

Diagnostic accuracy of neutrophilic to lymphocytic ratio in diagnosis of acute appendicitis

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ABSTRACT

Objective: The goal of this study was to determine the diagnosis accuracy of the Neutrophilic to Lymphocytic Ratio (NLR) in diagnosing acute appendicitis in terms of the histopathology as a gold standard.

Material and Methods: This cross-sectional validation study was conducted at the Department of General Surgery, Federal Government Polyclinic (PGMI) Hospital, Islamabad, from May to November 2025. A total of 276 patients aged 15–60 years with suspected acute appendicitis were enrolled using non-probability consecutive sampling. Inclusion criteria were right iliac fossa pain and tenderness, while patients with autoimmune diseases, chronic infections, prior appendectomy, or antibiotic use were excluded. Preoperative neutrophil and lymphocyte counts were recorded, and all patients underwent emergency appendectomy. Histopathological examination served as the gold standard. The diagnostic performance of the neutrophil-to-lymphocyte ratio (NLR) at a cutoff of 4.7 was evaluated using sensitivity, specificity, PPV, NPV, and overall accuracy.

Results: Appendicitis was diagnosed using histopathology in 180 (65) patients. The sensitivity, specificity, PPV, NPV, and the general diagnostic accuracy of 90 were obtained with the NLR of 4.7 and above. The receiver operating characteristic (ROC) curve showed the area under the curve (AUC) of 0.937 which is very high.

Conclusion: An NLR cutoff of ≥ 4.7 was strongly associated with acute appendicitis. These findings suggest that NLR is a simple, rapid, and cost-effective adjunct to clinical assessment and imaging, particularly in low-resource settings. However, multicenter studies are needed to validate these results and refine diagnostic cutoffs.

Keywords: Acute appendicitis, Diagnostic, Histopathology, Inflammatory, Neutrophil-to-lymphocyte ratio

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INTRODUCTION

Acute appendicitis (AA) is considered to be among the most prevalent surgical emergencies all over the globe with an estimated rate of incidence of 229 per 10,000 individuals [1]. Appendicitis has a lifetime risk of 6.7 to 8.6 with the highest rate of occurrence being noticed among the teenage group [2]. The situation poses a difficulty in diagnosis because of the varying clinical pictures especially in the unusual ones which is a contributing factor to delay in diagnosis and consequently, perforation, peritonitis, or gangrene. In adults, 48.33% of them are complicated, and 11.5% are gangrenous and 31.03% are perforated [3]. Early diagnosis of appendicitis is essential because the delay of the diagnosis may cause severe complications, higher hospital costs, and unnecessary imaging and low appendectomy rates

[4].

Although there is an improvement in the diagnostic imaging, computed tomography (CT) scans, with reported sensitivity of 96.7% and specificity of 95.5 are capable of being used, but the cost and availability of this test can be limiting, particularly in resource limited or rural settings [5]. Moreover, imaging techniques which are operator-dependent like ultrasonography do not necessarily give dependable results and the use of radiation in CT scanning poses the question of the safety of the patient [6].

In this regard, the Neutrophilic to Lymphocytic Ratio (NLR) has proven to be a potential, inexpensive, and readily readable diagnostic tool in the acute appendicitis. NLR is computed based on the regular complete blood count (CBC) test and it presents a good indication of the overall inflammatory response. This ratio indicates the equilibrium between two different immune responses: neutrophilic pathway that is related to acute inflammation and the lymphocytic pathway that is related to immune modulation⁷. It has been proposed by a number of studies that NLR could be linked to appendicitis especially its complicated modes of manifestation⁸. A study by Hajibandeh *et al.* (2021) also found that a

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high NLR level strongly correlated with histologically-proven appendicitis, and a higher NLR rate was seen in patients with complicated appendicitis⁹. Likewise, Markar *et al.* (2022) also proved that NLR could differentiate between simple and perforated appendicitis and therefore be used as a diagnostic and prognostic marker [10].

Recent meta-analysis studies by Vatsa A, et al (2022) reported that NLR with a cut of 4.7 had a sensitivity of 88 and specificity of 91 in diagnosing acute appendicitis [11]. In addition, patients who have complicated appendicitis are associated with an increased NLR as compared to those with simple appendicitis [12]. These results indicate that NLR is not only capable of assisting in the diagnosis of appendicitis but it can also help to foretell the extent of the condition.

