ORIGINAL RESEARCH PAPER
Volume - 12 | Issue - 08 | August - 2023 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

A PROSPECTIVE COMPARATIVE STUDY OF ALVARADO SCORE AND ULTRASOUND IMAGING IN THE DIAGNOSIS OF ACUTE APPENDICITIS

General Surgery

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ABSTRACT

Background: Acute appendicitis is the acute inflammation of appendix which is the most common cause of acute surgical emergencies. Appendicitis can mimic other pathologies. **Aims and Objective:** To correlate Alvarado score with USG imaging in diagnosis of Acute appendicitis and study the usefulness of incorporating USG imaging in patients with low/equivocal Alvarado Score in improving the diagnostic accuracy in acute appendicitis. **Material and methods:** This was prospective comparative study carried out in 100 patients over the period of 01 year. Patients with clinical features of acute appendicitis and fitting in inclusion and exclusion criteria were selected. Detailed history was noted and clinical examination was done. Necessary investigations were done, modified Alvarado score was calculated and all were subjected to ultrasonography of abdomen and pelvis. Intra operative findings were noted about nature of appendix and histopathology findings were noted. **Results:** Out of all the patients who underwent appendicectomies, 63 (63%) were histologically positive for acute appendicitis, 16 (16%) were positive for chronic appendicitis and 21 (21 %) were histologically negative. Ultra-sonography had sensitivity of 92.41%, specificity of 4.76%, positive predictive value of 78.50%, negative predictive value of 14.29%. Diagnostic accuracy of 74%.USG report of 88 (88%) patients showed Acute Appendicitis, 5 (5%) showed appendicular perforation and the USG report of 7 (7%) patients werenormal. **Conclusion:** On correlation of Alvarado score and USG imaging with gold standard histopathological examination, we observed that Modified Alvarado Score is not superior to USG and both investigations together improve the diagnosis of acute appendicitis.

KEYWORDS

Alvarado Score, Ultrasound, Acute Appendicitis

INTRODUCTION

The word appendicitis refers to inflammation of appendix vermiformis. Symptoms generally include right lowerabdominal pain, nausea, vomiting, and decreased appetite. However, approximately 40% ofpeople do not have these typical symptoms. Severe complications of a ruptured appendixinclude widespread, painful inflammation of the inner lining of the abdominal wall and sepsis [1]

Appendicitis is caused by a blockage of the hollow portion of the appendix. This is most usually due to a calcified "stone" made of feces. Inflamed lymphoid tissue from a viral infection, parasites, gallstone, or tumors may also cause the blockage. This blockage leads to increased pressures in the appendix, decreased blood flow to the tissues of the appendix, and bacterial growth inside the appendix causing inflammation.

The combination of inflammation, reduced blood flow to the appendix and distension of the appendix causes tissue injury and tissue death. If this process is left untreated, the appendix may burst, releasing bacteria into the abdominal cavity, leading to increased complications [2]

The two most common imaging tests used are an ultrasound and computed tomography (CT scan). CT scan has been shown to be more accurate than ultrasound in detecting acute appendicitis.

However, ultrasound may be preferred as the first imaging test in children and pregnant women because of the risks associated with radiation exposure from CT scans. [3] Abdominal ultra-sonography, preferably with doppler sonography, is useful to detect appendicitis, especially in children.

Ultrasound can show the free fluid collection in the right iliac fossa, along with a visible appendix with amplified blood flow when using color Doppler, and non compressibility of the appendix, as it is essentially walled-off abscess.

Other secondary sonographic signs of acute appendicitis include the presence of echogenic mesenteric fat surrounding the appendix and the acoustic shadowing of an appendicolith [4, 5]In some cases (approximately 5%), ultrasonography of the iliac fossa does not reveal any abnormalities despite the presence of appendicitis.

Several scoring systems have been developed to try to identify people who are likely to have appendicitis. The performance of scores such as the Alvarado score and the Pediatric Appendicitis Score, however, are variable. [5]

The Alvarado score is the most known scoring system. A score below 5 suggests against adiagnosis of appendicitis, whereas a score of 7 or more is predictive of acute appendicitis. In a person with an equivocal score of 5 or 6, a CT scan or ultrasound exam may be used to reduce the rate of negative appendectomy. [6] The scoring system used by Alvarado and USG imaging wasused.

