EVALUATION OF MODIFIED ALVARADO SCORING SYSTEM IN THE DIAGNOSIS OF ACUTE APPENDICITIS

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ABSTRACT

BACKGROUND
Acute appendicitis is one of the most common cause of abdominal surgical emergencies. The diagnosis of acute appendicitis is clinical. Despite its frequency, the diagnosis of appendicitis is sometimes difficult. Early diagnosis and prompt operative intervention is the key for successful management of acute appendicitis. In order to reduce the negative appendectomy rate, various scoring systems have been developed for supporting the diagnosis of acute appendicitis. The most commonly used scoring system is Alvarado score and equally its modifications.

Aims and Objectives-
1. To evaluate the Modified Alvarado Score System (MASS) in the diagnosis of acute appendicitis.
2. To find out sensitivity, positive and negative predictive value of MASS.
3. To find out negative appendicectomy rate.

MATERIALS AND METHODS
This is a prospective study conducted in tertiary care teaching hospital in Vidarbha from November 2016 to October 2017. Total 196 patients were evaluated, of which 14 were excluded according to exclusion criteria. Therefore, 182 patients were included in this study.

RESULTS
182 patients were included in this study. Total 126 (67 males and 59 females) patients were operated. On histopathology, appendicitis was confirmed in 102 (58 males and 44 females) patients. Overall, sensitivity and specificity of Alvarado score was 71.57% and 45.83%. Positive and negative predictive values were found to be 84.88% and 27.5% respectively. Positive appendicectomy rate was found to be 80.95%. Overall, negative appendicectomy rate was 19.05%.

CONCLUSION
Acute appendicitis is usually a clinical diagnosis and should remain one in the vast majority of patients coming with right iliac fossa pain. Alvarado scoring system is a very useful method to make a clinical diagnosis of acute appendicitis and can be arrived virtually in no time.

KEYWORDS
Modified Alvarado Score, Appendicitis, Right Iliac Fossa Pain.


BACKGROUND
Acute appendicitis is one of the most common causes of abdominal surgical emergencies. About 6% population is expected to have appendicitis in their lifetime.1 Approximately, 2 lakh appendectomies for acute appendicitis are performed annually in USA.2 The diagnosis of acute appendicitis is clinical. Despite its frequency, the diagnoses of appendicitis is sometimes difficult.3,4,5,6,7,8,9

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diagnostics after elapse of more than a century since its first description, it continues to be a diagnostic problem and diagnostic inaccuracy in acute appendicitis has remained unchanged.

The most important diagnostic test is physical examination. The accuracy of physical examination ranges from 71% to 97% depending on the experience of the surgeon. In order to reduce the negative appendicectomy rate, various scoring systems have been developed for supporting the diagnosis of acute appendicitis and eliminate any risk of perforation, which in turn increases the rate of post-operative complication.

The most commonly used scoring system is Alvarado score and equally its modifications. Modified Alvarado score consisted of three symptoms, three signs and laboratory findings as described by Alvarado and later modified by Kalan et al.

**Aim**
To evaluate the MASS in the diagnosis of acute appendicitis.

**Objectives**
1. To find out sensitivity, positive and negative predictive value of MASS.
2. To find out negative appendicectomy rate.

**MATERIALS AND METHODS**
This is a prospective study conducted in tertiary care teaching hospital in Vidharbha from November 2016 to October 2017. Total 196 patients were evaluated, of which 14 were excluded according to exclusion criteria. Therefore, 182 patients were included in this study.

All Patients above Age 10 Years having Pain in Right Lower Abdomen were included in this Study

**Study Design**
Observational Study.

**Study Population**
All patients with clinical diagnosis of acute appendicitis.

**Study Setting**
Department of Surgery of Dr. P.D.M. M.C. Amravati.

**Study Period**
1st of November 2016 to 31st of October 2017.

**Sampling Method**
Convenience sampling.

**Data Collection Tool and Collection Method**
Patients of 10 years and above age group and both the sexes were taken into the study having right lower abdominal pain and if clinical diagnosis was acute appendicitis they were investigated and subsequently divided into the three groups according to the Alvarado scoring system.

