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Does Neutrophil to Lymphocyte Ratio Predict Hospital Stay in Appendectomy Patients?

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We aimed to investigate the relationship between neutrophil to lymphocyte ratio (NLR) and the postoperative length of hospital stay. In addition, the impact of radiologic and histopathologic findings on hospital stay was also evaluated. This was a retrospective study; 103 patients with appendicitis were included. Diagnosis was confirmed with computerized tomography (CT) scans, ultrasonography, and histopathologic examination. Correlations between the length of hospital stay and age; sex; NLR; c-reactive peptide (CRP) levels; appendix diameter on CT scan or ultrasonography; appendix localization; and pathology reports were evaluated. The length of hospital stay was not related to age or sex. The length of hospital stay after appendectomy was correlated with appendix diameter on CT scan and phlegmonous appendicitis, but it was not associated with NLR, CRP levels, or appendix diameter on ultrasonography. This is a pioneer study, given there is no comprehensive study to date evaluating the association between NLR levels and the length of hospital stay of patients with acute appendicitis. NLR is not associated with the length of hospital stay. Appendix diameter with CT scan and appendix pathology reports are correlated with the length of postoperative hospital stay in appendectomy patients.

Key words: Neutrophil to lymphocyte ratio – Acute appendicitis – Computerized tomography – Appendiceal diameter – Length of stay

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Acute appendicitis is one of the common causes of acute abdominal pain. Luminal obstruction is the primary pathophysiological mechanism in the development of inflammation of the appendix vermiformis.[1,2] Severe complications such as perforation, intra-abdominal abscess, and peritonitis may be observed in acute appendicitis. Surgical intervention is essential to control the disease and its complications.[3,4] The disease-related mortality rate has been reported to be lower than 1%. However, this rate is increased in complicated cases and elderly patients.[5] It was also reported that complications and older age lead to longer hospital stays.[6]

Thus, evaluation of the severity of the disease with acute or perforated appendicitis is crucial for surgeons. Rapid, systematic, and careful assessment may help surgeons prevent life-threatening complications such as peritonitis and sepsis.[7]

Accurate and rapid diagnosis of acute appendicitis decreases perforation-related complications, negative appendectomy rates, and postoperative hospitalization period.[6,8]

Recent studies revealed that the neutrophil to lymphocyte ratio (NLR) is a very important parameter in early preoperative diagnosis and the prognosis of acute appendicitis.[8,10,11]

The current study aimed to investigate the relationship between NLR and the postoperative length of hospital stay. In addition, the impact of radiologic and histopathologic findings on hospital stay was evaluated.

Patients and Methods

A retrospective study was performed in patients who underwent appendectomy for acute appendicitis. Patient identifying information was not included in the study.

It was noted that the diagnosis of acute appendicitis in patients included in the study was confirmed with histopathologic examinations. Computerized tomography (CT) images were obtained using a multisection CT scanner (Alexion Advance, 16 slice, TSX-034A/1C, Toshiba Medical Systems, Otawara, Tochigi Prefecture, Japan) with 5-mm reconstruction thickness at 5-mm intervals through the abdomen and pelvis.

The following data were collected retrospectively: age, sex, NLR, white blood cell counts, c-reactive peptide (CRP) levels, appendix diameter on CT scan or ultrasound, localization of the appendix, and the length of hospital stay. Patients with myocardial disorders, neurological disorders, diabetes mellitus, chronic renal failure, malignant disorders, or chronic pulmonary diseases were excluded from study.

All statistical analysis was performed using statistical software (SPSS 13.0 for windows, SPSS, Inc, Chicago, Illinois). Frequency and descriptive analysis including age and sex analysis were performed. Fisher exact test was used to evaluate the presence of differences in the study cohort for NLR. Pearson correlation test and linear regression analysis were used to evaluate the correlations between the study parameters. Power analysis was not necessary for this retrospective study. Values of $P < 0.05$ were considered as significant. All statistical analyses were performed by a single investigator (FY).

Results

Basic demographic and clinical features of the study cohort were presented in Table 1. In this cohort, 5 (4.9%) of the patients were aged >60 years and 34 (33.1%) of the patients were females. The data corresponding to appendix diameter measured via CT scan and ultrasonography were absent in 6 (5.8%) and 68 (66.0%) of the patients, respectively. Localization of the appendix was not reported in 6 ([5.8]%) patients; whereas, the appendix was reported to be located in various positions other than retrocecal in 65 (64.1%) of the patients. In 80 (77.7%) of the patients, acute appendicitis was confirmed with histopathologic examination. Phlegmonous

Table 1 Basic demographic and clinical features of the study cohort

Patients, n	103
Age (y), mean ± SD (range)	30.6 ± 12.5 (16–69)
Ratio, F/M	34/69
Neutrophil count (mm^3), mean ± SD (range)	10,461.6 ± 372.1 (1700–25,300)
Lymphocyte count (cells/μL), mean ± SD (range)	1858.1 ± 83.2 (150–4200)
NLR	7.1 ± 7.0 (0.9–56)
C-reactive peptide level (mg/L), mean ± SD	4.6 ± 5.3 (0.1–31.5)
Appendix diameter on CT (mm), mean ± SD (range)	9.7 ± 2.6 (4–18)
Appendix diameter on ultrasonography (mm), mean ± SD (range)	9.3 ± 2.9 (6–18)
Retrocecal localization, n (%)	32 (31.1%)
Phlegmonous appendicitis, n (%)	20 (19.4%)
Acute appendicitis, n (%)	80 (77.7%)
Normal appendix, n (%)	3 (2.9%)
Length of hospital stay (d), mean ± SD (range)	2.2 ± 1.2 (1–7)