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. Patients who had Alvarado score >7 were assumed to have a preoperative diagnosis of Acute appendicitis and proceeded with emergency appendectomy.

Ultrasound examination is done following the clinical examination for all patients included in the study. Those patients having Ultrasonographic diagnosis of acute appendicitis were preceded with emergency appendectomy. The appendix removed was sent for histo-pathologic examination.

Histo-pathologic Examination diagnosis was regarded as final diagnosis. Utility of Alvarado Score and Ultrasonography in making a preoperative diagnosis of acute appendicitis is then seen and compared. Appendix specimen will be sent for HPE for final confirmation of diagnosis. All the results will be analysed and

tabulated according to age, sex, Alvarado components, pre-operative score, USG imaging, Surgery done and HPE results

This study involves correlating the acute appendicitis between clinically diagnosed and histo-pathologically examined specimen and the role of Alvardo scoring system and ultrasound in early diagnosis of acute appendicitis and to exclude negative appendectomies, in patents who present with RIF pain with / without fever and vomiting, admitted to the department of Surgery at PBM hospital.

Modified Alvarado score for diagnosis of appendicitis

Feature	Points
Migratory right lower quadrant pain	1
Anorexia	1
Nausea or vomiting	1
Tenderness in the right lower quadrant	2
Rebound tenderness in the right lower quadrant	1
Fever >37.5°C (>99.5°F)	1
Leukocytosis of white blood cell count >10 × 109/liter	2
Total	9

MATERIALAND METHODS

The current study is a hospital-based cross prospective study. Duration of the study was 01 year from Jan 2022 to Dec 2022. An informed written consent was obtained from all the subjects.This research was carried out at the Department ofgeneral surgeryon the patients undergoing appendicectomies in S.P. Medical College and P.B.M Hospital, Bikaner.

Sampling Method: Convenience sampling

Inclusion Criteria

1. All patients presenting with right iliac fossa pain were included in this study.
2. Patients 18 years and above were included in the study irrespective of gender.

Exclusion Criteria

1. Patients not willing to participate in study
2. Patients with recurrent appendicitis.
3. Clinically patients with gynecological and urological diseases were excluded from this study.
4. Patients with appendicular mass on ultrasonography

Data Collection:

The data collected from under study population through a pretested and semi-structured questionnaire mentioned; Data collected from all components of Alvarado scoring system including clinical history and examination and from laboratory reports, radiological investigation, intra-operative finding and post-operative histopathology report findings noted.

Statistical Analysis

The recorded data compiled and entered in a spreadsheet computer program (Microsoft Excel 2007) and appropriate tests applied. For all tests, confidence level and level of significance were set at 95% and 5% respectively.

RESULTS

It is observed that the out of 100 patients of presenting with the right iliac fossa pain above 12 years according the age of the patients ranged from 12 years to 65 years with a mean age of 31.72±12.73 years. Maximum number of patients, 35% were in the 21–30 years age group followed by the 11 to 20 years age group with 23% (table 1).

Table 2 show the total number of cases in this study was 100. Out of 100 patients, 63 (63%) were male and 37 (37%) were female. According to table 3 & 4 respective data shows that, 84 (84%) patients had migration of pain to RIF, 63 (63%) patients had anorexia and 70 (70%) patients had Nausea/Vomiting and 91 (91%) patients had tenderness in the RIF, 61 (61%)patients had rebound tenderness and 71 (71%) patients hadfeverrespectively.

In the present study, 70 (70%) patients had leukocytosis>10,000. Vise 7 (7%) patients had a score of 1-4, 37 (37%) patients hadascore of 5-6, 46 (46%) patients had a score of 7-8 and 10 (10%) patients had a scoreof 9. Vise 57 (57%) patients had a positive Modified Alvaradoscoring compared to 43 (43%) patients who had a negative Modified Alvaradoscoring. Vise USG report of 88 (88%) patients showed Acute Appendicitis, 5 (5%) showed Appendicular Perforationand the USG report of 7 (7%) patients werenormal and Out of all the patients who underwent appendicectomies, 63 (63%) werehistologically positive for acute appendicitis, 16 (16%) were positive for chronic appendicitis and 21 (21 %) were histologicallynegative were found respectively in table 5-9.

