

Prognosis and Treatment Selection in Appendicitis: Insights from Alvarado Score, Appendicitis Inflammatory Response Score, NLR and PLR

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ABSTRACT:

Appendicitis ranks among the leading causes of acute abdominal pain in both adults and children. Scoring systems like the Alvarado score, while established and validated, have drawbacks that newer systems like the AIR score aim to overcome. The aim of the study is to investigate if certain predictive markers can be helpful in identifying appendicitis early and guiding the selection of appropriate treatments. The Retrospective study conducted in Tamil Nadu for 6 months. The study include 206 patients with acute appendicitis. Statistical analysis was conducted using IBM's SPSS. The research involved a male majority (54.37%) with all patients displaying right lower quadrant tenderness. Most cases (77.67%) opted for laparoscopic appendicitis surgeries. Notably, there was a marked NLR ratio difference between laparoscopy and laparotomy patients, favoring higher NLR ratios. Alvarado scores varied significantly across different appendicitis inflammatory response levels. The study highlighted a strong positive correlation between NLR and PLR ratios, as well as with appendicitis inflammatory response scores. It also indicated a positive association between variables, suggesting a trend towards higher values in one corresponding to higher values in the other. This study concluded that a significant association among the Alvarado score, Appendicitis Inflammatory Response (AIR) score, Neutrophil-to-Lymphocyte Ratio (NLR), and Platelet-to-Lymphocyte Ratio (PLR) in patients with acute appendicitis.

KEYWORDS: Acute Appendicitis, Alvarado Score, Appendicitis Inflammatory Response Score, Neutrophil-To-Lymphocyte Ratio And Platelet-To-Lymphocyte Ratio

I. INTRODUCTION

Appendicitis is a condition in which the appendix becomes inflamed and filled with pus and

causes severe pain and it is an inflammation of the vermiform appendix.¹ The appendix is a small finger-shaped pouch that projects out from your colon on the lower right side of your abdomen. Appendicitis is described as the inflammation of the vermiform appendix that may result in necrosis and perforation. Obstruction, inflammation, or infection can cause the appendix to rupture leading to peritonitis.² This condition usually requires surgery as medical management due to the fact that acute appendicitis can often be life threatening. Appendicitis is the leading cause of emergency abdominal surgeries. Approximately 40 % of people do not have these typical symptoms. Severe complications of a ruptured appendix include widespread, painful inflammation of the inner lining of the abdominal wall and sepsis . There is no known cause for appendicitis . New scoring models and enhanced imaging in computed tomography permit accurate diagnosis of appendicitis and its manifestations in most patients.³ There are two types, Acute appendicitis and Chronic appendicitis.

EPIDEMIOLOGY

Appendicitis is a global disease. The incidence of appendicitis is stable in most Western countries. Data from newly industrialized countries is sparse, but suggests that appendicitis is rising rapidly. Appendicitis occurs most often between the ages of 5 and 45, with a mean age of 28. The incidence is approximately 233/per 100,000 people, prevalence rate is 2-7% in Tamil Nadu.⁹ Males have a slightly higher predisposition to developing acute appendicitis than females, with a lifetime incidence of 8.6% and 6.7% for men, and women, respectively. Approximately 300,000 hospital visits yearly in the United States for appendicitis-related issues. The incidence of acute appendicitis has been declining steadily since the late 1940s, and the

current annual incidence is 10 cases per 100,000 population.^{10,11}

TYPES:

- ACUTE APPENDICITIS
- CHRONIC APPENDICITIS

ACUTE APPENDICITIS:

It develops very fast within a few days to hours and requires prompt medical treatment or surgery. Acute appendicitis (AA) is a common cause of abdominal pain and one of the most frequent surgical conditions in emergency, which can turn into perforation and peritonitis. The clinical diagnosis of AA is often challenging and involves a synthesis of clinical, laboratory, and radio-logical findings. The diagnostic workup could be improved by using clinical scoring systems that involve physical examination findings and inflammatory markers.¹³ The role of diagnostic imaging, such as ultrasound (US), computed tomography (CT), or magnetic resonance imaging (MRI), is another major controversy

CHRONIC APPENDICITIS:

The inflammation lasts for a long time. It is a rare condition, the exact pathophysiology of chronic appendicitis is less understood, traditionally it has been defined as a long-standing inflammation or fibrosis displayed as right lower quadrant (RLQ) pain for more than 48 hours, or intermittent in nature. Patients with chronic appendicitis may present with recurring RLQ abdominal pain unrelated to any febrile infection, or with self-limiting pain that resolves on its own.¹⁴ It is characterized by a less severe and almost continuous abdominal pain. It has a clinical picture lasting longer than 1-2 days and extending over weeks, months, even years. The exact etiology of CA is unclear. Certain resources have reported it as the cause of partial obstruction in the lumen of the appendix.

