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Diagnostic tools in diagnosing acute appendicitis - Alvarado Score, CRP, USG, and CT (Abdomen)

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Abstract

Aims. *To evaluate scope of diagnosing tools-Alvarado score, CRP, USG, and CT in acute appendicitis.*

Method. *Conducted observational study of 152 patients in Department of Emergency Medicine, Sri Ramachandra Medical College and Research Institute, Chennai, India between January to December 2022. The diagnostic tool's (Alvarado score, CRP, USG, CT (abdomen), sensitivity, specificity, accuracy, and ROC were analyzed to diagnose acute appendicitis.*

Results. *Among 152 study patients, males - 86, females - 66, higher number of age group was <30 years, abnormal variables in study patients are BP - 79%, HR - 80%, RFP pain - 57%, anoxia - 78%, nausea/vomiting - 68%, RIF tenderness - 69%, rebound tenderness - 63.8%, elevated temperature - 62%, pain - 44.7%, leukocytosis - 70.7%, and left shift - 38.2%.*

In comparison, Alvarado scores-identified 98% patients, (<5 score - 8.2%, 5-6 score - 30.6%, >7-61.2%) (0.0271), CRP - identified 95.1% (<0.001), USG identified (group 1-33%, group 2-12.2%, group 3-11.3%, and group 4-43.5%, and CT identified 152/152 (100%) patients with acute appendicitis.

The odds ratio/95% CI of diagnostic tools (USG - 0.878, 0.66, CRP - 7.337, 2.623, Alvarado score - 0.81, 0.687). Sensitivity (Alvarado's score - 84.74%, USG - 83.33%, CRP - 76.43%), and specificity was (Alvarado's score - 84.32, USG - 72.97%, CRP-83.86%. The PPV (Alvarado's score - 74.56%, USG - 75.5%, CRP - 33.16%), NPV (Alvarado's score - 32.5%, USG - 79.1%, CRP - 81.03%), and diagnostic accuracy (Alvarado's score - 72.01%, USG - 73.05%, CRP - 68.81%).

ROC in individual tools-Alvarado score was specific than USG, and CRP. ROC in combination tools-Alvarado score and USG was specific than USG, and CRP.

Conclusion. *Among the diagnostic tools tested, as individual tool-Alvarado score was specific, in combination, and Alvarado score and USG were accurate, specific, sensitive, hence combination of tools will identify acute appendicitis early to reduce mortality by undiagnosed or late diagnosed.*

Keywords: acute appendicitis, Alvarado score, C-Reactive-Protein (CRP), Ultrasonography (USG), Computed Tomography (CT), appendix, diagnostic tools

INTRODUCTION

The appendix is an organ that is tube-shaped and small, attached to the large intestine, and when the appendix is inflamed or infected, or clogged, a serious health issue called appendicitis occurs. The only standard treatment is surgery.

The classification of appendicitis is mainly uncomplicated, and complicated. Uncomplicated appendicitis is characterized by acute appendicitis without clinical

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or radiological evidence (inflammatory mass, sputum, or abscess). Complicated appendicitis is characterized by rupture of the appendix and subsequent formation of an abscess or mucus. The incidence of complicated appendicitis is higher in older men [1].

Moris, D et al. reported that appendicitis is one of the emergency requirements of abdominal surgery Worldwide, annually the surgery for appendicitis ranges from 96.5 to 100 per 100,000 adults, and around 7-12% in the general population with acute appendicitis [2,3]. Over the decade of 40 years, laparoscopy has been performed gradually. Surgery has become routine. Laparoscopic appendectomy results in less postoperative pain, faster recovery, faster hospital discharge, and an immediate return to normal health compared to the open approach [4].

Recent clinical studies have demonstrated that nonsurgical treatment of acute uncomplicated appendicitis with antibiotics alone is effective [5-7]. Oh, S. J et al. reported that the main reason for appendicitis is mostly infection by bacteria most commonly Proteobacteria-24%, Firmicutes-37%, Actinobacteria-16%, and Bacteroidetes-18% [8].

Appendicitis is commonest in men (male: female ratio: 1.4:1). Lifetime incidence of appendicitis is 8.6% in men compared to 6.7% in women. Children under 9 years of age have the lowest incidence. People with higher incomes (US$44,691 vs. US$30,027) and education (college graduates and those without degrees) have lower rates of acute appendicitis [9].

Around 60% of the diagnosed patients with acute appendicitis can be treated well with antibiotics alone [10-12]. Di Saverio, S et al. describes if acute appendicitis is left undiagnosed or untreated that can increase the risks ultimately leading to death. Along with the common occurrence of acute appendicitis, the diagnosis of acute appendicitis remains a challenge for clinicians, indicating the need for appropriate diagnostic tools, and innovative approaches to improve acute appendicitis patients, to bring fast recovery [13].