Table 2 NLR correlation with age, sex, appendix diameter on CT or ultrasonography, CRP levels, appendix localization, and pathology reports

	Neutrophil to lymphocyte ratio	
	*r**	*P* value*
Age	0.100	0.313
Sex	–0.112	0.258
Appendix diameter on CT	0.074	0.470
Appendix diameter on ultrasonography	–0.078	0.654
C-reactive peptide levels	–0.058	0.561
Appendix localization	–0.003	0.976
Pathology reports	0.117	0.238

*Pearson correlation test; *r* refers to the correlation coefficient and $P < 0.05$ indicates statistical significance.

Table 3 Correlation of the length of hospital stay with age, sex, NLR, appendix diameter on CT or ultrasonography, CRP levels, appendix localization, and pathology reports

	Length of hospital stay	
	*r**	*P* value*
Age	0.023	0.818
Sex	–0.064	0.519
NLR	0.016	0.872
CRP	0.182	0.066
Appendix diameter on CT	0.332	0.001
Appendix diameter on ultrasonography	–0.147	0.399
Appendix localization	0.175	0.086
Pathology reports	–0.364	0.000

*Pearson correlation test; *r* refers to the correlation coefficient and $P < 0.05$ indicates statistical significance.

appendicitis was reported in 20 (19.4%) of the patients. The appendix was normal in 3 (2.9%) of the patients. The length of hospital stay was 1, 2, and 3 days in 35 (34%), 34 (33%), and 21 (20.4%) of the patients, respectively. The length of hospital stay was less than 3 days in 13 (12.6%) of the patients.

The correlation of NLR with age, sex, appendix diameter on CT and ultrasonography, CRP levels, appendix localization, and pathology reports was presented in Table 2. Age and sex were not found to be correlated with neutrophil or lymphocyte counts or NLR. In addition, no correlation was found between age and sex with CRP levels, appendix diameter on CT, and localization of the appendix (data was not presented).

The correlation of the length of hospital stay with age, sex, neutrophil or lymphocyte counts or NLR, CRP levels, appendix diameter with CT, appendix localization, and pathology reports is presented in Table 3. The length of hospital stay after appendectomy was correlated with appendix diameter measured with CT scan and pathologic reports. However, we observed no relationship between the length of hospital stay and age and sex, NLR, CRP levels, appendix diameter with ultrasonography and appendix localization.

Discussion

Early diagnosis of acute appendicitis is rather confusing, and failure in early diagnosis may lead to morbidity and mortality. The primary goal should be accurate and early diagnosis of appendicitis. However, there is no specific laboratory test to diagnose acute appendicitis accurately. Leukocyte and neutrophil counts are commonly used in the diagnosis of acute appendicitis, but their specificity and sensitivity rates are poor.[8] Recently, NLR was reported to be a significant predictor of inflammation and presented as useful in the preoperative diagnosis of acute appendicitis.[9] NLR was found to be significantly higher in patients with acute appendicitis compared with those without acute appendicitis.[8,10,11] NLR was also found to be significantly elevated in patients with complicated appendicitis compared with those with uncomplicated appendicitis.[7,12] The present study aimed to investigate the relationship between NLR, preoperative appendix diameter on CT scan, and histopathologic findings with the length of hospital stay in appendectomy patients. Our results indicated that NLR was not associated with the length of hospital stay. However, increased appendix diameter on CT scan preoperatively and histopathologic findings were directly related to the length of hospital stay after appendectomy.

Gohil *et al*[13] reported an association between NLR and prolonged hospital stay following colorectal cancer surgery. Similarly, Lee *et al*[14] have reported the utility of NLR in predicting severe cholecystitis, as higher NLR was found to be related to prolonged length of stay in the hospital. The lack of correlation between NLR and length of hospital stay in the present study may have resulted from the exclusion of the patients with chronic diseases since chronic diseases have been previously associated to significant elevation of inflammation markers.[15] However, our findings make this a pioneer study since there is no comprehensive study yet evaluating the relationship between NLR levels and length of stay in the hospital in the patients with acute appendicitis. We suggest that a prospective rather than a retrospec-

tive study, which will be designed to clarify this potential correlation, may provide more eligible data and better functional outcomes.

CT scans have been introduced as a valuable diagnostic test in acute appendicitis. It has been reported that CT scans in patients with suspected appendicitis decrease negative appendectomy rates.[16–18] In the present study, we observed that appendix diameter demonstrated via CT scan is related to the length of hospital stay. No similar data were found in the literature.

Pathologic reports of the patients included in this study demonstrated that the length of hospital stay is significantly increased in the patients with complicated appendicitis in accordance with the data reported in previous studies.[6,19,20]

Conclusion

The present study suggests that NLR is not associated with the length of hospital stay after appendectomy while appendix diameter demonstrated via CT scan is correlated with the length of hospital stay. Study results also showed that the length of hospital stay is significantly extended in complicated appendicitis. However, prospective and comprehensive studies are needed to expose the deterministic role of NLR in acute appendicitis.

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