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Original Research Article

Diagnosis and management of acute appendicitis by Alvarado scoring with ultrasonography as supportive tool

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ABSTRACT

Background: Acute appendicitis remains as one of the most common surgical entity requiring early intervention. Delay in management results in complications and misdiagnosis results in negative appendectomy. Hence there is always a need to develop a well-designed protocol for diagnosis and to reduce negative appendectomy. Alvarado score for diagnosis of acute appendicitis is an easy, affordable and diagnostic which has been evaluated early with variable reports. In cases with equivocal score, additional tools like sonography may provide a reliable result in accurate diagnosis of acute appendicitis. Objective of the study was to determine the diagnostic accuracy of Alvarado score and ultrasonography in diagnosis of acute appendicitis. To determine the sensitivity, specificity and predictive values of ultrasonography in cases operated with histopathological correlation.
Methods: A prospective observational study was conducted at our hospital by department of general surgery for a period of six months. All suspected cases of appendicitis were scored by Alvarado score and cases with>5 were performed additional USG for further evaluation. All the cases of appendicitis that underwent surgery were further confirmed by histopathological correlation with USG and clinical Alvarado score.
Results: A total of 200 cases were enrolled with male predominance (57.5%) and mean age of study group was 34.26±8.64 years and male to female ratio of 1.3:1.69% of cases presented with Alvarado score of 7 and above, while 21% of cases with 5-6. Migratory pain in RIF was the commonest symptom and tenderness RIF was the most common sign.160 cases (80%) were operated totally with 75% cases lap appendectomy and 25% cases by open appendectomy. USG was performed on 160 cases and 146 were positive and 14 were negative whereas histopathologically 142 cases were confirmed as Acute appendicitis. The sensitivity, specificity, PPV and NPV of USG is 97.18%, 55.56%, 94.52% and 71.43%. The accuracy of USG is 92.5.
Conclusions: Acute appendicitis is first and foremost a clinical diagnosis with scoring systems and imaging being necessary adjuncts in equivocal cases. USG is an easily available tool in diagnosis of acute appendicitis. Application of USG as adjunct tool to Alvarado scoring improves the diagnostic accuracy.

Keywords: Alvarado score, Acute appendicitis, Histopathology, Ultrasonography

INTRODUCTION

Acute appendicitis is one of the most common surgical emergencies with a life time prevalence of 1 in 7, with an incidence of 1.5-1.9/1000 in male and female population.[1] Despite advances in surgical techniques the diagnosis is still a major challenge, a misdiagnosis or delay in intervention leads to perforation with more morbidity and associated mortality. Deciding based on surgical signs and symptoms alone results in negative appendectomy where the incidence is still 15 -30% in all the countries.[2]

Hence, the approach was to score a patient of acute appendicitis with many scoring systems developed. Alvarado scoring system was developed by Alvarado in 1986 based on clinical signs, symptoms and laboratory investigations. Alvarado tool is widely used as it is easy, affordable and relatively accurate. A score of > 7 by Alvarado clinically confirms a case as acute appendicitis and surgery was the choice, but further many studies have stated that Alvarado score alone is not sufficient in clinical diagnosis as it results in some equivocal cases which are misdiagnosed and under diagnosed leading in delay and complications.[3,4] Hence, incorporation of supportive diagnostic tools as an aid in diagnosis of acute appendicitis was suggested. Among the various tools, imaging studies of the abdomen were great supportive aids.

Ultrasonography of the abdomen is an economical, affordable, non-invasive tool with a reported accuracy of 71% to 95%, but doubts persists about the role of USG on patient outcomes. Hence questions arise whether sonography should be performed on patients with high Alvarado score or to all the patients to decrease the misdiagnosis and increase the accuracy, but efficacy of sonography is still operator dependent and may result in significant inter-observer variability in diagnosis of acute appendicitis.[5]

The present study was undertaken to determine the diagnostic accuracy of Alvarado score and ultrasonography in diagnosis of acute appendicitis. To determine the sensitivity, specificity and predictive values of ultrasonography in cases operated with histopathological correlation.

METHODS

The present study was conducted at Narayana medical college and general hospital, a tertiary care hospital by department of general surgery. The study period was for one year from June 2015 to May 2016. All the cases attending the surgical OP and department of emergency medicine with pain abdomen were examined and clinically confirmed suspected cases of appendicitis were included in the study. The study was approved by the institutional ethical committee and all the necessary procedures were conducted as per ethical guidelines.

