziz Mutlu Barlas, M.D.,[1] Saygın Altıner, M.D.,[1] Recep Balık, M.D.,[3] Seyit Murat Aydın, M.D.,[1] Abdullah Şenlikci, M.D.,[1] Mevlut Recep Pekcici, M.D.[1]

[1]Department of General Surgery, University of Health Sciences Ankara Training and Research Hospital, Ankara-*Türkiye*
[2]Department of Intensive Care, University of Health Sciences Ankara City Hospital, Ankara-*Türkiye*
[3]Department of Infectious Diseases and Clinical Microbiology, University of Health Sciences Haydarpaşa Numune Training and Research Hospital, İstanbul-*Türkiye*

ABSTRACT

BACKGROUND: Acute cholecystitis (AC) is an acute inflammatory disease of gallbladder and it is one of the most common causes of acute abdominal pain. Determining the severity of AC at hospital admission is extremely important to choose the most effective treatment method and predict vital prognosis. The aim of this study was to investigate the effectiveness of immature granulocyte percentage (IG%) in grading AC severity.

METHODS: This retrospective study was carried out on 528 patients hospitalized due to AC diagnosis. Demographic data, white blood cell (WBC) count, neutrophil lymphocyte ratio (NLR), IG%, C-reactive protein (CRP) levels, and imaging results of patients were recorded. Furthermore, patients' length of hospital stay was determined. Tokyo Guidelines were used to grade AC severity. According to this grading, patients were classified into three groups as grade 1 (mild), grade 2 (moderate), and grade 3 (severe) AC. Differences among groups were analyzed statistically.

RESULTS: There were 386 patients (73.1%) in the mild AC group, 102 patients (19.3%) in the moderate AC group, and 40 patients (7.6%) in the severe AC group. WBC, NLR, CRP and IG% were significant parameters in discriminating mild AC from moderate and severe AC. However, only IG% was a significant parameter in discriminating moderate AC from severe AC. Moreover, the power of IG% to discriminate between patients with mild and moderate AC and those with severe AC was dramatically higher than the other parameters.

CONCLUSION: Increased IG% is seen as an effective and reliable predictor in the early determination of AC severity.

Keywords: Acute cholecystitis; immature granulocyte percentage; inflammatory markers; severity grading; Tokyo guidelines.

INTRODUCTION

Acute cholecystitis (AC) is one of the most common causes of acute abdominal pain. This disease is caused by cystic duct obstruction due to gallstones in 90% of cases. However, in 10% of cases, gallstones cannot be detected in the gallbladder, which is called acute acalculous cholecystitis.[1] Acute acalculous cholecystitis occurs in situations such as major surgery, severe trauma and burns, sepsis, total parenteral nutrition, and prolonged intensive care stay.[2] It is predicted that approximately 10% of the general population has gallbladder stones and 20% of people with gallstones apply to emergency services during their lives with AC symptoms.[3]

Cite this article as: Ünal Y, Tuncal S, Küçük B, Barlas AM, Altıner S, Balık R, et al. An effective and reliable marker in gradıng the severity of acute cholecystitis: Increased immature granulocyte percentage. Ulus Travma Acil Cerrahi Derg 2022;28:1716-1722.

Address for correspondence: Salih Tuncal, M.D.
Sağlık Bilimleri Üniversitesi Tıp Fakültesi, Ankara Eğitim ve Araştırma Hast., Genel Cerrahi Kliniği, Ankara, Türkiye
Tel: +90 312 - 595 30 00 E-mail: tuncalsalih7@gmail.com

Ulus Travma Acil Cerrahi Derg 2022;28(12):1716-1722 DOI: 10.14744/tjtes.2021.86322 Submitted: 12.10.2021 Revised: 15.10.2021 Accepted: 13.12.2021

AC may cause mild inflammation symptoms and local complications such as gangrene, perforation, abscess, and biliary peritonitis. In some cases, severe cholecystitis may be observed characterized by organ failure threatening life.[4] Although mortality rate is generally lower than 1% in AC, this rate may exceed 10% in severe AC cases.[5]

AC diagnosis is made by a combination of physical examination findings, laboratory results such as white blood cell (WBC) count and C-reactive protein (CRP) and imaging results.[4] Together with AC diagnosis, the early prediction of disease severity is extremely important to determine a fast, appropriate, and reliable treatment approach and reduce morbidity and mortality rates.

