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Study of modified Alvarado score and ultrasound imaging with post - operative histopathology in diagnosis of acute appendicitis

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Abstract

Introduction: Acute appendicitis, though one of the commonest emergencies in surgical practice, can at times confuse the best of clinicians. Failure of an early diagnosis could lead to progression of the disease process with its attendant morbidity as well as occasional mortality. In spite of the technical advances, diagnosis of acute appendicitis remains a clinical entity. A negative appendectomy rate of 20% has been described in the surgical literature. The aim of the present study was to evaluate the diagnostic accuracy of appendicitis through a comparison of the modified Alvarado score (MAS) and the abdominal ultrasonogram for diagnosing patients with suspected acute appendicitis.

Patients and methods: An analytic and observational study was conducted on 50 patients during a period of 24 months, from October 2017 to September 2019. Patients that were initially suspected of presenting with acute appendicitis that were rule out before surgery were eliminated from the study and gynecological and urological diseases, pregnant females, any mass per abdomen and appendicular abscess and ruptured appendix diagnosed Intraoperatively were excluded from study. The variables analyzed were age, surgical result, and score results from the modified Alvarado score and preoperative Ultrasound findings. These were then compared with postoperative histopathology report.

Results and discussion: During the study period total 50 patients included in this study, all the patients underwent classical appendectomy. The mean age of patients is 32.84 ± 6.35 and male to female ratio of 3:2. Correlating the patients' modified Alvarado score (MAS) with the post-operative histopathological reports, the following observations were made. 5(10%) patients had a Modified Alvarado score of 1 – 4, out of which 3(60%) patients had histopathological evidence of reactive lymphoid hyperplasia and 2(40%) patients were found to be negative for appendicitis. None had a pathological evidence of acute appendicitis in either sex. In 15(30%) patients with MAS of 5-7, 8 (53.33%) patients had histopathological evidence of acute appendicitis; 6(40%) patients had reactive lymphoid hyperplasia and 1(6.66%) patient revealed unremarkable appendix on histopathology. Among the 30 (60%) patients with a modified Alvarado score of more than 7, 26(86.66%) had histopathological evidence of acute appendicitis; 3(10%) patients had reactive lymphoid hyperplasia and 1(3.33%) was unremarkable. All the patients were subjected to ultrasonogram of the abdomen. Of the 50 patients, 41 (82%) had USG findings suggestive of acute appendicitis. In 9 (18%) patients, the appendix did not reveal any features suggestive of acute appendicitis.

Conclusion: To conclude acute appendicitis is a common surgical abdominal emergency. Modified Alvarado score is an non-invasive, safe diagnostic procedure, which is simple, fast, reliable and repeatable. It can be used in all conditions, without expensive and complicated supportive diagnostic methods. Modified Alvarado score increases the diagnostic certainty of clinical examination in diagnosis of acute appendicitis.

Keywords: Modified Alvarado score, Acute Appendicitis, Ultrasound

Introduction

Acute appendicitis, though one of the commonest emergencies in surgical practice, can at times confuse the best of clinicians. Despite it being a common health problem, the diagnosis of acute appendicitis is still difficult to make, especially in young persons, the elderly and in reproductive age women. Various genitourinary or gynaecological inflammatory conditions can present with signs and symptoms similar to those of acute appendicitis. Failure of an early diagnosis could lead to progression of the disease process with its attendant morbidity as well as occasional mortality. In spite of the technical advances, diagnosis of acute appendicitis remains a clinical entity. A negative appendectomy rate of 20% has been described in the surgical literature.

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Hence a comprehensive scoring system, developed by Alvarado in 1986, in an attempt to reduce the negative appendectomy rate without causing an increase in the morbidity and mortality, has been evolved in making an affirmative diagnosis of acute appendicitis [2]. Among imaging modalities, graded compression ultrasonography is an expensive, fast and non-invasive method for the diagnosis of acute appendicitis. It is particularly useful in female patients when a differential diagnosis of twisted ovarian cyst, ectopic pregnancy or some other gynaecological pathology is being suspected [3].

The aim of the present study was to evaluate the diagnostic accuracy of appendicitis through a comparison of the modified Alvarado score (MAS) and the abdominal ultrasonogram for diagnosing patients with suspected acute appendicitis.

