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Original Research Article

The validity and utility of combining ultrasonography with different clinical scores in diagnosis of acute appendicitis

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ABSTRACT

Background: There are no controlled studies combining the use of either of the scores- Modified Alvarado, RIPASA or AIRS with ultrasonography. This study was conducted to evaluate the diagnostic accuracy of the existent clinical scoring systems in combination with ultrasound imaging in the diagnosis of acute appendicitis in our patients.
Methods: All patients with clinical diagnosis of acute appendicitis and who underwent emergency appendectomy were included in the study. A detailed history of presenting illness was elicited and clinical examination, relevant blood investigations and abdominal ultrasonography were done. All patients were scored according to MAS, RIPASA and AIRS. Histopathology was taken as the gold standard.
Results: The study included 118 patients. From our study population, 107 had acute appendicitis on histopathology. There was no statistically significant difference between the accuracy of MAS and RIPASA and both were equally good in diagnosing acute appendicitis as far as the diagnostic accuracy is concerned. Combined MAS, Combined RIPASA and Combined AIRS were obtained after combining ultrasonography findings with MAS, RIPASA score and AIRS respectively. The diagnostic accuracy, sensitivity, specificity, PPV and NPV for Combined MAS were 96.6%, 99.1%, 72.7%, 97.2% and 88.9% respectively, for combined RIPASA were 95.8%, 99.1%, 63.6%, 96.4% and 87.5% respectively and for combined AIRS was 96.6%, 99.1%,72.7%, 97.2%, and 88.9% respectively.
Conclusions: If ultrasonography is used in conjunction with current clinical scoring systems then the diagnostic accuracy is enhanced. Therefore, USG should be done in all cases being evaluated for acute appendicitis; irrespective of the score being used.

Keywords: Modified Alvarado scoring system, RIPASA, Appendicitis inflammatory response score, Ultrasonography, Appendicitis

INTRODUCTION

Diagnosing appendicitis poses a lot of issues. There is no single sign, symptom, or available diagnostic tool to accurately confirm the diagnosis.[1] Clinical suspicion continues to be relied upon for taking the decision to operate. To aid in the diagnosis, a number of clinical scores have been proposed such as the modified Alvarado scoring system (MAS), Raja Isteri Pengiran Anak Saleha appendicitis (RIPASA) and appendicitis inflammatory response score (AIRS).[2-4]

Among the scoring systems, the Alvarado score is most commonly used. It has been observed to be less specific in Asian populations as compared to European/American populations.[3] Other scoring systems have been devised

recently such as AIRS and the RIPASA score, which has a better sensitivity and specificity especially in context of Asian population.[3]

Imaging modalities are another means to assist in the diagnosis of acute appendicitis and reduce the negative appendectomy rates.[5-7] Due to its easier availability ultrasonography (USG), is the most commonly used imaging modality. Its drawback is variable sensitivity and specificity due to operator dependence.[8]

So far, no one has attempted to utilize all three options (clinical, biochemical and radiological) to formulate a single consolidated scoring system to improve the pre-operative diagnostic accuracy. We, therefore, conducted a comparative study to evaluate the diagnostic accuracy of the existent clinical scoring systems in combination with ultrasound imaging in the diagnosis of acute appendicitis in our patients.

METHODS

Study design

A prospective clinical comparative study was conducted in the hospitals associated with Kasturba Medical College, Mangalore between June 2015 to December 2016. The sample size of 77 was calculated with 89% sensitivity, 7% precision and 95% confidence interval.[9] The non-response rate was assumed to be 20%, so the total sample size came to 93. Selection of patients: All admissions in the surgical unit with the clinical diagnosis of acute appendicitis who were taken up for emergency appendectomy were included in the study based on the inclusion and exclusion criteria.

Inclusion criteria

All patients >18 years who undergo an emergency appendectomy.

Exclusion criteria

Exclusion criteria were age <18 years, evidence of generalized peritonitis, palpable mass in right iliac fossa (RIF), evidence of acute confusion state, dementia, septic shock and other associated abdominal diseases.

The patients were informed that the study is voluntary and the treatment would not be affected by participating or restraining from the study. No extra costs/visits of doctors were incurred as a part of the study.