So far, several laboratory parameters such as WBC, CRP, procalcitonin, and neutrophil lymphocyte ratio (NLR) have been used in numerous studies to determine AC severity.[6–9] The increase of immature granulocyte percentage (IG%), which presented a new inflammation marker by researchers, in peripheral blood, is known as an early indicator of severe infection and sepsis.[10–12] Studies carried out in recent years show that the IG% increase is more effective than traditional inflammation markers in complicated intraabdominal infections.[13–15]

This study investigated the effectiveness of increased IG% in plasma in predicting the AC severity.

MATERIALS AND METHODS

This retrospective study was approved by the Local Ethical Committee of the University of Health Sciences, the Faculty of Medicine, Ankara Training and Research Hospital. This study included 528 adult patients hospitalized with diagnosis of AC in the General Surgery Clinic of Ankara Research and Training Hospital between January 2018 and December 2020. Patients with diseases such as choledocholithiasis, acute cholangitis, acute pancreatitis, chronic hepatic disease, hepatobiliarymalignities, and those aged below 18 were excluded from the study.

The age, sex, physical examination results, laboratory results (WBC, NLR, CRP, and IG%), abdominal ultrasonography, and computerized tomography results of the patients were obtained from the electronic database of the hospital. The length of hospital stay (LHS) of patients was detected. Patients who stayed and died in intensive care unit (ICU) were recorded. Moreover, patients with organ/system dysfunction were identified to determine grade 3 AC in line with the Tokyo Guidelines (TG).[4]

AC diagnosis was made at hospital admission in line with the TG based on the existence of local inflammation signs such as right upper quadrant abdominal pain, tenderness, palpable mass, Murphy's sign, and systemic inflammation signs such as increased WBC, CRP, and characteristic imaging results of AC. For AC diagnosis, it is necessary that at least one sign from both the local and systemic inflammation signs be positive and imaging methods must support the diagnosis.[4]

The severity grading criteria of the TG, developed by worldwide consensus, were utilized to grade the severity of AC.[4] Accordingly, patients with AC were classified into three groups as grade 1 (mild), grade 2 (moderate), and grade 3 (severe) AC. Demographic data, inflammation markers (WBC, NLR, IG%, and CRP), length of ICU and hospital stay, and mortality rates were analyzed statistically and compared among the groups.

Statistical Analysis

The data were assessed through the IBM SPSS Statistics 25.0 statistical package software. Descriptive statistics were the number of units (n), percentage (%), and mean±standard deviation. Categorical variables analyzed either Pearson Chi-square or Fisher's exact test. Distribution of the data of continuous variables was assessed using the Shapiro–Wilk test and Q-Q graphics. Independent t-test used for continuous variables of the two groups analyzed with Student-test, and three or more groups analyzed with ANOVA. The Tukey HSD was used for pair-wise comparisons. The performance of immature granulocyte ratio in detecting moderate and severe cholecystitis cases was assessed by drawing receiving operating characteristics (ROC) curves. Threshold values were determined using the Youden index. Sensitivity, specificity, positive predictive, and negative predictive values (NPV) were calculated based on the obtained threshold values. The value of $p<0.05$ was accepted as statistically significant.

RESULTS

This study included 528 patients hospitalized with a diagnosis AC. Of the patients, 323 (61.2%) were female and 205 (38.8%) were male. The mean age of the patients was 54.7±16.8l; the youngest patient was 19 years and the oldest 96 years old.

The patients were classified into three groups as grade 1, grade 2, and grade 3AC based on the TG. Grade 1 AC consisted of 386 patients (73.1%), grade 2 AC of 102 patients (19.3%), and grade 3 AC of 40 patients (7.6%). Grade 2 patients who had at least one organ/system dysfunction at hospital admission and in follow-up and treatment after the admission were evaluated as grade 3.

Renal dysfunction existed in 17 patients with grade 3 AC. In these patients, creatinine levels were above 2 mg/dl and/or oliguric. Renal functions returned to normal following intravenous fluid replacement and supportive care in 15 of these patients. However, renal failure progressed in two patients despite the renal replacement therapy and these patients died due to severe metabolic acidosis and fluid-electrolyte imbalance.

Hepatic dysfunction was detected in 12 patients with grade 3 AC. The PT-INR levels of these patients were above 1.5. These patients did not have a known hepatic disease, a history of hepatotoxic drug or alcohol use, or a history of hepatitis. One patient died due to acute hepatic failure and hepatic encephalopathy.

Hematological dysfunction existed in six patients whose thrombocyte levels were below 100,000/mm^3. These patients, who were thought to have marrow depression due to severe infection, did not have hematological diseases. Thrombocyte levels returned to normal with proper treatment of severe AC and there was no need for thrombocyte replacement.

