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Original Research Article

A retrospective evaluation of Alvarado score in diagnosing acute appendicitis in a tertiary care hospital at Pondicherry

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ABSTRACT

Background: Acute appendicitis is a common and sometimes confusing cause of acute abdomen in all age groups. Diagnosis of appendicitis can be difficult, occasionally taxing the diagnostic skills of even the most experienced surgeon. Despite the increased use of USG, CT, the rate of misdiagnosis of appendicitis has remained the same (15.3%). To evaluate the usefulness of the Alvarado score as a simple and reliable tool in preoperative diagnosis of acute appendicitis.
Methods: This retrospective study conducted on 97 cases includes all patients who were admitted with a clinical diagnosis of acute appendicitis for a period of one year from February 2019 to January 2020 at IGMCRI Pondicherry with clinical suspicions of acute appendicitis were included in the study. The modified scoring system is based on 3 signs, 3 symptoms, and 1 laboratory finding. The patient was classified as males, females, and children (<12 years). These were further grouped based on the scores 7-9, 5-6, and <5.
Results: A total of 80 patients with a score of 7-9 and 5-6 were operated on. Among males with a score of 7-9, 35 patients were operated and 34 were found to have an inflamed appendix. Females with scores 7-9, 16 were operated and 11 were found to have an inflamed appendix.
Conclusions: Alvarado scores significantly reduce the number of negative laparotomies without increasing the overall rate of appendicular perforation. It is very effective in men and children but diagnostic laparoscopy or ultrasonography is advised to minimize the high false-negative rate in women.

Keywords: Appendicitis, Negative appendectomy rate, Clinical score

INTRODUCTION

Acute appendicitis is the acute inflammation of the appendix. It is a common, sometimes confusing, and often treacherous cause of acute abdomen at all age groups. Of all the abdominal emergencies, acute appendicitis heads the list of causes classified under an acute abdomen.[1] It is not surprising that the diseases of the appendix do not seem to have a place in areas of active clinical investigation and one finds, relatively few articles dealing with appendicitis.[2] But no one in current surgical practice can deny the fact that appendicitis still represents a large portion of cases and they continue to baffle them by their oft deceptive presentations and sometimes may cause quite an amount of morbidity and unnecessary mortality.[3] Acute appendicitis is commonly caused due to a variety of reasons namely difference in dietary habits, food adulterations, indulging in mixed diet habits, seasonal changes particularly colder periods. Acute appendicitis is prevalent among males and females irrespective of age factor but is noted in slightly large numbers among males and rarely found in infancy and old age.[4] The etiology of acute appendicitis is plenty among which obstruction to lumen and infection play an important role. Of all the infections *E. coli* is found to be the most common organism which is responsible for

acute appendicitis. The diagnosis of appendicitis can be difficult, occasionally taxing the diagnostic skills of even the most experienced surgeon.[5] Likewise, judgmental decisions in the management of patients with appendiceal inflammation or abscess can are difficult. The patient with appendicitis first recognizes that he has an episode of pain that is unique and then presents to a physician who recognizes the condition.[6] Delays in diagnosis arise from errors on the part of either the patient or physician, and all delays complicate the illness.[7] Patients presenting with acute lower abdominal pain remain a diagnostic challenge. Acute appendicitis is the most common indication for surgery in these patients. After careful clinical evaluations and observations, surgical intervention is undertaken.[8] Migrating pain and involuntary guarding and persistence or progression of clinical signs are the main criteria favoring operation.[9] Despite the increased use of ultrasonography, computerized tomographic scanning, and laparoscopy, the rate of misdiagnosis of appendicitis has remained constant (15.3%), as has the rate of appendiceal rupture.[10]