Data gathering

A detailed history was taken in all cases with special reference to the relevant points- pain (onset, nature, site, duration and migration of pain), fever and associated symptoms such as anorexia, nausea, vomiting, diarrhoea, constipation and burning sensation in urine. Thorough clinical examination was done in every patient with special attention to abdominal examination. The different signs of acute appendicitis i.e. tenderness in RIF, rebound tenderness, fever, rovsing sign were carefully looked for and findings were noted in the recording sheet by the duty doctor. Examination of blood including TLC, DLC, the morphology of WBC (shift of neutrophils) and CRP were done. Ultrasonography was done by the radiologist of the rank of a senior resident or above only. Based on the findings the sonologist were asked to grade their result as- unlikely/negative, probable or definitive. The final diagnosis was made by the surgeon on his clinical judgment. Calculations of MAS, RIPASA, AIR scores were done.[2,10,11]

Analysis

A computerized grouped database was constructed with study variables using SPSS-22 software. The diagnostic accuracy of the various systems was assessed individually using the pre-established criteria, both continuous score values and defined categorical sub-classifications were evaluated. In addition, an indigenously designed scoring system combining clinical and sonographic scoring was used. As shown in Image 1, Combined MAS, Combined RIPASA and Combined AIRS were obtained after combining ultrasonography findings with MAS, RIPASA score and AIRS respectively. A USG category score of 1, 2 or 3 was assigned to unlikely, probable or definite features of acute appendicitis respectively. Similarly, patients with MAS category score ≥7 were given MAS category score of 3; those with MAS score of 5-6 were given MAS category score of 2 and those with MAS score <5 were given MAS category score of 1. Patients with RIPASA category score ≥7.5 were given RIPASA category score of 3; those with RIPASA score of 5-7 were given RIPASA category score of 2, and those with RIPASA score<5 were given RIPASA category score of 1.Patients with AIRS category score ≥9 were given AIRS category score of 3; those with AIRS score of 5-8 were given AIRS category score of 2, and those with AIRS score<5 were given AIRS category score of 1. Combined MAS category score, Combined RIPASA category score, Combined AIRS category score were each obtained by adding USG category score to MAS category score, RIPASA category score and AIRS category score respectively. Patients with Combined category score of 5-6 were considered as a definite probability of acute appendicitis; a combined category score of 3-4 was considered as probable acute appendicitis and a combined category score of 1-2 was taken as unlikely/low probability. Accordingly, patients with definite and probable appendicitis (score 3, 4, 5 or 6) were taken as test positives and those with unlikely/low probability (score 1 or 2) were taken as test negatives. Histopathological examination was done to confirm the diagnosis. Infiltration of the muscularis propria by neutrophils was considered diagnostic of acute appendicitis.[12] $p<0.05$ was considered statistically significant.

RESULTS

We included 118 patients in our study. Seventy-four (62.7%) patients were between the age of 18-40 and 44 patients (37.3%) were greater than 40 years of age. The mean age of subjects in the study was 32.36±8.95. Male patients composed 66.9% of our study population while 33.1% of patients were female. Histopathology was taken as the reference gold standard for the diagnosis of acute appendicitis in our study. Out of the total 118 patients, 107 (90.7%) were found to have acute appendicitis on histopathology while 11 (9.3%) were normal on histopathology. This gave a negative appendectomy rate of 9.3%.

Table 1: Frequency and correlation of symptoms, signs and laboratory parameters with gold standard (histopathology) (n=118).

