

# To Study the Association between Alvarado Score and Severity of Appendicitis in Patients with Acute Appendicitis

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**Abstract:** ***Introduction:** Acute appendicitis is one of the common acute abdominal emergencies. Therefore there is a need of a scoring system with good sensitivity and specificity that can overcome the problem of negative appendectomy on exploration. The study was conducted to evaluate the association between the Alvarado score (AS) and severity of appendicitis in patients with acute appendicitis. **Aim:** To study the association between the Alvarado score (AS) and severity of appendicitis in patients with acute appendicitis who undergoes surgery. **Patients and Methods:** 50 patients undergoing emergency appendectomy who met the inclusion criteria were included in the study. Alvarado score were noted preoperatively. Intraoperative gross findings were noted and severity of appendicitis was assessed. **Result:** All 50 patients underwent positive appendectomy. In our study it was seen that increase in the Alvarado score is associated with increase in severity of intra operative findings of acute appendicitis. **Conclusion:** . In our study the association between Alvarado score and severity of acute appendicitis is statistically significant with a p value of <0.001. So Alvarado score is a good indicator for predicting the severity of acute appendicitis*

**Keywords:** Appendicitis, Alvarado Score, Appendectomy, Surgical Intervention, Intraoperative Findings

## 1. Introduction

Appendix is a worm like diverticulum arising from posteromedial wall of caecum about 2cm below ileocaecal orifice. The length of appendix varies from 2 to 20cm with an average of 9cm. It has variable positions in relation to neighbouring viscera like retrocaecal (65%), pelvic (30%), paracolic, preileal or postileal<sup>(1)</sup>.

Acute appendicitis is one of the common acute abdominal emergencies. It is estimated as much as 6% to 7% of general population will develop appendicitis during their lifetime, with the incidence peaking in the second decade of life<sup>(2,3)</sup>.

A typical patient is one presenting with right lower abdominal pain, nausea and vomiting and has got tenderness and guarding in right iliac fossa on examination. However these symptoms & signs are not very specific for appendicitis. Delay in diagnosis leads to complications significantly increasing morbidity. Therefore acute appendicitis needs to be considered in the differential diagnosis of nearly every patient with acute abdominal pain<sup>(4)</sup> and early diagnosis remains the most important goal.

A negative appendectomy rate of 20 - 40% has been reported in literature<sup>(5)</sup>. The main factors contributing to this high negative laparotomy rate have been the nonspecific clinical features of acute appendicitis. Removing normal appendix is an economic burden both on patients and health resources.

The pathophysiology of acute appendicitis explains why only half of the patients have a classical presentation. A white blood corpuscle (WBC) count is perhaps the most useful laboratory test.

Ultrasonography (USG) is an operator dependent modality and often misses or over diagnose the condition<sup>(6)</sup>. Contrast enhanced computed tomography (CECT) scan is the investigation of choice with high sensitivity and specificity for diagnosis but is expensive and not available at all centres particularly in developing countries, like India<sup>(7)</sup>.

Therefore there is a need of a scoring system with good sensitivity and specificity that can overcome the problem of negative appendectomy on exploration. One of the common scoring systems is Alvarado system which is based on clinical and laboratory evidence of acute appendicitis. It includes pain, migration to right iliac fossa (RIF), anorexia, nausea and vomiting, tenderness, rebound tenderness, fever, leucocytosis and shift of neutrophils to the left<sup>(8)</sup>. The Alvarado score (MANTRELS) is now one of the most well known and studied appendicitis score.

A number of nonappendiceal pathologies in the right iliac fossa can mimic appendicitis and a significant number of appendectomies are being performed for non - appendiceal pathologies.

Two most popular methods to remove the appendix are open appendectomy and laparoscopic appendectomy Both have their advantages and disadvantages, depending upon the availability of resources and expertise of operating surgeon. Laparoscopic appendectomy is more time consuming but has lower post - operative complications and lower hospital stay. On the other hand, delay in surgery can lead to complications like perforation and finally peritonitis<sup>(9)</sup>. Therefore there is a need to see the association of Alvarado score and severity of appendicitis.

In this study the severity of appendicitis intra operatively will be studied and classified according to the inflammatory process and the presence or absence of gangrene and perforation of appendix. The severity of appendicitis intra operatively will be classified in four grades:

- 1) Appendix with inflammation  $\pm$  periappendiceal fluid.
- 2) Appendix with presence of necrosis, gangrene or suppuration.
- 3) Appendix with perforation and localized peritonitis or abscess at the site.
- 4) Appendix with perforation and diffuse peritonitis.

