



Original Research Article

A Study of Efficacy of Alvarado Score vs Ultrasonography in Evaluation of Suspected Appendicitis

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Abstract

Background: Acute appendicitis is the most common cause of an 'acute abdomen' in young adults. Notwithstanding advances in modern radiographic imaging and diagnostic laboratory investigations, the diagnosis of appendicitis remains essentially clinical, requiring a mixture of observation, clinical acumen and surgical science. Several scoring systems have been developed in attempts to quantify and improve the accuracy of clinical assessment. The initial and most well-known was devised by surgeon Alfredo Alvarado in 1986. Imaging is vital to accurate and prompt diagnosis when the clinical presentation is equivocal. The aim of this study is to compare the utility of Alvarado score and ultrasound in diagnosis of acute appendicitis.

Material & Methods: An retrospective study was conducted over a period from Jan 2017 to Apr 2018 at our centre, a mid-zonal hospital under Armed Forces, India. Total 30 cases who underwent Emergency Appendicectomy were included in study. Patients who had Alvarado score >7 were assumed to have a preoperative diagnosis of Acute appendicitis and proceeded with emergency appendicectomy. Ultrasound examination is done following the clinical examination for all patients included in the study. Those patients having Ultrasonographic diagnosis of Acute Appendicitis were proceeded with Emergency Appendicectomy. The appendix removed was sent for Histopathologic Examination. Histopathologic Examination diagnosis was regarded as final diagnosis. Utility of Alvarado Score and Ultrasonography in making a preoperative diagnosis of Acute appendicitis is then seen and compared.

Results: Acute Appendicitis is more common in age groups 11-40 years and is rare in age <10 years and >40 years. The disease is more common in males. Alvarado Score has high sensitivity (95.8%) for Acute Appendicitis. It also has high positive predictive value (88.5%) for the disease. Ultrasonography on the other hand is moderately sensitive (79.2%) for Acute Appendicitis but has high positive predictive value (86.4%). However, Ultrasonography has very low negative predictive (37.5%).

Conclusion: Incidence of appendicitis is definitely higher in adolescents and young adults. The disease is more common in males than in females. Alvarado score is highly sensitive while Ultrasonography is moderately sensitive in diagnosing appendicitis. Alvarado score has good PPV and NPV for appendicitis. US while having good PPV, has low NPV for diagnosing appendicitis. Both Alvarado Score and US can be used as a good screening tool for diagnosing appendicitis.

Keywords: Alvarado Score, Appendicectomy, Appendicitis, Emergency, Surgery, Ultrasonography.

Introduction

Acute appendicitis is the most common cause of an 'acute abdomen' in young adults and, as such, the associated symptoms and signs have become a paradigm for clinical teaching. Notwithstanding advances in modern radiographic imaging and diagnostic laboratory investigations, the diagnosis of appendicitis remains essentially clinical, requiring a mixture of observation, clinical acumen and surgical science. In an age accustomed to early and accurate preoperative diagnosis, acute appendicitis remains an enigmatic challenge and a reminder of the art of surgical diagnosis.¹ Several scoring systems have been developed in attempts to quantify and improve the accuracy of clinical assessment. The initial and most well-known was devised by surgeon Alfredo Alvarado in 1986² and is based on eight clinical criteria. The criteria for the Alvarado score are shown in Table 1¹. Since then many studies have confirmed that the Alvarado score is a useful adjunct in predicting the presence of appendicitis but that it does not have sufficient positive predictive value (PPV) to be used exclusively.³⁻⁵ Imaging is vital to accurate and prompt diagnosis when the clinical presentation is equivocal. Ultrasonographic criteria for diagnosing appendicitis is shown in Table 2⁶. The aim of this study is to compare the utility of Alvarado score and ultrasound (US/USS) in diagnosis of acute appendicitis.

Table 1

Symptoms/Signs/Lab	Score
Migratory RIF pain	1
Anorexia	1
Nausea and vomiting	1
RIF tenderness	2
Rebound tenderness	1
Elevated temperature	1
Leucocytosis	2
Shift to left	1
Total	10

Table 2

Ultrasonographic signs Of Acute Appendicitis
Visualization of non-compressible bowel structure
Appendicular diameter >6 mm
Diffuse hypoechogenicity
Lumen distended with iso/hyperechoic material
Visualisation of appendicolith
Loss of wall layers
Peri-appendicular fluid collection
Visualisation of peri-appendicular fluid collection

Material and Methods

Study area and population: Patients undergoing emergency appendectomy at our centre (a mid-zonal hospital under Armed Forces, India).

Period of study: Jan 2017 to Apr 2018

No. of Cases: 30

Study Design: The study was a retrospective review of medical and imaging records of patients who had a preoperative diagnosis of Acute Appendicitis based on either clinical condition (Alvarado score) or Ultrasound or both.

Parameters studied: Age distribution of patients undergoing emergency appendectomy
Sex distribution of patients undergoing emergency appendectomy.

