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Evaluation of the Modified Alvarado Score in the Diagnosis of Acute appendicitis

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Abstract:
Background: *Acute appendicitis is the commonest surgical emergency. It can be diagnosed by clinical examination alone but ultrasound and CT scan have also been employed to get a definitive diagnosis in unclear cases. We have evaluated the role of Modified Alvarado score in the diagnosis of this disease with the aim to increase the sensitivity of the clinical diagnosis and decrease the use of expensive and time-consuming tests.*
Materials and methods: *50 cases of acute appendicitis were evaluated on the basis of Modified Alvarado score in this prospective study over the period of 2 years in the Department of Surgery, Government Medical College, Amritsar. Informed consent was taken and the data was analysed with the help of tables and bar graphs.*
Results: *Modified Alvarado scoring system was found to have high sensitivity for both males (84.2%) and females (78.9%) in this study group which was comparable to the high sensitivity of this system found in other studies. In addition to that, this system also had a high positive predictive value for both sexes.*
Conclusion: *In the diagnosis of acute appendicitis, the Modified Alvarado score is a fast, simple, reliable, non-invasive, repeatable and safe diagnostic modality without extra expense andcomplications.*
Keywords: *appendicitis, appendicectomy, Modified Alvarado score*

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I. Introduction

The vermiform appendix is present in human beings, certain anthropoid apes and wombat. Embryologically, appendix is a continuation of caecum arising from its inferior tip. Morphologically, it is the undeveloped distal end of large caecum found in many lower animals. It is true that many herbivores are provided with a wide-lumen caecal diverticulum in which bacteriolytic breakdown of cellulose takes place. However, walls of this diverticulum lack the heavy deposition of lymphoid tissue that characterises theappendix.

Diseases of appendix loom large in surgical practice. Appendicitis is the most common acute abdominal condition of non-traumatic nature. This malady was rare before the turn of this century and since that time has increasedrapidly.[1] When first recognised as a distinct clinical entity in the 16th century, it was termed as "Perityphlitis" because the inflammatory process that brought death of the patient was thought to have originated in the caecum.

The appendix is the original cause in acute affections of the right iliac fossa and thus the term 'Appendicitis' was coined and has ever since has been applied to this universal disease. Acute appendicitis is the most common cause of "acute abdomen'' in young adults and thus appendicectomy is the most frequently performed urgent abdominal operation.[2] Acute Appendicitis is a common cause of abdominal pain for which a prompt diagnosis is rewarded by a marked decrease in morbidity & mortality[3].

In 1986, Alvarado constructed a 10-point clinical scoring system, also known by the acronym MANTRELS, for the diagnosis of acute appendicitis as based on symptoms, signs and diagnostic tests in patients presenting with suspected acute appendicitis[4]. Kalan et al omitted left shift of neutrophil maturation and produced a modified score of 9[5]. The Alvarado score enables risk stratification in patients presenting with abdominal pain, linking the probability of appendicitis to recommendations regarding discharge, observation or surgical intervention. It is especially useful for ruling out appendicitis and selecting patients for further diagnostic workup[6.]

We have evaluated the role of Modified Alvarado score in the diagnosis of this disease with the aim to increase the sensitivity of the clinical diagnosis and decrease the use of expensive and time-consuming tests.

II. MATERIAL AND METHODS

For this prospective study, total 50 patients of acute appendicitis were evaluated on the basis of modified Alvarado score (Table I) over a time period of 2 years. The study was conducted in the department of Surgery, Government Medical College, Amritsar. Informed consent was taken from the patient before including them in the study.

Table I: MODIFIED ALVARADO SCORE

	SCORE
Symptom	
● Migratory right Iliac fossapain	1
● Anorexia	1
● Nausea/vomiting	1
Signs	
● Tenderness in right iliacfossa	2
● Rebound tenderness right iliacfossa	1
● Pyrexia>37.5°C	1
Laboratory findings	
● Leucocytosis	2
TOTAL	9

Interpretation for modified Alvarado score

Score of 7-9 = highly probable appendicitis
Score of 5-6 = probable appendicitis
Score of <4 = unlikely

The patients were selected for the study based on the following inclusion and exclusion criteria:

Inclusion criteria:

1. All patients diagnosed as acute appendicitis on clinical evaluation were included in the study.

Exclusion criteria:

1. Cases with ultrasound reports showing other pathologies along with appendicitis.
2. Patient undergoing laparotomy and incidentalappendicectomy.
3. Patient with pre-operative or intra-operative finding of appendicular mass or appendicularabscess.