Hence, the first diagnosis of acute appendicitis becomes prime important and for diagnosing patients with suspected appendicitis, several scoring systems were developed over the past decades [14]. One of the best scoring or diagnostic tools was Alvarado scoring in the past times, Al Awayshih, M. M et al. reported that the perforation rate of Alvarado scoring was 4%, PPV was 89%, sensitivity was 54%, and specificity was 75%, hence the Alvarado score is not a sensitive tool to aid in the diagnosis of acute appendicitis [15].

Mantoglu, B et al. explain that although such Alvarado scores or RIPASA were most commonly used, no clarity was found on which scoring system is a more suitable predictive diagnostic tool for the identification of acute appendicitis [16].

The other predictive diagnostic tool for acute appendicitis was CRP elevation, and Hasan, M et al. reported very clearly that CRP elevation is a predictive diagnostic tool for acute appendicitis. Hasan, M et al. also reported that the three predictive diagnostic factors were useful for early diagnosis of acute appendicitis: Persistent RIF pain lasting >24 hours, USS positivity <48 hours, and elevated CRP [17].

One of the most reliable diagnostic tools for the identification of acute appendicitis is CT, and Chan, J et al. explained that the CT is a cost-effective tool to guide the management of appendicitis because, in addition to its high diagnostic accuracy, its use in patients with suspected appendicitis leads to accurate results. The appendicitis-suspected patients evaluated by CT can prevent unnecessary hospitalizations and aid in rapidly identifying alternative disease processes [18]. Ranieri DM et al. reports that in approximately 4% of asymptomatic patients, appendicitis was found incidentally on CT. However, about 40% of patients with acute appendicitis have appendicitis on CT examination [19].

The other supreme diagnostic tool for the identification of acute appendicitis is Magnetic Resonance Imaging (MRI), and MRI is more costly than CT, with limited availability, and less experience using MRI to diagnose possible appendicitis, thus reducing its role in the diagnosis of patients with probable appendicitis. MRI can be used when there are concerns about ionizing radiation, especially when used on pregnant women and children [20,21].

For diagnosing acute appendicitis, CT is the most reliable diagnostic tool, but with certain limitations such as radiation exposure, the need for increased resources, and high cost. Overcoming these limitations, Pedram, A et al. reports that the USG (abdomen) is the best diagnostic tool that most clinicians approach as USG is easy to perform, portable, inexpensive, and best diagnostic accuracy with high precision [22].

In acute appendicitis involving low-risk and intermediate-risk surgeries such as laparoscopic appendectomy, frailty remains an important factor associated with increased postoperative mortality [23].

Hence, the above-discussed literature indicates that in clinical practice, it is essential to discuss the benefits or advantages, and risks or disadvantages of all possible and significant treatment options. The literature also suggests framing new recommendations for surgery approaches and antibiotic-preferred approaches based on patients' individualized clinical, radiological, and other diagnostic findings that are precise, accurate, and cost-effective diagnostic tools and also based on patients' expectations of treatment. Hence, we conducted this study to evaluate the best diagnostic tools among Alberado score; C-Reactive-Protein (CRP), Ultrasonography (USG), and Computed Tomography (CT) scan in the diagnosis of acute appendicitis.

Ethical clearance

Under the guidance of a guide and after the ethical committee approval, this study is conducted in the selected study subjects.

Conflicts: None

Funding: None

Inclusion criteria

- All patients aged 18 years and older with suspected right lower abdomen pain and diagnosed with acute appendicitis.
- Patients with appendicular masses receive conservative treatment later followed by interval appendectomy.
- Patients with recurrent appendicitis.

Exclusion criteria

- Patients with chronic infectious diseases like ileocecal tuberculosis.
- Patients with carcinoid tumors and other neoplastic lesions of the appendix.
- Patients below the age of 18 years.

MATERIALS AND METHODS

Methodology

Study Setting and Design

This study was conducted in the Department of Emergency Medicine, Sri Ramachandra Medical College & Research Institute, Chennai, India. This study is designed as an observational study.

Study Participants and Study Duration

152 patients were selected based on inclusion and exclusion criteria from January-2022 to Dec-2022 to conduct this study.

Study Procedure

The study patient was initially clinically diagnosed with appendicitis by an emergency physician. The diagnosis was then made using CRP, USG abdomen, and CT abdomen. The study will be conducted over one year.

Initial Clinical Diagnosis

A clinical diagnosis of acute appendicitis was made by a clinician based on symptoms of pain located in the right lower quadrant, a history of spreading pain, vomiting, fever, and peritoneal symptoms.