CLINICAL PRESENTATIONS SYMPTOMS

- Peri umbilical pain
- Pain shift to right iliac fossa
- Anorexia
- Nausea and vomiting

MURPHYS TRIAD

- Pain
- Vomiting
- Temperature

COMMON SYMPTOMS

- Pain in abdomen

- Loss of appetite
- Nausea
- Vomiting
- Migrating pain

SIGN OF APPENDICITIS

- Pyrexia
- Localized tenderness in right iliac fossa
- Muscle guarding
- Rebound tenderness²⁰

PATHOPHYSIOLOGY:

Appendicitis is most often caused by an obstruction of the appendices orifice. The underlying etiology of the blockage may differ between age groups. While lymphoid hyperplasia is necessary, it causes inflammation, localized ischemia, perforation, and the formation of a confined abscess or frank perforation with peritonitis. Lymphoid hyperplasia, parasite infections, fecaliths, or benign or malignant tumors can all cause this blockage. When a blockage causes appendicitis, the intraluminal and intramural pressures rise, resulting in small vessel occlusion and lymphatic stasis. When the appendix gets blocked, it fills with mucus and becomes swollen, and as lymphatic and vascular damage progresses, the appendix wall becomes ischemic and necrotic. Bacterial overgrowth then develops in the obstructed appendix, with aerobic organisms predominating early in the course and mixed aerobes and anaerobes later on. *Escherichia coli*, *Staphylococcus*, *Bacteroides*, and *Pseudomonas* are examples of common organisms. When there is substantial inflammation and necrosis, the appendix is at danger of perforation, resulting in a localized abscess and, in some cases, frank peritonitis. The most common position of the appendix is retrocecal. While the anatomical position of the root of the appendix is mostly constant, tail positions can vary. Possible positions include retro cecal, sub cecal, pre-and post-ileal, and pelvic.²⁴

DIAGNOSIS:

To help diagnose appendicitis, your doctor will likely take a history of your signs and symptoms and examine your abdomen.

Tests and procedures used to diagnose appendicitis include:

Physical exam to assess your pain. Your doctor may apply gentle pressure on the painful area. When the pressure is suddenly released,

appendicitis pain will often feel worse, signaling that the adjacent peritoneum is inflamed.

Your doctor may also look for abdominal rigidity and a tendency for you to stiffen your abdominal muscles in response to pressure over the inflamed appendix (guarding).

Your doctor may use a lubricated, gloved finger to examine your lower rectum (digital rectal exam). Women of childbearing age may be given a pelvic exam to check for possible gynaecological problems that could be causing the pain.

Blood test. This allows your doctor to check for a high white blood cell count, which may indicate an infection.

Urine test. Your doctor may want you to have a urinalysis to make sure that a urinary tract infection or a kidney stone isn't causing your pain.

Imaging tests. Your doctor may also recommend an abdominal X-ray, an abdominal ultrasound, computerized tomography (CT) scan or magnetic resonance imaging (MRI) to help confirm appendicitis or find other causes for your pain.^{25,26}

SCORING DIAGNOSIS:

- Alvarado score
- Appendicitis inflammatory response.

NEED OF THE STUDY:

- List out the clinical presentations associated with acute appendicitis
- Categorize patients into two groups based surgical approach underwent.
- Application of alvarado scoring system, Appendicitis inflammatory response scoring system and NLR/PLR among two study groups
- Correlation of alvarado scoring system with appendicitis inflammatory response scoring system
- Correlating the scoring systems with NLR/PLR among two study groups
- To list out the complications associated with surgical procedure of appendicitis.

METHODOLOGY:

STUDY DESIGN: The retrospective study.

STUDY SITE: Sudha Institute Of Medical Sciences In Erode, Tamil Nadu.