Findings	Total (n=118)	Acute appendicitis* (n=107)	Non-acute appendicitis* (n=11)	P value
	N (%)	N (%)	N (%)	
Symptoms				
Pain in RIF				
Present	118 (100)	107 (100)	11 (100)	Cannot be calculated
Absent	0 (0)	0 (0)	0 (0)	
Migratory pain from umbilicus to RIF				
Present	62 (52.5)	61 (57)	1 (9.1)	0.003
Absent	56 (47.5)	46 (43)	10 (90.9)	
Anorexia				
Present	111 (94.1)	100 (93.5)	11 (100)	1.000
Absent	7 (05.9)	7 (6.5)	0 (0)	
Nausea				
Present	81 (68.6)	81 (75.7)	0 (0)	<0.001
Absent	37 (31.4)	26 (24.3)	11 (100)	
Vomiting				
Present	81 (68.6)	81 (75.7)	0 (0)	<0.001
Absent	37 (31.4)	26 (24.3)	11 (100)	
Constipation				
Present	15 (12.7)	13 (12.1)	2 (18.2)	0.630
Absent	103 (87.3)	94 (87.9)	9 (81.8)	
Diarrhoea				
Present	15 (12.7)	13 (12.1)	2 (18.2)	0.630
Absent	103 (87.3)	94 (87.9)	9 (81.8)	
Burning micturition				
Present	29 (24.6)	29 (27.1)	0 (0)	0.063
Absent	89 (75.4)	78 (72.9)	11 (100)	
Signs				
Tenderness RIF				
Present	108 (100)	107 (100)	11 (100)	Cannot be calculated
Absent	0 (0)	0 (0)	0 (0)	
Guarding				
Present	81 (68.6)	79 (73.8)	2 (18.2)	<0.001
Absent	37 (31.4)	28 (26.2)	9 (81.8)	
Rebound tenderness				
Present	91 (77.1)	90 (84.1)	1 (9.1)	<0.001
Absent	27 (22.9)	17 (15.9)	10 (90.9)	
Fever(>37.5ºC)				
Present	20 (16.9)	18 (16.8)	2 (18.2)	1.000
Absent	98 (83)	89 (83.2)	9 (81.8)	
Obturator sign				
Present	3 (2.5)	3 (2.8)	0 (0)	1.000
Absent	115 (97.5)	104 (97.2)	11 (100)	

Continued.

Findings	Total (n=118)	Acute appendicitis* (n=107)	Non-acute appendicitis* (n=11)	P value
	N (%)	N (%)	N (%)	
Rovsing sign				
Present	29 (24.6)	29 (27.1)	0 (0)	0.063
Absent	89 (75.4)	78 (72.9)	11 (100)	
Psoas sign				
Present	6 (5.1)	5 (4.7)	1 (9.1)	0.452
Absent	112 (94.9)	102 (95.3)	10 (90.9)	
Laboratory				
Total leucocyte count				
10-14999/mm^3	20 (16.9)	19 (17.8)	1 (9.1)	<0.001
>15000/mm^3	81 (68.6)	81 (75.7)	0 (0)	
<10000/mm^3	17 (14.4)	7 (6.5)	10 (90.9)	
CRP levels				
≥50 mg/l	10 (8.5)	10 99.3)	0 (0)	0.595
10-49 mg/l	108 (91.5)	97 (90.7)	11 (100)	
Urinalysis findings				
Negative	102 (86.4)	92 (86)	10 (90.9)	1.000
Positive	16 (13.6)	15 (14)	1 (9.1)	

*Based on gold standard histopathology.

Table 2: Frequency and correlation of various scoring systems, USG and combined (with USG) clinical scores with gold standard (histopathology) (n=118).

Scoring system	Total (n=118)	Acute appendicitis* (n=107)	Non-acute appendicitis* (n=11)	P value
	N (%)	N (%)	N (%)	
MAS score				
MAS ≥7	94 (79.6)	93 (86.9)	1 (9.1)	<0.001
MAS <7	24 (20.3)	14 (13.1)	10 (90.9)	
RIPASA score				
RIPASA ≥7.5	104 (88.1)	100 (93.5)	4 (36.4)	<0.001
RIPASA <7.5	14 (11.8)	7 (6.5)	7 (63.6)	
AIRS score				
AIRS ≥9	71 (60.1)	71 (66.4)	0 (0)	<0.001
AIRS <9	47 (39.8)	36 (33.6)	11 (100)	
USG score				
Definitive or probable acute appendicitis on USG	104 (88.1)	101 (94.4)	3 (27.3)	<0.001
Acute appendicitis unlikely on USG	14 (11.8)	6 (5.6)	8 (72.7)	
Combined MAS score				
Combined MAS category 3	96 (81.3)	95 (88.8)	1 (9.1)	<0.001
Combined MAS category 2	13 (11.0)	11 (10.3)	2 (18.2)	
Combined MAS category 1	9 (7.62)	1 (0.9)	8 (72.7)	
Combined RIPASA score				
Combined RIPASA category 3	98 (83.0)	95 (88.8)	3 (27.3)	<0.001
Combined RIPASA category 2	12 (10.1)	11 (10.3)	1 (9.1)	
Combined RIPASA category 1	8 (06.7)	1 (0.9)	7 (63.6)	
Combined AIRS score				
Combined AIRS category 3	97 (82.2)	95 (88.8)	2 (18.2)	<0.001
Combined AIRS category 2	12 (10.1)	11 (10.3)	1 (9.1)	
Combined AIRS category 1	9 (07.6)	1 (0.9)	8 (72.7)	

*Based on gold standard histopathology.

