



Research Article

Modified Alvarado Score Versus Tzanakis Score for Diagnosing Acute Appendicitis in Changing Clinical Practice

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Abstract: *Background:* Preoperative diagnosis of acute appendicitis is classically a clinical one, but with the increasing use of technology for arriving at a fool proof diagnosis, surgeons rely on radiology to a considerable extent for decision making. Especially, in developing countries where time and resources are limited, a reliable Ultrasonography (USG) based score for diagnosing acute appendicitis improves decision making. This prospective study was carried out to compare Modified Alvarado Score & Tzanakis's Score for diagnosing acute appendicitis. *Methods:* 146 patients undergoing emergency appendectomy for suspected acute appendicitis were included in the study. This was a prospective study carried out from July 2014 to March 2016. Patients included in the study were scored according to Modified Alvarado Score (MAS) and Tzanakis Score (TS). The final diagnosis was confirmed by histopathology. *Results:* The sensitivity, specificity, positive predictive value, negative predictive value and likelihood ratio of MAS were 94.95%, 92.6%, 98.26%, 80.64% and 0.05 respectively, and of TS were 98.32%, 96.29%, 99%, 92.85% and 0.02 respectively. Negative appendectomy rate was 1.74% for MAS (cutoff ≥ 7) and 0.84% for TS (cutoff ≥ 8). Overall negative appendectomy rate was 18.5%. *Conclusion:* Tzanakis score is simple, applicable and effective for diagnosing acute appendicitis.

Keywords: Modified Alvarado Score, Tzanakis's Score, Acute Appendicitis

1. Introduction

The term "appendicitis" was not used until Reginald Fitz described this condition in 1886.¹ Acute appendicitis is one of the most common causes of abdominal surgical emergencies with a lifetime prevalence of approximately 1 in 7 worldwide.² It is associated with high morbidity and occasional mortality related to the failure of making an early diagnosis. It has been estimated that approximately 6% of the population will suffer from acute appendicitis during their lifetime; therefore, much effort has been directed toward early diagnosis and

intervention.³⁻⁴ Acute appendicitis especially male is still a clinical diagnosis. Abdominal pain being the most common symptom. In the classic presentation, the patient describes the pain as beginning in the periumbilical or epigastric region and then migrating to right iliac fossa. This is associated with fever, anorexia, nausea, and vomiting. This "classic" symptomatology only occurs in 50-60% of cases making the diagnosis difficult.⁵ Difficulties in diagnosis especially arise in very young, elderly patients and females of reproductive age because they are more likely to have an atypical presentation, and many other conditions may mimic acute appendicitis in

these patients.⁶

A negative appendectomy rate of 20-40% has been reported in the literature and many surgeons advocate early surgical intervention for the treatment of acute appendicitis to avoid perforation, accepting a negative appendectomy rate of about 15-20%.⁷ Removing normal appendix is an economic burden on both patients and health resources. Misdiagnosis and delay in surgery can lead to complications like perforation and finally peritonitis.⁸

Ultrasound is very technician dependent and may ultimately mislead surgeons due to variability and patient's body habitus/bowel gas etc. Many scoring systems for the diagnosis of acute appendicitis have been tried.⁹ These scoring systems are essentially old systems that never become popular by the majority of general surgeons. The MAS has been shown by recent studies to be easy, simple and cheap diagnostic tool for supporting the diagnosis of acute appendicitis (Table 1).⁹⁻¹⁰

Table 1. Modified Alvarado Scoring System.

Symptoms	Score
Migratory right iliac fossa pain	1
Nausea/Vomiting	1
Anorexia	1
Signs	
Tenderness in right iliac fossa	2
Rebound tenderness in right iliac fossa	1
Elevated temperature	1
Laboratory findings	
Leukocytosis	2
Total	9

Tzanakis score is a combination of clinical evaluation, ultrasonography, and inflammatory markers. There are altogether four variables and 15 points (Table 2) and a score of 8 or more diagnoses acute appendicitis requiring surgery. Its sensitivity, specificity, and diagnostic accuracy are 95.4%, 97.4%, and 96.5% respectively.¹¹ Our study compares the efficacy of MAS and TS in diagnosing acute appendicitis.