Hypotension was detected in two of the patients, which caused cardiological dysfunction. Noradrenaline infusion was applied to these patients who could not achieve a mean arterial pressure of 65 mmHg following intravenous fluid replacement. Noradrenaline dosage was reduced in one patient and eventually discontinued in as the infection declined. Hemodynamic stability was not achieved in the other patient despite appropriate antibiotherapy, multiple vasopressors, and inotropic agent support. Thus, the patient died due to septic shock.

Respiratory dysfunction existed in two patients, with PaO_2/FiO_2 ratio lower than 300 in arterial blood gases. Only one patient was provided with oxygen support, while invasive mechanical ventilator support was given to the other patient. The patient connected to a mechanical ventilator died due to severe acute respiratory distress syndrome and secondary infections.

Regression in consciousness was detected only in one of grade 3 patients. The cerebral imaging of the patient whose Glasgow coma scale declined and who was drowsy did not reveal any pathology to explain the situation. The clinical condition of this patient also declined after the AC treatment and the patient returned to normal.

When the groups were assessed in terms of sex, grade 1 and grade 2 AC were observed more frequently in females, while grade 3 AC was more common in males, which was statistically significant (p=0.02). The mean age of the patients increased as the disease severity increased. There was a statistically significant difference among the three groups in terms of mean age (p<0.001).

The mean LHS was 3.7±1.9 days in grade 1, 7.8±3.6 days in grade 2 and 17.7±19.3 days in grade 3. There was a statistically significant difference among three groups in terms of LHS (p<0.001). No patients stayed in ICU in grade 1, whereas four patients (3.92%) stayed in ICU in grade 2 and 24 patients in grade 3. The difference among the groups in terms of ICU stay was significant (p<0.001). When the groups were compared in terms of mortality rates, one patient in grade 1 (0.28%), one patient in grade 2 (0.9%), and five patients in grade 3 (12.5%) died. There was no significant difference between grade 1 and grade 2, while a significant difference existed between grade 1 and grade 3 and between grade 2 and grade 3 (p<0.01). Table 1 presents the demographic data, length of hospital, and ICU stay and mortality rates of the patients.

The intergroup comparison of mean values of inflammation markers (WBC, NLR, IG%, and CRP) showed that there were statistically significant differences between grade 1 and grade 2 and between grade 1 and grade 3 in all the markers (p<0.001). However, there was a significant difference between grade 2 and grade 3 only for IG% (p<0.001) (Table 1).

Table 1. Comparison of the demographic data, length of hospital stay, mortality rates and inflammation markers among the groups

	Grade 1 (mild) AC	Grade 2 (moderate) AC	Grade 3 (severe) AC	p-value
Number of patients, n (%)	386 (73.1)	102 (19.3)	40 (76)	
Sex, n (%)				
Female	249 (64.5)	56 (54.9)	18 (45)	0.020
Male	137 (35.5)	46 (45.1)	22 (55)	
Mean age (year)	51.2±15.7^a	60.5±15.9^b	74.1±12.6^c	<0.001
LHS (day)	3.7±1.9^a	7.8±3.6^b	17.7±19.3^c	<0.001
ICU, n (%)	0 (0)^a	4 (3.9)^b	24 (60)^c	<0.001
Mortality, n (%)	1 (0.26)^a	1 (0.98)^a	5 (12.5)^b	<0.001
WBC (10^3/uL)	10.2±3.2^a	15.9±4.9^b	15.8±6.3^b	<0.001
CRP (mg/dL)	47.7±61.9^a	150.6±112.5^b	150.6±105.9^b	<0.001
IG%	0.4±0.2^a	1.3±1.1^b	2.6±1.8^c	<0.001
NLR	4.4±3.9^a	9.7±8.5^b	12.9±8.3^b	<0.001

The subscripts of a, b, and c denote the statistically significant difference between the groups. LHS: Length of hospital stay; ICU: Intensive care unit; WBC: White blood cell; CRP: C-reactive protein; IG%: Immature granulocyte percentage; NLR: Neutrophile lymphocyte ratio; vs: Versus.

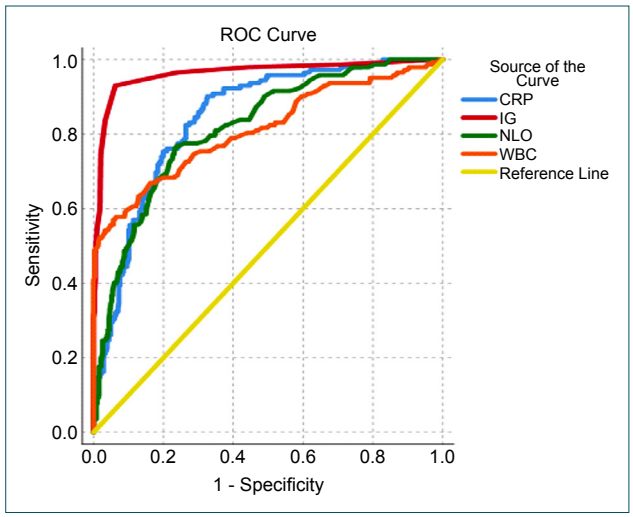

Figure 1. Receiver operating characteristic curve analysis of inflammation markers in discriminating grade 1 (mild) acute cholecystitis from grade 2 (moderate) and grade 3 (severe) acute cholecystitis.