The clinical history, signs and symptoms, demographic data of cases was collected and after a thorough clinical examination the Alvarado score was recorded and categorized into three groups based on the score and management was planned. Cases placed in Group II and III were referred to department of radiology for recording ultra-sonographic (USG) findings. Ultrasound was carried out by residents using a non-compressible blind loop equal to or greater than 6 mm in anteroposterior diameter in indicated cases. Baseline laboratory investigations like Hb, TLC, DLC, X-ray abdomen and KUB and ECG were done for all the cases enrolled in the study. The clinical data, Alvarado score, investigative findings and ultrasonographic findings were recorded in a separate proforma.

Inclusion criteria

- All patients of >5 years of age clinically suspected as Appendicitis
- Patients who gave consent for participation in the study.

Exclusion criteria

- Patients with H/O previous abdominal surgery
- Patients with generalized peritonitis
- Patients with gynecological or urological or other surgical abdominal conditions
- Patients with mass in right iliac fossa (RIF)
- Patients not consented for the study.

Sonographic diagnostic criteria for appendicitis

- Any visualization
- Appendiceal diameter greater than 6.0 mm
- Muscular wall thickness ≥ 3.0 mm
- Presence of a complex mass

The sensitivity and specificity of USG findings were recorded and compared with pathological reports. The pathological evaluation of the appendix was done by department of pathology. The diagnosis of appendicitis was made on histological grounds based on infiltration of muscularis propria by neutrophil granulocytes.

Statistical analysis

All the data was primarily entered in Microsoft excel spread sheet and verified. The statistical analysis was done by SPSS version 17. The study population was described using age and gender distributions which are presented as means and proportions. The USG findings were compared with histology findings and sensitivity, specificity, predictive values and accuracy was calculated.

RESULTS

In the present study 200 suspected cases of appendicitis were enrolled with 115 males (57.5%) and 85 females (42.5%) with male to female ratio 1.35:1. The most common age group in the study was 26-35 years with overall 31% (males: 29.57% and females: 32.94%) followed by 16-25 years (25%) and 36-45 years (17.5%). The mean and standard deviation of age of patients was 34.26±8.64 years (8-65 years). Based on the Alvarado score recorded all 200 cases were grouped into, Group-I with 20 cases (10%), male 12 and female 8 cases, Group -II with 42 cases (21%) with 24 males and 18 female and Group-III with 138 cases (69%), 79 males and 59 females (Table 1). All the cases in Group-I was in range of 1-4

(appendicitis unlikely) and was managed conservatively and discharged. 42 cases in Group-II was in range of 5-6 (appendicitis probably) and kept for further observation and 22 cases further progressed and were operated and 19 cases who didn't progress were managed conservatively and discharged. All the cases in group-III (appendicitis) were operated. A total of 160 cases (80%) were sent for USG findings and operated. 40 cases were emergency cases and operated by open appendectomy and 120 cases underwent elective lap appendectomy (Table 2). Appendix of operated cases was sent for histopathological evaluation.

Table 1: Age incidence and Alvarado score in relation to age.

	Male (no.) (%)	Female (no.) (%)	Total
Age			
5-15 years	12 (10.43)	7 (8.24)	19 (9.5)
16-25 years	28 (24.35)	22 (25.88)	50 (25)
26-35 years	34 (29.57)	28 (32.94)	62 (31)
36-45 years	20 (17.39)	15 (17.65)	35 (17.5)
46-55 years	14 (12.17)	8 (9.41)	22 (11)
>55 years	7 (6.09)	5 (5.88)	12 (6)
Total	115 (57.5)	85 (42.5)	200
Range	8-65	12-58	8-65
Grade of Alvarado score			
1-4 (appendicitis unlikely)	12	8	20 (10)
5-6 (appendicitis probably)	24	18	42 (21)
7-10 (appendicitis definitive)	79	59	138 (69)

Table 2: Type of management.

Group	No.	%	Outcome
Group I (score 1-4)	20	10	Discharged
Group-II (score 5-6)	42	21	19-discharged
			22-operated
Group-III (score 7-10)	138	69	Operated
Total operated	160	80	
Type of operation			
Open appendectomy	40	25	
Lap appendectomy	120	75	

Table 3: Distribution of clinical signs and symptoms.

Clinical features	No. of cases	%
Migratory pain in RIF	198	99
Anorexia	172	86
Nausea/vomiting	168	84
Tenderness RIF	200	100
Rebound tenderness RIF	164	82
Temperature elevation	170	85
Leucocytosis	168	84

Tenderness in the RIF was the commonest symptom (100%) followed by migratory pain in Right iliac fossa (99%), 86% of cases had Anorexia, nausea and vomiting in 84% of cases, rebound tenderness in RIF in 82% cases and pyrexia in 85%. Leukocytosis (>10,000) was seen in 84% of cases with marked neutrophil predominance (Table 3).

Table 4: Comparison of USG findings with histopathology reports in operated cases.

