

Correlation between Alvarado score and histopathology in appendicitis – A pilot study

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Abstract

Introduction: Alvarado scoring system is an easy, clinical tool in the preoperative evaluation of acute appendicitis. Many a times, the diagnosis is made by the clinical examination along with ultrasonography and computed tomography scan. Alvarado score (AS) supposedly improves the diagnostic accuracy and consequently reduces negative exploration.

Aims: The aim of this study was to explore the possibility of a correlation of preoperative Alvarado scoring with histological evidence.

Materials and Methods: This pilot study was carried out to evaluate histopathological (HP) correlation with AS, in 100 patients admitted in the department of surgery of a rural medical college. HP grades were first constructed, and then, the score was compared so as examine the correlation if any. A Histopathology report (HPR) grade of 5 was taken as normal appendix.

Results: In a sample size of 100, there were a maximum of 46 patients with AS score 5 and 6 and 44 patients with HP Grade 4. Using receiver operating characteristic curve, the cutoff for the score was 5 with a sensitivity of 58.24% and specificity of 33.33%. The negative appendectomy rate was 9%.

Conclusion: The AS score correlates poorly with the HP findings.

Keywords: Alvarado score, appendicitis, histopathology

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Submitted: 18-Jul-2021 **Accepted:** 17-Aug-2021 **Published:** 22-Dec-2021

INTRODUCTION

Acute appendicitis is probably the most common surgical emergency in almost all age groups. Appendicitis is a very common disease with a lifetime prevalence of 7%–8%. The clinical presentation of acute appendicitis may vary from a nonspecific vague abdominal pain to the classic presentation of right iliac fossa pain, tenderness, and rebound tenderness. Left untreated, appendicitis has the potential for severe complications, including perforation, sepsis, and even death. Early and accurate diagnosis is essential to prevent

morbidity and mortality related to appendicitis. In attempts to increase the diagnostic accuracy and reduce the high negative appendectomy rate, various scoring systems, imaging modalities, and novel techniques have been devised; however, most of these are complex, expensive, and difficult to implement in emergency situation and in a rural setup. The treatment being surgical, negative appendectomy rates are high due to various reasons which we would not dwell upon here. The present study was conducted to evaluate Alvarado scoring system for the diagnosis of acute appendicitis and its co relation to histopathology

Access this article online	
Quick Response Code:	Website: www.ijcpc.org
	DOI: 10.4103/ijcpc.ijcpc_7_21

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How to cite this article: Prabhu VV, Pawar V. Correlation between Alvarado score and histopathology in appendicitis – A pilot study. *Int J Clinicopathol Correl* 2021;5:54-9.

findings. Decision-making in cases of acute appendicitis poses a clinical challenge, especially in developing countries where advanced radiological investigations do not appear cost-effective and may not be accessible at many places, and hence, clinical parameters remain the mainstay of diagnosis and subsequent management.

In diagnosing appendicitis, clinicians balance the risk of misdiagnosis, removing a normal appendix in patients whose signs and symptoms may not be typical, against the risk of perforation of the appendix that might occur while waiting to see if typical findings emerge that warrants surgery. Despite the growing availability of advanced diagnostic testing (U. S/C. T), a recent population-based study in the USA indicated that there was essentially no change in the frequency of negative appendectomy.^[1] However, histopathological (HP) studies are the gold standard for the diagnosis of acute appendicitis. This study was done to test the correlation between Alvarado score (AS) and HP findings. On the contrary, pathologists too have problems in review and reporting the specimens of appendix, especially when there are normal features. It is precisely for this reason that this study first categorized the histological grades and then studied the correlation with the AS.

The AS failed to predict appendicitis in younger children because it does not contain variables that allow for the separation of appendicitis from the numerous other conditions mimicking it in the pediatric population.^[2]

MATERIALS AND METHODS

This study was initiated after approval from the ethical committee. All the patients attending surgical outpatient with complaints of pain in the right Iliac fossa were included. After taking a proper history, the patients were physically examined and a probable diagnosis of appendicitis was made. The patients were scored according to the AS [Table 1]. An ultrasonological examination was done, and the diagnosis of appendicitis was confirmed. Once a decision to perform an appendectomy was done an informed consent for the procedure was taken. Appendectomy was done and the specimen sent to the department of pathology in a formalin container for HP evaluation.

Two sections of the specimen were taken, i.e. longitudinal and transverse including the mesoappendix. The specimen was examined for gross signs of inflammation such as its size, external surface for congested vessels, and the appearance of mesoappendix. On cut section, the lumen was examined for its diameter, fecoliths, worms, and exudate. The slides prepared and examined by hematoxylin and eosin stain.

