

Role of Modified Alvarado Score in the Diagnosis of Acute Appendicitis

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I. Introduction

Acute appendicitis has remained the most common diagnosis of emergency hospital admissions requiring laparotomy.[1,2] Approximately 6% of the population suffers from acute appendicitis during their lifetime. The mortality rate is less than 0.1% for non-complicated appendicitis, 0.6% in gangrenous appendicitis, and 5% for perforated cases. Therefore much effort has been directed towards early diagnosis and intervention.[3] The diagnosis of appendicitis can be difficult, occasionally taxing the diagnostic skills of even the most experienced surgeons .The classical signs and symptoms of acute appendicitis were first reported by Fitz in 1886.[4] As the incidence of perforation is usually proportional to the duration of the disease process, traditional teaching has encouraged surgeons to operate even if the diagnosis is probable rather than wait until it is certain. The morbidity and mortality rates associated with appendicectomy are greatly increased when perforation ensues.[5] There is three time increase in wound infection rate, fifteen fold increases in intra – abdominal abscess and mortality may be 50 times greater.[3] Appendiceal perforation can also cause tubal infertility.[6] Hence aim of the surgeon must be to operate before perforation occurs, in spite of high rate of negative appendicectomy. The removal of normal appendix carries a price, the usual spectrum of immediate post-operative complications like hemorrhage, wound infection, intra-abdominal abscess in up to 15% of patients.[3] and late complications such as intestinal obstruction, incisional hernia[7] , right sided inguinal hernia[8] and sterility due to fimbrial adhesions.[9] Hence 20-44% negative appendicectomy rate which surgeons hence hitherto accepted, can no longer be justified.[10] Despite extraordinary advances in modern imaging and other diagnostic investigations, the accurate pre-operative diagnosis of acute appendicitis remains an enigmatic challenge. Scoring systems appear to be ideal, convenient accurate, non-invasive and require no special equipment. Modified Alvarado's score is the most simple to use, easy to apply and is also dynamic since it relies only on history, clinical examination and basic laboratory investigations.[11] The present study aims to evaluate the usefulness of the modified Alvarado Scoring system in the preoperative diagnosis of acute appendicitis to reduce the false positive appendicectomy rate.

II. Material And Methods

Present study was carried out in I.G. Medical College and Hospital, on admitted patients, of right iliac fossa (RIF) pain and suspected cases of acute appendicitis during the period of one year from 01-01-2013 to 31-12-2013 and included 50 patients. The evaluation of the patients was done by history, clinical examination, Modified Alvarado Score, investigations and histopathological examination of appendicectomy specimen. Detailed history was taken in every case with emphasis on migratory RIF pain, anorexia, nausea / vomiting, burning micturation, fever, menstrual history and history of tuberculosis. Every case was thoroughly examined and with emphasis on recording of pulse, temperature, tenderness in right iliac fossa, rebound tenderness in right iliac fossa, digital rectal examination was done. The tests done on admitted patients with right iliac fossa pain, were Hb, TLC, DLC, ESR, random blood sugar, serum urea, serum creatinine. Urine for albumin , sugar and microscopic examination . Histopathological examination of appendix in all operated cases was done. The patients with right iliac fossa pain were subjected to Chest radiograph – PA view, radiograph Abdomen (standing) and USG – Abdomen (using high frequency transducer).

Modified Alvarado Score

The scoring system as described is based on 3 symptoms, 3 signs and 1 laboratory test.[12]

MODIFIED ALVARADO SCORING SYSTEM	
FEATURES	SCORE
Symptoms	

➤ Migratory RIF pain	1
➤ Anorexia	1
➤ Nausea / vomiting	1
Signs	
➤ Tenderness RIF	2
➤ Rebound tenderness RIF	1
➤ Elevated temperature ($\geq 37.5^{\circ}\text{C}$)	1
Laboratory	
➤ Leucocytosis ($>10 \times 10^9 / \text{L}$)	2
➤ Total score	9