The ROC curve was drawn to determine the power of inflammation markers in discriminating grade 1 AC from grade 2 and grade 3 AC (Fig. 1). According to this curve, all the markers were statistically significant in discriminating grade 1 AC from grade 2 to grade 3 AC ($p<0.001$ for all the markers). However, the area under curve (AUC), sensitivity, specificity, positive predictive values (PPV), and NPV of IG% were significantly higher than the other markers (0.96%, 92.9%, 93.7%, 84.6%, and 97.3%, respectively) (Table 2).

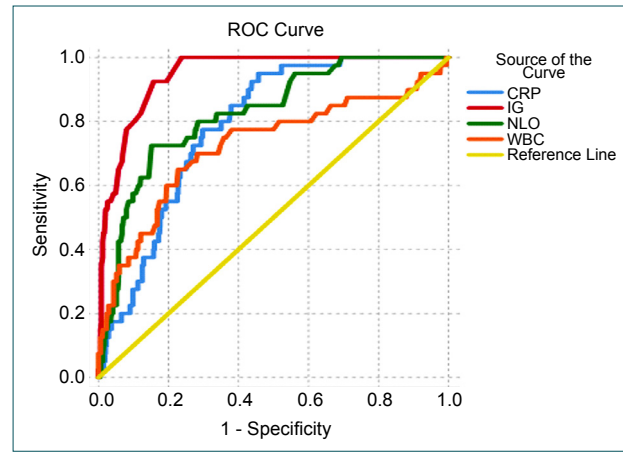

Figure 2. Receiver operating characteristic curve analysis of inflammation markers in discriminating grade 1 (mild) and grade 2 (moderate) acute cholecystitis from grade 3 (severe) acute cholecystitis.

The analysis of the ROC curve (Fig. 2) drawn to determine the effectiveness of inflammation markers in discriminating grade 1 and grade 2 AC from grade 3 AC showed that IG% had a significantly higher predictive power for grade 3 AC than the others (for IG%, AUC: 0.95, sensitivity: 92.5%, specificity: 84.2%, PPV: 32.5%, and NPV: 99.3%) (Table 3).

DISCUSSION

Gallbladder stone is a significant health issue observed in approximately 10% of society. While 40–60% of the cases are

Table 2. ROC analysis results in discriminating grade 1 (mild) acute cholecystitis from grade 2 (moderate) and grade 3 (severe) acute cholecystitis

Grade 1 vs grade 2 - grade 3	AUC	95%CI	Cut-off	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	p-value
IG%	0.962	0.941–0.983	>0.6	92.96	93.78	84.6	97.3	<0.001
CRP	0.844	0.809–0.880	>38.2 (mg/dL)	90.14	67.36	50.4	94.9	<0.001
NLR	0.817	0.777–0.857	>5.2	76.76	76.17	54.2	89.9	<0.001
WBC	0.812	0.766–0.859	>14.9 (10^3/uL)	57.04	94.3	78.6	85.6	<0.001

ROC: Receiver operating characteristic; AUC: Area under curve; CI: Confidence interval; PPV: Positive predictive value; NPV: Negative predictive value; vs: Versus; WBC: White blood cell; CRP: C-reactive protein; IG%: Immature granulocyte percentage; NLR: Neutrophile lymphocyte ratio.

Table 3. ROC analysis results for discriminating grade 1 (mild) and grade 2 (moderate) acute cholecystitis from grade 3 (severe) acute cholecystitis

Grade 1-2 vs grade 3	AUC	95%CI	Cut-off	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	p-value
IG%	0.945	0.922–0.969	>0.8	92.5	84.22	32.5	99.3	<0.001
CRP	0.786	0.731–0.841	>37.3 (mg/dL)	95	54.3	14.6	99.3	<0.001
NLR	0.825	0.761–0.889	>8.5	72.5	84.84	28.2	97.4	<0.001
WBC	0.724	0.627–0.821	>13.7 (10^3/uL)	65	77.25	19	96.4	<0.001