They were grouped under five heads [Table 2]. The AS of these patients too was noted, and these patients were placed under their respective HPR groups. Grade 1 indicated an extraserosal extension of inflammation whereas Grade 5 indicated a sparse mucosal and submucosal inflammatory picture [Figures 1-5]. The purpose of this classification was necessitated to identify any correlation between the score and pathological findings which would be more evidence based.

These data were then analyzed statistically using the (SPSS 22 software IBM VERSION 22 IBM, USA) and relevant tools, to identify whether any correlation existed between the AS and histology. It was assumed that histological Grades 1-4 were at higher risk and Grade V was at least risk.

RESULTS

This study comprised of a sample size of 100 cases. Of which, 44 were male and 56 were female. There were a maximum of 46 patients with AS score 5 and 6 and

Table 1: Alvarado score

	Points
Symptoms	
Migration of pain to RIF	1
Anorexia	1
Nausea/vomiting	1
Signs	
Tenderness in RIF	2
Rebound tenderness	1
Fever >37.3	1
Laboratory	
Leucocytosis >10,000/cm ²	2
Shift to left	1

Score 5-6: Appendicitis possible, 7-8: Appendicitis probable, 9-10: Appendicitis very probable. RIF: Right iliac fossa

Table 2: Histological grading

Grade	Type	Histology
1	Gangrenous appendicitis, phlegmonous	Focal or diffuse necrosis of mucosa. Acute inflammatory exudate in all layers. Evidence of diffuse myonecrosis
2	Suppurative appendicitis with periappendicitis and perforation	Mucosal microabscesses, small abscesses in the wall with inflammation extending beyond the serosa with evidence of focal myonecrosis
3	Acute appendicitis	Ulcerated mucosa with microabscesses, hyperplastic lymphoid follicles in the submucosa. Diffuse acute inflammation extending upto muscularis propria. Congested blood vessels in serosa
4	Acute on chronic appendicitis	Acute and mononuclear cell infiltrate in the wall. Submucosal fat metamorphosis and evidence of fibrosis. Thinned out muscle coat
5	Normal	Sparse inflammation limited to mucosa

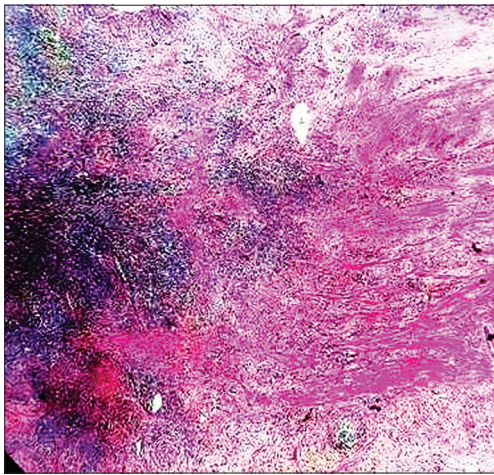


Figure 1: Hematoxylin and eosin, x5: Grade I suppurative appendicitis with necrotic mucosa, acute inflammatory exudate in all layers and evidence of myonecrosis



Figure 2: Hematoxylin and eosin, x5: Grade II acute appendicitis with periappendicitis showing extension of acute infiltrate in mesoappendix

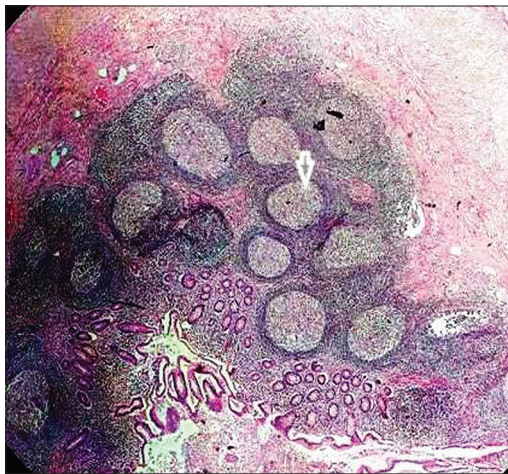


Figure 3: Hematoxylin and eosin, x5: Grade III acute appendicitis with ulcerated mucosa, acute and chronic inflammation in all layers, congested vessels in serosa



Figure 4: Hematoxylin and eosin, x5: Grade IV chronic appendicitis showing thinned out muscle coat, submucosal fat metamorphosis and mononuclear cell infiltrate in all the layers