Hence, this study is designed to evaluate the association between the Alvarado score (AS) and severity of appendicitis in patients with acute appendicitis.

## Patients and Methods

### Study design:

A Hospital based prospective type of observational study conducted between feb 2021 to august 2022 in department of General Surgery, Shri Mahant Indiresh Hospital, Patel Nagar, Dehradun

### Inclusion Criteria

- 1) Age of patient more than 18 years of both sex.
- 2) All patients of Acute appendicitis will be included with following criteria:
  - a) Patient who will present with RIF pain and diagnosed clinically as Acute appendicitis
  - b) Diagnosis confirmed radiologically by USG/CT/MRI.
  - c) Patient who undergoes surgery (laproscopic/open appendicectomy)

### Exclusion Criteria

- 1) Age less than 18 years of age
- 2) Patient not giving consent for the purpose of study
- 3) Patients of acute appendicitis/ appendicular lump who will be managed conservatively.
- 4) Patient who will present with right iliac fossa pain but diagnosed to have disease other than acute appendicitis.

## Study Planning

- All eligible patients will be properly counseled and explained about the nature and purpose of the study. Secrecy and confidentiality will be maintained.
- After informed written consent, patients will be recruited into the study.
- Patients who are diagnosed clinically as acute appendicitis because of RIF pain, anorexia, nausea, vomiting and fever will be included in the study.
- Patient will be subjected to blood investigation including TLC, DLC and other supportive investigations and their Alvarado score will be noted.
- Diagnosis of these patients of Acute appendicitis will be confirmed radiologically by USG/CT/MRI
- Patient with confirmed diagnosis of Acute appendicitis will be subjected to surgery (laproscopic/open appendicectomy)
- Intraoperative gross findings of appendix and abdomen will be noted and severity of acute appendicitis will be assessed as per prescribed criteria.
- Data so collected will be analysed by appropriate statistical test

## 2. Observation and Result

A total of 50 patients who met the inclusion criteria were included in the study. It was observed that 12% of the patients were in age group of <20 years while 72% of the patients were in age group of 20 - 40 years, 16% of the patients were in age group of >40 years. Out of 50 patients 33 were Males while 17 of the patients were Females. In the study it was observed that 26 patients had no migratory pain while 24 patients had migratory pain. 42 patients had anorexia while 8 patient had no anorexia. In the study it was observed that all 50 patients had Nausea/Vomiting as well as tenderness in RIF. In the study 11 of the patients had no Rebound Tenderness while 39 patients had Rebound Tenderness.

It was observed that 18 patients had no Elevated temperature while 32 of the patients had Elevated temperature. In our study observed that 28 patients had TLC <10000 while 22 had >10000. 37 of the patients had no Shift to left while 13 patients had Shift to left.

**Table 1:** Distribution of Patients according to Alvarado Score and Intraoperative Grading of Appendicitis

Alvarado Score	Number of Patients	No. of Patients in Grade 1 With %	No. of Patients in Grade 2 With %	No. of Patients in Grade 3 With %	No. of Patients in Grade 4 With %
1	0	0	0	0	0
2	0	0	0	0	0
3	0	0	0	0	0
4	1	1 (100%)	0	0	0
5	8	8 (100%)	0	0	0
6	15	15 (100%)	0	0	0
7	7	2 (28.5%)	5 (71.5%)	0	0
8	10	0	5 (50%)	5 (50%)	0
9	8	0	1 (12.5%)	5 (62.5%)	2 (25%)
10	1	0	0	0	1 (100)
TOTAL	50	26	11	10	3