ROC: Receiver operating characteristic; AUC: Area under curve; CI: Confidence interval; PPV: Positive predictive value; NPV: Negative predictive value; vs: Versus; WBC: White blood cell; CRP: C-reactive protein; IG%: Immature granulocyte percentage; NLR: Neutrophile lymphocyte ratio.

asymptomatic, 20% of patients apply to emergency services with clinical symptoms of AC in one part of their lives.[3,9] Therefore, AC is among the disease the general surgeons encounter the most frequently worldwide and cholecystectomy is among the most frequently performed operations.[16]

AC diagnosis is made based on clinical, laboratory, and imaging findings. AC generally exhibits mild self-limiting inflammation symptoms, but in some cases, it may lead to local complications such as emphysema, gangrene, perforation, abscess, biliary peritonitis, and bilioenteric fistula. Furthermore, severe AC cases characterized by organ failure may appear particularly in elderly patients with weak immune resistance. This clinical status mostly requires treatment in ICUs and mortality rates go over 10% in these patients.[4,17] Moreover, as disease severity increases, the LHS and medical costs also increase. Consequently, it is vital to establish AC diagnosis and determine the severity of the disease early for choosing the appropriate and effective treatment. Although numerous studies were carried out for this purpose in recent years, the first comprehensive and modern study accepted across the world is the TG. TG was published in 2007 (TG07) and revised twice, in 2013 (TG13) and 2018 (TG18).[4,17,18] In TG, AC was classified into three groups as grade 1 (mild), grade 2 (moderate), and grade 3 (severe) AC in terms of clinical and laboratory results, imaging results, and the existence of organ/system dysfunction.

Of 528 patients in our study, 386 (73.1%) had grade 1, 102 (19.3%) had grade 2, and 40 (7.6%) had grade 3 AC. Of the patients, 323 (61.2%) were female and 205 (38.8%) were male. While grade 1 and grade 2 AC were encountered more frequently in females, grade 3 AC was more common in males. Furthermore, as the severity of AC increased, the mean age of the patients increased as well. All these data were consistent with the literature.

TG aims to standardize the diagnosis, severity grading, and treatment of AC and guide general surgeons. According to TG13 and TG18, there are mild inflammation symptoms in grade 1 AC in the gallbladder. Laparoscopic cholecystectomy (LC) can be implemented safely as a low-risk procedure early (within the first 72 h after the symptoms appear) in these patients. There is no organ dysfunction in grade 2 AC, but severe local complications (emphysema, gangrene, perforation, abscess, and biliary peritonitis) can be seen. The ideal treatment in these patients is LC if the patient is suitable for general anesthesia and if there is a surgical team with advanced laparoscopy. However, if the patient is at risk for general anesthesia, conservative treatment and gallbladder drainage (percutaneous cholecystostomy) should be considered.[17] If diagnosis and treatment are delayed in grade 2 AC, the general condition of the patient may quickly deteriorate and grade 3 (severe) AC characterized by organ failure may appear. These patients may require treatment in ICU and mortality rates are higher than grade 1 and 2.[17] Therefore, it is crucial to predict this risk. In grade 3 AC, early LC is recommended by the experienced surgical team for patients who become suitable for general anesthesia following effective supportive care.[18,19] However, in grade 3 AC patients whose general condition does not improve despite appropriate conservative treatment, early gallbladder drainage should be performed as a bridge treatment before cholecystectomy.[20,21]

A study showed that as the severity of AC increased, LHS, the need for ICU, and medical costs increased too.[22] Our study was compatible with the literature in terms of LHS and ICU. We did not calculate the medical costs in this study, but it is possible that as the LHS and ICU increases, medical costs also increase in proportion to this.

In a study carried out with more than 5000 patients, 30-day mortality rates in patients with grade 3 AC (5.4%) were significantly higher than grade 1 patients (1.1%) and grade 2 patients (0.8%).[23] In our study, while the mortality rate was 12.5% in grade 3 AC patients, it was 0.9% in grade 2 and only 0.2% in grade 1. We can explain the high mortality rates in grade 3 with insufficiency in the early diagnosis of these patients.

There is a need for simple, low-cost, fast, and effective biomarkers to determine the severity of AC in the first admission to the hospital. According to the literature, various researchers use numerous inflammation markers for this purpose (WBC, CRP, NLR, and procalcitonin).[6–9,24–26] CRP, which is used the most frequently for this purpose, is a well-known acute phase reactant and it is released from hepatocytes in bacterial infections depending on tissue damage.According to a previous study, CRP could be an excellent marker that is more effective than WBC in discriminating gangrenous and non-gangrenous cholecystitis.[26] In our study, CRP was very effective in discriminating grade 1 AC from grade 2 and grade 3 AC, whereas it was ineffective in discriminating grade 2 AC from grade 3.