And, table no 12 shows that the comparison between Modified Alvarado Score and ultrasound diagnosis of Acute Appendicitis was found to be statistically significant and the P value was 0.048.

Observation Tables

Table-1 Age distribution of patients.

Age Groups	Frequency	Percent
12 - 20	23	23.0
21 - 30	35	35.0
31 - 40	18	18.0
41 - 50	14	14.0
51 - 60	9	9.0
61 - 70	1	1.0
Total	100	100.0

Table-2 Gender distribution of patientsstudied

Sex	Frequency	Percent
Female	37	37.0
Male	63	63.0
Total	100	100.0

Table-3 Symptoms of patients studied

Symptoms Studied		Count	%
MIGRATION OF PAIN TO RIF	No	16	16.0%
	Yes	84	84.0%
ANOREXIA	No	37	37.0%
	Yes	63	63.0%
NAUSEA/VOMITING	No	30	30.0%
	Yes	70	70.0%

Table 4: Signs of patients studied

SIGNS STUDIED		COUNT	%
TENDERNESS IN RIF	No	9	9.0%
	Yes	91	91.0%
REBOUND TENDERNESS	No	39	39.0%
	Yes	61	61.0%
ELEVATED TEMPERATURE	No	29	29.0%
	Yes	71	71.0%

Table 5: Leukocytosis (TLC >10,000)

LEUCOCYTOSIS	Frequency	Percent
No	30	30.0
Yes	70	70.0
Total	100	100.0

Table 6: Modified Alvarado Scoring

Modified Alvarado Score	Frequency	Percent
1 - 4	7	7.0
5 - 6	37	37.0
7 - 8	46	46.0
9	10	10.0
Total	100	100.0

Table 7: Modified AlvaradoScoring (Positive/Negative for appendicitis)

Alvarado Score	Frequency	Percent
Negative (<7)	43	43.0
Positive (7 +)	57	57.0
Total	100	100.0

Table 8: USG imaging of patient studied

USG REPORT	FREQUENCY	PERCENT
ACUTE APPENDICITIS	88	88.0
APPENDICULAR PERFORATION	5	5.0
NORMAL	7	7.0
Total	100	100.0

Table 9: HPE findings of patientsstudied

HISTOPATHOLOGY REPORT	FREQUENCY	PERCENT
ACUTE APPENDICITS	63	63.0

CHRONIC APPENDICITS	16	16.0
NORMAL	21	21.0
Total	100	100.0

Table 10: Comparison of MAS from previous studies

Study	Modified Alvarado Score			
	1-4	5-6	7-8	9
P. Prabhu et al 2019[58]	10%	16%	74%	
Dr. Sapna T et al. (2021)[57]	8%	24%	68%	
Samudre, Sayali&Munde, Anil. (2021)[56]	21.5%	20.5%	58%	
Present study	7%	37%	46%	10%

Table 11: Comparison of Statistical values of USG as compared with HPE within different studies

Study	Sensitivity	Specificity	Positive predictive value	Negative predictive value	Accuracy
Mishra A et al 2018[60]	71.26	61.54	92.54	24.24	
Hem Chander Pandey et al 2018[59]	79.2	50	86.4	37.5	
Samudre, Sayali&Munde, Anil. (2021)[56]	78.19	50	96.07	12.76	
Present Study	92.41%	4.76%	78.50%	14.29%	74%

Table 12: Correlation of ALVARADO score according to USG report of patients studied

	USG REPORT			Total
Modified Alvarado Score	Acute Appendicitis	Appendicular Perforation	Normal	
Negative (<7)	38 (43.2%)	0(0.0%)	5 (71.4%)	43(43.0%)
Positive (7 +)	50(56.8%)	5(100.0%)	2(28.6%)	57(57.0%)
Total	88(100.0%)	5(100.0%)	7(100.0%)	100(100.0%)

Pearson Chi-Square = 6.081; df = 2; p-value = 0.048

DISCUSSION

Acute appendicitis remains a common abdominal emergency throughout the world. The diagnosis of acute appendicitis continues to be difficult due to variable presentation of the disease and lack of reliable diagnostic test. History and clinical examination provide useful information regarding diagnosis and now days the diagnosis of appendicitis is mainly done on a clinical basis. The Alvarado score is simple scoring system that can be instituted easily. The Alvarado score was modified by Kalen and proposed as Modified Alvarado score.