In this study , we used modified version of the Alvarado score by excluding one laboratory findings ; shift to the left of neutrophil maturation ($> 75\%$). Patients with Modified Alvarado Score of 1-4 are considered unlikely to have acute appendicitis , those with a score of 5-6 have a possible diagnosis of acute appendicitis, not convincing enough to have urgent surgery, and those with score of 7-9 are regarded as probable acute appendicitis. The Modified Alvarado Score can increase or decrease on reassessment. The diagnosis made by Modified Alvarado Score and confirmed with operative findings i.e. appendix inflamed or not, gangrene of appendix present or not, periappendicular fluid is present or not and histopathological examination of appendix in all operated cases. Sensitivity and specificity of our new method was compared to standard coated data in literature.

Observations

The youngest case was 6 years old and the oldest was 55 years of age. The mean age was 25.50 ± 12.63 years. It was observed that maximum number of 13(26%) cases belong to 21 – 30 years of age group and minimum number of 1 (2%) cases belongs to 41-50 years of age group. In our study , 33 (66%) cases were males and 17 (34%) cases were females.

On assessment, the patients were categorized into 3 groups as mentioned in Table 1

In our study , out of 50 patients 24 patients were male and 14 patients were female and 12 were children (Table 1)

Table : 1 – Showing group – wise distribution of cases

Groups	No. of patients(n-50)	Percentage(%)
Male (group I)	24	48
Female (group II)	14	28
Children(group III)	12	24
Total	50	100

In our study , we observed that migratory pain was present in 36(72%) cases with history of pain around the umbilical region initially which later shifted to RIF . Anorexia was present in 44(88%) of cases. Nausea / vomiting was present in 42(84%) of cases . Elevated temperature was present in 28(56%) of cases. Rebound tenderness was present in 43(86%) of cases. Tenderness RIF was present in 50(100%) of cases. Leucocytosis was seen in 35(70%) of cases. (Table 2)

Table : 2 – Showing symptoms , Signs and Lab findings

	No. of Patients	Percentage (%)
Symptoms		
▪ Migratory pain	36	72
▪ Anorexia	44	88
▪ Nausea/vomiting	42	84
Signs		
▪ Tenderness RIF	50	100
▪ Rebound tenderness	43	86
▪ Elevated temperature	28	56
Lab findings		
▪ Leucocytosis	35	70

Group – wise distribution of chief symptoms

In our study we observed that 20(83.3%) cases presented with migratory pain RIF, 18(75%) were having anorexia and 16 (66.67%) were having nausea / vomiting in group I (n – 24) . In group II (n – 14) , 5 (35.7%) cases were presented with migratory pain RIF, anorexia and nausea / vomiting were present in 14(100%) patients each . Whereas in group III(n – 12) , 11 cases presented with migratory pain RIF and all the 12(100%) cases were having anorexia and nausea / vomiting .(Table 3)

Table : 3 – showing group – wise distribution of chief symptoms

Symptoms	No. of cases in group I (n-24)	No. of cases in group II (n-14)	No. of cases in group III (n-12)
Migratory pain RIF	20(83.3%)	05(35.7%)	11(91.66%)
Anorexia	18(75%)	14(100%)	12(100%)
Nausea / vomiting	16(66.67%)	14(100%)	12(100%)

Group – wise distribution of chief signs

It was observed that all 24 (100%) cases were having tenderness RIF , rebound tenderness was present in 21 (87.5%) cases and elevated temperature was present in 11 (45.8%) cases in group I . In group II, 14 (100%) cases were having tenderness RIF, 11(78.5%) cases were having rebound tenderness and 9(64.2%) cases were having elevated temperature. In group III, 12(100%) cases were having tenderness RIF , 11(91.6%) cases were having rebound tenderness and 8 (66.6%) cases were having elevated temperature .(Table 4)

Table : 4 – showing group – wise distribution of chief signs

Symptoms	No. of cases in group I (n-24)	No. of cases in group II (n-14)	No. of cases in group III (n-12)
Tenderness RIF	24(100%)	14(100%)	12(100%)
Rebound tenderness	21(87.5%)	11(78.5%)	11(91.6%)
Elevated temperature	11(45.8%)	09(64.2%)	08(66.6%)

Group – wise distribution of laboratory findings

In our study , we observed that 15(62.5%) cases were having leucocytosis in group I (n-24). In group II (n-14), 11(78.6%) cases were having Leucocytosis , whereas in group III (n-12), 9(75%) cases were having Leucocytosis.

