Diagnostic Accuracy of Combined Alvarado Scoring and Ultrasound Imaging In the Diagnosis of Acute Appendicitis-A Cross Sectional Study from Tertiary Care Hospital in North East India

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Abstract: *Acute appendicitis is the most common cause of an acute abdomen requiring surgery, with a lifetime risk of developing about 7%. Appendicitis is common in less than 50 years old, with a peak incidence in the second and third decades. Symptoms of appendicitis overlap with a number of other conditions making diagnosis a challenge, particularly at an early stage of presentation. The diagnosis of appendicitis is largely clinical and appendicectomy is the treatment of choice. Delayed diagnosis of appendicitis could lead to complications like perforated appendix, peritonitis, sepsis, increased morbidity and mortality. Right iliac fossa pain can be a presenting complaint of different pathologies that may mimic appendicitis especially in the female population causing diagnostic difficulties and often leads to negative appendicectomies. Making decision based on the patient's signs and symptoms results in removing normal appendices (negative appendicectomy) in 15% to 30% of cases. The main aim is to decrease the negative appendicectomy and also decrease the appendiceal rupture rates. A decrease in unnecessary appendicectomies should not cause an increase in perforation rates. Removing of the normal appendix merely based on the patients signs and symptoms will cause them unwanted financial burden, which is very much accountable in a population which has considerable number of families belonging to the low socioeconomic status. A new tool to help in the diagnosis of acute appendicitis would thus be welcome in order to compare the diagnostic accuracy of combined Alvarado scoring and ultrasound imaging in the diagnosis of acute appendicitis a cross sectional study was conducted among 150 patients of acute appendicitis with or without complication in the Department of General Surgery, Regional Institute of Medical Sciences, Imphal, Manipur from August 2016 to July 2018.*
Keywords: Acute appendicitis, Alvarado Score, Ultrasound, Appendicectomy.

I.   Introduction

        The vermiform appendix is a tubular structure attached to the base of the caecum at the confluence of the three taeniae coli. It is approximately 8-10 cm long in adults and represents the underdeveloped distal end of the large caecum seen in other animals. In humans it is regarded as a vestigial organ with no known function, but now it is understood that appendix is an immunological organ that actively secretes immunoglobulin A and acute inflammation of this structure is called acute appendicitis. Appendix and caecum starts to develop as outpouchings from the caudal limb of the midgut by the sixth week of human embryonic life. The appendiceal outpouchings begins to elongate at around fifth month to achieve a vermiform appearance and maintains its position at the tip of caecum throughout development.[1, 2]The etiology of acute appendicitis is still not fully understood and it is probably multifactorial like obstruction, dietary, genetic, infectious and immunological factors. This may be caused by fecolith or inspissated stool, lymphoid hyperplasia, parasites or neoplasm.[3] Although acute appendicitis is the most common primary condition of the appendix, other conditions also can affect the appendix.[4]These can be primarily inflammatory (e.g. endometriosis, appendiceal diverticulitis, inflammatory bowel disease) or noninflammatory (e.g. neoplasia) in origin. Immediately performed appendicectomy is traditionally considered to be the gold-standard treatment for acute appendicitis. Rapid and accurate diagnosis is important because the period between the initiation of the symptoms and start of the surgical procedure increases the rate of complications

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i.e. appendicular abscess, appendicular perforation, which may results in sepsis and even death. The rate of clinical diagnosis of acute appendicitis is approximately 85%.[5] Current advanced imaging methods such as ultrasonography (USG), computed tomography and magnetic resonance imagings are promising, they are not adequate. Therefore, novel methods that differentiate acute appendicitis from nonspecific abdominal pain and reduce the rate of negative appendicectomy are needed. Such methods should be inexpensive and convenient, with results obtained in a shorter period. In 1986, Alvarado constructed a 10-point clinical scoring system, also known by the acronym MANTRELS, for the diagnosis of acute appendicitis as based on symptoms, signs and diagnostic tests.[6]The Alvarado score enables risk stratification in patients presenting with abdominal pain, linking the probability of appendicitis to recommendations regarding discharge, observation or surgical intervention. The Alvarado score is a useful diagnostic 'rule out' score at a cutoff point of 5 for all patient groups. The score is well calibrated in men, inconsistent in children and over-predicts the probability of appendicitis in women across all strata of risk.

The aim of this study is to compare the diagnostic accuracy of combined Alvarado score and ultrasound imaging in the diagnosis of acute appendicitis.