Table 3: Comparison of available scoring systems, USG and combined (with USG) clinical scoring systems based on the statistical and clinical performance of a test.

	MAS (%)	RIPASA score (%)	AIRS (%)	USG (%)	Combined MAS (%)	Combined RIPASA Score (%)	Combined AIRS (%)
Sensitivity	86.9	93.5	66.4	94.4	99.1	99.1	99.1
Specificity	90.9	63.6	100	72.7	72.7	63.6	72.7
PPV	98.9	96.2	100	97.1	97.2	96.4	97.2
NPV	41.7	50	23.4	57.1	88.9	87.5	88.9
Accuracy	87.3	90.7	69.5	92.4	96.6	95.8	96.6

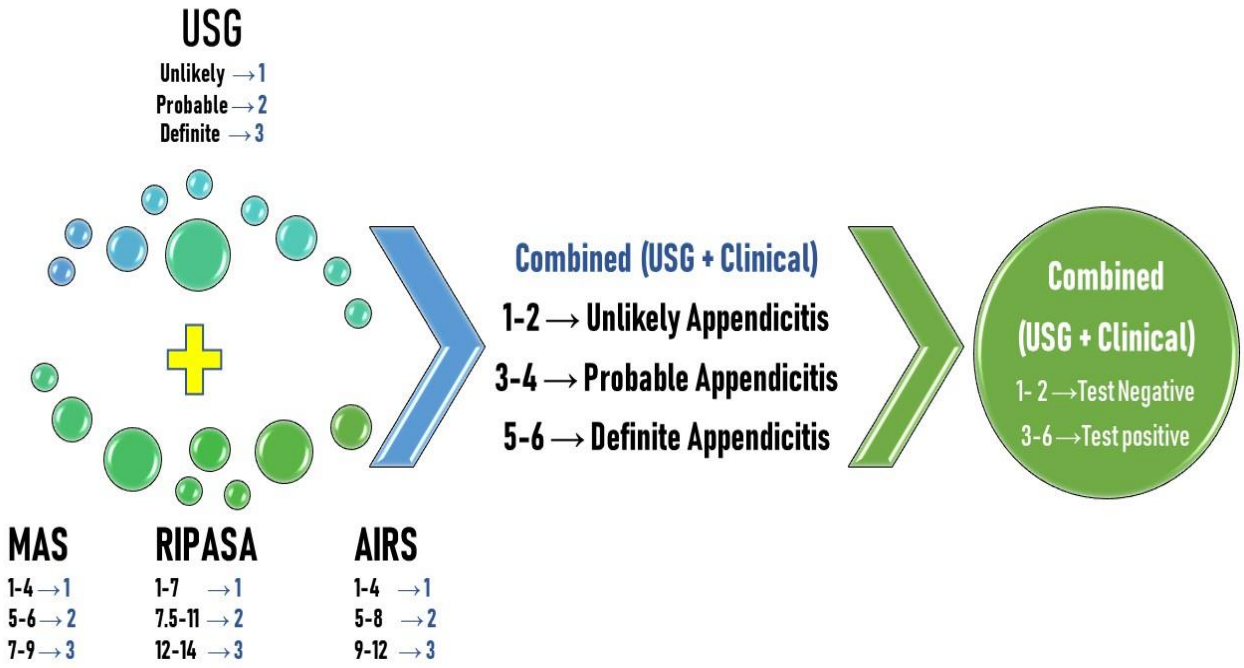

Figure 1: Scoring system to calculate combined scoring system for the study population.