In a similar studycarried out with 1959 patients, the cutoff values of NLR for mild, moderate, and severe AC were 4.1, 3.25, and 4.17, respectively, while the AUROC values were 0.94, 0.87, and 0.98, respectively. According to these results, the discriminatory power of NLR for all AC forms was better than WBC and similar to CRP.[9] In the present study, the cutoff value of NLR in discriminating mild AC from moderate and severe AC was 5.2. Furthermore, AUROC values of NLR were similar to those of CRP and WBC and lower than IG%.

Another study determined that procalcitonin was more effective than WBC and CRP in discriminating grade 1 AC from grade 2 and grade 3 AC. Furthermore, the study concluded that procalcitonin alone was not adequate to assess the severity of AC and it could be added into the TG in severity assessment.[8]

IG% is a new and promising inflammation marker that clinicians do not adequately know. IG%, which are not detected

in healthy individuals, in peripheral blood increases in severe infections and sepsis, which results from the increased activation of bone marrow.[10,11] Today, IG% can be easily and rapidly measured through routine CBC count in automated hematological analyzers. The previous studies showed that increased IG% was better than conventional inflammation parameters in predicting of severe intraabdominal infections.[13–15,27] Moreover, it was also shown that IG% might indicate therapeutic effectiveness of treatment implemented in cases of severe infections.[28]

In one of our previous studies, we determined that the AUROC, sensitivity, and specificity values of IG%, and accordingly, its power of predicting complicated appendicitis was higher than WBC and NLR.[13] Another study compared DNI, which reflects the fraction of circulating immature granulocytes and the number of neutrophils, NLR, and CRP in discrimination of acute diverticulitis that requires and do not require immediate surgical intervention. At the end of the study, the researchers concluded that the diagnostic value of DNI was significantly higher than the others.[29]

Conclusion

Early prediction of AC severity in the first admission to the hospital leads to appropriate and effective treatment along with the lower morbidity and mortality rates, a shorter hospital stay, and lower medical costs. According to the results of our study, the ability of increased IG% in predicting severe AC was significantly higher than the other laboratory parameters.

Consequently, IG% can be easily and rapidly measured through routine CBC count without additional time and costs. We can say that increased IG% is a reliable parameter in determining the severity of AC. Furthermore, we suggest the use of IG% by clinicians in determining the severity of AC in the clinical routine and adding it to the TG.

Ethics Committee Approval: This study was approved by the Ankara Training and Research Hospital Clinical Research Ethics Committee (Date: 29.07.2021, Decision No: E-21-723).

Peer-review: Externally peer-reviewed.

Authorship Contributions: Concept: Y.Ü., S.T., B.K., A.M.B.; Design: Y.Ü., B.K.; Supervision: S.A., M.R.P.; Resource: Y.Ü., S.T.; Materials: Y.Ü., B.K., S.A., R.B.; Data: B.K., R.B.; Analysis: S.M.A., A.Ş.; Literature search: M.R.P.; Writing: Y.Ü., S.T., B.K.; Critical revision: A.M.B., S.A.

Conflict of Interest: None declared.

Financial Disclosure: The authors declared that this study has received no financial support.