STUDY PERIOD: The study was performed for period of six months.

STUDY POPULATION: Acute appendicitis patients.

SAMPLE SIZE: 206

STUDY CRITERIA:

INCLUSION CRITERIA

- Patients with confirmed diagnosis of appendicitis
- Patients with suggestive reports of surgical procedure.
- Patients with complete laboratory data.

EXCLUSION CRITERIA

- Patients with other underlying inflammatory conditions like viral hepatitis, chronic liver disease, thrombolytic disease.
- Pregnancy population
- Patients aged under 5 years were excluded, due to important physiological differences in the leukocyte count.

STATISTICAL ANALYSIS:

SPSS (Statistical package for social sciences), IBM(International Business Machines) was used to carry out the statistical analysis. The comparison between two study groups were employed by using chi-square test and correlation between the scoring system including Alvarado score, AIR, NLR and PLR was employed using spearman correlation coefficient.

PLAN OF THE STUDY:

The entire study was planned to be carried out for a period of 6 months. The proposed study was designed in following phases to achieve the objectives.

PHASE I

- ❖ Preparation of protocol.
- ❖ Identify the need of the study.
- ❖ Literature survey on basis of the study.

PHASE II

- ❖ Designing the Proforma
- ❖ Selection and sample size determination
- ❖ Collection of patient details (patient case history, diagnosis, lab reports, medication order sheets).

PHASE III

- ❖ Data entry to Microsoft excel and Graph Pad prism (statistical graphing software)
- ❖ Data analysis
- ❖ Conclusion and Documentation

PHASE IV

- ❖ Data interpretation
- ❖ Conclusion and documentation
- ❖ Report writing.

II. RESULTS AND OBSERVATION

TABLE 1: AGE AND GENDER WISE DISTRIBUTION OF PATIENTS WITH ACUTE APPENDICITIS (n=206)

AGE	MALE (n=112)		FEMALE (n=94)	
	No. of patients	% of patients	No. of patients	% of patients
0-10	7	6.25	3	3.19
11-20	34	30.35	22	23.4
21-30	38	33.92	37	39.36
31-40	13	11.6	11	11.7
41-50	9	8.03	10	10.63
51-60	2	1.78	7	7.44
61-70	2	1.78	2	2.12
71-80	7	6.25	2	2.12
TOTAL	112	99.96	94	99.96

TABLE 2: DISTRIBUTION OF CLINICAL PRESENTATION OF ACUTE APPENDICITIS AMONG STUDY PARTICIPANTS

SYMPTOMS	NO. OF PATIENTS	% OF PATIENTS
Right lower quadrant tenderness	206	100
Elevated temperature(>99.1F)	110	53.3
Rebound tenderness	102	49.51
Anorexia	79	38.34
N/V	126	61.16
Migration of pain to right lower quadrant	100	48.54
Leukocytosis(>10,000 WBC)	194	94.17
Left shift (>75% neutrophils)	206	100

TABLE 3: DISTRIBUTION OF STUDY POPULATION WHO WERE UNDERGONE SURGICAL PROCEDURES

GENDER	LAPAROSCOPY		LAPAROTOMY	
	No of patients	% of patients	No of patients	% of patients
Male	87	54.37	25	54.34
Female	73	45.62	21	45.65
TOTAL	160	99.99	46	99.99

TABLE 4: ANALYSIS OF CLINICAL FEATURES BASED ON ALVARADO SCORE:

LEVEL	LAPAROSCOPY		LAPAROTOMY		P value
	No of patients	% of patients	No of patients	% of patients	
Compatible (<5)	9	5.625	3	6.5	<0.0001
Probable (5-7)	58	36.25	13	28.26	
Confirmed(>7)	93	58.125	30	65.21	
TOTAL	160	100	46	99.97	

*p value <0.05 considered as statistically significant

TABLE 5: ANALYSIS OF CLINICAL FEATURES BASED ON APPENDICITIS INFLAMMATORY RESPONSE SCORE

INTERPRETATION	LAPAROSCOPY(n=160)		LAPAROTOMY(n=46)		P value
	No.of. patients	% of patients	No.of. patients	% of patients	
Score 0-4	21	13.125	5	10.8	0.002
Score 5-8	119	74.37	26	56.52	
Score 9-12	20	12.5	15	32.6	
TOTAL	160	99.995	46	99.92	