METHODS

This retrospective study conducted on 97 cases includes 97 patients who were admitted to Indira Gandhi medical college and research institute, Pondicherry. From February 2019 to January 2020 with clinical suspicions of acute appendicitis were included in the study. The modified scoring system is based on 3 signs, 3 symptoms, and 1 laboratory finding. The patient was classified as males, females, and children (<12 years). These were further grouped based on the scores 7-9, 5-6, and <5. Failure of early diagnosis can lead to the progression of the disease with its attendant morbidity and occasional mortality. To achieve accuracy in early diagnosis of acute appendicitis, a scoring system described by Alvarado was adopted to reduce the negative appendicectomy rate without increasing morbidity and mortality.[5] The scoring system was initially introduced as an adjunct to diagnosis to correct a high false-positive appendicectomy rate. The scoring system as described by Alvarado is based on three symptoms, three signs, and two laboratory findings. Patients with a score of 1-4 were not considered likely to have acute appendicitis, those patients with a score of 5-6 were considered to have a possible diagnosis of appendicitis, but not convincing enough to warrant immediate surgery, and these were marked for further review. Those with a score of 7-8 were considered to have a probable acute appendicitis and those with a score of 9-10 were considered to have an almost definitive acute appendicitis and submitted to surgery. Depending upon individual presentation of signs and symptoms a score was calculated for each case of suspected acute appendicitis from 9 values. The observed value in each case was added and expressed as an end score. All necessary investigations were done on all patients. The cases subjected to emergency surgery were adequately prepared. Whenever vomiting persisted, Ryles tube aspiration was done. Parenteral fluids, electrolyte supplementation, broad-spectrum antibiotics were administered. Hourly temperature, pulse, and respiratory chart were maintained. Surgery was done under general or spinal anesthesia. When the diagnosis of acute appendicitis was certain grid-iron incision was employed. The right paramedian incision was used when the diagnosis was doubtful or when frank peritonitis was suspected. Before resection, the appendix was assessed. The specimen of the appendix was sent for histopathological examination and the reports were analyzed. A study of observations was done and an attempt was made to correlate the clinical presentations in each patient with the pathological findings.

Statistical analysis

Data entry was made in the Microsoft excel software in codes and analysis was done with an SPSS-20 computer package. Categorical variables are expressed as percentages whereas continuous variables are expressed as mean ± standard deviation. Association between the categorical variable was found by the chi-square test and the relationship between the continuous variable was assessed by student's t-test.

RESULTS

In this series of 97 cases, the patients who presented with acute symptoms and were pre-operatively diagnosed to have acute appendicitis were studied. Of the 100 cases that were admitted to the hospital with suspicion of acute appendicitis, 80 cases were taken up for surgery based on the clinical scoring system. Among the 80 cases that were operated 70 cases had acutely inflamed appendix. The percentage of inflamed appendix found in the operation was 87.5%.

Table 1: Age and sex distribution.

Age (years)	No. of cases		
	Males	Females	Total
0-10	3	1	4
11-20	17	16	33
21-30	28	11	41
31-40	10	4	14
41-50	1	2	3
51-60	1	2	3
61-70	0	1	1
Total	60	37	0

Table 1 shows the age group in which acute appendicitis occurred commonly was between 11 and 30 years i.e., about 75%, an observation consistent with reports from India. Incidence is less in younger and older age groups with a peak incidence in the second and third decade. In the present series, the males outnumbered females in a ratio of 3:2. In the Lewis et al series of 1000 cases, the incidence of acute appendicitis was found to occur most commonly in the age group of 20-30 years, and the male to female ratio was 3:2.

Table 2: Site of pain.

Site	Percentage (%)
Right iliac fossa	32
Umbilical to right iliac fossa	36
Epigastric	8
Diffuse	11
Central abdominal	12

Table 2 shows pain was the commonest presenting symptom and had been observed in all the cases (100%) in the present series. The classical shifting of pain from the umbilical to right iliac fossa was present in 38% of cases. The next common symptoms observed were nausea/vomiting in 70% of cases, fever in 64% cases, and anorexia in 70%. Burning micturition was seen in 10% and bowel disturbance was seen in the form of constipation (16%) and diarrhea (6%). The majority of the patients had aching type of pain and some had colicky pain. Vomiting occurred initially with one or two bouts with or without nausea. Vomiting appeared after the onset of pain. Fever was of low grade with a corresponding rise in the pulse rate. Majority of the patients presented within 24 hours after the onset of pain, most of them presenting between 12-24 hours after onset of pain.

Table 3: Physical signs.

Signs	Percentage (%)
Tenderness at rt iliac fossa	96
Fever	70
Rebound tenderness	77
Rovsing's sign	22
Hyperesthesia at Sherren's triangle	18
Mass in RIF	12

Table 3 shows on clinical examination of the patient, tenderness at right iliac fossa was 96%. It was present when the inflammation was severe. Rebound tenderness was present in 77%. In these cases, there was a presence of local peritoneal involvement or when the inflamed appendix was more anteriorly placed. Abdominal rigidity (9%) was due to perforated appendix or gangrenous appendicitis. Rovings' sign was positive at 22%. This sign is often positive whenever inflammation is present in the right iliac fossa. Psoas test was positive in 24% of patients whereas the obturator test was positive in 15% due to retro causal appendix. Hyperaesthesia was present in 18 and 12% of cases had appendicular mass.

Table 4 shows in the present study the total leucocyte count was increased by 78%, and it was within the normal range of 22%. 66% had a total count of 11,000 or more. The value of white cell count in the diagnosis of acute appendicitis is disputed though there is a definite relationship between the severity of the disease on the one hand and leukocytosis on the other hand.