REFERENCES

1. Yusoff IF, Barkun JS, Barkun AN. Diagnosis and management of cholecystitis and cholangitis.Gastroenterol Clin Nort Am 2003;32:1145–68.
2. Wang AJ, Wang TE, Lin CC, Lin SC, Shih SC. Clinical predictors of severe gallbladder complications in acute acalculous cholecystitis. World J Gastroenterol 2003;9:2821–3. [CrossRef]
3. Shaffer EA. Gallstone disease: Epidemiology of gallbladder stone disease. Best Pract Res Clin Gastroenterol 2006;20:981–96. [CrossRef]
4. Hirota M, Takada T, Kawarada Y, Nimura Y, Miura F, Hirata K, et al. Diagnostic criteria and severity assessment of acute cholecystitis: Tokyo guidelines. J Hepatobiliary Pancreat Surg 2007;14:78–82. [CrossRef]
5. Thangavelu A, Rosenbaum S, Thangavelu D. Timing of cholecystectomy in acute cholecystitis. J Emerg Med 2018;54:892–7. [CrossRef]
6. Sadettin Er, Ozden S, Celik C, Yuksel BC. Can we predict severity of acute cholecystitis at admission? Pak J Med Sci 2018;34:1293–6. [CrossRef]
7. Gurbulak EK, Gurbulak B, Akgun IE, Duzkoylu Y, Battal M, Celayir MF, et al. Prediction of the grade of acute cholecystitis by plasma level of C-reactive protein. Iran Red Crescent Med J 2015;25:17:e28091. [CrossRef]
8. Yuzbasioglu Y, Duymaz H, Tanrikulu CS, Halhalli HC, Koc MO, Tandoğan M, et al. Role of procalcitonin in evaluation of the severity of acute cholecystitis. Eurasian J Med 2016;48:162–6. [CrossRef]
9. Beliaev AM, Angelo N, Booth M, Bergin C. Evaluation of neutrophil-to-lymphocyte ratio as a potential biomarker for acute cholecystitis. J Surg Res 2017;209:93–101. [CrossRef]
10. Senthilnayagam B, Kumar T, Sukumaran J, Jeya M, Rao KR. Automated measurement of immature granulocytes: Performance characteristics and utility in routine clinical practice. Patholog Res Int 2012;2012:483670.
11. Ayres LS, Sgnaolin V, Munhoz TP. Immature granulocytes index as early marker of sepsis. Int J Lab Hematol 2019;41:392–6. [CrossRef]
12. Park BH, Kang YA, Park MS, Jung WJ, Lee SH, Lee SK, et al. Delta neutrophil index as an early marker of disease severity in critically ill patients with sepsis. BMC InfectDis 2011;11:299. [CrossRef]
13. Ünal Y. A new and early marker in the diagnosis of acute complicated appendicitis: Immature granulocytes. Ulus Travma Acil Cerrahi Derg 2018;24:434–9. [CrossRef]
14. Lee SJ, Park EJ, Lee KJ, Cha YS. The delta neutrophil index is an early predictive marker of severe acute cholecystitis. Dig Liver Dis 2019;51:1593–8.
15. Bedel C, Korkut M, Selvi F. New markers in predicting the severity of acute pancreatitis in the emergency department: Immature granulocyte count and percentage. J Postgrad Med 2021;67:7–11. [CrossRef]
16. Knab LM, Boller AM, Mahvi DM. Cholecystitis. Surg Clin North Am 2014;94:455–70. [CrossRef]
17. Yokoe M, Takada T, Strasberg SM, Solomkin JS, Mayumi T, Gomi H, et al. New diagnostic criteria and severity assessment of acute cholecystitis in revised Tokyo guidelines. J Hepatobiliary Pancreat Sci 2012;19:578–85. [CrossRef]
18. Yokoe M, Hata J, Takada T, Strasberg SM, Asbun HJ, Wakabayashi G, et al. Tokyo guidelines 2018: Diagnostic criteria and severity grading of acute cholecystitis (with videos). J Hepatobiliary Pancreat Sci 2018;25:41–54. [CrossRef]
19. Miura F, Takada T, Strasberg SM, Solomkin JS, Pitt HA, Gouma DJ, et al. TG13 flowchart for the management of acute cholangitis and cholecystitis. J Hepatobiliary Pancreat Sci 2013;20:47–54. [CrossRef]
20. Zeren S, Bayhan Z, Koçak C, Kesici U, Korkmaz M, Ekici MF, et al. Bridge treatment for early cholecystectomy in geriatric patients with acute cholecystitis: Percutaneous cholecystostomy. Ulus Travma Acil Cerrahi Derg 2017;23:501–6. [CrossRef]
21. Okamoto K, Suzuki K, Takada T, Strasberg SM, Asbun HJ, Endo I, et al. Tokyo guidelines 2018: Flowchart for the management of acute cholecystitis. J Hepatobiliary Pancreat Sci 2018;25:55–72. [CrossRef]
22. Hayasaki A, Takahashi K, Fujii T, Kumamoto K, Fujii K, Matsumoto E, et al. Factor analysis influencing postoperative hospital stay and medical costs for patients with definite, suspected, or unmatched diagnosis of

acute cholecystitis according to the Tokyo guidelines 2013. Gastroenterol Res Pract 2016;2016:7675953. [CrossRef]