RIF pain was the most consistent symptom present in 100% of the patients (Table 1). One hundred and eight (91.5%) patients had pain since <48 hours. The mean time to presentation was 16.08 hrs with an SD 12.12 hours and median 12.5 hours (range 6-72 hours). Leucocytosis (Total leucocyte count >10000/mm^3) was present in 101 patients (85.5%) and 17 patients (14.4%) had normal TLC. Elevated CRP in the range of 10–49 mg/l was seen in 108 patients (91.5%) while CRP was ≥50 mg/l in 10 patients (8.5%). The chi-square test shows that migratory pain (p=0.003), nausea (p<0.001), vomiting (p<0.001), guarding (p<0.001), rebound tenderness (p<0.001) and raised TLC >10000/mm3 (p<0.001) were statistically significant indicators of acute appendicitis (Table 1).

MAS was ≥7 in 94 patients (79.66%) and <7 in 24 patients (20.34%). On further analysis with histopathology; it was found that MAS could diagnose 93 (86.9%) patients out of 107 histopathologically positive acute appendicitis patients thereby yielding a sensitivity of 86.9% (Table 2). In our study, one patient was falsely diagnosed with acute appendicitis by MAS scoring. Therefore, the negative appendectomy rate for MAS comes out to be 1.06%.

RIPASA score was ≥7.5 in 100 patients (93.5%) and <7.5 in 7 patients (6.5%). RIPASA could diagnose 100 (93.5%) patients out of 107 histopathologically proved acute appendicitis patients (Table 2). This yields a sensitivity of 93.5%. However, four patients were falsely diagnosed with acute appendicitis by RIPASA scoring. Thus, the negative appendectomy rate for RIPASA comes out to be 3.85%.

When AIRS was applied on all 118 patients in the present study, 71 patients (60.2%) were in high probability (score ≥9) while rest 47 patients (39.8%) were in indeterminate

or low probability (Table 2). It was found that AIRS could diagnose only 71 (66.4%) patients out of 107 histopathologically proved acute appendicitis patients, thereby, yielding a sensitivity of 66.4%. Thirty-six (33.6%) cases of histopathologically proved acute appendicitis were missed by AIRS system. There were no false positive cases when using AIRS (negative appendectomy rate –0%). Among the various scoring systems, RIPASA score had the highest diagnostic accuracy (90.7%) while AIRS had the lowest diagnostic accuracy (69.5%) (Table 3).

On ultrasound imaging, it was suggestive of definite or probable acute appendicitis in 104 patients (88.1%) while 14 patients (11.9%) were unlikely to have acute appendicitis. Three patients were falsely diagnosed with acute appendicitis by USG although histopathology showed them to be non-appendicitis. Thus, the negative appendectomy rate for USG comes out to be 2.89%. In our study ultrasound achieved a diagnostic accuracy of 94.1% which is higher than any of the individual scoring systems (Table 3).

Using a combined MAS category score, 106 patients with histologically proved acute appendicitis were detected as test positives. MAS alone could only identify 93 patients of histologically proved acute appendicitis. Thus 13 more patients were detected using this combined score leading to increased sensitivity (99.1%) (Table 3). Combined RIPASA could exclude 7 (63.6%) patients out of 11 histopathologically negative patients, thereby yielding a specificity of 63.6%, PPV of 96.4%, NPV of 87.5% and diagnostic accuracy was 95.8% (Table 3). Using a Combined AIRS category score, 97 patients (82.2%) were definite acute appendicitis; 12 patients (10.2%) in the probable category while rest nine patients (7.6%) were unlikely to have acute appendicitis. Using this combined system 106 patients with histologically proved acute appendicitis were detected as test positives. Thus 35 more patients with acute appendicitis were detected using combined AIRS (as compared to AIRS) leading to increased sensitivity (99.1%) (Table 3).