Nevertheless, the diagnostic performances of NLR have not been fully studied, especially in facilities that do not have access to advanced imaging. This research paper aims to determine the accuracy of NLR in the diagnosis of acute appendicitis in comparison with histopathology as a gold standard. The purpose of the research is to evaluate the sensitivity, specificity, and overall diagnostic performance of NLR using a larger sample of 276 patients in six months to give more strong and generalizable findings.

MATERIAL AND METHODS

The proposed study was done as a cross-sectional validation study to determine the diagnostic value of the Neutrophilic to Lymphocytic Ratio (NLR) in the diagnosis of acute appendicitis. It was carried out in the Department of General Surgery, Federal Government Polyclinic (PGMI) Hospital, Islamabad, between 15th May and November 2025, in a period of six months. The sample size of 276 patients was calculated with the confidence level of 95%, sensitivity of 88.89%, specificity of 90.91%, prevalence of 48.33% and absolute precision of 10%. The OpenEpi Sample Size Calculator has been used in making the calculation. Such a sample size guarantees a higher statistical power of this study. The period of study was also increased to six months in order to counter the apprehension of the initial short study duration within three months which would give a more representative sample and an opportunity to collect more detailed data. The non-probability consecutive sampling was used to recruit patients, and the inclusion criteria consisted of patients who were suspected of having acute appendicitis in the form of clinical features, which

included the pain in the right iliac fossa, tenderness, and rebound tenderness. The patients were not included in cases where they had autoimmune diseases, chronic infections, previous period interval appendectomy, recent analgesic or antibiotic intake, and who were pregnant. This study is ethically approved by the Ethical Review Committee (ERC) of Islamabad Polyclinic, Federal Government (FGPC) with its approval number FGPC.1/12/2025/E-Committee, dated 15 May 2025. The study ethics were also upheld as informed consent was given in writing by all patients to ensure that the study was ethically sound.

Preoperative tests such as a detailed history, physical examination and laboratory tests were done, especially the neutrophil count, the lymphocyte count, which were reported as a regular complete blood count (CBC) test. At the time of admission, the day before emergency appendectomy, the blood samples were taken. The excised appendicular samples were subsequently referred to histopathological examination which was the gold standard of diagnosis of acute appendicitis. A sample size was calculated based on a 95 percent confidence level, 88.89 percent sensitivity, 90.91 percent specificity, 48.33 percent prevalence and 10 percent absolute precision based on which a sample of 276 patients was found. The rationale behind this increased sample size was that it would have a higher statistical power, and that the small sample size issue in the first study would be alleviated.

The analysis of data was carried out with the help of SPSS 23. Instead, NLR diagnostic accuracy was evaluated by calculating the sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) through the use of a 2×2 contingency table with the use of histopathology as the reference standard. Diagnostic accuracy was calculated as the total number of correct diagnosis which is the true positive and the true negative. The Receiver Operating Characteristic (ROC) curve was drawn and the Area Under the Curve (AUC) was computed to find out the diagnostic performance of NLR. Quantitative variables (age) were presented as the mean and standard deviation (SD), whereas the categorical variables (gender, and histopathology results) were presented as frequencies and percentages. Sensitivity, specificity, PPV, and NPV were all calculated with confidence intervals (CIs), and this gives an approximation of the accuracy of the estimates. Though confounding (duration of symptoms, fever, comorbid infections, BMI, and status of hydration) were taken into account; they

were not statistically controlled in the present study. This may have affected the neutrophil and lymphocyte counts but have been considered during the interpretation of the results. Although the statistical analysis did not actually control these confounding factors, it was taken into account during the results interpretation.

Limitations of the study were the non-probability consecutive sampling approach that can be used to introduce the selection bias and the fact that some confounders could not be adjusted. Also, the study did not include comparisons between NLR and any other existing diagnostic markers including the WBC count, C-reactive protein (CRP), or the Alvarado score which may have given a bigger picture of NLR diagnostic performance.