23. Yokoe M, Takada T, Hwang TL, Endo I, Akazawa K, Miura F, et al. Validation of TG13 severity grading in acute cholecystitis: Japan-Taiwan collaborative study for acute cholecystitis. J Hepatobiliary Pancreat Sci 2017;24:338–45. [CrossRef]
24. Mahmood F, Akingboye A, Malam Y, Thakkar M, Jambulingam P. Complicated acute cholecystitis: The role of c-reactive protein and neutrophil-lymphocyte ratio as predictive markers of severity. Cureus 2021;27:e13592. [CrossRef]
25. Beliaev AM, Marshall RJ, Booth M. C-reactive protein has a better discriminative power than white cell count in the diagnosis of acute cholecystitis. J Surg Res 2015;198:66–72. [CrossRef]
26. Mok KW, Reddy R, Wood F, Turner P, Ward JB, Pursnani KG, et al. Is C-reactive protein a useful adjunct in selecting patients for emergency cholecystectomy by predicting severe/gangrenous cholecystitis? Int J Surg 2014;12:649–53. [CrossRef]
27. Ansari-Lari MA, Kickler TS, Borowitz MJ. Immature granulocyte measurement using the sysmex XE-2100. Relationship to infection and sepsis. Am J Clin Pathol 2003;120:795–9. [CrossRef]
28. Park JH, Byeon HJ, Lee KH, Lee JW, Kronbichler A, Eisenhut M, et al. Delta neutrophil index (DNI) as a novel diagnostic and prognostic marker of infection: A systematic review and meta-analysis. Inflamm Res 2017;66:863–70. [CrossRef]
29. Kang HS, Cha YS, Park KH, Hwang SO. Delta neutrophil index as a promising prognostic marker of emergent surgical intervention for acute diverticulitis in the emergency department. PLoS One 2017;12:e0187629. [CrossRef]

ORİJİNAL ÇALIŞMA - *ÖZ*

Akut kolesistitin şiddetini derecelendirmede etkili ve güvenilir bir belirteç: Artmış immatür granülosit yüzdesi

Dr. Yılmaz Ünal,[1] Dr. Salih Tuncal,[1] Dr. Berkay Küçük,[2] Dr. Aziz Mutlu Barlas,[1] Dr. Saygın Altıner,[1] Dr. Recep Balık,[3] Dr. Seyit Murat Aydın,[1] Dr. Abdullah Şenlikci,[1] Dr. Mevlut Recep Pekcici[1]

[1]Sağlık Bilimleri Üniversitesi Tıp Fakültesi, Ankara Eğitim ve Araştırma Hastanesi, Genel Cerrahi Kliniği, Ankara
[2]Sağlık Bilimleri Üniversitesi Tıp Fakültesi, Ankara Şehir Hastanesi, Yoğun Bakım Kliniği, Ankara
[3]Sağlık Bilimleri Üniversitesi Haydarpaşa Numune Eğitim ve Araştırma Hastanesi, Enfeksiyon Hastalıkları ve Klinik Mikrobiyoloji Kliniği, İstanbul

AMAÇ: Akut kolesistit (AK) safra kesesinin akut enflamatuvar hastalığıdır ve akut karın ağrısının en yaygın sebeplerinden biridir. Hastaneye kabulde AK şiddetini belirlemek en etkili tedavi yöntemini seçmek ve hayati prognozu tahmin etmek için son derece önemlidir. Bu çalışmanın amacı, immatür granülosit yüzdesinin (IG%) AK şiddetini derecelendirmedeki etkinliğini araştırmaktır.

GEREÇ VE YÖNTEM: Bu geriye dönük çalışma AK tanısıyla hastaneye yatırılan 528 hasta üzerinde yapıldı. Hastaların demografik verileri, beyaz küre sayısı (WBC), nötrofil lenfosit oranı (NLR), IG% ve C-reaktif protein (CRP) düzeyleri ve görüntüleme bulguları kaydedildi. Ayrıca hastaların hastanede kalma süreleri tespit edildi. AK şiddetini derecelendirmek için Tokyo Kılavuzları kullanıldı. Bu derecelendirmeye göre hastalar grade 1 (hafif), grade 2 (orta) ve grade 3 (şiddetli) AK olarak üç gruba ayrıldı. Gruplar arasındaki farklar istatistiksel olarak analiz edildi.

BULGULAR: Hafif AK grubunda 386 (%73.1), orta AK grubunda 102 (%19.3) ve şiddetli AK grubunda 40 (%7.6) hasta mevcuttu. Hafif AK'yı orta ve şiddetli AK'dan ayırmada WBC, NLR, CRP ve IG% anlamlı parametreler idi. Ancak orta AK'yı şiddetli AK'dan ayırmada sadece IG% anlamlı parametre idi. Ayrıca IG%'sinin hafif ve orta AK'lı hastaları şiddetli hastalardan ayırma gücü diğer parametrelerden önemli ölçüde daha yüksek idi.

TARTIŞMA: Artmış IG% AK şiddetinin erken tespitinde etkili ve güvenilir bir tahmin edici olarak görülmektedir.

Anahtar sözcükler: Akut kolesistit; enflamasyon belirteçleri; immatür granülosit yüzdesi; şiddet derecelendirmesi; Tokyo Klavuzları.

Ulus Travma Acil Cerrahi Derg 2022;28(12):1716-1722 doi: 10.14744/tjtes.2021.86322