A total of 50 patients fulfilling the above mentioned criteria were selected and enrolled in the study. Written informed consent was obtained and related vital information was recorded. Routine investigations like CBC, LFT, RFT, urine complete and ultrasound whole abdomen were recorded for all participants.

Methodology

During the surgical procedure, the operating surgeon recognized the findings of inflammation (fibrotic/ edematous/ gangrenous/ perforated/ fluid in peritoneal cavity) during the operation and a specimen was sent for histopathological examination. If the pathologist reported no evidence of acute inflammation in the organ, the case was designated as false positive. The whole length of appendix was sectioned for histopathological study.

III. OBSERVATIONS AND RESULTS

In these 50 cases were the patients who presented with acute symptoms and pre-operative diagnosis of acute appendicitis. All the tabulated clinical information was subjected to data analysis and all the results were then studied carefully. Out of the total 50 cases that were admitted to the hospital with suspected acute appendicitis, 47 cases were taken up for surgery based on the clinical scoring system. Among the 47 cases that were operated, 39 cases had acutely inflamed appendix. The percentage of inflamed appendix found on operation was 82.97%. (Table II). The selected patients were further distributed on the basis of age and sex and study revealed that about 81% of the cases of Acute Appendicitis occurred between the age group of 11-30 years. (Table III).

TABLE II: CASES OF ACUTE APPENDICITIS

Total no. of cases of suspected appendicitis	No. of Cases operated	No. of operated cases found to have inflamed appendix	Percentage of cases with inflamed appendix
50	47	39	82.97

TABLE III: AGE & SEX DISTRIBUTION OF PATIENTS

Age in years	Male		Female		Total	
	No. of patients	%age	No. of patients	%age	No. of patients	%age
≤10	2	8.33	1	3.85	3	6.00
11-20	9	37.50	6	23.08	16	32.00
21-30	10	41.67	14	53.85	24	48.00
31-40	2	8.33	4	15.38	6	12.00
41-50	1	4.17	1	3.85	2	4.00
Total	24	100.00	26	100.00	50	100.00

TABLE IV: Presentation of clinical features

Clinical Features	Number (n=50)	Percentage
Abdominal pain	50	100
Anorexia	40	80
Nausea /Vomiting	40	80
Constipation	5	10
Diarrhoea	3	6
Burning micturition	6	12

The selected patients presented with abdominal pain, anorexia, nausea, vomiting, constipation, diarrhea and burning micturition. The abdominal pain was the commonest presenting symptom and was observed in all the cases (100%) in the presentseries. The next common symptoms observed were nausea/vomiting in 80% of cases and anorexia in 79% ofcases. Burning micturition was seen in 12 % and bowel disturbance in the form of constipation was seen in 10% and as diarrhoeain 6%. (Table IV). The classical shifting of pain from umbilical region to right iliac fossa (RIF) was seen only in 36% of the cases. In 52% of the cases, pain was localised to RIF, and 12% of the cases had diffuse abdominal pain. (Figure 1)

