Can the Modified Systemic Inflammation Score Predict Complicated Appendicitis?

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ABSTRACT

Objective: To differentiate between complicated and uncomplicated acute appendicitis using the modified systemic inflammation score (mSIS) preoperatively.

Study Design: Observational study.

Place and Duration of the Study: The Emergency Surgery Service of General Surgery Clinic of Ankara Bilkent City Hospital, Turkey, between 2021 and 2022.

Methodology: The study included 2,584 patients older than 18 years who underwent surgery with the diagnosis of acute appendicitis. Patients with malignant diseases and those younger than 18 were excluded. The patients' demographic characteristics, laboratory data, surgical notes, and pathology results were electronically obtained and analysed. According to the surgical findings and pathology records, gangrenous, perforated, and phlegmonous cases and those with any abscess focus were included in the complicated group and the remaining cases were included in the uncomplicated group. mSIS was evaluated as 0 if albumin was ≥4.0 g/dL and LMR (the lymphocyte-to-monocyte ratio) was ≥3.4, 1 if albumin <4.0 g/dL or LMR <3.4, and 2 if albumin <4.0 g/dL and LMR <3.4.

Results: mSIS was 0 in 868 (33.6%) cases and 1-2 in 1,716 (66.4%) cases. When the patients with mSIS values of 0 and 1-2 were compared, there was a statistically significant difference (p=0.03). mSIS 1-2 was found to have 85% sensitivity and 42% specificity in predicting complicated appendicitis. In addition, the probability of complicated appendicitis was 1.48 times higher among the patients with an mSIS of 1-2.

Conclusion: Complicated appendicitis cases can be predicted preoperatively by simply calculating mSIS using the routine laboratory parameters.

Key Words: *Complicated acute appendicitis, mSIS, Appendectomy.*

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INTRODUCTION

Acute appendicitis usually develops as a result of inflammation secondary to obstruction in the lumen of the appendix vermiformis due to lymphoid hyperplasia or fecaliths. The inflammation of this structure leads to problems in blood supply and the development of pathogenic microorganisms associated with distention and increased pressure.[1] Acute appendicitis is one of the most common emergent surgical pathologies in general surgery clinics, and the lifetime risk of developing this condition is approximately one in 11.[2,3] Although the accepted approach in the of acute appendicitis is appendectomy, antibiotic therapy is successful at a rate of 88-94% in uncomplicated cases.[4]

The rate of morbidity due to acute appendicitis is reported to be 10% in general, which can increase to 17-28% for the age range of 60-85 years and reach to 50% in those over 85 years.[5] Another important factor is whether appendicitis is complicated or otherwise.[6] Acute appendicitis cases are classified as uncomplicated or complicated according to surgical findings and pathological features.[2,6] In general, phlegmonous, gangrenous, and perforated cases, and those with an abscess were classified as complicated. The differentiation of the complicated and uncomplicated cases in the preoperative period is of paramount importance for determining the optimal treatment approach and reducing morbidity and mortality rates.[6] However, this differentiation is extremely difficult, and various imaging methods, serum biomarkers, and scoring systems have been defined for this purpose.[3,4,7] A low albumin level has been reported to be associated with nutritional disorders, immune deficiency, and a poor prognosis.[8] The modified systemic inflammation score (mSIS), which combines the albumin level and the lymphocyte-to-monocyte ratio (LMR), is used to predict prognosis and survival in certain types of cancer.[8,9] In recent years, it has been reported that mSIS can be used to evaluate the severity of acute cholecystitis as an inflammatory disease.[8-10] This study aimed to differentiate between complicated and

uncomplicated cases using mSIS and determine the severity of the disease in patients with suspected acute appendicitis.

METHODOLOGY

This unicentric observational study was conducted after obtaining approval from the Ethics Committee (dated: 14 December 2022, no. E1-22-3104). The electronic records of patients who underwent appendectomy with the diagnosis of acute appendicitis at the Emergency Surgery Service of the General Surgery Clinic of Ankara Bilkent City Hospital, Turkey in 2021 and 2022, were retrospectively reviewed. Patients aged over 18 years who underwent appendectomy were included in the study. Patients younger than 18 years, those with malignancies, pregnant women, patients with immunodeficiency or haematological diseases, those using immunosuppressant agents, those undergoing appendectomy simultaneously with any other surgical intervention, those with COVID-19 positivity, and those whose acute appendicitis diagnosis could not be confirmed by pathology records were excluded.

