

Role of Alvarado Score and Changes in C-Reactive Protein (CRP), S. Bilirubin and Mean Platelet Volume (MPV) in Pre-Op Diagnosis of Acute Appendicitis

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Abstract:

Aim: The aim of the present study was to evaluate the role of Alvarado score and changes in C-reactive protein, S. bilirubin and MPV in preop diagnosis of acute appendicitis.

Materials and Methods: This prospective, analytical study was conducted in the Department of General Surgery, Civil Hospital and B.J. Medical College, Ahmedabad from October 2023 to October 2024. 100 patients were selected for this study as per the inclusion and exclusion criteria, with age more than 8 years and right iliac fossa pain as the main complaint.

Result: The maximum patients were in the age group of 11-30 years having 75 males and 25 females. In our study, the patients whose Alvarado score was 7 or more have the high chances of having the Acute Appendicitis. There was no significant relationship ($p < 0.01$) between C-reactive protein, S. bilirubin and MPV with patients having Alvarado score more than 7. So, C-reactive protein, S. bilirubin and MPV are not a reliable marker in preop diagnosis of acute appendicitis.

Conclusion: Alvarado score as scoring system is valuable and valid instrument of discrimination between acute appendicitis and non-specific abdominal pain. There is no role in combining the clinical (Alvarado score) and laboratory parameters for diagnosis of acute appendicitis.

Keywords: Acute Appendicitis, Alvarado Score, C-Reactive Protein (CRP), S. Bilirubin, Mean Platelet Volume (MPV).

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Introduction

Acute appendicitis is one of the most common causes of acute abdomen requiring surgical intervention. Hence early diagnosis, treatment and surgical intervention is required to reduce the morbidity and sometimes mortality associated with complications such as Gangrene, Perforation, Peritonitis and Abscess formation. Worldwide perforated Appendicitis is one of the leading general surgical causes of death. Early diagnosis is often based on history and clinical examination as Right Iliac Fossa pain is the main Complain. This approach sometimes result in negative appendicectomy as many conditions of Gastro-Intestinal tract like Inflammatory Bowel Disease, Meckel's Diverticulitis, Renal stone, Ovarian torsion and Haemorrhagic Ovarian cyst can mimic the acute appendicitis. On the other hand, atypical presentation is common in relatively

younger children and adolescent females. This may result in difficulty in diagnosis which can result in delayed intervention and consequently lead to increased incident of complications. In such scenario, Alvarado score and other laboratory parameters such as C- Reactive Protein (CRP), S. Bilirubin, and Mean Platelet Volume (MPV) are helpful in the pre- op diagnosis of acute appendicitis. The Alvarado Scoring system is a clinical scoring system that can be applied to a patient to support the clinical diagnosis of acute appendicitis. It is based on 6 clinical features and 2 laboratory investigation. Searching through medical literature, there is various laboratory parameters (WBC, s. bilirubin, CRP and MPV) being evaluated as potential diagnostic markers for Acute Appendicitis, but results according to different studies vary substantially. On

the other hand, some large meta-analysis found that individual laboratory and clinical parameters alone have low or no predictive value in the diagnosis of Acute Appendicitis, but combined their predictive value increases a lot. Hence, we used the clinical as well as other laboratory parameters to look for their accuracy, efficacy and their changes according to it in diagnosis of acute appendicitis.

Scoring systems are valuable and valid instruments of discrimination between acute appendicitis and non-specific abdominal pain. The advantages are that they readily available and cheap.

Aims and Objectives: To evaluate the usefulness of the Alvarado Score, CRP, S. Bilirubin and Mean Platelet Volume (MPV) in pre-op diagnosis of Acute Appendicitis

Materials and Methods

This prospective, analytical study was conducted in the Department of General Surgery, Civil Hospital and B.J. Medical College, Ahmedabad from October 2023 to October 2024.

Inclusion Criteria:

- Age – \geq 8years
- Patients having Complain of Right iliac fossa pain associated with fever and vomiting

Exclusion Criteria

- Patient seen in emergency department with Right iliac fossa pain having ultrasound suggestive of normal appendix
- Patients having pre-existing altered CRP, s. Bilirubin and MPV for any known illness.