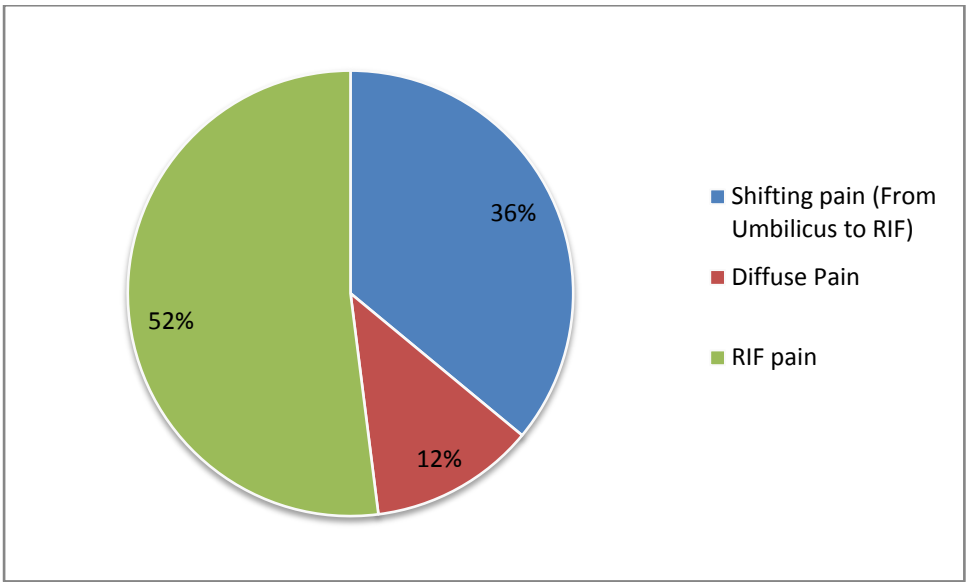


Figure 1: Representation of classical shifting of pain from umbilical region to Right iliac fossa (RIF)

The results revealed low grade fever in 71% of cases. Majority of the patients presented within 48 hrs after the onset of pain. Rebound tenderness was present in 71%, suggesting the presence of local peritonitis or anteriorly placed inflamed appendix. Rovsing's sign was positive in 14%. Psoas test was positive in 8% cases, whereas Obturator test was positive in 16% due to the presence of retrocaecalappendix. Rectal tenderness was present in 8% of thecases. (Table V)

TABLE V: Presentation of clinicalsigns

Clinical Features (Signs)	**Number**	**Percentage**
RIF Tenderness	48	96
Rebound Tenderness	35	71
Fever	35	71
Abdominal guarding	4	8
Psoas sign	4	8
Obturator sign	8	16
Rovsing's sign	7	14
Rectal tenderness	4	8

1. Low grade fever was present in 71% of cases. Majority of the patients presented within 48 hrs after the onset of pain. Rebound tenderness was present in 71%. In these cases, there was presence of local peritonitis or when inflamed appendix was more anteriorly placed.
2. Rovsing's sign was positive in 14%.Psoas test was positive in 8% cases, whereas Obturator test was positive in 16% due to retrocaecal appendix.
3. Rectal tenderness was present in 8% of the cases. (Table V)

TABLE VI: PRESENTATION OF CLINICAL FEATURES

Clinical Features		Number	%
Symptoms	Migratory RIF pain	50	100
	Anorexia	40	80
	Nausea/Vomiting	40	80
Signs	RIF-tenderness	48	96
	Rebound – Tenderness	35	70
	Fever	35	70
Lab findings	Leucocytosis	37	74

Clinical Features

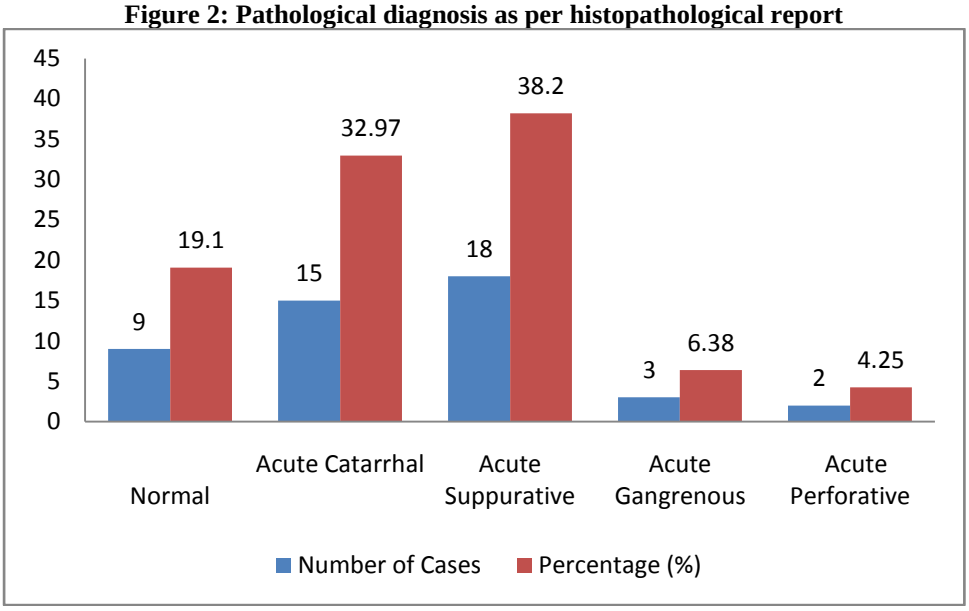
On clinical examination, tenderness at McBurney's point was the commonest sign (96%). Guarding was present in 8% of patients, indicating severe inflammation. In the present study the TLC was increased in 74%. (Table VI)