Group-wise distribution of cases with Modified Alvarado Score ≥ 7

In our study, out of total 24 cases in group I, 17 (70.8%) cases were having Modified Alvarado Score ≥ 7 . In group II (n-14), 12 (85.7%) cases were having Modified Alvarado Score ≥ 7 whereas in group III (n-12) , 11 (91.6%) cases were having Modified Alvarado Score ≥ 7 . All cases with Modified Alvarado Score ≥ 7 underwent an appendicectomy (Table 5)

Table : 5 – showing group – wise distribution of cases with Modified Alvarado Score ≥ 7

Group	No. of patients(n-50)	No. of patients with MAS ≥ 7
Group I	24	17(70.8%)
Group II	14	12(85.7%)
Group III	12	11(91.6%)

Group wise distribution of cases with Modified Alvarado Score < 7

In group I , out of 24 patients , 5 were having Modified Alvarado Score 6 and 2 were having Modified Alvarado Score 5 , who were thought on clinical ground to require appendicectomy after 24 hour observation , because still they were having persistent pain in RIF associated with vomiting and tenderness in RIF along with other associated criteria.

In group II , out of 14 cases , 1 case was having Modified Alvarado Score 6 and 1 was having Modified Alvarado Score 5 , who were thought on clinical ground to require appendicectomy after 24 hour observation , because till they were having persistent pain in RIF associated with vomiting and tenderness in RIF along with other associated criteria

In group III , 1 case was having Modified Alvarado Score 6 who were thought on clinical ground to require appendicectomy after 24 hour observation, because still he was having persistent pain in RIF associated with vomiting and tenderness in RIF along with other associated criteria.

All the patients who had modified Alvarado Score < 5 were discharged after inpatients observation. In these patients the condition did not progress further and none of the patients developed an appendix mass or generalized peritonitis from perforation . All the patients who had low score < 5 were discharged and did not subsequently report for an appendicectomy (Table 6)

Table:6 – showing group – wise distribution of cases with Modified Alvarado Score < 7

Groups	Total no. of patients (n-50)	No. of patients with MAS 6	No. of patients with MAS 5
Group I	24	5	2
Group II	14	1	1
Group III	12	1	-

Appendicectomy in patients having Modified Alvarado Score ≥ 7 showing false positive appendicectomy rates and sensitivity of Modified Alvarado Score

In group I , appendicitis was confirmed histological in 15 of the 17 cases who underwent appendicectomy, a sensitivity of 93.75% (proportion of true positive). Two cases were included as false positive appendicectomy . In group II appendicitis was confirmed histological in 8 of the 12 cases who underwent appendicectomy , a sensitivity of 66.66% (proportion of true positive). 4 cases were included as false positive appendicectomy . In addition in group III, 11 children out of 12 has histological proven appendicitis producing a sensitivity rate 91.66% (Table 7)

Table:7 showing sensitivity of Modified Alvarado Score in patients with MAS ≥ 7

Groups	Total no. of patients (n-50)	No. of patients with MAS > 7	Appendicitis	False positive appendicectomy	Sensitivity
I	24	17	15	2	93.75%
II	14	12	8	4	66.66%
III	12	11	11	-	91.66%

Appendicectomy in patients having modified Alvarado score < 7 showing false positive appendicectomy rates and sensitivity of Modified Alvarado Score

It was observed that patients who went to operation theatre with Modified Alvarado Score of < 7 , seven were male , two were female and one child . Of these 6 of male had histological proven appendicitis producing a sensitivity rate of 69% and one of the two women had histological proven appendicitis producing a sensitivity rate of 50% (Table 8)

Table:8 showing sensitivity of Modified Alvarado Score in patients with MAS < 7

Groups	Total no. of patients (n-50)	No. of patients with MAS < 7	Appendicitis	False positive appendicectomy	Sensitivity
I	24	7	6	1	69.00%
II	14	2	1	1	50.00%
III	12	1	1	-	-

These patients were the only ones to have their diagnosis delayed , but this was not directly attributable to the scoring systems and they would have been observed for a period regardless. No patients required surgery who had a score of less than 5. In our study we found that the mean postoperative hospital stay was 4.06 ± 0.68 days.