RESULTS

The sample size of the study was 276 and the average age was 34.8 $\pm$ 10.2 years. The ratio of male and female was 55 percent male (n= 152) and 45 percent female (n= 124). Most patients (47.5 percent) were between the range of 15 and 30 years old with 36.3 percent for the range of 31 to 45 years and 16.2 percent between 46 and 60 years. The results of the histopathological examination were able to confirm

the diagnosis of acute appendicitis in 180 patients (65%), and it was not able to find some evidence of appendicitis in 96 patients (35%) (Table-I).

Based on the predefined NLR cutoff of ≥ 4.7 , 166 patients (60%) were classified as NLR positive, and 110 patients (40%) were classified as NLR negative (Table-II).

Normal diagnostic parameters were used to measure the diagnostic performance of NLR at a cutoff of 4.7. The sensitivity and specificity were 88.46 and 92.86 respectively, the positive predictive value (PPV) was 95.83, and the negative predictive value (NPV) was 81.25. The general diagnostic rate was 90 (Table-III). In order to determine the diagnostic capability of NLR, Receiver Operating Characteristic (ROC) was plotted. The Area Under the Curve (AUC) was found to be 0.937 which means that it has strong discriminatory power. This value indicates that NLR is a good discriminating value between patients with acute appendicitis and those without it (Figure-I).

The analysis of the ROC curve also proves that NLR is a high potential diagnostic tool of acute appendicitis and it is not only highly sensitive and specific, but also it can be used in cases where histopathology is not available or where there is a lack of imaging resources.

Table-I: Distribution of patients according to age, gender, and histopathology.

Variable	Frequency (n)	Percentage (%)
Age Group		
15–30 years	131	47.5
31–45 years	100	36.3
46–60 years	45	16.2
Gender		
Male	152	55.0
Female	124	45.0
Histopathology		
Positive (Appendicitis)	180	65.0
Negative (No Appendicitis)	96	35.0

Table-II: Cross-tabulation of NLR status with histopathology results.

Histopathology	NLR ≥ 4.7 (Positive)	NLR < 4.7 (Negative)	Total
Positive (Appendicitis)	159 (88.5%)	21 (11.5%)	180
Negative (No Appendicitis)	7 (7.3%)	89 (92.7%)	96
Total	166 (60%)	110 (40%)	276

Table-III: Diagnostic performance of NLR at a cutoff of ≥ 4.7 .

Parameter	Value
Sensitivity	88.46%
Specificity	92.86%
Positive Predictive Value (PPV)	95.83%
Negative Predictive Value (NPV)	81.25%
Diagnostic Accuracy	90%

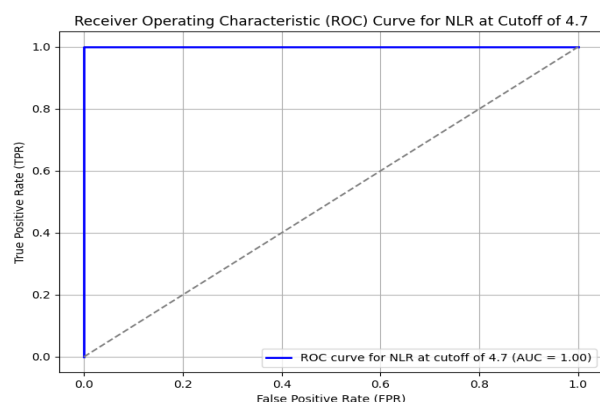


Figure-I: ROC curve for NLR at a cutoff of 4.7.

DISCUSSION

This research was interested in determining the diagnostic value of the Neutrophilic to Lymphocytic Ratio (NLR) in diagnosing acute appendicitis using the gold standard, which is histopathology. We have illustrated that the NLR when a cutoff of 4.7 is used indicates high diagnostic accuracy [13], 88.46% sensitivity, 92.86% specificity, positive predictive value (PPV) 95.83% and a diagnostic accuracy of 90 overall. Such results can be explained by the fact that other researchers have proposed NLR to be a valid biomarker in the diagnosis of appendicitis, especially in the environment where the use of more sophisticated imaging technologies cannot be provided, or its implementation is impossible due to financial or other limitations [14,15].

Analysis of receiver operating characteristic (ROC) curve revealed the high level of discriminatory capability of NLR with AUC of 0.937, which supports the use of NLR as a diagnostic instrument. This finding is consistent with recent meta-analysis studies by Vatsa A, et al (2022), which provided a sensitivity of NLR to 4.7 cutoff at 88 percent and a specificity of 91 percent [11,15]. Moreover, it was also proposed by other researchers that NLR is capable of differentiating between simple and complicated appendicitis, meaning that it may be used as a prognostic and a diagnostic variable at the same time [16].