Patients and methods

An analytic and observational study was conducted on 50 patients during a period of 24 months, from October 2017 to September 2019 in the Department of General Surgery, Mamata General Hospital, Khammam. It included patients with any age and both gender, presenting with right iliac fossa pain and diagnosed with presumptive diagnosis of acute appendicitis operated on at the Mamata General Hospital, Khammam. Patients that were initially suspected of presenting with acute appendicitis that were ruled out before surgery were eliminated from the study and gynecological and urological diseases, pregnant females, any mass per abdomen and appendicular abscess and ruptured appendix diagnosed Intraoperatively were excluded from study. The variables analyzed were age, surgical result, and score results from the modified Alvarado score and preoperative Ultrasound findings. These were then compared with postoperative histopathology report.

Method of collection of data: All the subjects elicitation of the history and physical examination was carried out including all the components of the modified Alvarado score. All the patients were investigated with routine surgical work up including Hb%, TLC, DLC, Biochemical markers, Viral markers, ECG, X ray erect abdomen, Chest X-ray and ultrasound of abdomen and pelvis. Patients were evaluated by the Modified Alvarado scoring system and Ultrasonogram of the abdomen and subjected to surgery. The Modified Alvarado score was calculated in the grades of 1 to 4, 5 to 7 and more than 7. All the operated specimens were subjected to Histopathological studies. All the data were recorded in the designated proforma for each patient for analysis. The modified Alvarado score and the findings of abdominal ultrasound were then correlated with the histopathological examination data. All the results were analyzed and tabulated according to age, sex, preoperative Alvarado score, Ultrasound imaging, per operative findings and histopathological examination results. All the patients were

followed up postoperatively for 6 months, with visits at 01, 03 and 06 months

Statistical analysis: The outcomes were recorded and analyzed at the end of the study. Student’s t test was used for analysis of quantitative data. Pearson’s test was used for analysis of qualitative data. Differences were considered statistically significant, if P<0.05. IBMSPSS Statistics for Windows, version 26 (IBM Corp., Armonk, N.Y., USA) software program was used for statistical calculations.

Results

During the study period total 50 patients included in this study, all the patients underwent classical appendicectomy. All the findings were evaluated and tabulated accordingly. In the present study the incidence of clinically diagnosed appendicitis was maximum in 21-30 years of age group (44%) and the least incidence was in the 6th decade (2%). The mean age of patients is 32.84±6.35. Among the 50 patients, 31 (62%) were males and 19(38%) were females with a male to female ratio of 3:2.

Clinical Presentation According to the Modified Alvarado's Components: In the components of the Modified Alvarado score, 49(98%) patients had right iliac fossa tenderness; 44(88%) of the patients had right iliac fossa pain; 39(78%) of the patients had anorexia; 36(72%) of the patients had nausea/vomiting; 33(66%) of the patients had leukocytosis; 28(56%) of the patients had rebound tenderness and only 18(36%) of the patients had pyrexia. These are illustrated in table-1.

Table1: Clinical presentation according to the Alvarado's Components

Alvarado's Components	Frequency (%)
Migratory RIF Pain	44 (88)
Anorexia	39 (78)
Nausea/ Vomiting	36 (72)
RI Tenderness	49 (98)
Rebound Tenderness	28 (56)
Pyrexia	18 (36)
Leukocytosis	33 (66)

Distribution in the Different Grades of Alvarado Score: Out of the 50 patients studied, based on the modified Alvarado score, 30 (60%) patients had a score of more than 7; 15 (30%) patients had a score between 5-7 and only 5(10%) patients had a score between 1 and 4. Out of the 5(10%) patients with a score of 1-4, 3(6%) were males and 2(4%) were females. Among the 15(30%) patients with a score between 5 and 7, 11(22%) were males and 4(8%) were females. Out of the 30 (60%) patients with the score of more than 7, 17(34%) were males and 13(26%) were females. These findings are illustrated in table 2.

Table 2: Sex Distribution in the different grades of Alvarado Score

Alvarado Score	Male(n=31)		Female(n=19)		Total(n=50)	
	No. of Cases	Percentage	No. of Cases	Percentage	No. of Cases	Percentage
1to 4	3	6	2	4	5	10
5to 7	11	22	4	8	15	30
>7	17	34	13	26	30	60
Total	31	62	19	38	50	100

Correlation of Alvarado Score with Histopathology: Correlating the patients’ modified Alvarado score (MAS) with the post-operative histopathological reports, the following observations were made. 5(10%) patients had a Modified

