

# Role of Modified Alvarado Score in the Diagnosis of Acute Appendicitis

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**This descriptive study was conducted on hundred consecutive patients, presented in the emergency department with symptoms and signs suggestive of acute appendicitis during the period from March 2001 to August 2002, in Sir Ganga Ram Hospital Lahore. The diagnosis of acute appendicitis was based on Modified Alvarado Score. The patients selected for this study were of all age groups and both sexes. Patients with established peritonitis, known surgical problems other than acute appendicitis and with mass formation were excluded from this study. The scoring system used in study is having the sensitivity 95.8%, specificity 84.6%, positive predictive value 85.2% and diagnostic accuracy 85%.**

**Key words: Acute Appendicitis, Appendicectomy, Modified Alvarado Score, Peritonitis.**

Acute appendicitis is the most common abdominal surgical emergency, which the general surgeons have been dealing with for the last 100 years<sup>1</sup>. The reported lifetime prevalence is as high as one in seven<sup>2</sup>.

Appendicitis in its classical form is easy to diagnose. However it is difficult to diagnose in very young or elderly patients and women of reproductive age due to atypical symptoms<sup>3</sup>. These diagnostic difficulty leads to delayed or missed diagnosis, resulting in complications leading to higher morbidity and mortality. Moreover removal of normal appendix, is an economical loss both for the patients and health services, along with other complication<sup>4</sup>.

A variety of different approaches have been described to overcome the diagnostic difficulties, to increase the diagnostic accuracy and to decrease the negative appendicectomy rate.

Recently for the diagnosis of acute appendicitis, a scoring system was used, consist of three symptoms, three signs and one laboratory investigation. Interpretation and use of the scoring system is as follows:

Modified Alvarado Score:

O.Bengezi and M. Al-Fallouji have modified the Alvarado score into a more practical, reliable and easy score for junior doctors to use and interpret for safe and accurate decision-making in patients with acute appendicitis.

Table 1: Modified Alvarado Score (mnemonic of MANTREEL)

|             |   | Value |
|-------------|---|-------|
| Symptoms    | Migratory RIF pain  | 1     |
|             | Anorexia  | 1     |
|             | Nausea /vomiting  | 1     |
| Signs       | Tenderness RLA  | 2     |
|             | Rigidity and/or rebound tenderness RIF  | 1     |
|             | Elevation of temperature  | 1     |
|             | Extra sign(s) e.g., cough test and/or Rovsing's sign and/or rectal tenderness | 1     |
|             | Laboratory diagnosis  | 2     |
| Total score |   | 10    |

## Patients and methods:

It was conducted on 100 consecutive patients presented in emergency department of Sir Ganga Ram Hospital Lahore, having symptoms and signs suggestive of acute appendicitis during the period from March 2001 to August 2002. The patients of all age groups and both sexes were included in this study. Except those patients who were having signs and symptoms of generalized peritonitis, Urinary tract infection, gynecological disease, Mass in right iliac fossa, Patients with known surgical problems other than appendicitis/pain in right lower quadrant.

The patient included in the study was hospitalized and the finding were recorded. There were eight variables in this proforma, which were based on the Modified Alvarado scoring system.

All values were added and according to the aggregate score, patients were divided in three groups. These were:

Group I:

Score 1-4: Patients with score one to four was non-surgical group and was discharged after giving symptomatic treatment. They were given clear instructions to come back to emergency department, if symptoms were persist or increased.

Group II:

Score 5-7: Patient with aggregates score between 5 to 7 were admitted in the surgical ward for observation. These patients were reassessed after four to six hour interval by the same registrar who admitted them for observation. Their condition either settled, persist or deteriorate and were treated accordingly.

Group III:

Score 8-10: Patient with score 8 to 10 were admitted in surgical ward and prepared for the emergency appendicectomy, no further investigation were done if the age of the patient was less than 40 years with no other systemic pathology. In patients with age more than 40 years, investigation were carried out, which are:

- Blood Urea and serum creatinine.
- Blood sugar Random.
- Chest X-ray.
- ECG.

In some patients especially in women, where exact diagnosis was still in doubt, ultrasonography (USG) was performed to exclude other pathologies.

**Results:**

In this study, one hundred patients, 40 male and 60 female, with clinical features suggestive of acute appendicitis were included. The male to female ratio was 1:1.5. Their ages ranged from 8 years to 60 years. The mean ± SD age was 19.9±8.84 years and median age was 22 years. Most of the patients 59% were aged 11-20 years.