Methodology

Sample size: Total 100 Patients were included for this study. The patient selection was done according to their Inclusion and Exclusion criteria, with age more than 8 and Right Iliac fossa pain as the main complaint. In this study, we examined the patients on the basis of their symptoms and signs according to the Alvarado Score presented in

emergency department. These patients were admitted for the same. These were subjected to the Laboratory investigation CRP, S. Bilirubin and MPV to support the diagnosis of acute appendicitis. Other investigations were included the Complete Blood Count (CBC) and ultrasound.

Data collection: All of the patient's records were prospectively collected from the database of Civil Hospital Ahmedabad (CHA). All the signs and symptoms of patients suggestive of acute Appendicitis noted. Their Laboratory investigation done. Values of CBC, CRP, S. Bilirubin and MPV was checked.

This data was entered in excel worksheet and master chart was prepared. The Alvarado score of each Patient was determined by a combination of clinical and laboratory parameters. And they classified in patient having Alvarado score 7 or more than 7 and patients having Alvarado score less than 7. Patient's Laboratory investigation that is WBC count, Neutrophil count, CRP, S. Bilirubin and MPV noted and entered in excel worksheet.

All the data was analysed, interpreted accordingly and master chart was prepared. According to master chart Alvarado Score of patients analysed. Relationship between the Alvarado score and CRP, S. Bilirubin and MPV was checked.

Ethical consideration: Ethical clearance was taken for conducting the study and research from the ethical Committee, B.J. Medical College, and Ahmedabad-CHA. Patients themselves and relatives/Guardian were informed about the purpose of the study and their consent taken for the same.

Observation and Results

Total 100 patients were included in this study, out of which 75 were male participants and 25 were female participants. Present study result showed that the maximum participants were in the age group of 11-30 years of age. Pain in the right iliac fossa pain was the main complaint in almost all the patient.

Table 1: Characteristic of study population.

Variables		Number	Percentage
Age group in years	8-10	1	1
	11-20	30	30
	21-30	53	53
	31-40	14	14
	>40	2	2
Sex	Male	75	75
	Female	25	25
Presenting Complain	Pain in RIF	100	100
	Nausea	90	90
	Vomiting	35	35
	Anorexia	40	40
	Fever	95	95

Table 2: Clinical presentation of Alvarado Score

No.	Clinical Features of Alvarado Score	Yes
1	Migration of pain	80
2	Anorexia	40
3	Nausea/Vomiting	90
4	RIF Tenderness	100
5	Rebound Tenderness	75
6	Fever	95
7	Leucocytosis	80
8	Neutrophilia	80

The most prevalent clinical condition is RIF Tenderness, present in almost all the patients included in the study, followed by Fever (95%), 90% with nausea and vomiting, 80% with migration of pain, 40% with Anorexia, 75% with rebound Tenderness. Leucocytosis and Neutrophilia present in 80% of the study group.

Table 3: Categorization of Patients according to their Alvarado score Analysis of the study subjects based on the Alvarado score is given below.

Alvarado score	Patients no.
≥7 or more	80
5-6	19
<5	1

In our study, the patients who's Alvarado score was 7 or more have the high chances of having the Acute Appendicitis. Those who are having Alvarado score between 5 and 6, requires other supportive investigation to confirm the possibility of Alvarado score.

Those whose score were less than, have the less chances or unlikely to have the appendicitis.

Table 4: Changes in C - reactive protein, S. Bilirubin and MPV in study subjects

In this study, we have done the Laboratory investigation (CRP, S. Bilirubin and MPV) in patients coming to emergency department with Right iliac fossa pain and other clinical features suggestive of acute Appendicitis. The study result was given as chart below.

Table 4(a): CRP level in study subjects

CRP	Patient no.
<5 mg/dl	16
≥5 mg/dl	84

Table 4(b): S. Bilirubin level in study subjects

S. Bilirubin	Patient no.
<1.2mg/dl	90
>1.2mg/dl	10

Table 4(c): MPV level in study subjects

MPV	Patient no
6-11fl	90
>11fl	10

In this study, the patients out of 100, 84 patients who had clinical features of acute appendicitis according to Alvarado Score have CRP level more than 5mg/dl.