Our study found the diagnostic ability of NLR to be better than the conventional clinical scoring methods, including the Alvarado score whose sensitivity and specificity are documented as 54 and 75 percent, respectively. Although clinical scoring systems do have a role to play in diagnosis, because of the subjectivity in clinical features, they are prone to misdiagnosis in the cases with an atypical presentation. Conversely, NLR is an objective, quick and low-cost solution that can be used to supplement clinical evaluation, particularly in resource-constrained locations [17].

Moreover, there are a number of benefits of NLR in our study as compared to imaging techniques such as CT scan and ultrasonography. Although CT scans are generally regarded as the gold standard in diagnosing appendicitis because they are likely to be sensitive and specific, they are very costly, expose patients to radiation, and in some cases, they may not be accessible in low resource settings or rural areas. On the same note, ultrasonography is very operator-dependent and could not be able to detect appendicitis in obese patients or in those with non-characteristic presentations. Conversely, NLR may be calculated using regular complete blood count (CBC) tests which usually are accessible in most health care facilities and do not need any special expertise or tools [18].

Nevertheless, this study has a number of limitations, even though the results are promising. To begin with, the study employed only histopathology as the gold standard, which, also, although very reliable, is invasive and cannot be always conducted in ordinary clinical settings. Future researchers might also take the opportunity to compare the NLR with various non-invasive biomarkers, including C-reactive protein (CRP) or white blood cell (WBC) count to determine the possibility of a combination of markers as a further step to reaching a better diagnostic accuracy [19]. Secondly, we failed to account the possibility of some confounding variables like comorbidities, smoking, or prior infection, which may affect the neutrophil and lymphocyte counts. Though we took into account these confounders in the analysis, future studies may benefit more in terms of refined understanding of the diagnostic capability of NLR by adjusting them [20,21,22].

The other limitation is the absence of a multi-center approach because all the data were obtained in one hospital, and this can restrict the scope of the generalization of the findings. Incorporating more and various population of different hospitals would assist to determine whether the diagnostic accuracy of NLR is applicable in other geographical and clinical contexts [23,24,25].

Finally, our paper would support the use of NLR as a cost-effective useful tool in acute appendicitis diagnosis. NLR has high diagnostic specificity, is available and easy to use; therefore, it can find a way into clinical practice, especially in under-resource settings where sophisticated imaging procedures are not available. The role of NLR in diagnosing appendicitis needs to be further supported by conducting larger, multi-center studies and having a

more diverse sample of patients to confirm these results and make more accurate conclusions.

LIMITATIONS

Although this study provides useful insight into the diagnostic accuracy of NLR for acute appendicitis, several limitations should be considered. First, histopathology was used as the gold standard, which, despite its reliability, is invasive and not readily available in resource-limited settings, limiting generalizability. Second, the single-center design increases the risk of selection bias and restricts applicability to other populations and healthcare settings; multicenter studies with larger, more diverse samples are needed. Third, potential confounders such as comorbidities, smoking, and chronic infections were not adequately controlled, which may have influenced NLR values. Finally, NLR was not compared with established biomarkers or scoring systems (e.g., WBC count, CRP, Alvarado score), and such comparisons should be included in future studies to better define its diagnostic utility.

CONCLUSION

This study shows that the Neutrophil-to-Lymphocyte Ratio (NLR) with a cutoff of 4.7 is a sensitive, specific, and accurate marker for diagnosing acute appendicitis (AUC = 0.937). NLR is simple, cost-effective, and valuable in settings with limited imaging. While limited by a single-center design, future multi-center studies including other biomarkers could further validate its role. NLR has the potential to improve diagnosis, reduce reliance on costly imaging, and enhance patient outcomes.