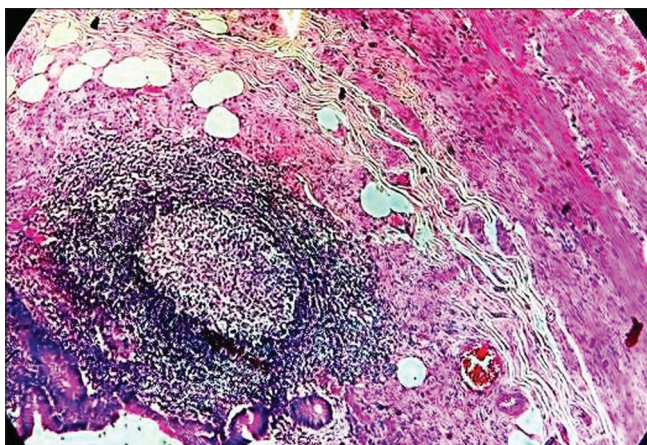


Figure 5: Hematoxylin and eosin, x5: Grade V unremarkable appendix

Table 3: Correlation of Alvarado score and histopathology groups

Serial number	AS	Number of patients	Histopathology grade				
			1	2	3	4	5
1	<5	16	1	2	2	9	2
2	5-6	46	1	6	8	29	2
3	7-8	26	5	7	7	5	2
4	9-10	12	4	2	2	1	3
Total		100	11	17	19	44	9

$P=0.012, \chi^2=25.57$. Hence results are significant. AS: Alvarado score

various references a narrowed AS of <7 and more than 7 were taken initially.^[3] The AS was tabulated with the HPR grade [Table 4] which indicated a statistically significant association with a $P = 0.000098$. On statistical analysis of the correlation between the AS and HP using Pearson correlation test, there was a statistically significant relation but a low degree of positive correlation [Table 5].

44 patients with HP Grade 4 [Table 3]. For the purpose of statistical analysis and the standard cutoff of AS from

On using receiver operating characteristic (ROC) [Table 6], it was observed that the optimum AS was 5.50, i.e. between

Table 4: Relation of narrowed Alvarado score and histopathology grade

Histopathology grade	AS <7	AS >7
1	2	9
2	8	9
3	10	9
4	38	6
5	4	5
Total	62	38

$P=0.000098, \chi^2=23.5461$. AS: Alvarado score

Table 5: Correlation between Alvarado score and HPR

	HPR score
Pearson correlation	0.331
<i>P</i>	0.001
<i>n</i>	100

HPR: Histopathology report

Table 6: Receiver operated curve

Coordinates of the curve		
Test result variable(s): AS		
Positive if greater than or equal to ^a	Sensitivity	1 - specificity
0.00	1.000	1.000
1.50	0.889	1.000
2.50	0.889	0.989
3.50	0.889	0.956
4.50	0.778	0.846
5.50	0.667	0.582
6.50	0.556	0.363
7.50	0.333	0.209
8.50	0.333	0.077
9.50	0.000	0.011

AS: Alvarado score

a score of 5 and 6. We studied the histological correlation using this new value. Comparing this new value with the HP score, the sensitivity and specificity was deduced, according to which the sensitivity of AS was 58.24% and specificity was 33.33%. Using this data of AS 5, as the modified cutoff thrown up by the ROC, the association and screening were studied [Table 6] which suggested that there were 53 patients with AS >5.5 and HPR grade <4 and only 5 patients with higher AS score but an insignificant inflammation on HPR. Similarly, there were 16 cases who had a lower AS but a lower HPR grade (Grade < 4). There was a greater degree of discordance.

There were nine patients of HPR Grade 5 who underwent appendectomy which indicates a negative appendectomy of 9%.

DISCUSSION

Acute appendicitis is one of the most frequent abdominal emergencies in surgical practice^[3] and it is initiated by a compromise in the venous outflow due to an increase in the intraluminal pressure. This in turn leads to a stasis of the intraluminal contents such as mucosal secretions,

fecoliths, and worms leading to a conducive environment for bacterial proliferation resulting in oedema and neutrophilic infiltrates in the wall of appendix that may extend to the periappendiceal tissue.^[4] Histologically, early cases of appendicitis show mucosal microabscesses and purulent exudate in the lumen. If untreated it progresses to a transmural extension involving the entire thickness up to serosa leading to suppurative appendicitis and eventually perforation.^[5,6] Subsequently, in untreated cases, this ends up in gangrenous necrosis and myonecrosis and a phlegmon.^[7]

Various laboratory and imaging modalities although helpful, are not unambiguously diagnostic. They have to be correlated with history and physical findings to achieve an acceptable degree of diagnostic accuracy. There are various scoring systems used to improve the diagnostic accuracy of appendicitis.^[8] Acute appendicitis poses a clinical challenge, especially in developing countries where advanced radiological investigations do not appear cost-effective, and hence, clinical parameters remain the main stay of diagnosis.

