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A prospective cohort study to assess the clinical profile of acute appendicitis and evaluate the combined use of modified Alvarado score and ultrasonography in a tertiary care center in India

Yadav GD[1], Nishant Saxena[2], Anju Yadav[3], Shraddha Verma[4], Mohd Arshad[5]

[1]Professor and Head, [2,4]Assistant Professor, [5]Postgraduate Resident, Department of General Surgery, GSVM Medical College, Kanpur, Uttar Pradesh, India, [3]Specialist, Department of Pediatrics, ESIC Hospital, Kanpur, Uttar Pradesh, India

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ABSTRACT

Background: Acute appendicitis is one of the most common causes of acute abdomen presentation to the hospital. If not treated in time, it may lead to perforation. Alvarado score is a clinical scoring system used in the diagnosis of acute appendicitis. The score is based on laboratory findings, clinical symptoms, and signs. We stipulate that ultrasonography and modified Alvarado score (MAS) can be synchronously and concomitantly be used to reach a trustable diagnosis of acute appendicitis. **Aims and Objectives:** The aims of this study were to assess the clinical profile of acute appendicitis and evaluate the combined use of MAS and ultrasonography (USG) in a tertiary care center in India. **Materials and Methods:** This is a prospective observational study, in which a cohort of patients presenting with acute abdomen due to acute appendicitis to the department of general surgery (Out Patient Department and Emergency) of L.L.R. Hospital attached to G.S.V.M. Medical College, Kanpur and meeting specific inclusion criteria were sampled between October 2021 and January 2022. **Results:** Our study re-enforces and supports demographic findings of prevalence as well as clinical findings reported in the previous studies on acute appendicitis. **Conclusion:** CECT of the abdomen can prove to be financially straining for people seeking treatment at public health care centers in developing or underdeveloped countries. Our study suggests that USG can be concomitantly and synchronously be used with MAS to reach a trustable diagnosis without the need for a CECT of the abdomen.

Key words: Acute appendicitis; Appendectomy; Appendix; Modified Alvarado score; Ultrasonography

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INTRODUCTION

Acute inflammation of the appendix is known as acute appendicitis. It is the most common cause of acute abdomen presentation to the hospital as well as one of the most common cause of urgent abdominal surgical procedure.[1,2] The lifetime risk of developing acute appendicitis in adults and children is about 8.6% in males and 6.7% in females making it one of the most leading causes of acute abdomen.[3] Acute appendicitis is believed to result from obstruction of the appendiceal lumen which leads to inflammation of the appendix and increased mucus secretion which subsequently results in bacterial overgrowth.[4] Acute appendicitis can progressively lead to perforation. The clinical signs and symptoms of acute appendicitis include periumbilical pain that can migrate to the right lower quadrant, tenderness and rebound tenderness, nausea, fever, anorexia, and vomiting.[5] Although the incidence of acute appendicitis manifests considerable variability, it has been found that the areas with

Address for Correspondence:
Dr. Mohd Arshad, Postgraduate Resident, Department of General Surgery, GSVM Medical College, Kanpur - 208 002, Uttar Pradesh, India.
Mobile: +91-9839831494. **E-mail:** arshadkgmu9839@gmail.com

low incidence of acute appendicitis are also the areas that are more prosperous and more educated.[6] Approximately 50,000 appendectomies are performed in England and more than 300,000 are performed in the United States per year.[7,8] The current trends in the management of acute appendicitis involve appendectomy within a day of diagnosis and antibiotics for acute uncomplicated acute appendicitis and emergency appendectomy when acute appendicitis takes a systemic course.[9,10]

Alvarado score is a clinical scoring score used for making a diagnosis of acute appendicitis. It was developed by Alvarado to help physicians reach an accurate diagnosis of acute appendicitis. The maximum total score on Alvarado score is 10 and is based on clinical symptoms, laboratory findings, and signs.[11,12] However, the score was later modified by Kalan et al., by omitting "shift to left" from the laboratory findings.[13] This score is now widely used and is known as modified Alvarado score (MAS).[12] Early diagnosis of acute appendicitis is important from the point of view of the fact that it is associated with significant morbidity and mortality due to various complications. Hence, clinical findings, including signs and symptoms and MAS, should be used along with radiological findings such as contrast-enhanced computed tomography (CECT) and ultrasonography (USG) as well as histopathological examination (HPE) to reach an accurate diagnosis. A previous study concerning this topic done in India by Mukhopadhyay et al., used Alvarado score instead of the much widely accepted MAS. The same study also considered CECT findings of patients along with USG findings despite the fact that CECT can prove to be a major financial burden in the Indian public healthcare scenario.[14] Another study conducted in northern India by Kansakar et al., used MAS as well as USG findings to evaluate the efficacy of the combined use of both of them in predicting acute appendicitis, thus overcoming the shortcomings of study conducted by Mukhopadhyay et al.[15] Our hospital is a tertiary care center situated in northwestern Uttar Pradesh in India and it receives a humongous patient load of appendicitis patients. Thus, in this study, we have tried to replicate the methodology applied by the above studies on our cohort of patients to check if the results hold true for our scenario or not.