**Mass: (Modified Alvarado Score System)**

<table>
<thead>
<tr>
<th>Character</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>M - Migration of pain to right iliac fossa</td>
<td>1</td>
</tr>
<tr>
<td>A - Anorexia</td>
<td>1</td>
</tr>
<tr>
<td>N - Nausea/Vomiting</td>
<td>1</td>
</tr>
<tr>
<td>T - Tenderness in right iliac fossa</td>
<td>2</td>
</tr>
<tr>
<td>R - Rebound tenderness</td>
<td>1</td>
</tr>
<tr>
<td>E - Elevated temperature</td>
<td>1</td>
</tr>
<tr>
<td>L - Leukocytosis</td>
<td>2</td>
</tr>
<tr>
<td>S - Shift to the left of neutrophils</td>
<td>1</td>
</tr>
</tbody>
</table>

Then, further investigation in the form of pre-operative profile and USG of abdomen and pelvis was done in every patient. X-ray abdomen and X-ray KUB was done in selected cases. Scores of each patient were calculated according to MASS, then patients were divided into 3 groups.

Group 1 Score 1-4 Acute Appendicitis, unlikely
Group 2 Score 5-6 Probable
Group 3 Score 7-10 Very Probable

All the patients of Group III were operated, while Group I and Group II were observed for 24-48 hours in the ward. Patients were further evaluated and if score system goes equal or above (≥) 7 then these patients were considered for surgery. All the specimens of excised appendix were sent for Histopathology for confirmation whether features of appendicitis were present or else. Those who responded to conservative treatment were discharged.

All data were evaluated according to the Histopathology reports that is considered as gold standard. Approval from the Scientific Review Committee and Institutional Ethical Committee was taken before starting the study.

**Inclusion Criteria**
All patients above 10 years of age with clinical diagnosis of acute appendicitis.

**Exclusion Criteria**
1. Mass in right iliac fossa.
2. Patients with gynaecological, urological and surgical problems other than appendicitis.
3. Incomplete documentation in case sheets.
4. If not willing for inclusion in study group.

**Informed Written Consent**
Was taken from all patients.
Anaesthesia
Patients were done under general or spinal anaesthesia as per need.

Surgical Procedure
Standard conventional open surgical procedure for appendicitis.

Data Entry and Statistical Analysis
Data was entered in Microsoft Excel and was analysed in SPSS software version 16 and appropriate test of significance was applied.

RESULTS

<table>
<thead>
<tr>
<th>Age (In Years)</th>
<th>No. of Patients</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>11 - 20</td>
<td>41 (22.53%)</td>
<td>24</td>
<td>17</td>
</tr>
<tr>
<td>&gt;20 - 30</td>
<td>78 (42.86%)</td>
<td>40</td>
<td>38</td>
</tr>
<tr>
<td>&gt;30 - 40</td>
<td>28 (15.38%)</td>
<td>15</td>
<td>13</td>
</tr>
<tr>
<td>&gt;40 - 50</td>
<td>25 (13.73%)</td>
<td>16</td>
<td>9</td>
</tr>
<tr>
<td>&gt;50 - 60</td>
<td>08 (4.40%)</td>
<td>05</td>
<td>03</td>
</tr>
<tr>
<td>&gt;60 - 70</td>
<td>02 (1.10%)</td>
<td>02</td>
<td>00</td>
</tr>
<tr>
<td>Total</td>
<td>182 (100%)</td>
<td>102</td>
<td>80</td>
</tr>
</tbody>
</table>

Table 1. Distribution of Patients as per Age Group

A total of 182 patients were included in the study, of which 102 were males (56.04%) and 80 were females (43.96%). Age ranged from 11 years to 69 years, mean age was 29.54 years and median was 28.0 years. Male-to-female ratio was 1.27: 1.