Table 4: Total leucocyte count per mm^3.

Total leucocyte count (per mm^3)	No. of cases	Percentage (%)
<9000	16	16
9000-10000	04	04
10000-14000	30	30
14000-18000	44	44
Above-18000	03	03

Table 5: Results of Alvarado score (total cases 100).

Gender	No. of patients	Score			Mass in RIF
		>7-9	5-6	<5	
Male	51	39	8	5	7
Female	36	14	18	6	5
Children	10	10	0	0	0
Total	97	63	26	11	12

Table 5 shows our assessment of the patients categorized the patients into three groups viz. male; female; and children. Out of the 97cases studied 51 are male; 36 are female and 10 are children (<12 year). Out of 51 male patients, scores of ≥7-9 were 39; scores of 5-6 were 8;5 patients had scores <5, and 7 had a mass in Right Iliac Fossa. These 12 patients of score <5 and mass in RIF were observed in the hospital and did not undergo surgery. The patients with a mass in RIF were advised for interval appendicectomy. Out of 38 female patients; scores of ≥7-9 were 14; scores of 5-6 were 18; scores of <5 was 6, and 5 female patients had a mass in RIF. These 11 patients of score <5 and mass in RIF were treated and advised on the same line as the male patients. All the 10 children had a score of ≥7-9 and were operated upon.

Table 6: Sensitivity and specificity.

Variables	Percentage (%)
Males with score 7 to 9	
Sensitivity	87.77
Specificity	50
Positive predictive value	97.14
Females with score 7 to 9	
Sensitivity	55
Specificity	44.44
Positive predictive value	68.75

Table 6 shows total of 80 patients was operated on, out of which 41 were males; 29 were females, and 10 were children. In male patients having a score of ≥7-9; 35 patients had acute appendicitis; 1 patient had normal appendix and 2 patients had diseases in the form of ileal perforation and Meckel's diverticulitis. Male patients having a score of 5-6 were 6; out of which 5 patients had acute appendicitis; 1 patient had normal appendix and 1 patient had mesenteric lymphadenitis. In female patients having a score of ≥7-9; 11 had acute appendicitis; 5 patients had normal appendix and 3 patients had other diseases, out of which 2 had PID;1 had twisted right

ovarian cyst; In females with a score of 5-6; 9 had acute appendicitis, and 4 patients had PID. All the 10 children subjected to the operation had acute appendicitis.

DISCUSSION

The appendix develops as an underdeveloped distal end of the caecum in the sixth week of intrauterine life. The appendix develops from the post arterial segment of the midgut, along with the caecum, ascending colon, and right two-third of the transverse colon. Initially, a bud called caecal bud arises from the post-arterial segment very near to the apex of the loop.[11] The proximal part of the bud grows rapidly to form the caecum but the distal part remains narrow and forms the appendix. Subsequently, the lateral or right wall of the caecum grows much more rapidly than the medial wall. Thus, the point of attachment of the appendix comes to lie on the posteromedial aspect of the caecum.[12] Korner et al stated that acute appendicitis remains a common abdominal emergency throughout the world. 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.[13] We find the value of the Alvarado score which was modified by Miranda et al for its routine use in clinical practice. The modified Alvarado score is simple to use and easy to apply since it relies only on history, clinical examination, and a basic laboratory investigation. The surgical treatment of appendicitis is one of the great public health advancements of the last 150 years.[14] Puig et al in their study appendectomy for appendicitis is the most commonly performed emergency in the world. Additionally, appendicitis is a disease of the young, with 40% of the cases occurring in patients between the ages of 10 and 29 years.[15] Rajagopalan et al reported the associated mortality rate of appendicitis to be at least 67% without surgical therapy.[16] Raman et al The sensitivity and specificity of the modified Alvarado scoring system in our series were as high as 84%. This indicates that by particularly adopting the modified Alvarado scoring system many negative appendicectomies can be reduced. Patients in whom the Alvarado score was <5 did not need subsequent appendicectomy indicating the usefulness of the modified Alvarado scoring system which correlates our study.[17] Russel et al in our series when the score was more than 7 indicating a strong possibility of intraabdominal infection localized to the Right Iliac fossa surgery was performed within 6 hours of a patient getting admitted to the hospital. The observation was that these patients had badly inflamed appendix with impending perforation once again indicating the sensitivity and specificity of the scoring system.[18] In patients in whom score was between 5 and 6 were observed for 12-24 hours and re-assessed, where there was the persistence of abdominal tenderness with increased WBC count appendicectomy was carried out.[18] These patients were also found to have congested and inflamed appendix. In our series, we had 10 cases of patients in the pediatric age-group. All of them had a score of 7-9 and were operated on within 6 hours. Per operative, the finding was of highly inflamed appendix indicating a sensitivity of 100% in children.[19] Stroman et al studied that, 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. In our series, we had 28 cases of female patients.[20]