Alvarado Scoring

The Alvarado score was used to classify study patients into three classes: patients with acute appendicitis score >7, patients with a score 5-6, probable appendicitis, and patients with a score <5. - No appendicitis.

CRP Testing

Patients who meted the inclusion criteria performed CRP and WBC counts upon arrival at the emergency department. CRP above 6 mg/L was considered positive.

USG (Abdomen)

Appendicitis is considered positive if the appendix diameter was greater than 6 mm. USG with an appendix diameter of less than 6 mm or visually absent, or without direct evidence of appendicitis in the USG abdomen (such as inflammatory fat changes or free fluid around the appendix), was considered negative for appendicitis.

Based on the above criteria, the study patients were further classified into four groups:

Group-1: Normal appendix (diameter <6 mm) visualized.

Group-2: No appendix visible and no secondary signs of appendicitis.

Group-3: Appendix not visualized, but one or more secondary signs detected.

Group-4: Visual Appendicitis with inflammation or perforated appendix.

CT (Abdomen)

Abdominal CT is considered positive if the appendix diameter was >6 mm in diameter, free fluid is present, and fatty chains are present. Abdominal CT is considered negative if the appendix diameter was less than 6 mm or not visible [24].

Data Collection

The study patient's demographic details such as age, gender, and clinical investigations such as Blood Pressure (BP) [25], Heart Rate (HR) [26], Functional Oxygen Saturation (SaO2) [27], Right Iliac Fossa (RIF) pain [28], Anorexia [29], Nausea and Vomiting [30], RIF tenderness [31], elevated temperature [32], Leukocytosis [33], left shift [34], Alvarado scoring [35], CRP [36], Pain scoring [37], USG (abdomen) [38], and CT [39] findings were observed, and documented.

Analysis

The 152 study patients were first identified with normal appendix and with appendicitis. The collected data were further analyzed for the positivity, and negativity of each diagnostic tool such as Alvarado scoring, CRP, USG, and CT. The analyzed data were tabulated and represented as info-graphics in the result section.

Statistical Analysis of Data

Data analysis was done using SPSS software version 21. Data were expressed as frequencies and percentages. The comparison of diagnostic tools for the identification of acute appendicitis was analyzed and presented as a p-value, odds ratio, 95% Confidential Interval (CI), and Receiver Operating Characteristic (ROC) curve. The efficiency of diagnostic tools for the identification of acute appendicitis was also analyzed for sensitivity,

specificity, positive predictive value, negative predictive value, accuracy, and report. A p-value <0.05 was considered statistically significant.

RESULTS

A total of 152 study patients were selected for this study, and the basic profile of appendicitis study patients was recorded and tabulated. Among the 152 study patients (male: female-86:66) the percentage of 56.6% and 43.4% respectively. Study patients below the age of 30 years were 90 (59.2%), and patients with >30 years of age were 62 (40.8%). Abnormal blood pressure and abnormal heart rate were observed in 121 (79.4%), and 122 (80.3%) of the study patients respectively (Table 1).

Among the study patients, RIF pain was observed in 87 (57.2%), and among them, pain scoring was recorded, and found moderate, and worst pain were found in 84 (55.3%), and 68 (44.7%) of patients respectively. The symptoms or complaints presented by the study patients were anorexia (135, 78.9%), nausea & vomiting (104, 68.4%), RIF tenderness (105, 69.1%), rebound tenderness (97, 63.8%), and elevated temperature was found in 95 (62.5%) of study patients. Among the 152 study patients, leukocytosis, and left shift were present in 107 (70.4%), and 58 (38.2%) respectively (Table 1).

Among the 152 study patients, the Alvarado Score diagnostic tool diagnosed and identified 98 patients with acute appendicitis, among them, Alvarado Score - <5 was in 8 (8.2%) appendicitis patients, 5-6 were 30 (30.6%) patients, and >7 Alvarado Score were 60 (61.2%) of appendicitis patients. Among the 152 study patients, CRP was elevated in 97 (95.1%) study patients thus identifying the patients with acute appendicitis, (Table 1).

Among the 152 study patients, based on the classification by USG finding, group 1 was diagnosed in 38 (33.0%), group-2 was diagnosed in 14 (12.2%), group-3 was diagnosed in 13 (11.3%), and group-4 (acute appendicitis) was diagnosed in 50 (43.5%) of the study patients. Among the 152 study patients, CT diagnostic tool was able to diagnose acute appendicitis in all (152) the study patients (Table 1).