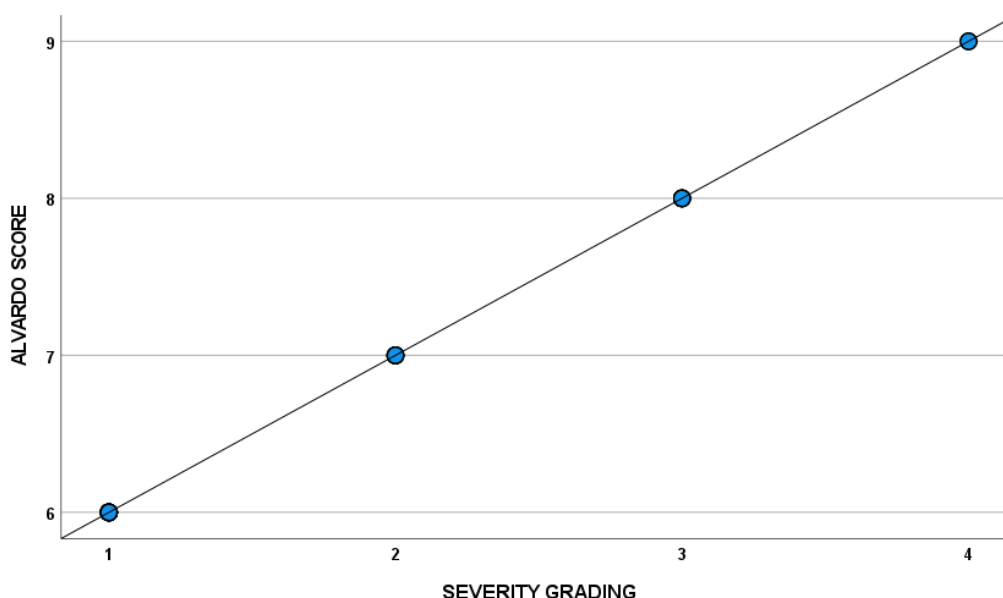
In the above table there was no patients with Alvarado score < III. There was only one patient with Alvarado score IV who had GRADE 1 appendicitis intra operatively. Patients

with Alvarado score of V were 8 and all had GRADE 1 appendicitis intra operatively. Patients with Alvarado score of VI were 15 and all were categorised in GRADE 1

appendicitis intra operatively. Patient with Alvarado score of VII were 7 out of which 2 patients had GRADE 1 and 5 patient had GRADE 2 appendicitis intra operatively. Patients with Alvarado score of VIII were 10 in number out of which 5 patients had GRADE 2 and 5 patients had GRADE 3 appendicitis intra operatively. Patients with Alvarado score of IX were 8 in number out of which 1 patient had GRADE 2, 5 patients had GRADE 3 and 2 patients had GRADE 4 appendicitis intra operatively. There was only 1 patient with Alvarado score of X and the patient had GRADE 4 appendicitis intra operatively.

**Table 2:** Correlation between Alvarado Score and severity of grading

Intraoperative grading of appendicitis	N	Mean Alvarado score	p value
APPENDICITIS Grade 1 (Appendix with inflammation ± periappendiceal fluid)	26	5.69	<b>&lt;0.001</b>
APPENDICITIS Grade 2 (Appendix with presence of necrosis, gangrene or suppuration)	11	7.64	
APPENDICITIS Grade 3 (Appendix with perforation and localised peritonitis or abscess at site)	10	8.50	
APPENDICITIS Grade 4 (Appendix with perforation and diffuse peritonitis)	3	9.33	



**Chart 17**

In our study, patients with Alvarado score between 1 - 4 was 2%, patients with Alvarado score between 5 - 6 was 46%, patients with Alvarado score between 7 - 8 was 34% and patient's with Alvarado score between 9 - 10 was 18%.

Our study was done to see the correlation between Alvarado score and intraoperative severity of appendicitis. All patient's Alvarado score were noted and they underwent open appendectomy and intra operative finding was noted. Severity of appendicitis intra operatively was categorised in 4 GRADES. GRADE 1 was appendix with inflammation ± periappendiceal fluid, GRADE 2 was appendix with presence of necrosis, gangrene or suppuration, GRADE 3 included appendix with perforation and localised peritonitis or abscess at site and GRADE 4 was appendix with perforation and diffuse peritonitis.

In our study, intraoperatively the appendix were inflamed (52%), followed by appendix with gangrene or necrosis (22%).20% of patients had appendix with perforation and localised peritonitis or abscess at site and 6% patient had perforated appendix with diffuse peritonitis.

In our study GRADE 1 appendicitis intra operatively was present in 26 patients with mean Alvarado score of 5.69. GRADE 2 appendicitis intra operatively was present in 11 patients with a mean Alvarado score of 7.64. GRADE 3 appendicitis intra operatively was present in 10 patients with a mean Alvarado score of 8.5. GRADE 4 appendicitis intra operatively was present in only 3 patient with a mean Alvarado score of 9.33.