II. Material And Methods

The study is a cross sectional study carried out in a Dept. of General Surgery from August 2016 to July 2019 who admitted with the diagnosis of acute appendicitis. Clinically and ultrasound diagnosed patients with acute appendicitis admitted and operated between Aug 2016 to July 2018, in the Department of General Surgery, RIMS were taken for study.

Study Design: Cross sectional study
Study Setup: Dept of General Surgery, RIMS, Imphal
Study Duration: August 2016 to July 2018.
Sample size: 150 patients.
Sample size calculation: Sample size calculated by using the specificity formula

$N (Sp) = \dfrac{TP+FN}{1- P}$

$N = \dfrac{138.25}{1-0.8}$

N= 150.26 Thus sample size for this study was taken as 150.

Inclusion criteria:
1. All age groups between 13 to 65 years (undergoing emergency appendicectomy).
2. Both genders.

Exclusion criteria:
1. Patients less than 13 years and more than 65 years of ages.
2. Incidental, interval appendicectomies.
3. Pregnant women and those with other medical conditions like Diabetes mellitus, immunocompromised persons, HBsAg positive or HIV positive and caecal mass.
4. Patients who are involved in other clinical Trials.
5. Patient not willing to participate in the study.

Procedure methodology

Patients of either sex between 13 and 65 years of age who underwent emergency appendicectomy in a 2 year period in the Department of General Surgery, Regional Institute of Medical Sciences, Imphal were included in the study.

After taking the proposed informed consent, data were collected using the questionnaire / proforma.
The primary data for this study was the blood investigations of the patients.
The following tests were carried out for patients diagnosed as acute appendicitis under General Surgery care and admitted to RIMS Hospital, Imphal Manipur.
• Routine blood investigations (i.e. total leukocyte count, differential count, platelet count, reticulocyte count etc.)
• Kidney function test
• Liver function test
• Seropositivity for HBsAg, HCV, HIV
• Blood sugar
• Chest X-ray, ECG
• Urine examination (routine & microscopy)

Data collected were age, sex, and duration of symptoms, clinical / operative diagnosis and routine blood test. Clinical diagnosis was confirmed by histopathology.

Outcome Parameters: - Clinical data, physical examination, laboratory and imaging studies.

WORKING DEFINITION: - Alvarado scoring more than 5 was taken as significant for acute appendicitis. Acute appendicitis is the acute inflammation of the appendix. Alvarado scoring is calculated by using clinical symptoms, signs and laboratory investigations.

STUDY TOOLS: - A preformed proforma was used to gather information about the subjects of study. Tools and materials used are as follows
a)   Sterile surgical gloves
b)   Disposable sterile 2cc syringe
c)   Oxalate vial
d)   Spirit swabs
e)   Tourniquet
f)   Ultrasonography

Statistical analysis:-
SPSS software version-21(IBM Corp., IL USA) was used for the statistical analysis. The x2 test and ANOVA were used to analyze the statistical difference between the 2 groups. P value of less than 0.05 is considered as significant.

III. Result
A cross sectional study was conducted among 150 patients of acute appendicitis with or without complications in the Department of General Surgery, RIMS, Imphal, Manipur from August 2016 to July 2018 to compare the diagnostic accuracy of combined Alvarado scoring and ultrasound imaging in the diagnosis of acute appendicitis.