We further analyzed the comparison of diagnostic tools such as CRP, USG, CT, and Alvarado scoring for diagnosis of acute appendicitis. Comparing the above 4 diagnostic tools to diagnose appendicitis, CRP was elevated in 97 patients identifying acute appendicitis in 97 patients with a statistical significance of <0.001. Based on the USG finding, the study patients were classified into 4 groups, among them group-1 was found in 38 patients, group-2 in 14 patients, group-3 in 13 patients, and group-4 in 50 (acute appendicitis) patients (Table 2).

We also have done a comparison of the Alvarado Score's positivity and negativity and found <5 Alvarado score was found in 8 patients, the Alvarado score 5-6, and >7 was found in 30, and 60 patients respectively with statistical significance 0.0271. Ct as a diagnostic

TABLE 1 *Basic Profile of Appendicitis Study Patients*

Variables	No (%)
Gender (n=152)	
Males	86 (56.6)
Females	66 (43.4)
Age Categories (in years) (n=152)	
≤30 years	90 (59.2)
>31 years	62 (40.8)
Blood Pressure (n=152)	
Abnormal	121 (79.6)
Normal	31 (20.4)
Heart Rate (n=152)	
Abnormal	122 (80.3)
Normal	30 (19.7)
SaO_2 (n=152)	
Abnormal	0 (00.0)
Normal	152 (100.0)
Right Iliac Fossa (RIF) pain (n=152)	
Present	87 (57.2)
Absent	45 (42.8)
Pain Scoring (n=152)	
No Pain	0 (00.0)
Moderate Pain	84 (55.3)
Worst Pain	68 (44.7)
Presenting Complains (n=152)	
Anorexia	135 (78.9)
Nausea & Vomiting	104 (68.4)
RIF tenderness	105 (69.1)
Rebound Tenderness	97 (63.8)
Elevated Temperature	95 (62.5)
Leukocytosis (n=152)	
Present	107 (70.4)
Absent	45 (29.6)
Left Shift (n=152)	
Present	58 (38.2)
Absent	94 (61.8)
Alvarado Score (n=98)	
<5	8 (8.2)
5-6	30 (30.6)
>7	60 (61.2)
CRP (n=102)	
Normal	5 (4.9)
Elevated	97 (95.1)
USG finding (n=115)	
Group 1	38 (33.0)
Group 2	14 (12.2)
Group 3	13 (11.3)
Group 4	50 (43.5)
CT finding (n=152)	
Present	152 (100.0)
Absent	0 (00.0)

tool was able to diagnose all (152) study patients with acute appendicitis (Table 2).

TABLE 2 *Comparison of Diagnostic Tools (USG, CRP, CT, Alvarado scoring) for Identification of Appendicitis*

CRP	Positive (n=102)	Negative (n=50)	P value
Normal	5	15	<0.001*
Elevated	97	35	<0.001*
USG	**Positive (n=115)**	**Negative (n=37)**	**P value**
Group 1	38	10	0.4965
Group 2	14	2	0.242
Group 3	13	3	0.5823
Group 4	50	22	0.091
Alvarado Score	**Positive (n=98)**	**Negative (n=54)**	**P value**
<5	8	10	0.0587
5-6	30	21	0.3030
>7	60	23	0.0271*
CT	**Positive (n=152)**	**Negative (n=0)**	**P value**
Scanning	152	0	--

We have also analyzed the odds ratio, and 95% CI to the diagnostic tools, the odds ratio for USG was 0.878, for CRP was 7.337, and for Alvarado's score was 0.81. The 95% CI interval for USG was 0.66, 1.168, and for CRP, and Alvarado scores were 2.623, 20.527, and 0.687, 1.1746 respectively (Table 3).

TABLE 3 *Odds Ratio, and 95% Confidence Interval of USG, CRP, and Alvarado score in Identification of Appendicitis*

Model	Odds Ratio	95% Confidence Interval (CI)
USG	0.878	(0.66, 1.168)
CRP	7.337	(2.623, 20.527)
Alvarado Score	0.81	(0.687, 1.1746)

We further analyzed the efficiency of diagnostic tools for the identification of acute appendicitis, we found Alvarado's score had a sensitivity of 84.74%, USG had 83.33% of sensitivity, whereas CRP had 76.43% of sensitivity. The specificity of Alvarado score, and USG were 84.32%, and 72.97% respectively, whereas CRP had 83.86% of specificity (Table 4).

The Positive Predictive Value (PPV) of Alvarado score and USG were 74.56%, and 75.5% respectively, whereas CRP had 33.16% of PPV. The Negative Predictive Value (NPV) of Alvarado score and USG were 32.5%, and 79.17% respectively, whereas CRP had 81.06% of NPV. The diagnostic accuracy of Alvarado score and USG were 72.01%, and 73.05% respectively, whereas CRP had 68.81% of diagnostic accuracy (Table 4).