Only 10 patients have the s. bilirubin more than 1.2mg/ dl. MPV level was high in 10 patients in this study.

Table 5: Relationship between Alvarado score and CRP, S. Bilirubin and MPV

In our study, we checked the relationship between the Alvarado score having the score 7 or more with C-reactive protein, S. bilirubin and Mean Platelet Volume. Alvarado score with value 7 or more is highly suggestive of acute Appendicitis.

Relationship between Alvarado score and CRP

Total 80 patients have Alvarado score more than 7. In this 70 patients have the CRP level >5mg/dl, rest 10 patients have the normal CRP level. 19 Patients

have the Alvarado score less than 7. In this, 14 patients have the CRP level $>5\text{mg/dl}$. To check the association between these two variables, Chi Square test of independence was done. The relation between these 2 variables was significant.

The Chi Square value between these two variable was 3.6458 with p value .05621. The result is not significant at $p < .01$.

Table 5(a): Relationship between Alvarado score and CRP

Alvarado score (pt. no.)	CRP ($\geq 5\text{mg/dl}$)	CRP ($\leq 5\text{mg/dl}$)
≥ 7 (80)	70	10
< 7 (20)	14	6

Table 5(b): Relationship between Alvarado score and S. Bilirubin

Out of 80 patients with Alvarado score more than 7, 8 patients have the s. bilirubin $>1.2\text{mg/dl}$, rest 72 patients have the S. Bilirubin in normal range. Out of 19 patients with Alvarado score less than 7, 3

patients have the s. bilirubin level $>1.2\text{mg/dl}$, rest 17 patients have the S. Bilirubin in normal range.

To rule out the association between Alvarado score and s. bilirubin chi square test applied. The chi square statics is 0.4086, with p value .522691. The result is not significant at $p < .01$.

Table 5(b): Relationship between Alvarado score and S. Bilirubin.

Alvarado score (pt no.)	S. Bilirubin ($>1.2\text{mg/dl}$)	S. Bilirubin ($<1.2\text{mg/dl}$)
≥ 7 (80)	08	72
< 7 (20)	3	17

Table 5(c): Relationship between Alvarado score and MPV

Total 80 patients with Alvarado score more than 7, 8 patients have the MPV more than 11, rest 72 patients have the MPV in normal range. Out of 20 patients with Alvarado score less than 7, only 2 has

the high MPV, rest 18 has the MPV in normal range.

Significance between these two variables was checked again by chi square. The chi square value is 0. The p value is 1. The result is not significant at $p < .01$.

Table 5(c): Relationship between Alvarado score and MPV

Alvarado score	MPV ($>11\text{fl}$)	MPV (6-11)
≥ 7 (80)	8	72
< 7 (20)	2	18

Discussion

Acute Appendicitis remains a common abdominal emergency throughout the world. In addition to significant mortality and morbidity, negative appendectomy also responsible for loss of precious staff hours and financial resources. The diagnosis of acute appendicitis remains a challenge and difficult to diagnose due to variables presentation of the disease, lack of reliable diagnostic test and specific marker.

The diagnosis of acute appendicitis still remains problematic due to unacceptably high negative appendectomy rate in spite of the introduction of modern imaging technique. Though CT, Ultrasound and Laparoscopy gave the best diagnostic accuracy though their use is fraught with many limitations: first, CT emits radiation that could lead to cancer in future and second it is not cost effective in low income countries. The ultrasound on the other hands dependent not only on the quality of the machine, but also on the operator and inter observer variation is a disadvantage. So even today, a thorough clinical examination with basic investiga-

tion like WBC count remains the cornerstone in the diagnosis of acute appendicitis.