<table>
<thead>
<tr>
<th>Alvarado Score</th>
<th>No. of Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥7</td>
<td>86 (48%)</td>
</tr>
<tr>
<td>5 - 6</td>
<td>72 (39%)</td>
</tr>
<tr>
<td>1 - 4</td>
<td>24 (13%)</td>
</tr>
<tr>
<td>Total</td>
<td>182</td>
</tr>
</tbody>
</table>

Table 2. Distribution of Patients according to Alvarado Score

<table>
<thead>
<tr>
<th>Alvarado Score</th>
<th>Acute Appendicitis (HP +ve)</th>
<th>Normal Appendix (HP -ve)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;7 (45)</td>
<td>43 [a]</td>
<td>2 [b]</td>
</tr>
<tr>
<td>1 - 6 (22)</td>
<td>15 [c]</td>
<td>7 [d]</td>
</tr>
</tbody>
</table>

Table 4. Histopathology in Operated Males

<table>
<thead>
<tr>
<th>Alvarado Score</th>
<th>Acute Appendicitis (HP +ve)</th>
<th>Normal Appendix (HP -ve)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;7 (41)</td>
<td>30 [a]</td>
<td>11 [b]</td>
</tr>
<tr>
<td>1 - 6 (18)</td>
<td>14 [c]</td>
<td>4 [d]</td>
</tr>
</tbody>
</table>

Table 5. Histopathology in Operated Females

24 (13%) patients were having score within 1 - 4 range, whereas 72 (39%) and 86 (48%) patients were having score within 5 - 6 and 7 - 10 range respectively; 17 (70.83%) males and 7 (29.17%) females within 1 - 4 range; 40 (55.56%) males and 32 (44.44%) females in the group having score range 5 - 6; 45 (52.33%) males and 41 (47.67%) females in the group having score range 7 - 10.

In males the sensitivity was found to be 74.14% and in females, sensitivity was found to be 68.18%.

In males, specificity was found to be 77.78% and in females, specificity was found to be 26.67%.

Overall, sensitivity and specificity of Alvarado score was 71.57% and 45.83%.

Positive and negative predictive values were found to be 84.88% and 27.5% respectively.

Positive appendicectomy rate was found to be 80.95%.

Negative appendicectomy rate in males is 13.44% and in females is 25.5%.

Overall, negative appendicectomy rate was 19.05%.

<table>
<thead>
<tr>
<th>Condition</th>
<th>No.</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wound Infection</td>
<td>8</td>
<td>6.35%</td>
</tr>
<tr>
<td>Wound Dehiscence</td>
<td>2</td>
<td>1.59%</td>
</tr>
<tr>
<td>Abd. and Pelvic abscess</td>
<td>0</td>
<td>0.0%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>10</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

Table 6. Post-Operative Complications (out of 126 Operated Patients)

<table>
<thead>
<tr>
<th>Condition</th>
<th>No.</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain in abdomen</td>
<td>182</td>
<td>100%</td>
</tr>
<tr>
<td>Migration of pain to right iliac fossa</td>
<td>129</td>
<td>70.37%</td>
</tr>
<tr>
<td>Anorexia</td>
<td>92</td>
<td>50.54%</td>
</tr>
<tr>
<td>Nausea/ Vomiting</td>
<td>78</td>
<td>42.85%</td>
</tr>
<tr>
<td>Fever</td>
<td>102</td>
<td>56.04%</td>
</tr>
<tr>
<td>Others (urinary complaint/ diarrhoea)</td>
<td>07</td>
<td>03.85%</td>
</tr>
</tbody>
</table>

Table 7. Showing Distribution of Clinical Symptoms and Signs Symptoms

<table>
<thead>
<tr>
<th>Condition</th>
<th>No.</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tenderness in RIF</td>
<td>173</td>
<td>95.05%</td>
</tr>
<tr>
<td>Rebound tenderness</td>
<td>69</td>
<td>37.91%</td>
</tr>
<tr>
<td>Tachycardia</td>
<td>122</td>
<td>67.03%</td>
</tr>
<tr>
<td>Temperature ≥37.5</td>
<td>115</td>
<td>63.19%</td>
</tr>
</tbody>
</table>

Table 8. Signs

DISCUSSION
In present study, we found that acute appendicitis is common in age group > 20 - 30 years (42.86%). Next group was > 10 - 20 years (22.53%). These findings were similar to Talukder DB et al.8

86 patients having score 7 - 10 underwent appendicectomy. Acute appendicitis was confirmed after histopathology in 73 patients, of which 5 patients had perforation of appendix (3 males and 2 females) and 4 patients had gangrenous appendicitis (2 males and 2 females). 13 patients had normal appendix on histopathology (2 males and 11 females).