Aims and objectives

The aims of this study were to assess the clinical profile of acute appendicitis and evaluate the combined use of modified Alvarado score (MAS) and USG.

MATERIALS AND METHODS

This is a prospective observational study, in which a cohort of patients presenting with acute abdomen due to acute appendicitis to the department of general surgery (Outpatient Department and Emergency) of L.L.R. Hospital attached to G.S.V.M. Medical College, Kanpur and meeting the below-mentioned inclusion criteria were sampled between October 2021 and January 2022. The ethical approval was sought from the Ethics Committee of G.S.V.M. Medical College (Ref. No. EC/BMHR/2021/52). Informed consent was taken from all the participants. The collected data have been kept strictly confidential and will only be a total of 82 patients with acute appendicitis were included in this study. Patients were analyzed as per age, sex, signs and symptoms, radiological findings, and duration of post-operative hospital stay. Complete blood count (CBC) and other routine blood tests were done. HPE was the diagnosis of choice for acute appendicitis.

Inclusion criteria

The following criteria were included in the study:

1. Patients of age more than 10 years but <60 years.
2. Periumbilical pain shifting to the right lower quadrant.
3. Pain localized to the right lower quadrant.
4. Localized tenderness.
5. Patients consenting to participate in the study.

Exclusion criteria

The following criteria were excluded from the study:

1. Patients of age <10 years or more than 60 years.
2. Patients with comorbidities such as diabetes mellitus and hyperthyroidism.
3. Patients with a palpable abdominal lump.
4. Patients with features of localized or generalized peritonitis.
5. Females with an arrested menstrual period based on the menstrual history, were referred to the gynecological department to rule out ectopic pregnancy.

Before the patients underwent appendectomy, it was made sure that MAS had been calculated, USG was done and pre-operative routing blood investigations such as CBC, random blood sugar, serum electrolytes, and coagulation profile (PT, INR) were done. First, MAS was calculated (Table 1) for patients with clinical suspicion of acute appendicitis. Then, they were advised USG abdomen (right lower quadrant) and the findings were recorded and documented. Finally, they were operated on and the

Table 1: The Modified Alvarado Score[13]

Migratory right iliac fossa pain	1
Anorexia	1
Nausea and vomiting	1
Tenderness of the right lower quadrant	2
Rebound tenderness of the right iliac fossa	1
Elevated temperature	1
Leukocytosis	2
Modified Alvarado Score	9

removed appendix was sent for HPE for confirming the diagnosis. Conservative management was not opted in any of the patients. All the findings were recorded and documented under various headings in an Excel Sheet using Microsoft Excel. The organized data were then statistically analyzed to derive the results of this study.

RESULTS

Maximum number of cases (73%) in this study were male patients (n=60). Maximum number of cases (n=32) were in the age group of 10-20 years. On USG, maximum number of cases (n= 72) were found to have increased appendicular diameter followed by increased wall thickness.

Out of the 82 patients that underwent appendectomy in our study, 73 (52 males,21 females) had positive histology for appendicitis while 9 (8 males, 1 females) were histologically negative for acute appendicitis. There was no mortality in this study.

The detailed results of this study have been further elucidated through figures 1-5 and tables 2-5. The results have been subsequently discussed in detail in the next section of the article.

DISCUSSION

In this study, the majority of cases were male patients contributing 73% of the total cases (n=60) and the females represented the remaining 27% of the total cases (n=22). Considering the distribution on the basis of age and sex (Table 2), the maximum number of cases were from 10 to 20 age group (39%, n=32) and the minimum number of cases were from 51 to 60 age group. The above demographic results are consistent with similar findings in previous studies.[16-18]

According to the results derived from our study (Figure 1), pain in the abdomen as a clinical symptom was present in all cases (100%, n=82). This was followed by nausea and anorexia seen in 91.4% cases (n=75) and fever was seen in 68.2% (n=56) of cases. These findings are consistent with the results derived in the study by Earley et al., and Laxman.[19]

A look at the prevalence of clinical signs in the participants of our study (Figure 2) suggests that tenderness over McBurney's point and rebound tenderness was present in all the cases (100%, n=82). This was followed by iliopsoas sign which was present in 36.5% of cases (n=30) and obturator sign which was present in 24.3% of cases (n=20). Total leucocyte count