For all patients who met the study criteria, demographic characteristics and laboratory parameters, including leukocytes, lymphocytes, monocytes, albumin, LMR, and the neutrophil-to-lymphocyte ratio (NLR) were obtained from the electronic records. The surgical findings and pathology results of the patients were examined, and the cases with gangrenous, perforated, localised, or generalised peritonitis and phlegmonous cases with abscesses were evaluated as complicated appendicitis. The remaining cases formed the uncomplicated appendicitis group.[11]

In all cases, mSIS was calculated by accepting a score of 0 if albumin was ≥4 g/dl and LMR was ≥3.4, 1 if albumin <4 g/dl or LMR <3.4, and 2 if albumin <4 g/dl and LMR <3.4.[12] The patients with mSIS scores of 0 and 1-2 were statistically compared. The study was conducted in accordance with the principles of the Declaration of Helsinki.[13] Statistical analyses were performed using the IBM Statistical Package for the Social Sciences, version 26 (IBM SPSS Corp., Armonk, NY, USA). Numerical data were presented as percentages (%). Mean ± standard deviation values were used to define normally distributed continuous variables, while non-normally distributed data were expressed as median (minimum-maximum). The area under the curve (AUC) analysis was performed for mSIS. The value of p <0.05 was considered statistically significant.

RESULTS

Of the 2,584 patients included in the study, 1,517 (58.7%) were males and 1,067 (41.3%) were females. The mean age was 37.2 ± 15 years for all the patients, 39.75 ± 16.28 years for the complicated group, and 35.07 ± 13.7 years for the uncomplicated group. There were 835 (32.3%) patients in the complicated group and 1,749 (67.7%) patients in the uncomplicated group. Table I presents the data on the patients' age, gender, and leukocyte, lymphocyte, monocyte, and NLR values. Statistically significant differences were found between the complicated and uncomplicated cases in terms of age, leukocyte count, lymphocyte count, monocyte count, and NLR.

Table II presents the mSIS values for the cases in both groups. mSIS was 0 in 868 (33.6%) and 1-2 in 1,716 (66.4%) cases. When evaluated according to the groups, mSIS was 0 in 124 (14.8%) and 1-2 in 711 (85.2%) complicated cases. In the uncomplicated group, mSIS was 0 in 744 (42.5%) and 1-2 in 1,005 (57.5%) patients.

When the patients with mSIS values of 0 and 1-2 were compared, there was statistically significant difference (p = 0.03). mSIS 1-2 had 85% sensitivity and 42% specificity with negative predictive value of 85% and positive predictive value of 41%, in the prediction of complicated appendicitis cases. In addition, the probability of complicated appendicitis was 1.48 times higher among the patients with an mSIS score of 1-2. In the receiver operating characteristic analysis, the AUC value of mSIS was determined to be 0.64 (95% confidence interval: 0.617-0.660, p <0.001, Figure 1).

Table I: Demographic characteristics and laboratory values of the complicated and uncomplicated acute appendicitis groups.

Parameter	Complicated (n = 835)	Uncomplicated (n = 1,749)	p-value
Age (years)	39.75 ± 16.28	35.07 ± 13.7	0.00
Male	516	1,001	
Female	319	748	
Leukocyte count (10^9/L)	14.56 ± 4.39	12.89 ± 4.28	0.00
Lymphocyte count (10^9/L)	1.53 ± 0.70	1.93 ± 0.92	0.00
Monocyte count (10^9/L)	0.73 ± 0.47	0.66 ± 0.83	0.00
Neutrophil-to-lymphocyte ratio	10.09 ± 7.16	7.07 ± 6.22	0.00

Values are reported as mean ± standard deviation; n: number.

Table II: Statistical analysis of mSIS 0 and mSIS 1-2 between the complicated and uncomplicated acute appendicitis groups.