Acute appendicitis was most common in the age group 21-30 yrs (33%) followed by <20 yrs (24.6%) and so on. Mean age was 31.67 years with standard deviation of 13.69 years. Minimum age for acute appendicitis in this study was 13 years and maximum was 65 years. Male constitutes 53.3% of the patients which was more than female which constitutes 46.7% of the patients. Clinically 134 cases (89.3%) had acute appendicitis and the remaining 10.7% had appendicular perforation. Alvarado score of 5 constitutes the majority of the patients 32.7% followed by score 6 in 27.4% in patients of acute appendicitis. On ultra sonography acute appendicitis was found in 94.7% and normal in 5.3% of cases. After operation acute appendicitis was present in 78.6% and appendicular perforation in 21.4%. 88.1% of patients diagnosed as acute appendicitis clinically had acute appendicitis and for appendicular perforation it was 100%. 95.8% patients with post operative finding of acute appendicitis diagnosed by ultrasound and 90.6% of appendicular perforation is diagnosed by ultrasound. On histopathology appendicitis was present in 100% of the cases.
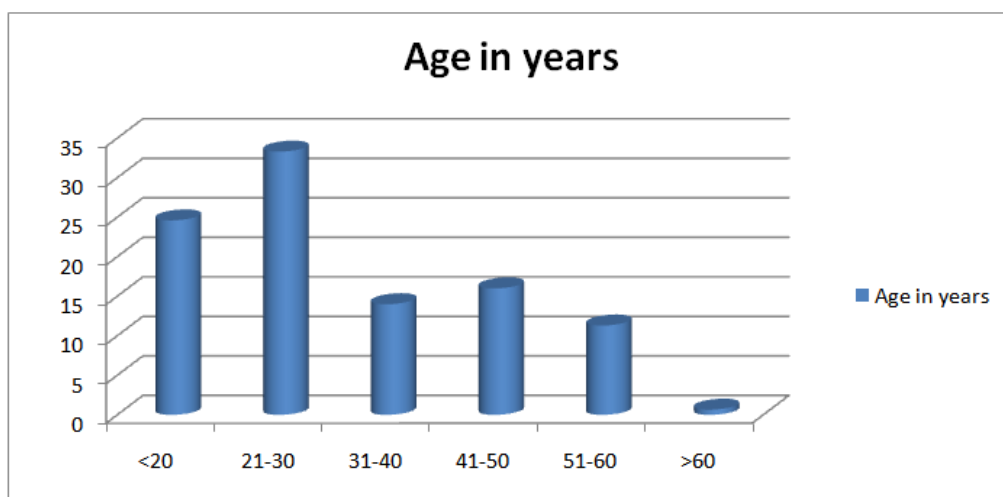

Figure 1: Bar diagram showing age distribution of patient with appendicitis

Table 1: Distribution of the patients by clinical diagnosis

Clinical Diagnosis	Frequency	Percentage
Acute appendicitis	134	89.3
Appendicular perforation	16	10.7
Total	150	100
Mean ± SD	1.10± 0.30	

Table 2: Distribution of the patients by Alvarado score

Alvarado score	Frequency	Percentage
4	26	17.3
5	49	32.7
6	40	26.7
7	29	19.3
8	6	4
Total	150	100
Mean ± SD	5.6±1.10	

Table 3: Distribution of the patients by ultrasound finding

Ultrasound finding	Frequency	Percentage
Acute appendicitis	142	94.7
Normal	8	5.3
Total	150	100
Mean ± SD	1.06± 0.27	

Table 4: Distribution of the patients by post operative findings

Post operative finding	Frequency	Percentage
Acute appendicitis	118	78.6
Appendicular perforation	32	21.4
Total	150	10
Mean ± SD	1.21± 0.03	

Table 5: Relation between clinical diagnosis and post operative findings

Clinical diagnosis	Post operative finding			Chi-square test p-value
	AA (%)	AP (%)	Total (%)	
Acute appendicitis	118 (88.1%)	16 (11.9%)	134 (100%)	Chi-square value=66.04 P value- 0.000
Appendicular perforation	0 (0%)	16(100%)	16(100%)	
Total	118 (78.6%)	32 (21.4%)	150 (100%)	

Table 6: Relation between post operative finding and ultrasound finding

Post operative diagnosis	Ultrasound finding		
	AA (%)	Normal	Total (%)
Acute appendicitis (AA)	113 (95.8%)	5 (4.2%)	118 (100%)
Appendicular perforation (AP)	29 (90.6%)	3 (9.4%)	32 (100%)
Total	142 (94.7%)	8 (5.3%)	150 (100%)

Table 7: Relation between Alvarado score and ultrasound finding

Ultrasound finding	Alvarado score					Total	Chi-square test p-value
	4	5	6	7	8		
Acute appendicitis	26 (18.3%)	49 (34.5%)	40 (28.2%)	21 (14.8%)	6 (4.2%)	142 (100%)	Chi-square= 35.26 pvalue-0.000
Normal	0 (0%)	0 (0%)	0 (0%)	8 (100%)	0 (0%)	8 (100%)	
Total	26 (17.3%)	49 (32.7%)	40 (26.7%)	29 (19.3%)	6 (4%)	150 (100%)	