Table 2. Tzanakis Scoring System.

Feature	Score
Right lower abdominal tenderness	4
Right lower abdominal rebound tenderness	3
Total Leukocyte count > 12000/dl	2
Ultrasonography suggestive of Acute Appendicitis	6
Total	15

2. Material and Methods

A prospective non-randomized study was done in the department of General Surgery, SKIMS Medical College Hospital. A total number of 146 patients who underwent emergency appendectomy for suspected acute appendicitis from July 2014 to March 2016 were included in the study.

Children ≤ 3 years old, elderly patients ≥ 75 years of age were not included in the study. Patients with alternative diagnosis during surgery with or without an inflamed appendix were excluded from the study population. Those with appendicular

abscess, appendicular mass, generalized peritonitis and those who did not consent for the study were excluded from the study.

All the patients included in the present study were suspected of having acute appendicitis based on history and clinical examination. All these patients underwent abdominal ultrasonography (USG), complete blood count (CBC), which includes total and differential leukocyte count as part of their assessment. Patients were scored according to MAS as well as TS at the time of admission and prior to surgery. Even the patients with scores below the cutoff values were subjected to surgery based on clinical assessment and judgment.

USG was done using 5 MHz linear transducer. We included only those patients in this study who underwent abdominal USG by the most senior consultant Radiologist of our institute to exclude observer bias. He was blinded to the results of physical examination and blood reports of the patients. Well established ultrasonographic criteria were applied to discriminate an acutely inflamed appendix from a normal one.¹² Those with radiologist's opinion of findings suggestive of acute appendicitis, based on these criteria were taken as USG positive and given points in TS accordingly. The final diagnosis was confirmed by histopathological examination of the specimen by the pathologist.

Statistical analysis was done by using Statistical Package for the Social Sciences Software (SPSS) Program for Windows® 10. Diagnostic power of the two scoring systems was assessed by calculating the area under the receiver-operator characteristic (ROC) curve. Statistical significance was accepted at the 5% level ($p < 0.05$).

3. Results

From July 2014 till March 2016, 376 patients suspected of acute appendicitis were operated in the General Surgery Department of SKIMS Medical College Hospital where this study was conducted. In 182 patients USG was done by the Resident Radiologists and hence excluded from the study. Two patients had intra-operatively Meckle's diverticulum with a normal appendix. 5 patients were > 75 years old and three patients were less than 3 years old. 15 patients had appendicular lump intra-operatively, while 7 patients had an appendicular abscess. 3 patients had generalized peritonitis and 13 patients did not give consent for the study. Thus we were left with a sample size of 146.

The most common position of appendix intraoperatively was retrocecal (78%). There was a slight male preponderance with 80 patients being males and 66 females (Male:Female = 1.2:1). The mean age of patients was 24.21 years with a standard deviation of 10.05 years. The mean duration of symptoms was 15.56 hours with a standard deviation of 7.85 hours. 81.5% (119 patients) had histologically proven appendicitis. Negative appendectomy rate among females was higher than in males (21.21% Vs 16.25%). Negative appendectomy rate was 1.74% for MAS (cutoff ≥ 7) and 0.84% for TS (cutoff ≥ 8). Overall negative appendectomy rate was 18.5%.

Table 3. Demographic Profile.

Total no. of patients	146
Male:Female	80:66 (1.2:1)
Mean age (Years)	24.21±10.05
Mean Duration of Symptoms	15.56±7.85

Acute appendicitis was significantly high (Odds Ratio = 0.032; 95% Confidence Interval = 0.011-0.094, p-value < 0.001) in patients with MAS ≥ 7 . The sensitivity and specificity of MAS were 94.95% and 92.6% respectively with a positive predictive value of 98.26% and negative predictive value of 80.64%. The likelihood ratio of MAS was 0.05 (Table 4).