According to Modified Alvarado Score, the patients were divided into three groups.

Group I: Discharge Group (Modified Alvarado Score 1-4):

Thirty patients (30%) had a Modified Alvarado Score of 1-4. These patients were evaluated and discharged. These were 13 males (43.3%) and 17 females (56.7%). Among them only 2 patients (6.7%), one male and one female, came back with increase in the severity of symptoms within 48 hours. Both have Modified Alvarado score of 8 on their second visit to emergency department. Operations were carried out, which showed that the male patient had acutely inflamed appendix and female had normal appendix and no other pathology was seen.

Group II: Observation Group (Modified Alvarado Score 5-7):

The result showed that 28 patients (28%) had score between 5-7, out of them 16 patients (57.1%) were females and 12 patients (42.9%) were males, They were admitted in surgical ward for observation and regular assessment, according to the protocol. In 12 patients (42.9%) the severity of symptoms increased, all of them underwent appendectomy on the basis of Modified Alvarado Score 8 or more on subsequent clinical examinations.

Table 2 Distribution of patients according to symptoms

| Symptoms                 | n=  | %age  |
|--------------------------|-----|-------|
| Pain right iliac fossa   | 100 | 100.0 |
| Pain started epigastrium | 86  | 86.0  |
| Anorexia                 | 50  | 50.0  |
| Nausia/Vomiting          | 58  | 58.0  |
| Fever                    | 34  | 34.0  |
| Diarrhoea                | 13  | 13.0  |

The operative findings and the histopathological reports showed that 10 patients (83.3%) had acutely inflamed appendix and one of them had gangrenous appendix. One female patient had right-sided salpingitis and one child had mesenteric lymphadenitis. Sixteen patients (57.1%) were discharged as the intensity of their symptoms was decreased and no patient was admitted for surgery.

Group III: Operative Group (Modified Alvarado Score 8-10):

In 42 patients the score was 8 or more. They were admitted and all of them underwent surgery. Among them, 27

patients (64.3%) were females and 15 patients (35.7%) were males. Operative findings and histopathology reports showed that 36 patients (85.7%) had acute appendicitis. Among them 26 patients (72.2%) had acute inflamed appendix, 6 patients (16. 7%) had gangrenous appendix and 4 patients (11.1%) had perforated appendix. In 6 patients (14.3%), appendix was found to be normal. Among them two patients, one male and one female had mesenteric lymphadenitis. One male had Meckle's diverticulitis, one female had acute cholecystitis. One female had right salpingitis and in one female patient no pathology was found. The range of score recorded in this study was 1-10. The mean score in discharged group was 3.5. The mean score in observaion group was 5.5. The mean score in patents, who underwent surgery, was 8.6.

Table 3: Overall sensitivity, specificity and positive predictive value according to symptoms:

| Symptoms                 | Sensitivity | Specificity | Positive predictive value |
|--------------------------|-------------|-------------|---------------------------|
| Referred pain            | 98%         | 25%         | 53%                       |
| Nausea/Vomiting          | 87%         | 67%         | 69%                       |
| Rebound                  | 87%         | 67%         | 69%                       |
| Tenderness               |             |             |                           |
| Elevation of Temperature | 66%         | 94%         | 91%                       |
| Total leukocyte count    | 74%         | 87%         | 83%                       |

The positive appendectomy rates in males were 93.33%, in females were 80% and in children was 90.90%. The negative appendectomy was 6.66% in males, 20% in females, 9% in children. The overall negative appendectomy rate was 15%. In males, the negative appendectomy rate was 10% and 19.44% in females.

Table 4: Distribution of patients according to signs

| Signs                           | Total patients |      | %age  |      |
|---------------------------------|----------------|------|-------|------|
|                                 | +ve            | -ve  | +ve   | -ve  |
| Tenderness right lower quadrant | 00.0           | 0.00 | 100.0 | 0.00 |
| Rebound Tenderness              | 58.0           | 42.0 | 58.0  | 42.0 |
| Rovsing's Sign                  | 48.0           | 52.0 | 48.0  | 52.0 |
| Rectal Tenderness               | 12.0           | 88.0 | 12.0  | 88.0 |
| Elevation of Temperature        | 34.0           | 66.0 | 34.0  | 66.0 |

The total number of the perforated appendices was 4 and all of them underwent surgery. So the perforation rate was 8.5%. Seven patients (14.9%) had gangrenous appendix. Simple acute appendicitis was present in 36 patients (76.6%).