IV. Discussion

It has been decades since appendicitis known to cause acute abdomen still early diagnosis of acute appendicitis maybe very difficult. Management of acute appendicitis depends on duration of symptoms and associated findings. Delayed diagnosis may lead to complications like perforation and peritonitis leading to increased morbidity and mortality while going for emergent surgery in early stages may lead to higher negative appendicectomy rates. A decision to operate based on clinical suspicion alone lead to removal of a normal appendix in 15 to 50% of cases. Many patients with acute appendicitis presents to emergency departments everyday and get diagnosed with various radiological investigations, but clinician working in rural areas may not have these facilities. Although ultrasonography is widely available but it is subjective and results may vary according to observer making it unreliable in many occasions whereas computed tomography is costly and not widely available making it difficult for people in rural areas. Several scoring systems have been developed using various clinical parameters and simple blood investigations to aid in the diagnosis of acute appendicitis.

Alvarado scoring system is most commonly and widely accepted scoring system used in the clinical practice. It includes total leukocyte count and shift to left in addition to clinical finding for diagnosis of acute appendicitis. Alvarado scoring system was modified to improve diagnostic accuracy and making it easier for application. The sensitivity and specificity of Modified Alvarado scoring system (MASS) and Alvarado scoring system ranges from 75-80% and 53-88%, respectively. As these scoring systems were developed in western countries, its application in Asian population resulted in very low sensitivity and specificity due to difference in ethnic origin and dietary habits. Therefore, diagnosis of acute appendicitis still remains challenging in spite of advancement in various laboratories, radiological and scoring systems.

Removing of the normal appendix merely based on the patients signs and symptoms will cause them unwanted financial burden, which is very much accountable in a population which has considerable number of families belonging to the low socioeconomic status. A new tool to help in the diagnosis of acute appendicitis would thus be welcome in order to compare the diagnostic accuracy of combined Alvarado scoring and ultrasound imaging in the diagnosis of acute appendicitis a cross sectional study was conducted among 150 patients of acute appendicitis with or without complication in the Department of General Surgery, Regional Institute of Medical Sciences, Imphal, Manipur from August 2016 to September 2018.

V. Conclusion

In this study 150 patients were enrolled for the study of which 80 patients (53.3%) were males while the remaining 70 patients (46.7%) were females. The mean age in this study population was 31.67 ± 13.69 years, minimum age was 13 years and maximum age was 65 years. Of the 150 patients, 134 (89.3%) were diagnosed as acute appendicitis while 16(10.7%) were diagnosed with appendicular perforation. On ultrasound 142 patients (94.7%) were diagnosed with acute appendicitis or appendicular perforation while 8(5.3%) had normal findings. Intraoperatively 118 patients (78.6%) were confirmed as acute appendicitis while 32 patients (21.4%) were diagnosed with appendicular perforation. Patients with Alvarado score of 5 were seen in 49 patients (32.7%) of acute appendicitis, followed by score 6 in 40 patients (26.7%) and score of 4 in 26 patients (17.3%) and so on. The mean Alvarado score in patients diagnosed with acute appendicitis was 5.6 ± 1.10. In 8 patients (5.3%) with normal finding ultrasound were found to had Alvarado score of 7. There was a significant positive correlation between the Alvarado score and ultrasound in the diagnosis of acute appendicitis.

References

[1]. Ergul E. Importance of family history and genetics for the prediction of acute appendicitis. Internet J surg. 2007;10(2).
[2]. Prystowsky JB, Pugh CM, Nagle AP. Appendicitis. Current problems in surgery. 2005 Oct;42(10):694-742.
[3]. Bundy DG, Byerley JS, Liles EA, Perrin EM, Katznelson J, Rice HE. Does this child have appendicitis?. Jama. 2007 Jul 25;298(4):438-51.
[4]. O'Connell PR. The vermiform appendix. InBailey & Love's Short Practice of Surgery 25th Edition 2008 Jun 27 (pp. 1205-1219). CRC Press.
[5]. Omiyale AO, Adjepong S. Histopathological correlations of appendicectomies: a clinical audit of a single center. Annals of translational medicine. 2015 Jun;3(9).
[6]. Addiss DG, Shaffer N, Fowler BS, Tauxe RV. The epidemiology of appendicitis and appendicectomy in the United States. American journal of epidemiology. 1990 Nov 1;132(5):910-25.
[7]. Hale DA, Molloy M, Pearl RH, Schutt DC, Jaques DP. Appendicectomy: a contemporary appraisal. Annals of surgery. 1997 Mar;225(3):252.