CONCLUSION

Alvarado scoring system significantly reduces the number of negative laparotomies. It can work effectively in routine practice as an adjunct to surgical decision-making in questionable appendicitis. The sensitivity of the scoring system in males with a score of >7 to 9 is 87.77%. With a specificity of 50%. The positive predictive value in males is 97.14%. The sensitivity of the scoring system in females with a score of >7 to 9 was 55% in our study. The specificity of 44.44%. The positive predictive value in females is 68.75%. In children, the test was very sensitive. Alvarado score is very effective in the diagnosis of acute appendicitis in children and men but some other diagnostic modality is necessary to ascertain the diagnosis in females along with the clinical scoring system.

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REFERENCES

1. Addiss DG, Shaffer N, Fowler BS, Tauxe RV et al. The epidemiology of appendicitis and appendectomy in the US. Am J Epidemiol. 2012:132:910-11.
2. Ajmani ML, Ajmani K. The position, length, and arterial supply of vermiform appendix. Anat Anz. 2005:153:369.
3. Alvarado A. A practical score for the early diagnosis of acute appendicitis. Ann Emerg Med. 2009;15:557.
4. Bower RJ, Bell MJ, Terhberg JL. Diagnostic value of the white cell count and neutrophil percentage in the evaluation of abdominal pain in children Surg Gynecol Obstet. 2009;152(424):19-23.
5. Brunicardi FC, Dunn DL, Hunter JG, Pollock RE, Anderson DK, Billiar TR et al. Schwartz's principles of surgery Mc Graw Hill Companies, Inc; 8th edition. 2005;111935.
6. Burchard K, Kjaeldgaard A. Investigation and analysis of the position, fixation, length and Embryology of the vermiform appendix. Acta Chir Scand. 2009;139:293.
7. David CH, Sabiston JR. Acute appendicitis in-The textbook of surgery, WB Saunders international, 15th edition. 2007;964-70.
8. Fishin P, Kelvin FM, Rice RP. Non-specificity of Barium enema findings in acute appendicitis. AJR.

2009;143:99-102.
9. Flum DR, Morris A, Koepsell T, Dellinger EP. Has misdiagnosis of appendicitis decreased over time? A population-based analysis. Arch Surg. 2002;137:799.
10. Fuchs JR, Schomberg JS, Shortsleeve MJ, Schuler JG. Impact of abdominal CT imaging on the management of appendicitis an update. J Surg Res. 2019;106:131.
11. Hale DA, Molloy M, Pearl RH et al: Appendectomy: A contemporary Appraisal. Ann Surg 2010 225: 252.
12. Jeffery RB, Jain KA, Nghiem HV. Sonographic diagnosis of acute appendicitis. Interpretive pitfalls. Am J Roentgenol. 2009;162:55.
13. Korner H, Sondenna K, Soreide JA. Incidence of acute nonperforated and perforated appendicitis: Age-Specific and sex-specific analysis. World J Surg. 2009;21;313.
14. Miranda R. Johnston AD, O'Leary JP. Incidental appendectomy frequency of pathologic abnormality Ann Surg. 2008;46;355.
15. Puig S, Hormann M, Rebhandl W. Ultrasound as a primary diagnostic tool about negative appendectomy: six years' experience. Radiology. 2003;226;101-5.
16. Rajagopalan AE, Mason JH, Kennedy N, Pawlikowski J. The value of Barium enema in the diagnosis of acute appendicitis. Arch Surg. 2010;112:531-3.
17. Raman SS, Lu DSK, Kadell BM, Vodopich DJ, Sayre J, Cryer H. Accuracy of non-focused helical CT for diagnosis of acute appendicitis A 5 years Review. Am J Roentgenol. 2002;1178:1319.
18. Russel RCG, Williams NS, Bulstrode Christopher JK. Bailey and love the short practice of surgery. Arnold publishers. 2004;1203-18.
19. Smith DE, Kivchmer NA, Steward DR. Use of Barium enemas in the diagnosis of acute appendicitis and its complications Am. J Surg. 2008;138:829-32.
20. Stroman DL, Bayouth CV, Kuhn JA. The role of computed tomography in the diagnosis of acute appendicitis. Am J Surg. 1999;178:485.

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