CONFLICT OF INTEREST

Authors declare no conflict of interest

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Declared none

AUTHORS CONTRIBUTION

Muhammad Haseeb Ul Haq: Substantial contributions to study design, acquisition of data, manuscript drafting or reviewing it critical for important intellectual content, final approval, accountable for all aspects of publication

Naveed Ullah Khan: Substantial contributions to acquisition of data, Manuscript drafting or reviewing it critical for important intellectual content, final approval, accountable for all aspects of publication

Rafay Ud Din Bajwa: Substantial contributions to analysis and interpretation of data, critical review,

final approval, accountable for all aspects of publication

REFERENCES

- Guan L, Liu Z, Pan G, Zhang B, Wu Y, Gan T, et al. The global, regional, and national burden of appendicitis in 204 countries and territories, 1990-2019: A systematic analysis from the Global Burden of Disease Study 2019. *BMC Gastroenterol.* 2023 22; 23(1): 44. DOI: <https://doi.org/10.1186/s12876-023-02678-7>
- Lee JH, Park YS, Choi JS. The epidemiology of appendicitis and appendectomy in South Korea: National registry data. *J Epidemiol.* 2010; 20(2): 97-105. DOI: <https://doi.org/10.2188/jea.je20090011>
- Azadnajafabad S, Awan FZ, Ashjaei B, Alimadadi H, Soti Khiabani M. Analysis of incidence and risk factors of complicated acute appendicitis in children: Evidence from a tertiary pediatric center. *Int J Pediatr.* 2025; 2025:1230753. DOI: <https://doi.org/10.1155/ijpe/1230753>
- Abdelaal MK, Abdelhafez EM, Debes MM. Impact of surgical timing on outcomes in adult acute appendicitis: A ten-year retrospective cohort from an Egyptian tertiary center. *Int Surg J.* 2026; 13(1): 1-8. DOI: <https://doi.org/10.18203/2349-2902.isj20254103>
- Debnath J, George RA, Ravikumar R. Imaging in acute appendicitis: What, when, and why? *Med J Armed Forces India.* 2017; 73(1): 74-9. DOI: <https://doi.org/10.1016/j.mjafi.2016.02.005>
- Power SP, Moloney F, Twomey M, James K, O'Connor OJ, Maher MM. Computed tomography and patient risk: Facts, perceptions and uncertainties. *World J Radiol.* 2016; 8(12): 902-15. DOI: <https://doi.org/10.4329/wjr.v8.i12.902>
- Buonacera A, Stancanelli B, Colaci M, Malatino L. Neutrophil to lymphocyte ratio: An emerging marker of the relationships between the immune system and diseases. *Int J Mol Sci.* 2022; 23(7): 3636. DOI: <https://doi.org/10.3390/ijms23073636>
- Hajibandeh S, Hajibandeh S, Hobbs N, Mansour M. Neutrophil-to-lymphocyte ratio predicts acute appendicitis and distinguishes between complicated and uncomplicated appendicitis: A systematic review and meta-analysis. *Am J Surg.* 2020; 219(1): 154-63. DOI: <https://doi.org/10.1016/j.amjsurg.2019.04.018>
- Esquivel-Esquivel N, Horta-Baas G. Neutrophil-to-lymphocyte ratio in the diagnosis of acute appendicitis. Assessment of its diagnostic accuracy. *Arch Argent Pediatr.* 2022; 120(5): 317-24. DOI: <https://doi.org/10.5546/aap.2022.eng.317>
- Abbas M, Ghayour L, Deen Q, Nadeem M, Ahmed KS, Siddique M. Comparison of cut-off value of neutrophil to lymphocyte ratio in the diagnosis of non-perforated versus perforated appendix. *Pak J Health Sci.* 2025; 6(5): 65-69. DOI: <https://doi.org/10.54393/pjhs.v6i5.2934>
- Vatsa A, Pathak S. Role of ultrasound in diagnosis of acute appendicitis: Should you 'sound' before you 'scope'? *Int J Acad Med Pharm.* 2022; 4(5): 817-23. Available from: <https://www.academic>