TABLE VII: RESULTS OF MODIFIED ALVARADO SCORE

Sex	Total		Score					
			7-9		5-6		<5	
	No. of patients	%age	No. of patients	%age	No. of patients	%age	No. of patients	%age
Male	24	48.00	17	70.83	5	20.83	2	8.33
Female	26	52.00	18	69.23	7	26.92	1	3.85
Total	50	100.00	35	70.00	12	24.00	3	6.00

Out of 50 cases studied, 24 were male, 26 were female. Out of 24 males, patients with a score of 7-9 were 17; score of 5-6 were 5 and 2 had score < 5. These 2 patients did not undergo surgery. Out of 26 female patients, 18 had a score of 7-9, 7 had a score of 5-6 and 1 scored<5 (Table VII).

Figure 2: Pathological diagnosis as per histopathological report



In 39% of cases, appendix was swollen and elongated on gross appearence which on histopathology was confirmed as a case of suppurative appendicitis. In 32% cases with catharrhal appendicits, appendix appeared to be infected, with dull and granular red membrance on gross appearence with congestion of the subserosal vessels. Only 4% of cases were found to be perforated on gross as well as on histopathology appearance (Figure 2).

TABLE VIIIa: RESULTS OF MODIFIED ALVARADO SCORE ON OPERATED PATIENTS

	Number Of Patients operated	Score 7-9	Appendicitis	Normal Appendix
Male	22	17	16	1
Female	25	18	15	3

Total of 47 patients were operated, out of which 22 were males, 25 females. 17 males having a score of 7-9 had acute appendicitis, 1 patient had normal appendix (it was found to be Meckel's diverticulitis on surgery). Amongst the females, 18 patients had a score 7-9, out of which, 15 had acute appendicitis and 3 patients had normal appendix with other diseases (2 patients had PID and 1 had mesentericlymphadenitis) (Table VIIIa).

TABLE VIIIb: RESULTS OF MODIFIED ALVARADO SCORE ON OPERATED PATIENTS

	Number of Patients operated	Score 5-6	Appendicitis	Normal Appendix
Male	22	5	3	2
Female	25	7	4	3

Male patients having a score of 5-6 were 5, out of which 3 patients had acute appendicitis and 2 patients had normal appendix with both having mesenteric lymphadenitis. In 7 females with a score 5-6, 4 had acute appendicitis, 3 had normal appendix with other diseases (2 PID and 1 mesenteric lymphadenitis) (Table VIIIb).

TABLE IX: DIAGNOSTIC VALUE OF MODIFIED ALVARADO SCORING SYSTEM

	Patients with score 7 to 9	Percentage
Males with Score 7 to 9	Sensitivity	84.2%

	Specificity	60.0%
	Positive Predictive Value	94.1%
Females with Score 7 to 9	Sensitivity	78.9%
	Specificity	50.00 %
	Positive Predictive Value	83.3%

In the study conducted:-
Sensitivity for males was observed to be higher than that of females in the group with score 7-9. Specificity for males and females was 60% and 50% respectively. Positive predictive value was also higher for the same scores in males (Table IX).