The association between Alvarado score and severity of appendicitis was statistically significant with p value <0.001. So there is a positive correlation that increase in Alvarado score is associated with increase in severity of acute appendicitis.

### 3. Discussion

In our study most of the patients with acute appendicitis were in third to fourth decade (20 - 40 years) of life (72%), followed by 5th decade more than 40 years (16 %) and lastly less than 20 years which constituted 12 %.

Smink DS et al <sup>(10)</sup> in their study found that incidence of

appendicitis gradually rises from birth, peaks in the 2nd decade, and gradually declines in the geriatric years. Nearly 60% of patients with acute appendicitis are less than 30 years of age. Thus the findings of our study were comparable to other studies.

In our study acute appendicitis was more common in male population with 33 male being affected by the disease in comparison to females which was 17. Christian Spina et al (2018) studied 240 patients of acute appendicitis and found that acute appendicitis was more common in male with a percentage of 70% in comparison to female which was 30%<sup>(11)</sup>.

In our study the most common presenting symptoms was right iliac fossa pain along with nausea/vomiting affecting 100% of cases followed by anorexia (84%) and fever (64%). History of migratory pain from periumbilical region to right iliac fossa was present in 40% of patient in our study. In our study it was observed that 78% of patients of acute appendicitis had rebound tenderness while 22% of the patients had no rebound tenderness.

According to Yeh B in his study he found that migration of pain from the periumbilical area to the right lower quadrant is the most discriminating feature in patients of acute appendicitis. This finding has a sensitivity and specificity of approximately 80%<sup>(12)</sup>.

In our study it was observed that 44% patient of acute appendicitis had TLC >10000 while 56% of the patient had <10000.

Essam Ebied et al in their study of 100 cases they concluded that raised total leucocyte count >10000 has sensitivity and specificity of 85% and 75% respectively in diagnosis of acute appendicitis<sup>(13)</sup>.

In our study out of 50 patients of acute appendicitis shift to left of neutrophils was seen in 26% patient and 74% patients did not show any shift to left of neutrophils.

Linda t et al in their study of use of white blood cell count and left shift in diagnosis of appendicitis found that out of 728 patients of acute appendicitis 40% with shift to left of neutrophil had appendicitis where as 1.8% without a left shift had acute appendicitis<sup>(14)</sup>.

In our study, in patients of acute appendicitis Alvarado score between 1 - 4 was 2%, patients with Alvarado score between 5 - 6 was 46%, patients with Alvarado score between 7 - 8 was 34% and patients with Alvarado score between 9 - 10 was 18%.

In our study GRADE 1 appendicitis intra operatively was present in 26 patients with mean Alvarado score of 5.69. GRADE 2 appendicitis intra operatively was present in 11 patients with a mean Alvarado score of 7.64. GRADE 3 appendicitis intra operatively was present in 10 patients with a mean Alvarado score of 8.5. GRADE 4 appendicitis intra operatively was present in only 3 patient with a mean Alvarado score of 9.33. The association between Alvarado score and severity of appendicitis was <0.001 which is statistically significant. So there is a positive correlation that

increase in Alvarado score is associated with increase in severity of acute appendicitis.

MK et al (2017) in "comparision of Alvarado and Ripasa scoring system in diagnosis of acute appendicitis and correlation with intra operative and histopathological findings" studied 100 patients in which he found 83 patients had inflamed appendix with a mean Alvarado score of 7.16, 7 patients had gangrenous appendix with a mean alvarado score of 8.57 and 5 patients had perforated appendix with a mean alvarado score of 9<sup>(15)</sup>.

Hence our study findings of increase in Alvarado score is associated with increase in the severity of appendicitis intra operatively were comparable to other studies.

#### 4. Conclusion

Our study was done in the Department of General Surgery, Shri Guru Ram Rai Institute of Medical and Health Sciences and associated Shri Mahant Indires Hospital, Dehradun (Uttarakhand) between the time period of Feb 2021 to August 2022 over a period of 18 months.

Present study was done to see the correlation between Alvarado score and severity of intra operative findings of acute appendicitis. Our study concluded that increase in the Alvarado score is associated with increase in severity of intra operative findings of acute appendicitis. The correlation is statistically significant with a p value of <0.001. So Alvarado score is a good indicator for predicting the severity of acute appendicitis.

Alvarado scoring system is simple to use, easy to apply and help in decision making for surgical intervention in patients of acute appendicitis.

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