Initial assessment can be improved by use of a clinical scoring systems. Alvarado scoring system is one of the many scoring systems available today. It is based on history, physical examination and laboratory test. It is cheap complimentary aid for supporting the diagnosis of acute appendicitis. Along with other laboratory parameters its value increases. So in our study we included the C - reactive protein, S. Bilirubin and MPV and along with Alvarado score in preop diagnosis of acute appendicitis.

A study conducted by Wilarusmee on diagnostic score of appendicitis: A systemic review of score performance in 2014 found that rebound pain was the most common sign (76.9%) followed by right lower quadrant tenderness (61.5%), and right lower quadrant guarding or elevated temperature (53.9% for both). Ten symptoms were considered in which nausea (64.3%) followed by migration and duration of pain (46.2%) were most commonly included. In our study out of 100 patients, RIF Tenderness was the most common sign presented in all patients

followed by fever in 95 patients and rebound tenderness in 75 patients. Most common symptom was the nausea/vomiting presented in 90 patients followed by migration of pain in 80 patient and anorexia in 40 patients.

A study conducted by Robert Ohle title of which is role of Alvarado score for predicting Appendicitis in 2011. In this study, they assessed the diagnostic accuracy of the score at the two cut-off points; score of 5(1 to 4 vs 5 to 10) and score of 7(1 to 6 vs 7 to 10). Calibration was analysed across the low (1 to 4), intermediate (5&6) and high (7 to 10) risk strata. They conclude that the Alvarado score is a useful diagnostic 'rule out' score at a cutoff point of 5 for all patients group. In our study, we divided the patient according to their Alvarado score in 3 groups. Patients with Alvarado score more than 7, those between 5 and 6 and those below 5. Out of 100 people from this study, 80 patients have the Alvarado score more than 7, 19 patients have the Alvarado score between 5 and 6 and 1 patient have the Alvarado score less than 5. Patients with Alvarado score more than 7 have high chances of having acute appendicitis.

Another prospective study conducted by Waleed S. Ahmed on Predictive value of Alvarado score and Ultrasound in the diagnosis of Acute Appendicitis in 2018. In this total 100 patients included. In this right lower quadrant pain was the highest percentage (54.9%) as presenting abdominal pain followed by periumbilical pain (29.4%) then followed by epigastric pain (9.8%) and the least presenting abdominal pain was generalized abdominal pain (5.8%). In our study, pain in Right Iliac Fossa was the main complaint in almost all patients (100), followed by fever (95) and then followed by nausea/vomiting (90) and then anorexia (40).

A study conducted by Faith Dal on role of Alvarado Score and biological indicators of CRP, procalcitonin and neopterin in diagnosis of acute appendicitis suggest that the although the Alvarado score is useful, additional testing and clinical approaches are valuable to inform the diagnostic procedure. When considered alone, serum CRP, PCT and NP values are insufficient for a diagnosis of acute appendicitis. However, they increased the diagnostic value of the Alvarado score and can be helpful in distinguishing complicated acute appendicitis cases. In our study, we combined the CRP, S. Bilirubin and MPV along with Alvarado score to see their usefulness in preop diagnosis of acute appendicitis. But in our study, total 84 patients out 100 patients have the CRP value more than 5mg/dl with Alvarado score more than 7 suggestive of acute Appendicitis. Out of 80 patients with Alvarado score more than 7, 70 patients have the CRP level >5mg/dl. But p value of this is .05621. Which suggest that CRP has no role in predicting acute appendicitis. While S. bilirubin and MPV value

also didn't altered or have significant high level in diagnosis of acute appendicitis. So, in our study it proves that there is no role in combining the clinical (Alvarado score) and laboratory parameters for diagnosis of acute appendicitis.