Table 2: Distribution of acute appendicitis patients based on age and sex

Age Group in Years	Number of Cases		Total
	Male	Female	
10–20	25 (78.1%)	7 (21.9%)	32 (39%)
21–30	24 (80.0%)	6 (20.0%)	30 (36.5%)
31–40	6 (66.7%)	3 (33.3%)	9 (10.9%)
41–50	3 (37.5%)	5 (62.5%)	8 (9.7%)
51–60	2 (66.7%)	1 (33.3%)	3 (3.6%)
Total	60 (73.0%)	22 (27.0%)	82 (100%)

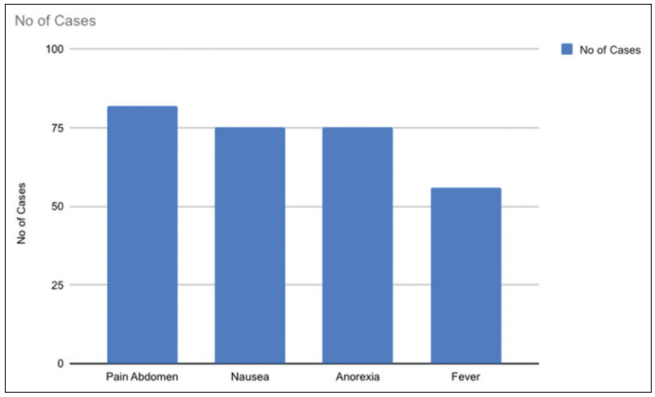

Figure 1: Distribution of acute appendicitis patients according to symptoms on a bar chart

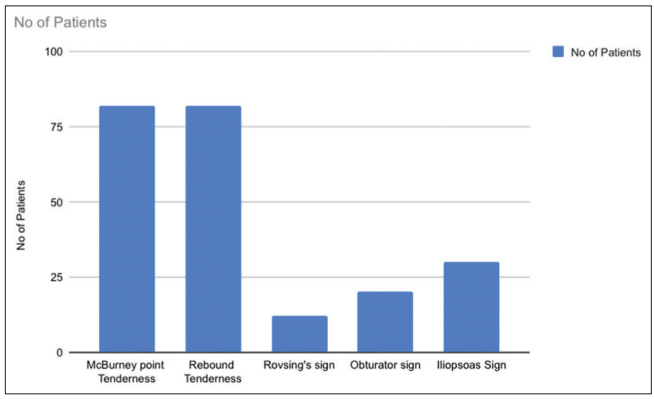

Figure 2: Distribution of acute appendicitis patients based on clinical signs

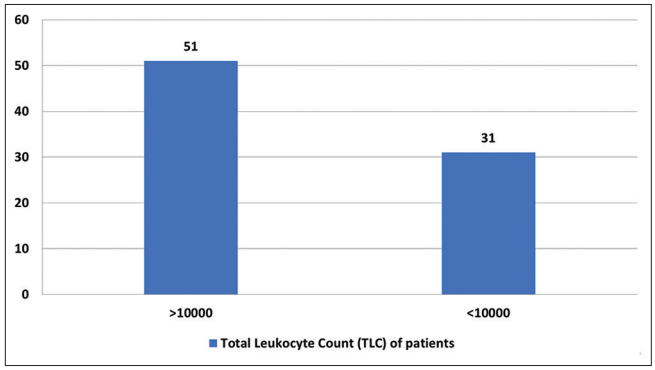

Figure 3: Distribution of acute appendicitis patients based on total leucocyte count

Table 3: Distribution of patients based on sex as per HPE findings

Sex	HPE+VE		HPE –VE	
	Male	Female	Male	Female
Number of Patients Total (82)	52	21	8	1
	73		9	

Table 4: Correlation of Modified Alvarado score with histopathology after appendectomy

Modified Alvarado Score	HPE+VE (73)		HPE –VE (9)	
	Male	Female	Male	Female
Group-A (≥7) (n=45)	35	9	1	0
Group-B (<7) (n=37)	17	12	7	1

Table 5: Correlation of USG with histopathology after appendicectomy

USG Finding	HPE+VE (n=73)		HPE –VE (n=9)	
	Male	Female	Male	Female
Positive (n=72)	50	18	4	0
Negative (n=10)	2	3	4	1

was raised in 62% of cases (n=51) which lend support to the findings in the previous studies (Figure 3).[18,20,21]

The most common USG finding in our study was increased appendicular diameter (87.8%, n=72) which was followed by appendiceal wall thickening (63.4%, n=52, Figure 4). These findings are again consistent with the findings in the earlier studies.[18,22]

Out of 82 patients having appendectomy in our study, 73 (52 males and 21 females) had positive HPE for appendicitis, while nine (eight males and one females) were HPE negative for acute appendicitis (Table 3).