Alvarado score of 1-4, out of which 3(60%) patients had histopathological evidence of reactive lymphoid hyperplasia and 2(40%) patients were found to be negative for appendicitis. None had a pathological evidence of acute appendicitis in either

sex. In 15(30%) patients with MAS of 5-7, 8(53.33%) patients had histopathological evidence of acute appendicitis; 6(40%) patients had reactive lymphoid hyperplasia and 1(6.66%) patient revealed unremarkable appendix on histopathology. Among the 30(60%) patients with a modified Alvarado score of more than 7, 26(86.66%) had histopathological evidence of acute appendicitis; 3(10%) patients had reactive lymphoid hyperplasia and 1(3.33%) was unremarkable. Hence overall, out of 50 cases, 34(68%) patients were confirmed histopathologically to have acute appendicitis, out of which, 26(76.47%) patients belonged to Modified Alvarado Score >7;

whereas 8(23.52%) patients belonged to MAS 5-7. There was no case of proven appendicitis in MAS group of 1-4. 12(24%) patients, out of 50, showed reactive hyperplasia, whereas 4(8%) patients had normal appendix. In patients with modified Alvarado Score > 7, the sensitivity was 76.47%, specificity was 75%; Positive predictive value (PPV) was 86.66% and negative predictive value (NPV) was 60%. In patients with modified Alvarado Score <7, the sensitivity was 23.52%, specificity was 25%; PPV was 40% and NPV was 13.33. The details of these observations have been depicted in table-3.

Table 3: Correlation of Alvarado score with histopathology in all patients

Modified Alvarado Score (No. of cases) (n=50)	Histopathology(n=50)						P-value
	Acute Appendicitis(n=34)		Reactive Lymphoid Hyperplasia (n=12)		Unremarkable (n=4)		
	No. of Cases	Percentage	No. of Cases	Percentage	No. of Cases	Percentage	
1-4 (n=5)	0	0	3	25	2	50	<0.002
5-7 (n=15)	8	23.52	6	50	1	25	
>7 (n=30)	26	76.47	3	25(10)	1	25	
Total (n=50)	34	100	12	100	4	100	

Correlation of Alvarado score with histopathology in Male:

In the present study, among 31(62%) male patients, 17(54.83%) had modified Alvarado score more than 7, among them 15(88.23%) patients had histological evidence of acute appendicitis and 2(11.76%) patients had reactive lymphoid hyperplasia. Of the 31(62%) males patients in this study, 11(35.48%) patients had a modified Alvarado score of 5-7. 6(54.54%) patients had histological evidence of acute appendicitis, 4(36.36%) patients had reactive lymphoid hyperplasia and 1(9.09%) has unremarkable histopathologic findings. 3(9.67%) out of 31 male patients with modified Alvarado score of 1-4, 2(66.66%) patients had histological evidence of reactive lymphoid hyperplasia and 1(33.33%) had normal histopathologic findings

score of > 7, 27(90%) patients had USG features of acute appendicitis and 3(10%) did not have any ultrasonographic features of acute appendicitis. In 15 patients with the MAS of 5-7, 9(60%) had features of acute appendicitis and 6(40%) were negative for appendicitis on USG. In the 5(10%) patients with a score between 1 and 4, all 5(100%) had features of acute appendicitis on USG. Statistically it was observed that most of patients with modified Alvarado Score more than 7 had acute appendicitis 27 (90%) with P-Value of 0.0001. The findings are illustrated in table 4.

Table 4: Correlation of Alvarado score with USG imaging

Modified Alvarado Score	Total No. Of Cases (n=50)	USG Imaging (n=50)		P-value
		Positive	Negative	
1-4	5	5	0	0.0001
5-7	15	9	6	
>7	30	27	3	

Correlation of Alvarado score with histopathology in Females:

In the present study, among 19(38%) female patients, 13(68.42%) patients had the modified Alvarado score more than 7. Histological evidence of acute appendicitis was seen in 11(84.61%) patients. Reactive lymphoid hyperplasia and normal appendix was seen in 1(7.69%) patient each. In 4(21.05%) patients with the score between 5 and 7 histological evidence of acute appendicitis and reactive lymphoid hyperplasia was seen in 2(11.76%) patients each. Of the 2(10.52%) female patients with the score of 1 to 4, 1(5.88%) had histological evidence of reactive lymphoid hyperplasia and 1(5.88%) revealed normal appendix on histopathologic study.