We also analyzed the ROC to test the best, precise diagnostic tool for the diagnosis of acute appendicitis, (Figure 1).

The specificity of Alvarado's score was good compared to USG, and CRP. The specificity of Alvarado's score, and CRP was good than USG. The PPV of Alvarado's score and USG was good than CRP. The NPV of Alvarado's score was good than USG, and CRP. The diagnostic accuracy for diagnoses of acute appendicitis was good with diagnostic tools Alvarado score and USG than CRP, (Figure 1).

We also analyzed the ROC for a combination of the best diagnostic tools for the diagnosis of acute appendicitis, (Figure 2).

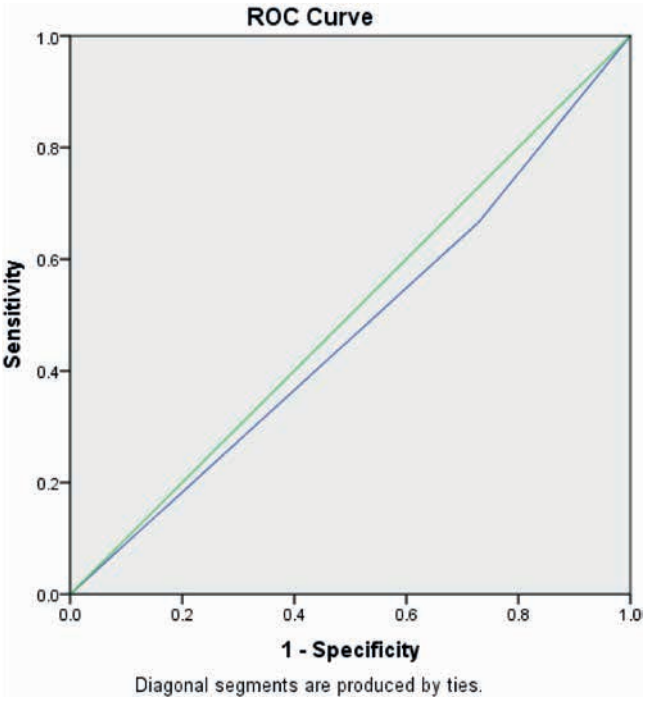
Among the combination of diagnostic tools analyzed with ROC for diagnosis of acute appendicitis, we found that the sensitivity of the combination of Alvarado score and USG were good, whereas the combination of USG, and CRP had less sensitivity. All (Alvarado score +USG +CRP) diagnostic tools also had good sensitivity of around 81%. The specificity of the combination of Alvarado score, and CRP was good than the combination of USG, and CRP. The specificity of all (Alvarado score +USG +CRP) diagnostic tools was around 80%, (Figure 2).

The PPV of a combination of Alvarado score, and USG was good than the combination of Alvarado score, and CRP, also CRP, and USG. The PPV of all (Alvarado score +USG +CRP) of the diagnostic tools was around 61%. The NPV of a combination of Alvarado score, and USG, Alvarado score, and CRP was good than the combination of USG and CRP. The NPV of all (Alvarado score +USG +CRP) diagnostic tools was around 64% (Figure 2).

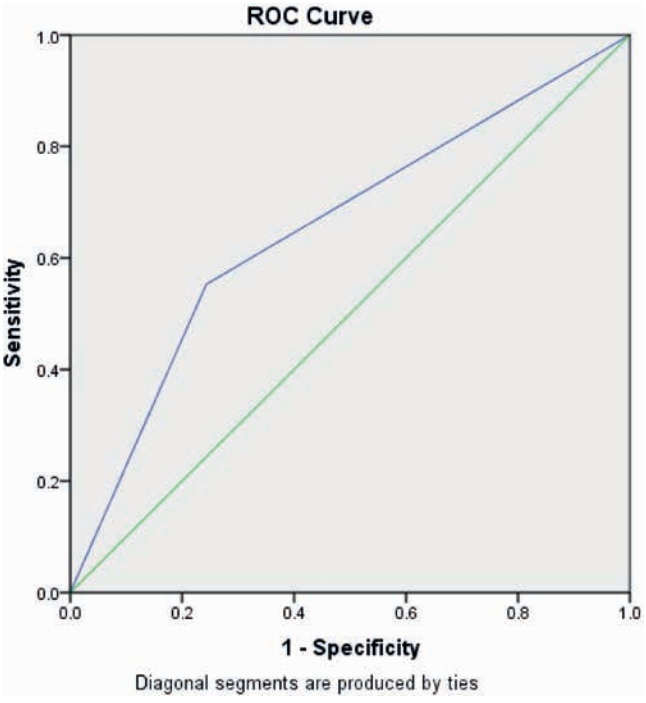
We also analyzed the ROC for diagnostic accuracy of diagnostic tools for diagnosing acute appendicitis and found a combination of diagnostic tools Alvarado score, and USG was accurate, sensitive, and specific, followed by USG, CRP than Alvarado score, and CRP. The diagnostic accuracy of all (Alvarado score +USG +CRP) diagnostic tools was around 72%, (Figure 2).