In this study, it was noticed that MAS is more accurate in case of higher scores (≥7), where 97.7% (n=44) of symptomatic cases were found to be positive on HPE and 2.3% (n=1) of the symptomatic cases is negative on HPE. It was less reliable in the lower scores (<7), where about 78.4% (n=29) of symptomatic patients were found to have positive HPE and 21.6% (n=8) of symptomatic patients were found to have negative HPE (Table 4).

On ultrasonography, 94.4% (n=68) cases with feature of acute appendicitis had positive HPE, whereas 5.6% (n=4) cases with features of acute appendicitis had negative HPE. About 50% (n=5) of the cases were negative for USG feature with positive HPE (Table 5). These findings show little to no variability with the findings in previous studies.[14,15,18,23,24]

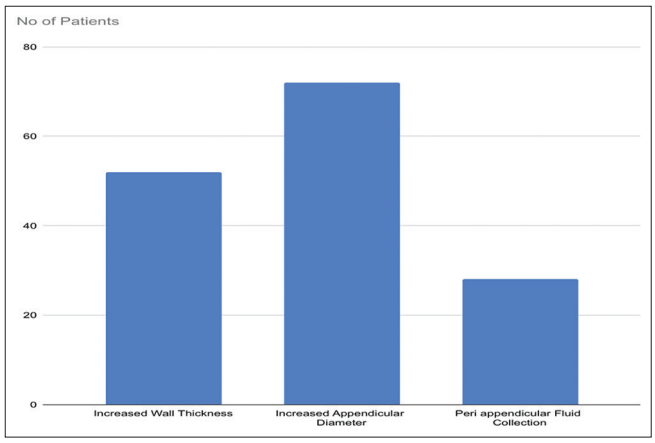

Figure 4: Distribution of acute appendicitis patients based on HPE findings

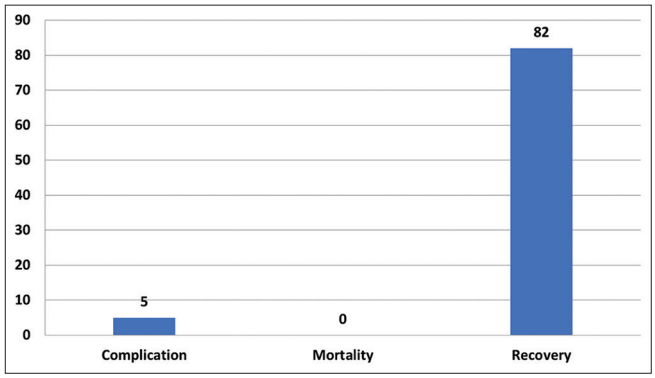

Figure 5: Distribution of acute appendicitis patients post appendectomy based on outcomes after surgery

In our study, all cases were managed surgically through laparoscopic or open appendectomy and all the cases (n=82) recovered with no mortality. Appendectomy was complicated by surgical site infection in five patients, which was managed conservatively with broad spectrum IV antibiotics (Figure 5).

Limitations of the study

One of the limitations of our study is that we could not include the patients that got treated for acute appendicitis at the primary health care center. Also, this study was conducted in a very short time frame of about four months due to which a sufficiently large cohort of patients may not have been included.

CONCLUSION

Our study re-enforces and supports demographic findings of prevalence as well as clinical findings reported in the previous studies on acute appendicitis. CECT of the abdomen can prove to be financially straining for people

seeking treatment at public health care centers in developing or underdeveloped countries. Our study suggests that USG can be concomitantly and synchronously be used with MAS to reach a trustable diagnosis without the need for a CECT of the abdomen.

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Authors' Contributions:
YGD- Concept and design of the study, prepared first draft of manuscript; **MA**- Interpreted the results; reviewed the literature and manuscript preparation; **YGD, MA, NS, AY, SV**- Concept, coordination, statistical analysis and interpretation, preparation of manuscript and revision of the manuscript.

Work attributed to:
GSVM Medical College, Kanpur - 208 002, Uttar Pradesh, India.

ORCID ID:
Dr. Yadav GD- https://orcid.org/0000-0002-5570-4748
Dr. Nishant Saxena- https://orcid.org/0000-0003-4779-754X
Dr. Anju Yadav- https://orcid.org/0000-0001-5910-8655
Dr. Shraddha Verma- https://orcid.org/0000-0003-2296-7477
Dr. Mohd Arshad- https://orcid.org/0000-0003-3580-0406

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