	Complicated (n = 835)	Uncomplicated (n = 1,749)	Total	p-value
mSIS 0	124	744	868	0.03
mSIS 1-2	711	1,005	1,716	

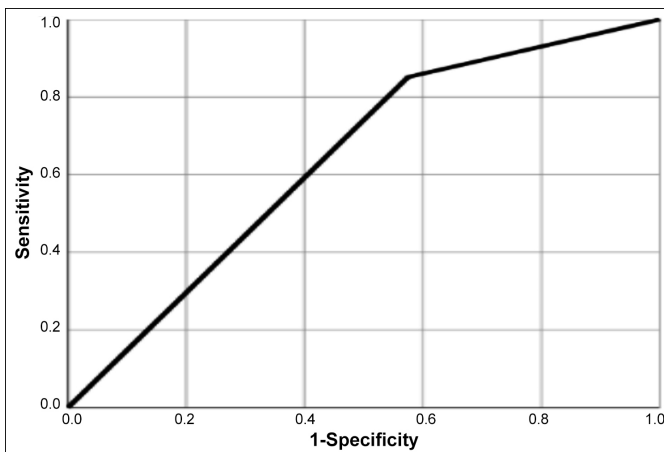*mSIS: Modified Systemic Inflammation Score.*

Figure 1: Receiver operating characteristic curve analysis of mSIS 1-2 in the prediction of complicated acute appendicitis cases.
mSIS: Modified Systemic Inflammation Score, AUC: Area under the curve, CI: Confidence interval.

DISCUSSION

Complicated acute appendicitis is an important cause of morbidity, especially in terms of its clinical features. mSIS is a scoring system that includes the preoperative albumin level and LMR. In addition to including a large cohort of patients, this study is the first to attempt to predict complicated appendicitis cases based on mSIS. On completion of the study, mSIS 1-2 was found to be statistically significant in predicting complicated appendicitis (p = 0.03). In addition, in patients with mSIS 1-2, the probability of complicated appendicitis increased by 1.48 times, and mSIS 1-2 had 85% sensitivity and 42% specificity in predicting complicated appendicitis. mSIS can be easily calculated using biochemistry and complete blood count parameters that are routinely evaluated in emergency departments and can assist clinicians in predicting complicated appendicitis early in the diagnostic process.

In addition to the clinical history and physical examination findings, laboratory parameters, scoring systems, and imaging methods are frequently used in the diagnosis of acute appendicitis.[7,14] However, it is not always possible to make a definitive and accurate diagnosis. Despite all the improvements in diagnosis and treatment methods, the rate of patients with normal pathology findings is still high, at a rate of 13-36%, and the perforation rate is reported to be 12-21%,[15,16] reaching 40-50% in the elderly.[5,17] As the rate of perforation increases, the rates of morbidity and mortality, the length of hospital stay, and related costs also increase. Therefore, new biomarkers are needed to distinguish between uncomplicated and complicated appendicitis. In the current study, 32% of the patients were found to have complicated appendicitis, although they were not of advanced age. This relatively higher rate compared to the literature may be associated with the study's hospital being a reference centre for both advanced and complicated appendicitis cases.

There are many studies in the literature suggesting that mSIS can be used to predict the severity of inflammatory diseases, such as acute cholecystitis.[10,18] In one of these studies, it was stated that mSIS had early diagnostic value in the diagnosis of complicated cholecystitis.[8] In other studies, it had been reported that LMR and mSIS are individual prognostic factors for survival and mortality in certain types of cancer, as well as diagnostic factors for infectious diseases, such as pneumonia.[9,19,20] Based on the results of this study, mSIS, which had been reported to predict the severity of infectious diseases in the literature, can also be used in the diagnosis of complicated appendicitis. The limitations of this study are its retrospective nature and single-centre data collection.

CONCLUSION

The mSIS can be calculated using a simple blood analysis at the time of admission in any healthcare centre. A score of 1-2 can be used to predict complicated acute appendicitis cases.

ETHICAL APPROVAL:
The Ethics Committee's approval was obtained on 14th December 2022, with the number E1-22-3104.

PATIENTS' CONSENT:
This retrospective study was conducted at the Emergency Surgery Service of the General Surgery Clinic of Ankara Bilkent City Hospital in 2021 and 2022 with electronic records of patients. Hence, there was no need for further consent from the patients.

COMPETING INTEREST:
The authors declared no competing interest.

AUTHORS' CONTRIBUTION:
EOH: Collected and analysed data, planned and designed the study, and drafted the manuscript.
SE: Planned and designed the study and drafted the manuscript.
TA: Performed the statistical analysis and edited the manuscript.
SMB: Collected and analysed data.
HB: Reviewed and edited the manuscript.
EC: Drafted the manuscript.
All authors approved the final version of the manuscript to be published.

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