TABLE 4 *Efficiency of Diagnostic tools (USG, CRP, and Alvarado score) in Identification of Appendicitis*

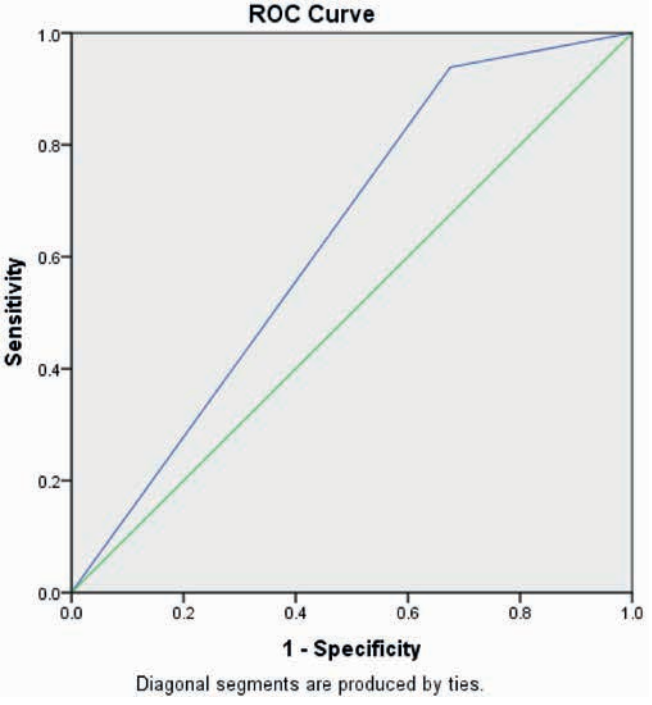
Diagnostic Modalities	Sensitivity	Specificity	Positive Predictive Value (PPV)	Negative Predictive Value (NPV)	Diagnostic Accuracy
Alvarado Score	84.74%	84.32%	74.56%	32.5%	72.01%
USG	83.33%	72.97%	75.5%	79.17%	73.05%
CRP	76.43%	83.86%	33.16%	81.06%	68.81%



USG



ALVARADO SCORE



CRP

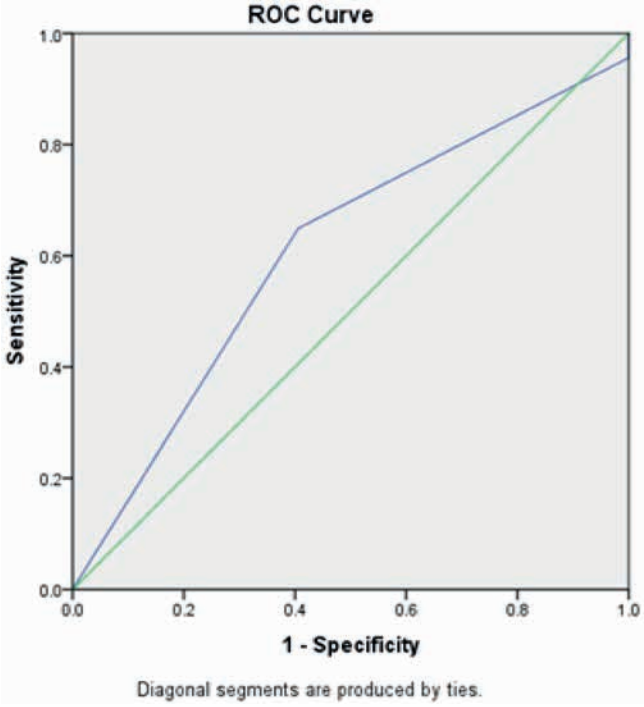
FIGURE 1 *Separate ROC for USG, Alvarado Score, and CRP in Identification of Appendicitis*