Correlation of USG Imaging with Histopathology: In all the 50 patients USG and Histopathology findings were compared. Among the 41(82%) patients with USG features suggestive of acute appendicitis, 29(58%) patients had histological features of acute appendicitis and 12(24%) patients were negative for acute appendicitis on histopathology. In the 9 patients who were negative for appendicitis on USG, 5(10%) patients and features of appendicitis and 4(8%) were negative for appendicitis on histopathological examination.

Correlation of Alvarado score and USG imaging: All the patients were subjected to ultra-sonogram of the abdomen. Of the 50 patients, 41(82%) had USG findings suggestive of acute appendicitis. In 9(18%) patients, the appendix did not reveal any features suggestive of acute appendicitis. These USG findings were compared with modified Alvarado scores calculated for each patient. Of the 30(60%) patients with a modified Alvarado

Correlation of Alvarado score and USG Imaging with Histopathology: All the findings from all the patients of ultrasound imaging and post-operative histopathologic studies were compared according to the corresponding modified Alvarado score. They are illustrated in table 5.

Table 5: Correlation of Alvarado score and USG Imaging with Histopathology

Modified Alvarado score	No. of Cases (n=50)	USG Imaging		Histopathology		
		Positive	Negative	Acute Appendicitis	Reactive Lymphoid Hyperplasia	Unremarkable
1-4	5	5	0	0	3	2
5-7	15	9	6	8	6	1
> 7	30	27	3	26	3	1
Total	50(100%)	41(82%)	09(18%)	34(68%)	12(24%)	04 (8%)

Discussion

Acute appendicitis remains a common abdominal emergency throughout the world. The diagnosis of acute appendicitis continues to be difficult due to the variable presentation of the disease and the lack of reliable diagnostic test. Though there are lots of advances in the diagnostic field with the invention of sophisticated investigations like ultrasonogram, CT and MRI, diagnosis of acute appendicitis remains an enigma for the attending surgeon. The results of this study were discussed and compared with various other studies [4]. The age group in which acute appendicitis occurred commonly was between 21 and 30 years. It was clear that incidence is less in younger age groups with peak incidence in second and third decade. In the present series the males outnumbered females in the ratio of 1.6:1. Pain was the commonest presenting symptom and has been observed in almost all the cases (88%) in the present series. In the components of the modified Alvarado score, 98% patients had right iliac fossa tenderness, 88% of the patients had right iliac fossa pain, 78% of the patients had anorexia, 72% of the patients had nausea / vomiting, 66% of the patients had leucocytosis, 56% of the patients had rebound tenderness and only 34% of the patients had pyrexia. For assessment, the patients were categorized into 2 groups namely, male and female. Out of 50 cases studied, 31 were male and 19 were female. Out of 31 males, score of > 7 were 12; score of 5-7 were 16 and 3 had score <5. Out of 19 female patients, 9 had score > 7, 8 had score 5-6 and 2 had score < 5. Management was on same lines for all the patients and classical appendectomy was performed. In the present study, the incidence of clinically diagnosed appendicitis was maximum in the age group of 21-30 years (44%) and the least incidence was in the 6th decade (2%). A study conducted by Kamal Bansal, *et al.* [5] also observed the same. Maximum number of patients were in between 21-30 years (18%) followed by 10-20 years. Another study by Patel V *et al.* [47] also identified similar results, where most of the patients were in 21-30 years (34.88%) followed by third decade (32.55%). Similar results were observed in this study. In this study of 50 patients, 31(62%) were males and 19(38%) were females. This was comparable with studies by Kamal Bansal *et al.* [5] and Jain *et al.* [6].

Clinical presentation according to the modified Alvarado's Components:

In the components of the Modified Alvarado score, 98% patients had right iliac fossa tenderness; 88% of the patients had right iliac fossa pain; 78% of the patients had anorexia; 72% of the patients had nausea / vomiting; 66% of the patients had leucocytosis; 56% of the patients had rebound tenderness and only 34% of the patients had pyrexia. Right iliac fossa pain was the common presenting symptom. However, it was observed that the classical migratory pain from umbilicus to McBurney's point was not seen in majority of the patients.

In a study conducted by Jain, *et al.* [6], 100% patients had right iliac fossa pain, 86% of the patients had anorexia, 84% of the patients had nausea / vomiting and rebound tenderness each, 98% of the patients had RIF tenderness and 85.33% of the patients had pyrexia.