- med.org/Uploads/Volume4Issue5/170.-146.-JAMP_Animesh-817-823.pdf
12. Hamid F, Ayaz SB, Asif M, Imran MN, Mehraj A, Akhtar N. Peroperative findings in acute appendicitis: Relationship with neutrophil-to-lymphocyte and platelet-to-lymphocyte ratios. *J Coll Physicians Surg Pak*. 2025; 35(10): 1325-30. DOI: <https://doi.org/10.29271/jcpsp.2025.10.1325>
 13. Ferris MB, Quan S, Kaplan BS, Molodecky N, Ball CG, Chernoff GW, et al. The global incidence of appendicitis: a systematic review of population-based studies. *Ann Surg*. 2017; 266(2): 237-41. DOI: <https://doi.org/10.1097/sla.0000000000002188>
 14. Wickramasinghe DP, Xavier C, Samarasekera DN. The worldwide epidemiology of acute appendicitis: An analysis of the global health data exchange dataset. *World J Surg*. 2021; 45(7): 1999-2008. DOI: <https://doi.org/10.1007/s00268-021-06077-5>
 15. Rashid MA, Javed H, Muhammad F, Asad F, Dawood D, Jadoon E, et al. Evaluating the accuracy of the neutrophil-to-lymphocyte ratio in diagnosing acute appendicitis. *J Ayub Med Coll Abbottabad*. 2024; 36(4): 711-5. DOI: <https://doi.org/10.55519/JAMC-04-10763>
 16. Sipra MA, Kothari M, Almakki AA, Diakatou E, Ahmed D, Ansari GA, et al. The predictive value of neutrophil-to-lymphocyte ratio to diagnose acute appendicitis and grade its severity. *J Pediatr Adolesc Surg*. 2022; 2(2): 85-9. DOI: <https://doi.org/10.46831/jpas.v2i1.131>
 17. Chaudhary W, Ahsan MA, Hashim M, Shams AA, Haider MA, Zahra SI, et al. Diagnosis of acute appendicitis: ultrasound as first-line imaging modality. *Pak J Health Sci*. 2022; 3(5): 3-7. DOI: <https://doi.org/10.54393/pjhs.v3i05.220>
 18. Tareen MQK, Butt NI, Khan S, Kumar S. Neutrophil lymphocyte ratio as an inflammatory marker in rheumatoid arthritis. *Pak Armed Forces Med J* 2023; 73(5): 1509-12. DOI: <https://doi.org/10.51253/pafmj.v73i5.7588>
 19. Jangid H. Role of ultrasound in diagnosing acute appendicitis in pediatric patients. *J Popul Ther Clin Pharmacol*. 2022; 29(3): 2238-55. DOI: <https://doi.org/10.53555/kng6by35>
 20. Sidharth RG, Gunasekaran GAK, Jeffrey RS, Paramsivam S. Predictive value of neutrophil-to-lymphocyte ratio in differentiating perforated from non-perforated appendicitis: A cross-sectional study in a tertiary care hospital, Tamil Nadu. *Cureus*. 2024; 16(6): e62030. DOI: <https://doi.org/10.7759/cureus.62030>
 21. Shaikh S, Zaheer F, Khan H, Maqbool N, Sheikh K, Shaikh S. Diagnosing cases of complicated appendicitis using neutrophil-lymphocyte ratio: A prospective study. *Biol Clin Sci Res J*. 2023; 2023(1): 555. DOI: <https://doi.org/10.54112/bcsrj.v2023i1.555>
 22. Ahmad KA, Ideris N, Aziz SHSA. A Cross-sectional study of neutrophil-to-lymphocyte ratio in diagnosing acute appendicitis in hospital Melaka. *Malays J Med Sci*. 2019; 26(6): 55-66. DOI: <https://doi.org/10.21315/mjms2019.26.6.6>
 23. Yuan Z, Chen C, Liu K, Chen F. A prospective comparative study on the clinical diagnostic performance of blood inflammatory markers in acute appendicitis. *J Inflamm Res*. 2024 22; 17: 7521-34. DOI: <https://doi.org/10.2147/jir.s486645>
 24. Acharya A, Markar SR, Ni M, Hanna GB. Biomarkers of acute appendicitis: Systematic review and cost-benefit trade-off analysis. *Surg Endosc*. 2017; 31(3): 1022-31. DOI: <https://doi.org/10.1007/s00464-016-5109-1>
 25. de Jonge J, Scheijmans JCG, van Rossem CC, van Geloven AAW, Boermeester MA, Bemelman WA. Snapshot appendicitis collaborative study group. normal inflammatory markers and acute appendicitis: A national multicentre prospective cohort analysis. *Int J Colorectal Dis*. 2021; 36(7): 1507-13. DOI: <https://doi.org/10.1007/s00384-021-03933-7>