Another study was conducted by Iva soldo on diagnosis of acute appendicitis using clinical and laboratory parameters in June, 2018 at Croatia. In this the control group of patients were more likely to present following symptoms: no changes in appetite ($P < 0.001$), diarrhoea ($P = 0.009$) and dysuria ($P = 0.047$). CRP and white blood cell count (WBC) were significantly higher in the group with confirmed AA compared to the control group (44.7 vs. 6.6 , and 13.6 ± 3.9 vs. 9.0 ± 3.4 , respectively; $P < 0.001$). The multivariate logistic regression analysis identified lack of appetite ($P = 0.013$), absence of diarrhoea ($P = 0.004$), and positive finding of signs of localized peritonitis ($P = 0.013$), as well as WBCs ($P < 0.001$) and negative urine test strip results ($P = 0.009$) as statistically significant predictors of AA. The highest percentage of correctly classified cases (82%) was achieved by combination of common clinical exam and basic inexpensive laboratory parameters (WBCs and urine test strip). In the present study, CRP has a p value .05621 in 70 patients with Chi Square value was 3.6458, which suggest that there is no relationship between CRP and patients having Alvarado score more than 7. S. bilirubin has a chi square value .522691 with Chi Square value was 0.4086. MPV has Chi Square value 0 with p value 1. This suggest that S. Bilirubin and MPV also have no significant changes in patients presented with clinical features of acute appendicitis.

A study conducted by Anil Reddy Pinate on CRP and S. bilirubin as a predictor of Acute appendicitis: a cross-sectional study in 2018 suggest that 78% patients had either perforated appendicitis or gangrenous appendicitis. While 70.45% patients of perforated appendicitis had positive value for total serum bilirubin as compared to only 29.55% of non-perforated appendix had the positive S. Bilirubin value.

In our study we have taken the CRP and S. bilirubin as predictor of acute appendicitis. Total 84 patients have the CRP level more than 5mg/dl, while only 10 patients have the S. bilirubin level ≥ 1.2 mg/dl. Relationship between Alvarado score and these parameters also checked. Chi square test applied for this which showed CRP and s. bilirubin has no significant association with patients having Alvarado score more than 7. Hence it proved that CRP and s. bilirubin is not a useful marker in preop diagnosis of acute appendicitis. Another study was conducted by Ademol aolusegu n Talabi in 2021. In this study the sensitivity and specificity of Alvarado score, C-reactive protein estimation, total white blood cell count in diagnosing acute appen-

ditis were 86.4% and 63.2%, 98.8% and 36.8%, and 51.9% and 89.5% respectively. Alvarado score has the highest area under ROC curve analysis 0.824, 95% CI of 0.724 to 0.924 compared with CRP, 0.769, 95% CI of = 0.647 to 0.891 and WBC count, 0.765, 95% CI of 0.643 to 0.887. Its inference was that Alvarado score outperformed other tests in setting the diagnosis of acute appendicitis. However, none of the tests can be relied on wholly for operative decision. Clinical judgement remains the bedrock for diagnosis and operative intervention in acute appendicitis. In our study, we also have taken the Laboratory parameters CRP, S. Bilirubin and MPV along with Alvarado score for diagnosis of acute appendicitis. But in our study also, none of the Laboratory investigation has association with Alvarado score more than 7 which suggestive of acute Appendicitis. So, they are not a reliable marker for diagnosis and confirmation of acute appendicitis. C-reactive protein has significant higher level in patient presented with complain of Right iliac fossa pain with tenderness. But the relation between Alvarado score and CRP is not significant at $p < .01$ with p value .05621 So CRP cannot be a potential marker in preop diagnosis of acute appendicitis. On the other hand, values of S. Bilirubin and MPV didn't have significant change in patients with Alvarado score more than 7. So, they are not a reliable marker in preop diagnosis of acute appendicitis.

Conclusion

Clinical examination and radiological investigation like ultrasound abdomen of the patient remains the mainstay in the diagnosis of acute appendicitis. Alvarado score may be of help in setting the diagnosis of Acute Appendicitis. Alvarado score as scoring system is valuable and valid instrument of discrimination between acute appendicitis and non-specific abdominal pain. The advantage is that it is readily available and cheap. On the other hand, CRP is non-specific and none of the three diagnostic test has significant association with patients presented with clinical features suggestive of acute Appendicitis. These three diagnostic tests can't be used as an exclusive standard in the preop diagnosis of Acute Appendicitis. At last, study with large sample size is required to identify any significant relationship between these 3 tests and diagnosis of acute appendicitis.

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