DISCUSSION

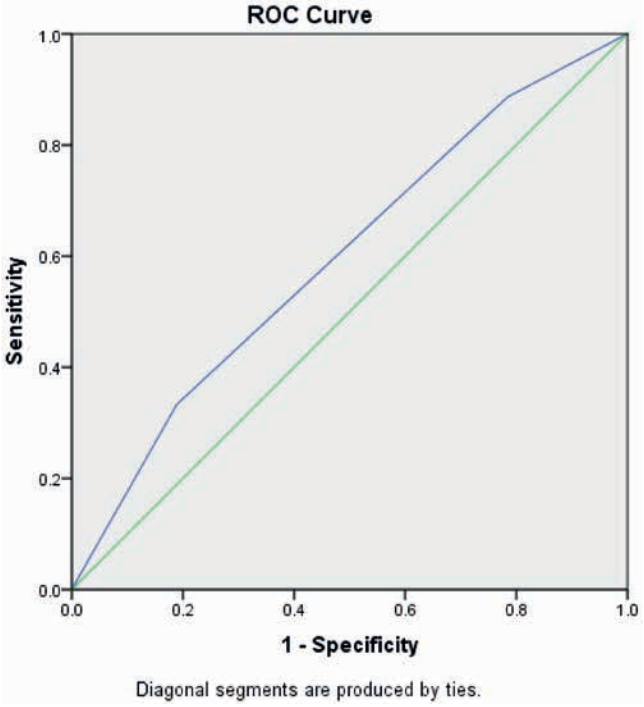
Appendicitis, if left untreated, the appendix will rupture or rupture within 48 to 72 hours after symptoms of acute appendicitis first appear. A ruptured appendix can cause a serious infection called peritonitis, leading to life-threatening conditions without prompt treatment.

Wichmann, D et al. reported that male patients with appendicitis were higher than females in their study, and our present study was compatible with Wichmann, D et al. study [40]. Damarsoy, F. F et al. study showed 26% of their study patients with appendicitis had low BP in 26%, and high BP in 29% of their study patients. 29% of their study patients had tachycardia, and in our study patients also, 79.6% of the study patients had abnormal BP, and 80.3% had abnormal heart rate. None of our study patients had Hypoxia (SaO_2 <94%) [41].

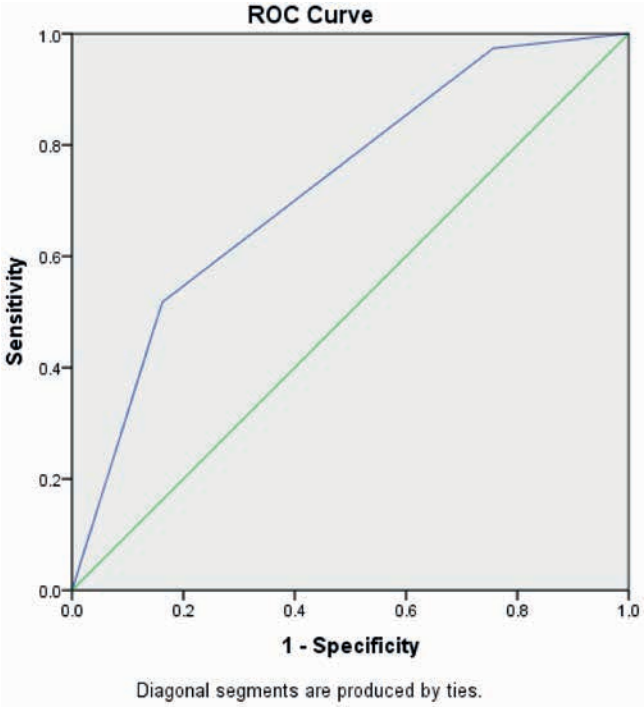
RIFT collaborative study group found that RIF is one of the main symptoms that patients with suspecting