	Histopathology report		
Variable	**Appendicitis**	**Normal**	**Total**
USG appendicitis	138 (TP)	8 (FP)	146
USG no appendicitis	4 (FN)	10 (TN)	14
Total	142	18	160

TP: true positives; FP: false positives; TN: true negatives; FN: false negatives.

Ultrasonographic results: a total of 160 cases underwent USG (males: 93 and females: 57). Out of 146 cases, which had positive findings on USG, 138 were histopathological positive and 8 were negative. Six of these cases were having normal appendix and two with metastatic lesions. Fourteen patients were reported negative by USG, 4 cases were positive by histopathology and 10 were both USG and histopathological negative. Summary of the findings of USG in relation to histopathology is presented in Table 4. The sensitivity, specificity, PPV and NPV of USG is 97.18%, 55.56%, 94.52% and71.43%. The accuracy of USG is 92.5

Histopathology results: out of 160 cases operated, 142 cases (88.75%) were confirmed as acute appendicitis and

18 cases (11.25%) were negative. The negative appendectomy rate was 11.25% in the study.

DISCUSSION

Clinical management of acute appendicitis is still a matter of concern. A good clinical decision reduces the delay in surgery by operating early and avoids unnecessary appendectomy which reduces the morbidity by operating. In this scenario, a good clinical scoring with additional supportive diagnostic parameters help in best clinical decision. Among various scoring systems developed, Alvarado score is simple, effective and can be easily applied.[6] Application of Alvarado score has reduced the negative appendectomy rate. In one of the study at Cardiff, application of Alvarado score has reduced the negative appendectomy rates from 44% to 14% proving its efficacy.[7]

In the present study Alvarado score was combined with ultrasonographic findings and histopathological reports to increase the accuracy and to reduce false appendectomy rates.[8] Ultrasonography is an affordable and inexpensive tool which has 55% to 98% sensitivity and 78% to 100% specificity, [9] however the data is variable and dependent upon study design, type of technique and operator dependent.

The mean age and standard deviation of cases in the present study was 34.26±8.64 years which coincides with the findings of Khan et al who reported the mean age as 20.2 years and Siddiqui et al with mean age 28.7±11.9 years.[10,11] The male to female ratio in present study was 1.35:1, indicating more incidence of males in present study which is on par with findings of Albulim and Talukder but contrast to findings of Paterson et al who suggested that there is no significant difference in the male to female ratio in the united kingdom.[12-14] Most of the patients in the study were between 26-35 years of age which is similar to findings of Nasiri et al and many other studies.[15]

Regarding the signs and symptoms of cases in the study, most common sign was rebound tenderness in right iliac fossa observed in 100% of cases which is also mentioned in the study of Singh Ca et al, who also mentioned that commonest symptom was pain in RIF which is also on par with the findings in present study.[16] However the signs and symptoms are always variable depending on multiple factors, e.g.: Position of appendix, associated adnexal masses etc. Vomiting that precedes pain is always suggestive of intestinal obstruction which is always confused with acute appendicitis.[17]

In the present study a total of 160 cases, who were placed in Group- II and Group- III with Alvarado score >6 were operated. 40 cases were managed conservatively and discharged without appendectomy. In these cases, managed conservatively USG was not performed as their score didn't progress further. Out of 160 cases, 40 cases underwent emergency operation and 120 cases lap appendectomy. In the total 160 cases in present study, 146 cases (91.25%) fulfilled the criteria for positive acute appendicitis by ultrasonography, having a positive predictive value of 94.52%, negative predictive value was 71.43%. The overall sensitivity and specificity of USG in the study was 97.18% and 55.56%. These findings in present study were comparable with findings of Schuh S et al and many other studies.[18] However, some of the studies have integrated other parameters like CRP with USG and increases the sensitivity and specificity which is contrary to the findings in present study.[19] In present study, the utility of ultrasound has been advocated as an adjunct to improve diagnosis in equivocal cases and determines further who needs further imaging with superior modality. Findings of present study were comparable with findings of Rasoul et al.[20]

In present study, histopathologically confirmed cases of acute appendicitis were 142 (88.75%) and 18 normal cases without histopathological diagnosis were operated with a negative appendectomy rate of 11.25% which is very minimal and comparable with the findings of Reddy et al who compared Alvarado score with histopathological reports.[21] Similarly many other studies also reported the same corresponding data related to negative appendectomy. [22]

CONCLUSION

To conclude, from present study Alvarado is still can be considered as good screening tool in cases with score >6. However, in equivocal cases with scores 5-6 additional parameters like USG can still support the clinical decision and can avoid the delay in surgery and complications like rupture of appendicitis, mucocele etc. Patients with score <4 are very unlikely to have acute appendicitis and can be discharged with conservative management and observation. Application of USG as adjunct tool to Alvarado scoring improves the diagnostic accuracy.

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