TABLE X: DIAGNOSTIC VALUE OF MODIFIED ALVARADO SCORING SYSTEM

Modified Alvarado Score	Histopathological Examination Result			
	Appendicitis		N. Appendix	
	No. of cases	Percentage	No. of cases	Percentage
7-9 (n=35)	31	88.5	4	11.4
5-6 (n=12)	7	58.3	5	41.6
Total	38	100.00	9	100.00

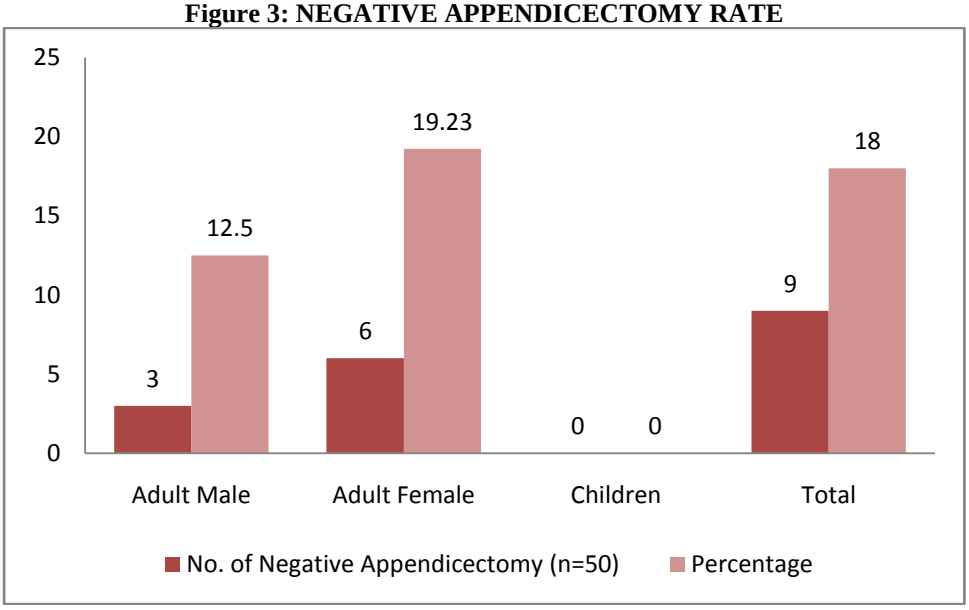
When comparing rates of normal appendix in the scores with range 7-9 and 5-6 respectively, it is clearly indicated that percentage of cases with normal appendix in group 7-9 is far lesser than in group 5-6. Increased proportion (36%) of negative appendicectomy is noticed for the Modified Alvarado Score 5-6 and significantly decreased proportion (10.15%) of negative appendicectomy is noticed for the Modified Alvarado Score 7-9 (Table X).

Table XI: DIAGNOSTIC VALUE OF MODIFIED ALVARADO SCORING SYSTEM

	Total no. of patients	Score 7-9	Appendicitis	Positive predictive value
Men	24	17	16	94.1
Women	26	18	15	83.
Score 5-6				
Men	24	5	3	60.0
Women	26	7	4	57.

Positive predictive value when compared between the two groups of scores, it was very clear that positive predictive value of 7-9 is much more than of 5-6. In our series, negative appendicectomy rate in females with score 5-6 was 42.7% and with score 7-9 was 16%. Men with score 5-6 had negative appendicectomy rate of 40% and with score 7-9 had negative appendicectomy rate of5.06% (Table XI).

Figure 3: NEGATIVE APPENDICECTOMY RATE



Females (19.23%) had more negative appendicectomy rate compared to males (12.5%), as the other diseases like pelvic inflammatory diseases were more common in the reproductive age group. Since intra-abdominal infection in females, particularly of lower abdomen, can be quite confusing, it is difficult to differentiate acute appendicitis from gynaecological conditions like twisted ovarian cyst and PID on clinical examination alone (Figure 3).