In the study conducted by Anand Hanumaiah [7], 51% patients had right iliac fossa pain, 94% of the patients had anorexia, 89% of the patients had nausea or vomiting, 48% of the patients had leucocytosis and 46% of the patients had rebound tenderness. Presence of RIF tenderness is similar between present study and Jain, *et al.* [6].

Correlation of Modified Alvarado Score with Histopathology

Correlating the Alvarado score with the histopathological reports, the following observations were made. In patients with a score between 1 & 4, none of the patients had pathological evidence of acute appendicitis in either sex. In 15 patients with a score between 5 to 7, 8(53.33%) had histopathological evidence of acute appendicitis. Among the 30 patients with a score of more than 7, 26(86.66%) patients had histopathological evidence of acute appendicitis and 4(13.4%) showed reactive lymphoid hyperplasia; In 15 patients with score between 5 & 7, 3(25%) had histopathological evidence of reactive lymphoid hyperplasia and 3(25%) had histopathological evidence of reactive lymphoid hyperplasia score between 1 & 4.

In this study the in patients with a score < 7 the histologically confirmed acute appendicitis was seen in 40% cases; whereas in patients with a score of > 7, it was 86.66%. There was no case of acute appendicitis among the patients with a score of 1 & 4. These findings were comparable to a study conducted by Kanumbaeta [8] with 5.88% appendicitis on histopathologic examination in patients with a MAS score < 7 and 94.11% in patients with score > 7.

In the present study, in patients with Alvarado Score > 7, the sensitivity was 76.47%, specificity was 75%, PPV was 86.66% and NPV was 60%; In patients with Alvarado Score < 7, the sensitivity was 23.52%, specificity was 25%, PPV was 40% and NPV was 13.33.

In 2019, Elliot Weisenberg gave an explanation that Hallmark of acute appendicitis is Neutrophilic infiltrates of the wall of the appendix. Acute mucosal inflammation is usually present, often Neutrophilic in filtrates within the lumen. Histologic findings alone are not sufficient to diagnose acute appendicitis. Depending on the severity of the inflammation, variable necrosis of the appendix wall is present with mucosal sloughing. Process may be divided into Acute focal, Acute supportive, gangrenous and perforative. Vessels may show thrombosis or contain lymphocytes resembling chronic lymphocytic leukemia. Granulation tissue response or cicatricial fibrosis may be apparent in some cases and minority of cases show lymphohistiocytic response containing foamy histiocytes termed xanthogranulomatous appendicitis [9].

In 2011, Akbulut S, *et al.* reported that histopathologic findings indicated that 1179(94%) of the appendectomy specimens were positive for acute appendicitis. Among these, 880 were phlegmonous appendicitis, and 148 were gangrenous appendicitis with perforation. Sixty-three were defined as lymphoid hyperplasia. Unusual pathology was found in 88 specimens [10].

Seventy-six of the specimens, accounting for 6% of the total, showed no pathology that supported the initial diagnosis of appendicitis, and they were classified as negative specimens. 58(76.3%) of these cases had undergone laparotomy with a Mc Burney incision, and the appendectomy procedure was standard. In 18(31.0%) of the laparotomy cases, the appendix appeared normal upon microscopic analysis, and other pathologic conditions were revealed upon further testing [8].

In 2014, D.P. Chula Kanishka stated that Histopathologic evidence of acute inflammation and luminal obstruction were evaluated to find the entomopathogenic relationship. 125 patients were included. 46% appendices were macroscopically normal but 79% of them were microscopically pathologic. 90% appendices were pathologic and microscopic evidence of acute inflammation was found in 82% of them. 12.5% and 3.5% of them had lymphoid hyperplasia and chronic inflammation, respectively, without any pathologic evidence of acute

appendicitis. Luminal obstruction was seen in 30% of appendices and 49% of them were histologically normal. 49% appendices with luminal obstruction had microscopic evidence of acute inflammation. Faecolith (49%), lymphoid hyperplasia (38%), fibrosis (8%), parasites (3%), and endometrial tissue (3%) were found obstructing the lumen. 78% of appendices with faecoliths were pathologic and 93% of appendices with lymphoid hyperplasia had no pathologic evidence of acute appendicitis. Clinical assessment is fairly accurate in diagnosis of acute appendicitis. Luminal obstruction may not be a significant process in pathogenesis, though obstruction with faecolith can commonly cause acute appendicitis. Luminal obstruction (mostly by lymphoid hyperplasia) without acute inflammation can still present with the clinical picture of acute appendicitis. Neoplasia is not a commonly encountered pathology in clinically diagnosed acute appendicitis^[11].