DISCUSSION

The diagnosis of acute appendicitis is predominantly based on clinical findings.[1] Our study included a total of 118 patients who were operated for clinically suspected acute appendicitis and fulfilled the eligibility criteria for our research. Histologically there were 107 (90.7%) patients with evidence of acute appendicitis while 11 (9.3%) patients did not have acute appendicitis. Thus, our negative appendectomy rate was 9.3%. In literature, a negative appendectomy rate varying from 6-20% has been reported.[7,13]

The various scoring systems have included different clinical symptoms and signs in their scoring method. In our study right iliac fossa pain was present in 107 patients (100%) and nausea and vomiting in 81 patients (75.7%). Migratory pain, nausea and vomiting came out to be statistically significant. These findings are consistent with the study of Korner et al in which they found that history of nausea or vomiting and pain migration to RIF were significant predictors of acute appendicitis.[14] A study by Andersson et al also, showed that the migration of pain was statistically significant in cases of acute appendicitis.[15]

Tenderness in RIF was present in all 107 patients, guarding was present in 79 patients (73.8%) and rebound tenderness in 90 patients (84%). Further analysis showed that only guarding and rebound tenderness are statistically significant in patients with acute appendicitis which was consistent with findings of Andersson et al study.[15]

Hematologic laboratory investigations showed leukocytosis (TLC >10000/mm^3) in 100 patients (93.5%) out of 107 patients with acute appendicitis. These findings are consistent with the study by Gronroos et al in which they found that mean leucocyte count was significantly higher in patients with acute appendicitis as compared to patients with non-inflamed appendicitis.[16]

Kalan et al showed that this modified Alvarado score (MAS) had a sensitivity of 93% in males and 67% in females in diagnosing acute appendicitis.[2] In our study, MAS was able to exclude ten patients (90.9%) out of 11 histopathologically negative patients, thereby yielding a specificity of 90.9%. The positive predictive values and negative predictive values of MAS were 98.9% and 41.7% respectively; therefore, the overall accuracy of the score came out to be 87.3%. Our study correlates well with the study by Kanumba et al in terms of sensitivity, specificity, PPV and accuracy.[17] However, the negative predictive value in our study is lower than this study. Other studies, such as the study by Macklin, have reported a wide variation in these values for MAS.[18] It may be due to a difference in demographics and sex distribution.

In the original Chong et al study using RIPASA score, they reported a sensitivity of 88%, specificity of 67%, PPV of 93%, NPV of 53% using a score ≥7.5 as the cutoff.[3] Similar to their study, RIPASA was able to exclude only seven patients (63.6%) out of 11 patients who were histopathologically negative in our study, thereby yielding a specificity of 63.6%, PPV of 96.2%, NPV of 50% and diagnostic accuracy of 90.7%.

Another study by Chong et al reported sensitivity of 98%, specificity of 81.3%, PPV of 85.3%, and NPV of 97.4%.[19] Similar to our study, it was shown that the sensitivity of RIPASA score is higher than the Alvarado score; while the specificity of RIPASA score is lower than the Alvarado score. In our study sensitivity of RIPASA (93.5%) was higher than MAS (86.9%) and the specificity was lower (63.6%) as compared to MAS (90.9%).

Another scoring system, AIRS was able to exclude all 11 patients out of 11 histopathologically negative patients, thereby yielding a specificity of 100%. The PPV was 100%, NPV was 23.4%, accuracy was 69.5%. The study by Castro et al reported a high sensitivity (around 100%) while low specificity (10%) in diagnosis of acute appendicitis.[11] Our results, therefore, do not match with the results reported by Andersson et al and Castro et al.[4,11]

There is a lack of more studies by others to verify the findings obtained by original developers of AIRS score. Differences in ethnic, geographic and demographic distribution may be responsible for differences observed in our study. Further studies need to be carried out to find the cause of this discrepancy. In our research, if AIRS would have been used in deciding to operate, the negative appendectomy rate would have been 0%. However, it should be remembered that AIRS has poor sensitivity (66.4%) in our study, resulting in 36 (33.6%) cases of histologically proved appendicitis being missed by this scoring system.

In our study, among the various available clinical scoring system, RIPASA score had the highest diagnostic accuracy (90.7%) while AIRS had the lowest diagnostic accuracy (69.5%). There was no statistically significant difference between the accuracy of MAS (87.3%) and RIPASA (p=0.406). We infer from it that MAS and RIPASA are both equally good in diagnosing acute appendicitis as far as the diagnostic accuracy.