Out of 72 patients having score 5 - 6, 38 (52.76%) underwent appendicectomy within 36 hours of admission after reassessment due to increased severity of symptoms and clinical deterioration and on revised scoring they were having score > 6; 11 (7 males and 4 females) operated patients of this group showed normal appendix on histopathology.

24 patients having score of range 1 - 4 were discharged within 48 hours of admission; 2 (1 male and 1 female) patients of this group were readmitted within 36 hours of discharge with increased severity of symptoms and were found score > 6 and underwent appendicectomy. Histopathology confirmed acute appendicitis in both the patients.
Total 126 (67 males and 59 females) patients were operated. On histopathology, appendicitis was confirmed in 102 (58 males and 44 females) patients. Positive appendectomy rate was found to be 80.95%. Negative appendectomy rate in males was 13.44% and in females was 25.5% respectively.

In males the sensitivity and specificity were 74.14% and 77.78%, whereas positive and negative predictive values were 95.16% and 3.181%.

Female had sensitivity and specificity of 68.18% and 26.67% respectively. Positive and negative predictive values were 73.17% and 2.222%.

Lone et al. showed sensitivity is more in males than females.

Symptom wise 129 (70.87%) patients presented with migration of pain to right iliac fossa. Fever was presenting symptoms in 102 (56.04%) patients.

On examination, tenderness in right iliac fossa was present in 173 (95.05%) patients. However, rebound tenderness was present in 69 patients (37.91%).

Perforation of appendices was seen in 5 patients (2.71%) and gangrenous appendicitis was seen in 4 patients (2.2%). Out of 24 patients in which appendix was found normal on histopathology.

11 patients had mesenteric lymphadenitis and 7 female patients had salpingitis.

Meckel's diverticulum (Wide neck) was seen in 2 patients and in 4 patients no pathology was found.

Overall, sensitivity and specificity of Alvarado score was 71.57% and 45.83% respectively and positive and negative predictive value was 84.88% and 27.5%.

The results of our study are comparable with the relevant literature. Our study shows sensitivity of 71.57% comparable with the literature ranging from 67% to 93% and specificity of 45.83% having range from 50% to 93% in the literature. The positive predictive value of 84.88% was comparable with literature reports of 97%, 97.6% and 83.5%.

We had a negative appendectomy rate of 19.05% (males 13.44% and females 25.5%). Similar results were reported in literature of 21%, 15.6% and 7%.

There are even opinions and evidences that if negative appendectomy rates are below 10% - 15% the surgeon is operating on too few patients on clinical ground, thus increasing the risk of complications.

Wound infection rate was 6.35% (8 patients). Wound dehiscence was seen in two patients (1.59%). Postoperatively, no patient showed abdominal and pelvic abscess.

Despite the availability of radiological (US/CT) investigative modalities, a recent population based study in USA indicated that there was essentially no change in the frequency of negative appendectomy.

Similar results were also reported, where the authors found USG did not have any additional benefit over Alvarado score and were of the opinion that USG is unnecessary in diagnosis of acute appendicitis.

CONCLUSION
Acute appendicitis is usually a clinical diagnosis and should remain one in the vast majority of patients coming with right iliac fossa pain. Alvarado scoring system is a very useful method to make a clinical diagnosis of acute appendicitis and can be arrived virtually in no time. It is simple, extremely cost effective and useful in even the remotest of geographies in the majority of patients of acute appendicitis.

REFERENCES