III. Discussion

Appendicitis is a common surgical emergency. The diagnosis is generally based on history and physical examination, supported by hematological and radiological tests. Modified Alvarado Score is simple to use, easy to apply, and is dynamic since it relies on history, clinical examination and basic laboratory investigations. The present study was designed to evaluate the Modified Alvarado score in the diagnosis of acute appendicitis. In our study, mean age was 25.5(SD+12.63), male were 33(66%) and females were 17(34%) comparable to the study conducted by Berry J and Malt RA (1984)¹³, where males were 148(60.2%) and females were 98 (39.8%) and to the study conducted by Asfar S et al (2000)¹⁴, where males were 54 (69.5%) and females were 24 (30.5%). In our series maximum cases were from age group 21-30 (26%) years while in study conducted by Lewis FR et al (1974)¹⁰, maximum cases were from age group 21-30 (35.5%) years. The chief symptoms and the signs in our study were compared with the studies conducted by Lewis FR et al ¹⁰ and Berry J, Malt RA (1984)¹³ and found to be in consistent with their findings as shown in the Table 1.

Table 1: Comparison of present study with other studies

Variables	Lewis FR et al (1974) ¹⁰ (n-772)	Berry J and Malt RA (1984) ¹³ (n-246)	Present study (2013) (n-50)
Anorexia	92%	61%	88%
Nausea/vomiting	78%	67.5%	84%
Migrated pain	75%	80%	72%
Elevated temperature	13%	34.3%	56%
Tenderness	99%	95.9%	100%
Rebound tenderness	68%	69.5%	86%

In our study, leukocytosis was present in 35 (70%) cases. Study conducted by Sasso RD et al (1970)¹⁵ showed that 80 - 82% of patients with acute appendicitis had a total white cell count of 10,000/mm.³ Neutrophils of more than 75% occurred in 78% of patients. Doraiswamy NV (1979)¹⁶ had reported that the white cell count and neutrophil count are especially sensitive in children. Thus although a raised white cell count is highly sensitive test for acute appendicitis, is rendered almost useless by its low specificity and it has little diagnostic value. The only value of the

white cell count would seem to be to prompt observation rather than operation in a patient who has equivocal feature of appendicitis together with normal count.

In our study, sensitivity of Modified Alvarado Score in male, female and children was 93.75%, 66.66% and 91.66% respectively in cases with MAS \geq 7 with false positivity rate 5.25 %, 33.34%, 8.34% respectively. Owen TD et al (1992)¹⁷ showed 94%, 78% and 88% sensitivity in men, women and children respectively in cases with Modified Alvarado Score $>$ 7. Whereas false positivity rate of 6%, 22% and 12% in men women and children respectively. Kalan M et al (1994)¹² showed 93%, 67% and 100% sensitivity in men, women and children respectively in cases with Modified Alvarado Score \geq 7. The negative appendectomy rate in women was 33%.

IV. Conclusion

Acute appendicitis is of the commonest yet difficult diagnostic problems confronting the surgeon. The patient may not have typical clinical findings. Therefore making the exact diagnosis is problematic. The study showed that use of Modified Alvarado Score in patients suspected of having acute appendicitis provides a high degree of sensitivity and specificity. The Modified Alvarado Scoring system is effective in men and children but additional use of ultrasonography or diagnostic laparoscopy can be advised to minimize the unacceptably high false positive rate in women. Hence it is recommended that Modified Alvarado Score should be applied in cases of acute appendicitis.

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