IV. DISCUSSION

Acute appendicitis remains a common abdominal emergency throughout the world. Early and accurate diagnosis is required to reduce the morbidity and mortality associated with delayed diagnosis and its complications. In addition to significant morbidity and mortality, negative appendicectomy is also responsible for loss of precious staff hours and financial resources. Though there are lots of advances in the diagnostic field with the invention of sophisticated investigations, diagnosis of acute appendicitis remains an enigma for the attendant surgeon. None of the investigations like USG, CT scan conclusively diagnose appendicitis. Its diagnosis continues to be difficult due to the variable presentation of the disease and the lack of reliable diagnostic test. Time and again, it has been proved that some of the investigations already discussed are costly, time consuming and require more sophisticated equipment and expertise, while some are not feasible and not readily available. So, even today, a thorough clinical examination with basic investigations like WBC count remains the cornerstone in the diagnosis of acute appendicitis.[7]

With this background many eminent surgeons and physicians have been adopting different scoring systems in order to decrease negative appendicectomy. A number of clinical scoring systems have been used as complementary aids in the diagnosis of acute appendicitis as initial assessment can be improved by their use. Modified Alvarado Scoring System is one of the many scoring systems available today. It is based on history, physical examination and few laboratorytests.It is a simple, easy to apply and cheap complementary aid for supporting the diagnosis of acuteappendicitis.[7]

The present study was undertaken to evaluate the usefulness of Modified Alvarado scoring system in reducing the number of negative appendicectomy and to evaluate its sensitivity & positive predictive value in the diagnosis of acute appendicitis. Our results and observations were discussed and compared with various otherstudies.

In the present series the male to female ratio was almost equal. The age group in which acute appendicitis occurred commonly was between 11 and 30 years. It is clear that incidence is less in younger and older age groups with peak incidence in 2nd and 3rd decade.

Pain was the commonest presenting symptom observed in all the cases in present series. The classical shifting of pain from umbilical region to RIF was seen only in 36% of the cases. In 52% of the cases pain was localised to RIF, and 12% of the cases had diffuse abdominalpain.

Next common symptoms observed were nausea/vomiting in 80% of cases and anorexia in 79% of cases. Burning micturition was seen in 12 % and bowel disturbance was seen in the form of constipation (10%) and diarrhoea (6%). Low grade fever was present in 71% of cases. Majority of the patients presented within 48 hrs after the onset of pain, with most of them presenting between 12-24 hrs of onset of pain.

On clinical examination, tenderness at McBurney's point was the commonest sign (96%). Guarding

was present in 8% of patients. It was present when the inflammation was severe. Rebound tenderness was present in 71%. In these cases, there was presence of local peritonitis or an anteriorly placed inflamed appendix. Rovsing's sign was positive in 14%. This sign is seen whenever there is inflammation in the RIF. Psoas test was positive in 8% cases, whereas Obturator test was positive in 16% due to the presence of retrocaecal appendix. Rectal tenderness was present in 8% of the cases. In the present study the TLC was increased in 74%.

Plain X-ray abdomen taken in erect posture showed ground glass appearance in 3 patients, suggestive of diffuse peritonitis. Free gas under the diaphragm was not present in the cases with perforated acute appendicitis.

For assessment, the patients were categorized into 2 groups of male and female. Out of 50 cases studied, 24 were male, 26 were female. Out of 24 males, patients with a score of 7-9 were 17; score of 5-6 were 5 and 2 had score < 5. These 2 patients did not undergo surgery. Out of 26 female patients, 18 had score of 7-9, 7 had score of 5-6 and 1 had score <5. Management was on the same lines as for males.

Total of 47 patients were operated, out of which 22 were males, 25 females. 17 males having score of 7-9 had acute appendicitis, 1 patient had normal appendix (found to have Meckel's diverticulitis during surgery). Male patients having score of 5-6 were 5, out of which 3 patients had acute appendicitis, 2 patients had normal appendix with both having mesenteric lymphadenitis.

In 18 female patients having a score 7-9, 15 had acute appendicitis, 3 patients had normal appendix with other diseases, out of which 2 patients had PID and 1 patient had mesenteric lymphadenitis. In 7 females with score 5-6, 4 had acute appendicitis, 3 had normal appendix with other diseases (2 PID and 1 mesenteric lymphadenitis). All the children subjected to appendicectomy had acuteappendicitis.

In our series a score of 7-9 using Modified Alvarado scoring system had a total sensitivity of 81.5%.