Table 5: Distribution of the patients according to investigations

| Investigation                             | n= | %age |
|---|----|------|
| Total leukocyte count more than 10,000/ml | 42 | 52   |

Table 6: Diagnostic accuracy of modified alvarado score according to the type of patient:

| Patient  | Positive rate | %age |
|----------|---------------|------|
| Male     | 14            | 93.3 |
| Female   | 24            | 80.0 |
| Children | 10            | 90.9 |

Mean Positive Rate was 85%.

Statistical Analysis: Statistical analysis of this study showed that 46 patients had true positive (+ve) results, 44 patients had true negative (-ve) results. Eight patients had false positive (+ve ) results and 2 patients had false nagative (-ve) results.

Sensitivity = True +ve / True +ve +false -ve x 100 = 95.8%

Specificity = True -ve/ True -ve +False +ve x 100 =84.6%

Positive predictive Value = True +ve / True +ve + False +ve x 100 = 85.2%

Diagnostic Accuracy:  $\frac{\text{Proven acute appendicitis}}{\text{Total No. of patients}}$  85%

In the male the sensitivity was 96.8%, specificity was 85.7%, positive predictive value was 88.6% and diagnosis accuracy was 93%.

In females the sensitivity was 93.7% specificity was 83.3% and positive predictive value was 78.9% and diagnostic accuracy was 80%.

**Discussion:**

Appendicitis is the disease known for centuries<sup>4</sup>. It is the commonest surgical problem in every community<sup>5</sup>. The diagnosis and management of appendicitis has remained a dilemma since long. It represents a diagnostic and therapeutic challenge for the surgeons. Despite a great advancement in modern medical technology, has not been much improvement in diagnosis and management of appendicitis<sup>6</sup>. As a result, negative appendectomy rate is high, especially in women of reproductive age<sup>7</sup>. Removal of the normal appendix is not free of complications. Due to fear of developing complications of appendicitis, 25% of negative appendectomy rate is acceptable<sup>8</sup>.

The indication for operative treatment remains based on clinical examination and the accuracy of diagnosis has improved little in decades, with a negative appendectomy rate is as high as 30 %. Only laparoscopy, ultrasonography and scoring systems have demonstrated good clinical results, but all have their drawbacks<sup>9</sup>. The role of a structured form has emphasized by several authors, on the basis of a scoring system<sup>10</sup>. Diagnostic accuracy increased by applying scoring systems. This observation agrees with that of others. Several explanations have been discussed. A placebo effect resulting from study condition, a checklist effect due to structured history taking and physical examination, and the effect that such a form (for scoring system) may have on the enthusiasm of clinicians. A structured form may

provide a more consistent preoperative patient assessment in terms of terminology and completeness of relevant history and examination<sup>11</sup>.

The scoring system used in this study works with data collected routinely in the emergency room and its application takes less than 5 minutes. This system was dynamic and a patient's score can increase or decreased on reassessment.

In this study there were 60 female and 40 male patients with female domination. This is comparable to the figures given by Macklin et al (1997) (54 male and 64 female). The high ratio of females as compared to males may be due to the fact that it is a female medical college attached hospital. Mean age of the patients is also comparable to that in other studies. In this study the mean age of the patient was 19.9(median age was 22 years with the range of 8-60 years. The study done by walker et al (1995), showed that the median age of the patient was 18 years, with the range of 6 to 81 years.

In our study, 75% of the patients with biopsy proven acute appendicitis had an elevated total leukocyte count (TLC), which was almost same as shown by Goodman et al (1995) i.e. 79% of patients with acute appendicitis had an elevated preoperative TLC. In this study, all patients (100%) with perforated appendix had an elevated TLC as compared by 87% observed by Coleman et al (1998) in his study.

The presence data shows that pain in the right iliac fossa had the sensitivity, specificity and positive predictive value of 98%. 35% and 53% respectively as compared to 94%, 70% and 34% respectively observed by Bohner et al (1994).

Rebound tenderness in the right lower abdomen had the sensitivity, specificity and positive predictive value of 87%, 67%, and 69% respectively in this study as compared to 91%, 80%, and 39% shown by Boher at el (1994).

Elevation of the temperature had the sensitivity, specificity and positive predictive value of 66%, 94%, and 91% respectively in this study as compared to 87%, 76%, and 26% respectively shown by Bohner et al (1994).