Table 4. MAS and Histopathology.

MAS	Ac. Appendicitis	Normal Appendix	Total number of patients
≥ 7	113	2	115
< 7	6	25	31
Total number of patients	119	27	146

Acute appendicitis was significantly high (Odds Ratio = 0.06; 95% Confidence Interval = 0.022-0.162, p-value < 0.001) in patients with TS ≥ 8 . The sensitivity and specificity of MAS were 98.32% and 96.29% respectively with a positive predictive value of 99% and negative predictive value of 92.85%. The likelihood ratio of MAS was 0.02 (Table 5).

Table 5. TS and Histopathology.

TS	Ac. Appendicitis	Normal Appendix	Total number of patients
≥ 8	117	1	118
< 8	2	26	28
Total number of patients	119	27	146

4. Discussion

AA is the most common surgical emergency; it is always a difficult task for a surgeon to diagnose AA.¹³⁻¹⁴ Despite the advances in the diagnostic field, the diagnosis of acute appendicitis remains an enigma for the attendant surgeon.¹⁵ None of the investigations like USG, CT, MRI can give a confirmatory diagnosis of acute appendicitis.¹⁶ With this background, many eminent surgeons and physicians have been adopting different scoring systems in order to decrease negative appendectomy rates. Different scoring systems like RIPASA, Alvarado, Ohman, Tzanakis are developed to help the surgeon in decision making in doubtful cases.

Tzanakis et al have reported that its scoring system had sensitivity and specificity of 95.4% and 97.4% respectively.¹¹ This is comparable to our study with sensitivity and specificity of 98.32% and 96.29% respectively. Sigdel GS et al reported sensitivity and specificity of 91.48% and 66.66% respectively.¹⁷ They maintained that low specificity was due to low sensitivity rate of USG (63.82%) due to individual bias. The high specificity in our study could be explained in terms of reducing observer bias by including only one radiologist in our study. Ultrasound examination is operator dependent and has variable levels of sensitivity and specificity (75-90% and 86-100%); Sigdel GS et al.¹⁸ also observed positive and

negative predictive values of 97.27% and 33.33% respectively while the same were 99% and 92.85% respectively in our study. The high negative predictive value is again due to the reduction of observer bias of radiology in our study.

Harsha BK et al reported a sensitivity of 98.8% and a specificity of 93.3% for MAS.¹⁹ They further reported PPV of 89.3% and NPV of 83.3% while the same were found to be 98.26% and 80.64% respectively. The higher PPV in our study is due to larger sample size as against 45 in the study done by Harsha BK et al. Sensitivity (94.95%) of MAS in our study is little lower than that reported by Harsha BK et al but the difference is not significant.

A negative appendectomy rate of 20-40% has been reported in the literature and many surgeons advocate early surgical intervention for the treatment of acute appendicitis to avoid perforation, accepting a negative appendectomy rate of about 15-20%.⁷ Overall negative appendectomy rate in our study was 18.5% which is comparable to various studies reported in the literature.^{9,10,19} Negative appendectomy rate among females was higher than in males (21.21% Vs 16.25%). The discrepancy is due to high chances of alternate diagnosis in females of reproductive age group.

The weakness of study is cases number being low. A need of prospective randomized study involving larger subject matter and utilizing a multi-intuitional approach to identify the variability in results. One should also utilize two tiers one only male, then one tier with the only female group and finally one group with both female and male combine and collect data. Then compare these groups/findings with placebo group meaning to utilize the current methods of diagnosing appendicitis diagnosis. Finally, the benign appendix should be way less than 10% in today's environment.

5. Conclusion

The Tzanakis score is simple, applicable and effective for diagnosing acute appendicitis.

Conflict of Interest

None declared.

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