TABLES XIIa and XIIb: COMPARING WITH KALAN ET AL[8] OUR SERIES ALSO HAS CONSISTENT RESULT

TABLE XIIa:

Results of the Modified Alvarado Score in Kalan et al series[5]				
	No. of patients	Score ≥7	Appendicitis	Sensitivity
Men	21	15	14	93%
Women	17	15	10	67%
	No. of patients	Score <7	Appendicitis	Sensitivity
Men	21	6	4	67%
Women	17	2	1	50%

TABLE XIIb:

Results of our series				
	No. of patients	Score 7-9	Appendicitis	Sensitivity
Men	24	17	16	94.1%
Women	26	18	15	83.3%
	No. of patients	Score 5-6*	Appendicitis	Sensitivity
Men	24	5	3	60%
Women	26	7	4	57.1%

*< 5 score not included as they were not operated (2 male, 1 female)

When compared with other studies, it is evident that Modified Alvarado scoring system has more sensitivity. It can be used as a complementary method in diagnosing acute appendicitis (Table XIII).

TABLE XIII: Comparison of sensitivity of Modified Alvarado score in our study with other studies

Series	Sensitivity
Kalan et al[8]	81.63%
Denizbasi A[9]	95.40%
Al-Hashemy et al[10]	53.90%

Dr Ramachandra et al[11]	88.6%
Shrivastava UK et al[12]	92.40%
Present study	81.50%

Increased proportion (36%) of negative appendicectomy is noticed for the Modified Alvarado Score 5-6 and significantly decreased proportion (10.15%) of negative appendicectomy is noticed for the Modified Alvardao Score 7-9.

In our series negative appendicectomy rate in females with score 5-6 was 42.7% and with score 7-9 was 16%. Men with score 5-6 had negative appendicectomy rate of 40% and with score 7-9 had 5.06%. Hence overall, females (19.23%) had more negative appendicectomy rate compared to males (12.5%), as other diseases like pelvic inflammatory diseases were more common in the reproductive age group. Since intra-abdominal infection in females, particularly of lower abdomen, can be quite confusing, it is difficult to differentiate acute appendicitis from gynaecological conditions like twisted ovarian cyst andPID on clinical examination alone, laparoscopy and abdomino-pelvic USG scan can be advised as a diagnostic tool to minimize negativeappendicectomy.

The Overall Modified Alvardo score ≥ 5 has got more sensitivity and diagnostic accuracy of diagnosing patients for appendicitis and by particularly adopting this system, negative laparotomies can be reduced to a figure of 18%.

In the present study, usefulness of the scoring system was demonstrated beyond doubt by reducing number of negative laparotomies especially in men and children. However in women the negative laparotomy was high and this can be avoided by laparoscopy.

The sensitivity and specificity of Modified Alvarado scoring system in our series was as high as 82%. This indicates that by adopting this scoring system many negative appendicectomies can be reduced. Patients in whom the Alvarado score was <5 did not need subsequent appendicectomy further indicating the usefulness of Alvarado scoring system.

In our series when the score was more than 7 indicating strong possibility of intra-abdominal infection localized to the Right Iliac fossa, emergency surgery was performed within 6 hours. These patients were found to have badly inflamed appendix with impending perforation. This once again indicates the sensitivity and specificity of the scoring system.

Patients with score 5-6 were observed for a period of 12-24 hours and re-assessed. If there was persistence of abdominal tenderness with increased WBC count, appendicectomy was carried out. These patients were also found to have congested and inflamed appendix.

In our series 3 cases were in paediatric age-group. All of them had a score of 7- 9 and were operated within 6 hours. Per operative finding was of inflamed appendix indicating a sensitivity of 100% in children. This is important keeping in mind the shortness of omentum in children which can cause early perforation and peritonitis with its attendant morbidity and mortality (Longino. L et al 1958[13], Menes TS and Bickell NA,2012[14]).

TABLE XVI: Results of Modified Alvarado score applied to patients with typical RIF pain

Total No. of Male patients	**24**
Patients with score 7-9	17
Patients with score 5-6	5
Patients with score < 5	2
Total No. of Female patients	**26**
Patients with score 7-9	18
Patients with score 5-6	7
Patients with score <5	1

The positive predictive value in Males was 94.1%. The positive predictive value in Females was 83.0%. Patients with score < 5 were kept under observation as none of them required surgery. All patients with appendicular mass were excluded out of this study and managed conservatively with advise for interval appendicectomy after 6-8 weeks. Histopathological examination of the resected appendix proved acute supurrative (39.36%) and acute catarrhal (32.97%) types to be predominant.