Total number of the operation done for the acute appendicitis was 56 and among them 47 patient has biopsy proven appendicitis. Based upon the Modified Avarado Scroing system, the negative appendectomy rate was 15% in this study. It is comparable with the results shown by the published literature (Gurleyik et al 1995, Ohmann et al 1995, Alvarea et al 1997). But keeping in mind the low perforation rate (8.5%), this neagative appendicitomy result was quite good because as the appendectomy rate decreases, the diagnostic accuracy increases, In males, the negative appendectomy rate was 6.66% and in females, the negative appendectomy rate was 20%. The studies by Ohmannet al (1995), Gurleyik et al (1995), Fenyo et al (1997) and Alvarez et al (1997) showed negative appendectomy rate of 21%, 17.5%(Female > 25%),

17.5%(Male 11.2% and female 25.4%) and 14.8% respectively.

The scoring system used in this study had the sensitivity of 95.8% (male 96.8% and female 93.7%), Specificity of 84.6% (male 85.7% and female 83.3%) positive predictive value of 85.2%(male 88.6% and female 78.9%) and diagnostic accuracy was 85%(male 93% and female 80%). Fenyó et al (1997) used another scoring system and had the sensitivity, specificity and positive predictive value of 73%, 87% and 72% respectively, Senbanjo (1997) showed diagnostic accuracy of 76%, 79% and 84.3% respectively. Scoring system used by Gallego et al (1998) showed the sensitivity and specificity of 60% and 73% respectively.

The diagnostic accuracy independently given in this study was 93.33% in males, 80% in females and 90.90% in children (Table 10) as compared with 94% in males, 78% in females and 88% in children given by Owen et al (1992).

#### Conclusion:

Use of the Modified Alvarado Score improves the preoperative diagnosis of acute appendicitis. The implementation of this scoring system is simple and cost effective for the hospital, it seems to be ideal for supporting the diagnosis of acute appendicitis, because it is non-invasive, requires no special equipment and can be used in routine.

By applying the Modified Alvarado Score, the diagnostic accuracy improved and negative appendicectomy and perforation rate was decreased. The length of hospital stay also decreased as fewer complications occurred.

The sensitivity, specificity and positive predictive value of the Modified Alvarado Score is better than just

clinical assessment of the surgeons. The result of study is encouraging, but the number of the patients is less, so that further testing and clinical application can be recommended.

#### References:

1. Hoffmann J, Rasmussen OO. Aids in the diagnosis of acute appendicitis. *Br J Surg* 1989; 76: 774-79.
2. Stephens PL, Mazzucco JJ. Comparison of ultrasound and the Alvarado Score for the diagnosis of acute appendicitis. *Conn med* 1999; 63:137-40.
3. Spirots NM, Eisenkop SM, Sirots TW, Poliakin RI, Hibbard LT. Laparoscopy, diagnostic and in cases of suspected appendicitis. Its use in women reproductive age. *Am J Obstet Gynecol* 1987; 156:90-94.
4. Lim HK, Bae SH, Seo GS. Diagnosis of acute appendicitis in pregnant women, Value of ultrasound. *Am J Res* 1994; 159:539-42.
5. Evans RH, Colbert RF. Acute perforated appendicitis-An unusual variant simulating acute acalculus cholecystitis. *J Clin Ultrasound* 1988; 16: 513-15.
6. Dunn EL, Moore EE, Elderling SC, Murphy JR. The unnecessary laparotomy for appendicitis: can it be decreased? *Am Surg* 1982; 48: 320-323.
7. Gilmore OJA, Brodribb NM, Browett JP. Appendicitis and mimicking conditions; a prospective study. *Lancet* 1975;ii: 421-24.
8. Jacob ET, Bar-Nathan N, Iuchtman M. Error-rate factor in the management of appendicitis. *Lancet* 1975;ii: 1032.
9. Jawaid A, Asad A, Munir A, Bhutto E, Choudry H, Aslam S, Ahmad U et al. Clinical Scoring System: a valuable tool for decision making in cases of acute appendicitis. *J Pak Med Assoc* 1999; 49: 254-59.
10. Alvarado A. A practical score for the early diagnosis of acute appendicitis. *Ann Emerg Med* 1986; 15: 557-64.
11. Korner H, Sondenaa JA, Soreide JA. Structured data collection improves the diagnosis of acute appendicitis. *Br J Surg* 1998; 85: 341-44.