TABLE 6: DISTRUBUTION OF PATIENTS ACCORDING TO THEIR NLR AND PLR DATA

S.N O	PARAMET ER	OBSERVATIO N	LAPAROSCO PY	LAPAROTOM Y	% OF PATIENT S	p value
1	NLR	Low	0	0	0	0.0001
		Normal	7	16	11.16	
		Increased	153	30	88.8	
2	PLR	Low	0	0	0	0.663
		Normal	99	25	60.19	
		Increased	61	21	39.8	

*p value <0.05 considered as statistically significant

TABLE 7: CORRELATION OF ALVARADO SCORE WITH APPENDICITIS INFLAMMATORY RESPONSE SCORE

Alvarado score	No .of patients with appendicitis inflammatory response score			Spearman correlation coefficient	P value
	0-4	5-8	9-12		
COMPATIBLE	12	0	0	+ 0.586	< 0.001
PROBABLE	14	57	0		
CONFIRMED	0	88	35		

*p value <0.05 considered as statistically significant

TABLE 8: CORRELATION OF ALVARADO SCORE WITH NLR AND PLR DATA

ALVARADO SCORE	NLR	Spearman correlation coefficient	Pvalue	PLR	Spearman correlation coefficient	p value
COMPATIBLE	2.806	+0.433	<0.001	109.29	+0.512	<0.001
PROBABLE	3.57			129.06		
CONFIRMED	6.45			168.57		

*p value <0.05 considered as statistically significant

TABLE 9: CORRELATION OF APPENDICITIS INFLAMMATORY RESPONSE SCORE WITH NLR AND PLR DATA

INTERPRETATION	NLR	Spearman correlation coefficient	p value	PLR	Spearman correlation coefficient	p value
Score 0-4	2.757	+0.444	<0.001	111.65	0.181	0.008
Score 5-8	5.17			155.21		
Score 9-12	6.147			158.551		

There is a direct positive correlation of appendicitis inflammatory response score and NLR data and PLR

TABLE 10: DISTRIBUTION OF PATIENT BASED ON DIAGNOSTIC METHOD EMPLOYED

IMPRESSION OF USG	NO. OF PATIENTS	% OF PATIENTS
Inflamed	24	17.77%
Inflammatory Change in Rif	59	43.70%
Perforation	52	38.50%
TOTAL	135	99.97%

TABLE 11: CORRELATION OF ALVARADO SCORE , APPENDICITIS INFLAMMATORY RESPONSE SCORE WITH DIAGNOSTIC METHOD EMPLOYED FOR APPENDICITIS

DIAGNOSTIC METHOD OF USG	ALVARADO SCORE			Spearman correlation coefficient	p value	INFLAMMATORY SCORE			Spearman correlation coefficient	p value
	<5	5-7	>7			0-4	5-8	9-12		
Inflamed	4	8	12	+0.331	<0.001	6	15	3	+0.441	<0.001
Inflammatory change in RIF	1	30	28			9	45	5		
Perforation	0	9	43			0	30	22		

Positive correlation - There is an association between two variables/ there is a tendency of higher values of one variable to be associated with higher values of the other

TABLE 12: AVERAGE LENGTH OF HOSPITAL STAY

NO.OF.DAYS	LAPAROSCOPY		LAPAROTOMY	
	NO.OF.PATIENTS	% OF PATIENTS	NO.OF.PATIENTS	% OF PATIENTS
1-2	19	11.87	0	0
3-4	126	78.75	12	26.08
5-6	15	9.37	14	30.43
7-8	0	0	5	10.86
9-10	0	0	10	21.73
11-12	0	0	5	10.86
TOTAL	160	99.99	46	99.96

The significant difference was analyzed by chi square test and the p value of <0.001.

TABLE 13 : POST OPERATIVE COMPLICATIONS AMONG STUDY POPULATION

COMPLICATIONS	LAPAROSCOPIC	LAPAROTOMY	p value
Pain	153	46	<0.001
Vomiting	124	34	
Wound infection	97	27	
Fever	72	24	

III. CONCLUSION

The current study revealed a significant association among the Alvarado score, Appendicitis Inflammatory Response (AIR) score, Neutrophil-to-Lymphocyte Ratio (NLR), and Platelet-to-Lymphocyte Ratio (PLR) in patients with acute appendicitis. This collective analysis suggests that these markers could be valuable in predicting the need for emergency treatment and guiding surgical interventions. Additionally, they may serve as primary supportive data for diagnosing acute appendicitis patients in situations where immediate access to ultrasound imaging details is not feasible.