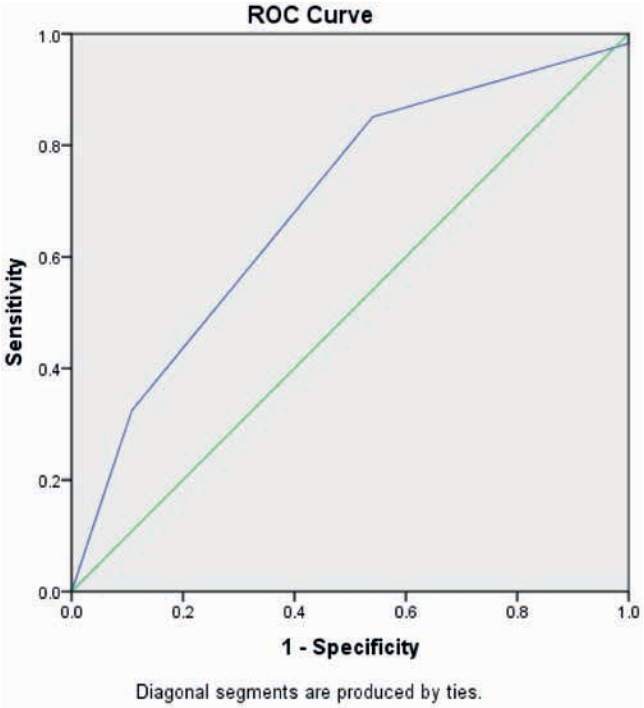
USG + CRP



USG+ALVARADO SCORE



CRP + ALVARADO SCORE



USG + CRP + ALVARADO SCORE

FIGURE 2 R*OC for USG+CRP, USG +Alvarado Score, CRP+ Alvarado Score, and CRP+USG+ Alvarado Score in Identification of Appendicitis*

acute appendicitis patients experience, and in our study, we found RIF pain was found in 57.2% of our study patients, among them 44.7% of patients experienced the worst RIF pain [42]. Takada, T et al. reported about 80-85% of patients report anorexia after the onset of abdominal pain, and 40-60% report nausea with or without vomiting. Our present study is compatible with Takada, T et al. study reporting 78.9% [43].

Giannis, D et al. suggest that laboratory investigation for suspected appendicitis should include both complete blood count and differential blood count that can identify leukocytosis, as leukocytosis is one of the elevated significant tests [44]. We also found that leukocytosis was high in 70.4% of our study patients. Rathnam, U et al. reported that CRP was the best diagnostic tool for diagnosing appendicitis in their study

subjects, and our study also found 97/152 patients with appendicitis [45]. Lukenaite, B et al. reports that non-invasive MRI reduces unnecessary surgery in pregnant patients suspected of acute appendicitis, and we found that non-invasive CT is the best diagnostic tool for diagnosis of appendicitis [46].

Fu, J et al. reported out of 18 studies, in 3,193 references, that USG (abdomen) has a sensitivity of 77.2% (95% CI-75.4-78.9%), specificity of 60% (95% CI-58-62%), and diagnostic odds ratio of 6.88% (95% CI-1.99-23.82) for identification of acute appendicitis, but did not report the advantages of the combination of diagnostic tools to diagnose appendicitis [47]. We in our study, found USG (abdomen) had a sensitivity of 83.332%, specificity of 72.97%, PPV of 75.5%, NPV of 79.17, and diagnostic accuracy of 73.05%. We are also reporting a combination of diagnostic tools Alvarado score, and USG was accurate, sensitive, and specific, followed by USG, CRP, then Alvarado score, and CRP.

Khan, S et al. reported that in their study of appendicitis, the Alvarado score had 83% sensitive, 62% specific, and accurate 65%, but Khan, S et al. study did not report the usage of a combination of diagnostic tools for diagnosing acute appendicitis [48]. Our study found that the Alvarado score had each 84% of sensitivity and specificity, PPV was 74%, NPV was 32%, and diagnostic accuracy was 72%. We are also reporting a combination of diagnostic tools Alvarado score, and USG was accurate, sensitive, and specific, followed by USG, CRP, then Alvarado score, and CRP.

The published data by Fatima, S. R et al. who conducted the usage of a combination diagnostic tool found that in the absence of infection or inflammatory findings on USG And normal blood parameters (total white blood cell count and neutrophil count) are highly diagnostic and allow the exclusion of appendicitis [49]. We also found that a combination of diagnostic tools Alvarado score, and USG was accurate, sensitive, and specific, followed by USG, and CRP.

Nyamuryekung'e, M. K et al. reported that CT is the most reliable and accurate diagnostic tool for the diagnosis of appendicitis [50]. We also found that CT was able to diagnose all (152/152) patients who had appendicitis.

CONCLUSIONS

The appendix is a pouch-like structure at the beginning of the large intestine of unknown purpose, and appendicitis symptoms are fever and heavy spreading pain near the navel to the abdomen, often presenting complaints are nausea, vomiting, loss of appetite, and chills. Appendicitis requires immediate surgery within 24 hours in risky acute appendicitis, usually diagnosed appendicitis is treated with antibiotics. If left undiagnosed, and untreated, the appendix will rupture, and cause an abscess or systemic infection (sepsis) leading to the fatality of the patients, hence our present study concludes, and recommends to clinicians that the usage of a combination of diagnostic tools for diagnosing acute appendicitis will provide diagnostic accuracy and found a combination of diagnostic tools such as Alvarado score, and USG which was found accurate, sensitive, specific in this present study, and will give a precise, swift, sensitive, and specific diagnosis of acute appendicitis, thus early diagnosis leading to early treatment directing to life savage.

Conflict of interest: The authors declare no conflict of interest.

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