USG was able to exclude only eight patients (73.7%) out of 11 histopathologically negative patients, thereby yielding a specificity of 72.7%. The PPV, NPV and accuracy were 97.1%, 57.1% and 92.4% respectively. Douglas et al reported similar sensitivity of 94.7% while specificity to be 88.9%.[20] A study by Nasiri et al reported sensitivity, specificity, PPV, NPV and accuracy rate of ultrasonography in the diagnosis of acute appendicitis to be 71.2%, 83.3%, 97.4%, 25% and 72.4% respectively.[21] Other studies also show USG sensitivity between 55%-98% and specificity between 78% -100%.[21-23]

The sensitivity of combined MAS in our study is 99.1%. Three patients were falsely diagnosed as acute appendicitis by combined MAS although histopathology showed them to be non-appendicitis. Thus, the negative appendectomy rate for Combined MAS comes out to be 2.75%. It reflects an improvement from the negative appendectomy rate of 9.3% obtained in our study where patients were operated on the basis of clinical suspicion alone without the use of scoring systems and/or USG. A study by Dsouza et al reported that additional information provided by ultrasound does improve the diagnostic accuracy of MAS.[24]

A study by Alexander et al showed that using Alvarado score with ultrasonography increases the sensitivity and diagnostic reliability of this scoring system.[25] They reported a sensitivity of 93.3% and specificity of 100% when using Alvarado score with USG, in contrast to using the Alvarado score alone yielded a sensitivity of 90.4% in their study. Our study also shows increased sensitivity when using combination scoring system of USG with modified Alvarado score. In our study, Combined MAS increased diagnostic accuracy to 94.1% as compared to MAS alone (87.3%).

Using a combined RIPASA category score, 98 patients (83.1%) were definite acute appendicitis; 12 patients (10.2%) in the probable category while eight patients (6.8%) were unlikely to have acute appendicitis. Using this combined system 106 patients with histologically proven acute appendicitis were detected as test positives. RIPASA alone could detect 100 patients of histologically proven acute appendicitis. Thus, six more patients were detected using combined RIPASA score leading to increased sensitivity. The sensitivity of Combined RIPASA in our study is 99.1%. Four patients were falsely diagnosed with acute appendicitis by combined RIPASA although histopathology showed them to be non-appendicitis. Thus, the negative appendectomy rate for combined RIPASA comes out to be 3.64%. This reflects an improvement from the negative appendectomy rate of 9.3% obtained in our study where patients were operated on the basis of clinical suspicion alone without the use of scoring systems and/or USG.

AIRS alone could only detect 71 patients of histologically proven acute appendicitis. Thus 35 more patients were detected using combined AIRS. The sensitivity of Combined AIRS in our study is 99.1% while the sensitivity of AIRS alone is 66.4%. This shows a considerable improvement in sensitivity of AIRS on combing it with USG. Three patients were falsely diagnosed as acute appendicitis by combined AIRS histopathology. Thus, negative appendectomy rate for combined AIRS comes out to be 2.75%. Combined AIRS could exclude 8 (72.7%) patients out of 11 histopathologically negative patients, thereby yielding a specificity of 72.7%. The PPV was 97.2% while NPV was 88.9%. The accuracy was 96.6%. No study in literature could be found by us that combined use of AIRS with ultrasonography.

We combined each of the individual scoring systems with ultrasonography and compared the combined scoring systems. This raised the diagnostic accuracy to 96.6% for combined MAS. The diagnostic accuracy of combined AIRS was also 96.6%. Combined RIPASA had a slightly lower diagnostic accuracy (95.8%). A study by Gallego et al also reported that using USG with standard scoring systems increases diagnostic accuracy in patients with suspected acute appendicitis.[26] As USG raises the diagnostic accuracy of each of these scores, we infer that USG should be done in all cases being evaluated for acute appendicitis; irrespective of the score being used.

CONCLUSION

Among the clinical scoring systems, RIPASA has the highest diagnostic accuracy as compared to MAS and AIRS. However, ultrasonography has a higher diagnostic accuracy as compared to any of the individual scoring systems. Therefore, use of scoring systems and/or ultrasonography helps to reduce the negative appendectomy rate. There were no statistically significant differences between the accuracy of combined MAS, combined AIRS and combined RIPASA. Thus, all three scoring systems when combined with USG are similar in terms of diagnostic accuracy. Since AIRS uses C-reactive protein which may not be routinely available in developing countries and also further increases the cost incurred to the patient. Either MAS or RIPASA may be more appropriate to be used in combination with ultrasonography than AIRS.

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