Diagnosis of Acute Appendicitis: In 1999, Stephens PL, Mazzucco JJ reported that ten (10.6%) patients had anormal appendix removed. Ultrasound alone resulted in a correct diagnosis in 87% of the time. Using the Alvarado score alone, a correct diagnosis was made 88% of the time. If the ultrasound alone were used for diagnosis, seven acute appendices would have been missed (10% false negatives) and three unnecessary operations would have been performed (4.6% false positives). If the Alvarado score alone were used for diagnosis, four acute appendices would have been missed (5.9% false negatives) and five unnecessary operations would have been performed (7.2% false positives). There were 45 true positives and no false positive results when both modalities were positive for appendicitis. When the Alvarado score was negative or equivocal, the addition of ultrasound decreased the false negative rate by 75%. In 2012, Shirzad Nasiri *et al.* reported that fifty-five male and 20 female patients were assessed. Of these patients 89.3% had acute appendicitis. The sensitivity, specificity, PPV, NPV and accuracy rate of ultrasonography was 71.2%, 83.3%, 97.4%, 25% and 72.4%, respectively. By taking a cutoff point of 7 for the MASS score, a sensitivity of 65.7%, specificity of 37.5%, PPV of 89.8%, NPV of 11.5% and accuracy of 62.7% were calculated. Using the cutoff point of 6, a sensitivity of 85.1%, specificity of 25%, PPV of 90.5%, NPV of 16.7% and accuracy of 78.7% were obtained. Ultrasound provides reliable findings for helping to diagnose acute appendicitis in a hospital. A cut off point of 6 for the MASS score will yield more sensitivity and a better diagnosis of appendicitis, though with an increase in negative appendectomy^[13].

Correlation of USG with Histopathology: Assessing the correlation of USG Score and histopathological evidence in this study, the observation made showed true positive of 90% (27/30) and false positive of 10% (3/30) in patients with Modified Alvarado score >7. When further observed in score from 5 to 7 it showed true positive of 60% (9/15) and false positive of 40% (6/15). In patients with Modified Alvarado score of 1 to 4, a true negative of 40% (2/5) was observed. In the present study on assessing the correlation of modified Alvarado score and ultrasonogram with histopathological evidence, the following conclusions were made. Assessing the correlation of the score and the sex distribution, 15/17 (91.66%) males with the higher modified Alvarado score (>7) showed histological evidence of acute appendicitis. Similar observation was made in females with scores more than 7, 11/13 (88.88%) patients had histological evidence of acute appendicitis. Thus the

Alvarado score showed a good correlation with the histopathological results, higher the score, greater the incidence of histologically proven acute appendicitis. Modified Alvarado score has a true positive of 86.6% (26/30) and false positive of 13.3% (4/30) in the patients with a score above 7. Assessing the correlation of USG Score and histopathological evidence showed true positive of 90% (27/30) and false positive of 10% (3/30) in patients with Modified Alvarado score > 7.

Conclusion

To conclude acute appendicitis is a common surgical abdominal emergency. Modified Alvarado score is an non-invasive, safe diagnostic procedure, which is simple, fast, reliable and repeatable. It can be used in all conditions, without expensive and complicated supportive diagnostic methods. Modified Alvarado score increases the diagnostic certainty of clinical examination in diagnosis of acute appendicitis. Ultrasonogram done in patients with equivocal or low modified Alvarado score is useful in identifying the missed out cases thereby preventing diagnostic delay and its attendant complications like appendicular perforation and abscess formation. There is no clear advantage of ultrasonography over Alvarado score for diagnosis of acute appendicitis in cases with high degree of clinical suspicion with a modified Alvarado score > 7. The additional information provided by USG does improve diagnostic accuracy in case of negative or equivocal Alvarado score. In establishing the diagnosis in patients with high clinical suspicion (MASS > 7) of having acute appendicitis, Modified Alvarado Scoring System is better compared to USG alone. When used both for diagnosis of acute appendicitis in patients with low clinical suspicion (MAS < 7), diagnostic accuracy increases and reduces negative appendectomy rates. Hence, it was concluded that Modified Alvarado Scoring System >7 is good enough for preoperative diagnosis of acute appendicitis, whereas additional investigation with ultrasound of abdomen adds to the diagnostic accuracy with a Modified Alvarado Score of < 7 in order to avoid negative appendectomy.

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