We studies patients with diagnosis of acute appendicitis and accessed the usefulness and accuracy of Alvarado score in the diagnosis of acute appendicitis. In the present study the mean age of the study group was 31 years with most patients were in younger age groups. Similar results were published by P. Prabhu et al 2019 [7] and Hem Chand et al [8]. Males are more commonly affected in our study with male: female ratio of 1.70. Other studies done by P. Prabhu et al 2019 [7], Hem Chander Pandey et al 2018 [8] and Mishra A et al 2018 [9] also reported male predominance in their studies.

In the present study, most common clinical presentation was migration of pain to RIF in 84 (84%) patients, 70 (70%) patients had Nausea/Vomiting and 60% had anorexia. P. Prabhu et al 2019 in their study also reported migratory pain to RIF, nausea/vomiting, and anorexia as the three most common presenting complaints in their study. DrHarekrishnaMajhi (2018) et al.[10] reported in their study that migratory pain to RIF was seen in 100% cases whereas anorexia in 62% and nausea/vomiting in 58% cases. The above studies are consistent with our present study.

In our study 70% of patients had leukocytosis of >10000 per dl. P. Prabhu et al 2019 also reported leukocytosis in 70% patients and DrHarekrishnaMajhi (2018) et al.61reported that 62% patients had leukocytosis. [10] The results of these previous studies are in concordance with our study.

In the present study, 7 (7%) patients had a score of 1-4, 37 (37%) patients hadascore of 5-6, 46 (46%) patients had a score of 7-8 and 10 (10%) patients had a scoreof 9. As shown in the above table, the findings reported by P Prabu et al [7] and Dr. Sapna T et al. (2021) are in concordance with our study.[11] Samudre, Sayali&Munde, Anil. (2021) reported slight higher percentage of patients with Modified Alvarado score of <5, this may be due to the variation in selection process of cases, and other factors like demographical factors. [12]

In the present study, out the 88 cases whose Ultrasound scan report showedAcuteAppendicitis, 50 (56.8%) patients had a positive Modified Alvarado score (>=7)and 38 (43.2%) patients had a negative Modified Alvarado score.

The comparison between Modified Alvarado Score and ultrasound diagnosis of Acute Appendicitis was statistically significant (P value = 0.048). This shows that when the score of Mean Alvarado score is less than 7, and there is doubt in the diagnosis of acute appendicitis, ultrasound can be of help in preventing negative appendicectomy. Samudre, Sayali &Munde, Anil. (2021) also reported that USG can aid in the diagnosis when MAS is less than 6 which is in agreement with our study.

In our present study we found out that though both Mean Alvarado Score and USG are good diagnostic tools to diagnose Acute appendicitis , USG is better to both diagnose and rule our negative surgeries because both sensitivity and specificity of USG was found better that Mean alvaroado score in our study.

The use of ultrasonography along with modified Alvarado score will be most useful in increasing the diagnostic accuracy of acute appendicitis. It would be interesting to compare the assessment of these patients using modified Alvarado score one group and another group as modified Alvarado score combined with ultrasonography in future study.

CONCLUSIONS

Modified Alvarado score and USG imaging both are good diagnostic tool for predicting acute appendicitis in classical presentation of acute appendicitis.In patients whose clinical scoring were above 7, it is recommended to consider emergency appendectomy. In patients with a clinical score of 5 to 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. Patients with the clinical score of <5 and USG not suggestive of acute appendicitis needs further diagnostic tests to exclude acute appendicitis.

Hence we finally recommend applying the Alvarado's clinical scoring in all patients presenting with a clinical diagnosis of acute appendicitis.

Various diagnostic aids have been used to increase the diagnostic accuracy of acute appendicitis but still the clinical diagnosis is superior. On correlation of Alvarado score and USG imaging with gold standard histopathological examination, we observed that Modified Alvarado Score is not superior to USG and both investigations together improve the diagnosis of acute appendicitis.

Disclosure Statement

This study is investigator initiated. The authors declare that they have no competing/conflict of interests in relation to this article.

Funding

No financial support from an external agency was used for this study.

Consent For Publication

- Not applicable.
- Ethics approval and consent to participate.
- The study protocol was approved by the medical ethics committee of the S.P. Medical College, Bikaner, Rajasthan(State), India.

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