LIMITATIONS:

Since this was a single centered study the findings may not be representative of those from multi centered studies. The study did not recruited patients on non-operative treatment as their complete laboratory data were not available.

FUTURE OF THE STUDY:

Comparison study on effectiveness of these scoring system in different clinical settings. Understanding patient preference and experience regarding treatment options of appendicitis and check whether these factors influence treatment decision making.

- [9]. Burlet K, Lam A, Larsen P, Dennett E. Acute abdominal pain-changes in the way we assess it over a decade. New Zealand Medicine Journal. 2017; 130(1463):3944. (<https://pubmed.ncbi.nlm.nih.gov/28981493/>)
- [10]. 8.Tamil Nadu, India. International Surgery Journal. 2017;4(3):929-931. (<https://www.ijurgery.com/index.php/isj/article/download/979/911/3219>)
- [11]. Charles S, Francis L, Appendicitis. Emergency Medicine Clinics of North America.1996;14(4):653-671.

REFERENCE:

- [1]. Nigel D, Karen N, Appendicitis. American Family Physician. 2016; 93(2): 142-143 (<https://www.aafp.org/pubs/afp/issues/2016/0115/p142.html>)
- [2]. Bom WJ, Scheijmans JCG, Salminen P, Boermeester MA. Diagnosis of Uncomplicated and Complicated Appendicitis in Adults. Scandinavian Journal of surgery.2021;110(2):170-179. (<https://www.ncbi.nlm.nih.gov/pmc/article/s/PMC8258714/>)
- [3]. Almeida L, Seo DJ, Gomez-E, et.al., Nonoperative vs Operative Management of Uncomplicated Acute Appendicitis: A Systematic Review and Meta-analysis. JAMA Surgery. 2022;157(9):828-834. (doi: 10.1001/jamasurg.2022.2937)
- [4]. Corfield, Justin, Appendicitis. Encyclopedia Britannica, 2023. (<https://www.britannica.com/biography/John-B-Murphy>)
- [5]. Teoule P, Laffolie J, Rolle U, Reissfelder C. Acute Appendicitis in Childhood and Adulthood. DeutschesArzteblatt International. 2020; 117(45):764-774. (doi: 10.3238/arztebl.2020.0764)
- [6]. Patterson JW, Kashyap S, Dominique E. Acute Abdomen. StatPearls. 2023; (<https://www.ncbi.nlm.nih.gov/books/NBK459328/>) ([https://doi.org/10.1016/S0733-8627\(05\)70273-X](https://doi.org/10.1016/S0733-8627(05)70273-X))
- [7]. Ellis H."Acute appendicitis". British Journal of Hospital Medicine. 2012; 73 (3):46-48. (doi:10.12968/hmed.2012.73.sup3.C46)
- [8]. Podda M, Gerardi C, Cillara N, et.al., Antibiotic Treatment and appendectomy for uncomplicated acute appendicitis in adults and children: A systematic Review and meta analysis. Annals of surgery, 2019; 270 (6): 1028-1040.



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- [14]. (<https://pubmed.ncbi.nlm.nih.gov/30720508/>)
- [15]. Kim J, Yang C, Joo HJ, et.al., Risks of complicated acute appendicitis in patients with psychiatric disorders. BMC Psychiatry. 2022; 22(1):763. (<https://pubmed.ncbi.nlm.nih.gov/36471298/>)
- [16]. Kanat BH, Solmaz OA, Bozdag P, et.al., Chronic appendicitis: the process from pre-diagnosis to pathology. European Review for Medical and Pharmacological Sciences. 2021; 25(24):7898-7902. (<https://pubmed.ncbi.nlm.nih.gov/34982452/>)
- [17]. Blohs M, Mahnert A, Brunnader K, et.al., Acute appendicitis manifests as two microbiome state types with oral pathogens influencing severity. Gut Microbes. 2023;15(1):2145845. (<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9879201/>)