V. CONCLUSION

The sensitivity of the Modified Alvarado scoring system in males with score ≥7 to 9 was 84.2% with specificity of 60.0%. The positive predictive value in males was 94.1%. The sensitivity of the scoring system in females with score ≥7 to 9 was 78.9% with specificity of 50%. The positive predictive value in females was 83.3%. In children, the test was highly sensitive. Thus, Alvarado score is very effective in the diagnosis of acute appendicitis in children and men but some other diagnostic modalities are necessary to ascertain the diagnosis in females along with the clinical scoring system to rule out other pelvicpathologies. The application of this scoring system improves diagnostic accuracy and consequently reduces negative appendicectomy and thus reduces complication rates. In the diagnosis of acute appendicitis, the Modified Alvarado score is a fast, simple, reliable, non-invasive, repeatable and safe diagnostic modality without extra expense andcomplications.

REFERENCES

[1]. Harris CW. The first elective appendicectomy. Canad J Surg. 1961;4:405-10.
[2]. Sharma R, Kaur A, Mittal S, Neki NS. Laparoscopic study of 25 cases of right iliac fossa pain for false positivity of clinically diagnosed cases of appendicitis. Int. J. Curr. Res. Med. Sci. 2017;3(7):18-23.
[3]. Owen TD, Williams H, Stiff G, Jenkinson LR, Rees BI. Evaluation of the Alvarado score in acute appendicitis. Journal of the Royal society of medicine. 1992 Feb;85(2):87.
[4]. Alvarado A. A practical score for the early diagnosis of acute appendicitis. Annals of emergency medicine. 1986 May 1;15(5):557-64.64
[5]. Kalan M, Talbot D, Cunliffe WJ, Rich AJ. Evaluation of the modified Alvarado score in the diagnosis of acute appendicitis: a prospective study. Annals of the Royal College of Surgeons of England. 1994 Nov;76(6):418.
[6]. Ohle R, O'Reilly F, O'Brien KK, Fahey T, Dimitrov BD. The Alvarado score for predicting acute appendicitis: a systematic review. BMC Med. 2011;9:139
[7]. Mohamed A, Bhat N. Acute Appendicitis Dilemma of Diagnosis and Management. internet journal of surgery 2009; 23(2).
[8]. Kalan M, Talbot D, Cunliffe WJ, Rich AJ. Evaluation of the modified Alvarado score in the diagnosis of acute appendicitis: a prospective study. Annals of the Royal College of Surgeons of England. 1994 Nov;76(6):418.
[9]. Denizbasi A, Unluer EE. The role of the emergency medicine resident using the Alvarado score in the diagnosis of acute appendicitis compared with the general surgery resident. European Journal of Emergency Medicine. 2003 Dec 1;10(4):296-301.
[10]. Al-Hashemy AM, Seleem MI. Appraisal of the modified Alvarado score for acute appendicitis in adults. Saudi Med J. 2004 Sep 1;25(9):1229- 31.
[11]. Ramachandra J, Sudhir M, Sathyanarayana BA. Evaluation of modified Alvarado score in preoperative diagnosis of acute appendicitis. Group. 2013 Nov 18;1(22):22.
[12]. Shrivastava UK, Gupta A, Sharma D. Evaluation of the Alvarado score in the diagnosis of acute appendicitis. Tropical gastroenterology: official journal of the Digestive Diseases Foundation. 2004;25(4):184-6.
[13]. Longino LA, Holder TM, Gross RE. Appendicitis in childhood: a study of 1,358 cases. Pediatrics. 1958 Aug 1;22(2):238-46.
[14]. Menes TS, Bickell NA. Appendicitis Perforation Rates and Time Interval between Symptom Onset and Surgery. InImaging of Acute Appendicitis in Adults and Children 2012 (pp. 23-33). Springer, Berlin, Heidelberg.

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