There are many drawbacks in using the scoring systems. Besides, the Alvarado scoring system is erroneous in the pediatric age group and women of child-bearing age.^[9]

This systematic review^[9] upholds the use of AS as a triage modality to utilize scarce hospital and faculty resources judiciously with cost-effectiveness. It can be applied to “rule out” appendicitis at a score below five points (sensitivity 94%–99%) but would not be prudent to use it as a “rule in” for appendicitis. Patients with a score <5 can be considered for discharge with a caveat, that watchful waiting and re-assessment may be required if symptoms change or deteriorate. The advantage of applying the AS in this way is that resources in terms of admitting the patient or performing diagnostic imaging can be restricted for only high score patients.^[9]

The authors worldwide have examined the applicability of the AS its modifications and the pediatric appendicitis score. However, we decided to study the HP picture in the various cases diagnosed with appendicitis and treated by appendectomy. A correlation between the pathological findings and clinical scoring was explored. This study has thrown up findings which are contrary to the established inferences. Although the authors could not find any data in the literature that graded appendicitis histopathologically, we constructed a grading system to facilitate the study for the exact correlation between the scoring system and pathology, as it is the only evidence-based proof

of inflammation. The thought that prompted us to first identify a grading system for the appendicular inflammation was to establish a system which could be compared to the clinical findings, which are subjective. Besides the patients catered to by our rural medical college cannot be relied upon to give a proper history. Fever, nausea, and migration of pain which are the constituents of the AS are difficult to elucidate from our class of patients with no offence meant to them.

Our study of 100 patients threw up a mixed result. The raw data suggested that patients with a higher AS showed up a Grade 5 HP that indicated that appendicitis was probably not the primary cause of abdominal pain. At the same time, a lower AS showed a lower grade on HP suggesting a discordance. We therefore used the ROC tool and discovered that the AS cutoff was at 5.5 thus differing with many other esteemed authors. Even at an AS of 5.5, the sensitivity was not very significant.^[9]

However, a systematic review by Ohle R *et al.* suggests a cutpoint of 5 was good enough for “ruling out” admission for appendicitis, however, a decision for surgery using the AS cannot be used to “rule in” a diagnosis of appendicitis. However, on searching the archives for identifying the pathological criteria to label appendicitis the result returned none. Hence, by using pathological textbooks, we designed the grades which are from 1 to 5 [Figures 1-5] in the descending order of severity, although we do not claim it to be an absolutely unambiguous grading.

We tested this study by using the ROC value thrown up by this study, i.e. 5.5 AS with a modified enhanced valued AS score of 7 and considering HPR grading 1–4 as high risk ones requiring surgical intervention and Grade 5 that could be treated conservatively. It showed that in the former there were six patients (10.2%) that had a higher AS score but a nondiagnostic HP, whereas in the latter, the scores did not correlate at all with the HP.

Why this discordance? As is said appendicitis is the black box of abdominal pain. Many of the studies often include only those patients who have undergone appendectomy and hence a high probability of under-reporting of false-negative cases. That apart, the AS score is to be used on patients with a suspicion of appendicitis, before all other diagnostic workups have been done. That is what has been suggested in this study when a HP evidence is used to correlate with the preoperative score. These facts were highlighted in the 3rd World Congress of WSES which observed that a histological grading is necessary to validate the scoring systems and develop a scoring system that

include the symptoms, clinical examination, and operative findings which would then constitute a near perfect score. As also the treatment received if any before the patient is scored by you and the delay in attending the hospital too are important factors to be considered.^[10]

However, if these suggestions are to be accepted then the scoring system cannot be used preoperatively as intraoperative findings and histopathology will only come into picture after surgery and not preoperatively. Besides, an attitude of the surgeon, operating on cases which could have been conserved citing “If I do not operate someone else will” or an overenthusiastic resident wanting to test his surgical skills may be a significant factor in many of the histological features turning out in favor of uncomplicated appendicitis. Hence, the authors feel that the AS scoring system should be used only as an additional tool and that clinical findings should overrule all other modalities.^[11]

However, the authors feel that a consensus HP grading of appendicitis^[12] is needed for an uniformity in correlating the score and histology. This study has a 9% negative appendectomy rate that compares with different studies worldwide.^[13]

CONCLUSION

An AS of 5 suggests ruling out admission for appendicitis and the scoring system is not in concordance with the

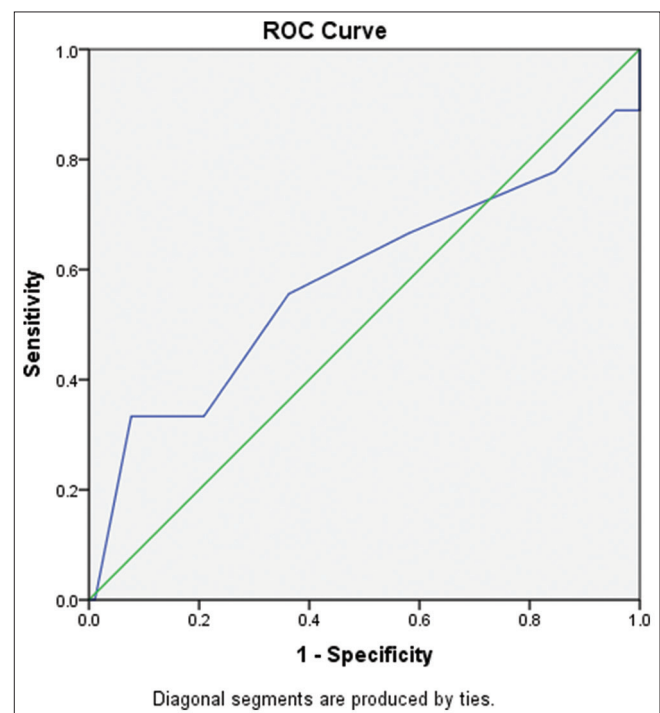


Figure 6: Receiver operator characteristic

histological findings. However, a larger sample size will be required to come to a definitive conclusion.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Abdeldaim Y, Mahmood S, Avinchev D. The Alvarado score as a tool for diagnosis of acute appendicitis. *Ir Med J* 2007;100:342.
2. Bond GR, Tully SB, Chan LS, Bradley RL. Use of the MANTRELS score in childhood appendicitis: A prospective study of 187 children with abdominal pain. *Ann Emerg Med* 1990;19:1014-8.
3. Dey S, Mohanta PK, Baruah AK, Kharga B, Bhutia KL, Singh VK. Alvarado scoring in acute appendicitis – A clinicopathological correlation. *Indian J Surg* 2010;72:290-3.
4. Vinay K, Abul K, Abbas, Aster JC. *Pathologic Basis of Disease. South Asia Ed., Vol. 2., Ch. 17 – The Gastrointestinal Tract.* Imprint: Elsevier India: Elsevier; 2020 p. 816.
5. Rubins R. *Essentials of Pathology. The Gastrointestinal Tract.* Chapter 13; 4th Edition, publisher Lippincott Williams. 2011, p 732.
6. Bhende YM. *General Pathology and Pathology of Systems.* Popular Prakashan pvt Ltd, 6th ed. 1982. p 365.
7. Odze RD, John R. *Surgical Pathology of Gastrointestinal Tract.* 3rd ed., Sec. 2., Ch. 18. Saunders. 2004. p. 517.
8. Memon ZA, Irfan S, Fatima K, Iqbal MS, Sami W. Acute appendicitis: Diagnostic accuracy of Alvarado scoring system. *Asian J Surg* 2013;36:144-9.
9. Ohle R, O'Reilly F, O'Brien KK, Fahey T, Dimitrov BD. The Alvarado score for predicting acute appendicitis: A systematic review. *BMC Med* 2011;9:139.
10. Di Saverio S, Birindelli A, Kelly MD, Catena F, Weber DG, Sartelli M, *et al.* WSES Jerusalem guidelines for diagnosis and treatment of acute appendicitis. *World J Emerg Surg* 2016;11:34.
11. Abou Merhi B, Khalil M, Daoud N. Comparison of Alvarado score evaluation and clinical judgment in acute appendicitis. *Med Arch* 2014;68:10-3.
12. Carr NJ. The pathology of acute appendicitis. *Ann Diagn Pathol* 2000;4:46-58.
13. Mariadason JG, Wang WN, Wallack MK, Belmonte A, Matari H. Negative appendectomy rate as a quality metric in the management of appendicitis: Impact of computed tomography, Alvarado score and the definition of negative appendectomy. *Ann R Coll Surg Engl* 2012;94:395-401.