Correlation of Alvarado Score > 7 with HPE proven diagnosis of appendicitis. Correlation of Ultrasonographic diagnosis of appendicitis with HPE proven diagnosis of appendicitis

Inclusion Criteria

A total of 30 cases who underwent emergency appendectomy between Jan 2017 and Apr 2018 at our centre are included in the study.

Exclusion Criteria

Patients who were planned for appendectomy following preoperative diagnosis of appendicitis but were found to have appendicular mass intraoperatively and therefore were not proceeded with appendectomy are excluded from study.

Study Procedure

Study is a retrospective review of medical, laboratory and imaging records of patients who underwent emergency appendectomy at our centre. A thorough history and clinical

examination was done for all patients. Lab investigations were done for all patients. Patients who had Alvarado score >7 were assumed to have a preoperative diagnosis of Acute appendicitis and proceeded with emergency appendicectomy. Ultrasound examination is done following the clinical examination for all patients included in the study. Those patients having Ultrasonographic diagnosis of Acute Appendicitis were proceeded with Emergency Appendicectomy. Patients in whom an appendicular mass was found intraoperatively and therefore not proceeded with appendicectomy are excluded from the study. The appendix removed was sent for Histopathologic Examination (HPE). Histopathologic Examination diagnosis was regarded as final diagnosis. Utility of Alvarado Score and Ultrasonography in making a preoperative diagnosis of Acute appendicitis is then seen and compared.

Results

Collected data was arranged in systemic manner, presented in various tables and figures and statistical analysis was made using Chi square test. Out of the 30 patients who underwent emergency appendicectomy, most of the patients (27) were in the age group 11-40 years. (Table 3 & Fig 1)

Table 3

Age Group (In Years)	No. Of Patients
0-10	2
11-20	7
21-30	9
31-40	11
>40	1
TOTAL	30

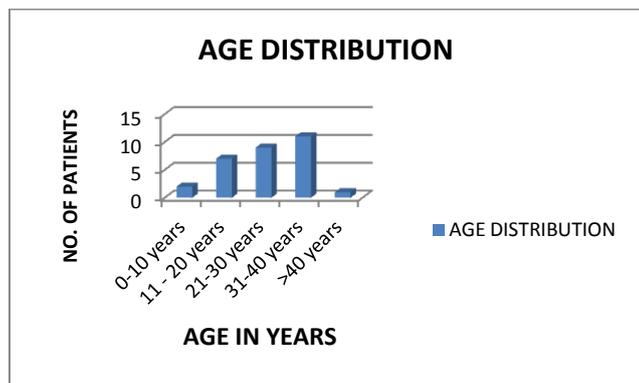


Fig. 1

Acute Appendicitis is rare in age group <10 years and greater than >40 years. Statistics reveal that there is a definite association between age and prevalence of acute appendicitis and disease is more prevalent in age group 11-40 years. (Chi square = 12.667, p = 0.0130 <0.05, df =4) Out of the total 30 patients who underwent emergency appendicectomy, 21 were male and 9 were females.(Table 4 & Fig 2)

Table 4

Total Patients	Male	Female
30	21	9

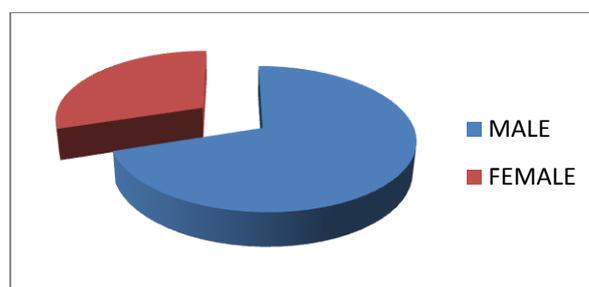


Fig. 2

Incidence of appendicitis was found to be higher in males than in females. Statistics reveal that there is a strong association between male sex and appendicitis. (Chi Square = 4.8, p = 0.02846 <0.05, df = 1) Patients who had Alvarado Score >7 were proceeded with Emergency Appendicectomy. Out of 26 patients having Alvarado Score >7, 23 had HPE diagnosis of Acute appendicitis. Only 3 patients who had Alvarado Score>7 were found to have normal appendix. (Table 5)

Table 5

Alvarado Score	Hpe		Total
	POSITIVE	NEGATIVE	
>=7	23	3	26
<7	1	3	4
Total	24	6	30

Further, when Alvarado Score is <7, only 1 patient out of the total 30 had HPE positive. Patients who had Ultrasonography suggestive of Acute appendicitis were proceeded with Emergency Appendicectomy. Out of 22 patients having USS suggestive, 19 had HPE diagnosis of Acute Appendicitis.(Table 6)

Table 6

Ultrasonography	Hpe		Total
	Positive	Negative	
Suggestive o f Appendicitis	19	3	22
Not Suggestive of Appendicitis	5	3	8
Total	24	6	30

Further, when USS is not suggestive of Acute Appendicitis, only 5 patients out of 30 were HPE positive. But there were 5 cases where USS was not suggestive of Acute Appendicitis, but patients had the disease. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) of Alvarado score and Ultrasonography in diagnosing the disease is as shown in Table 7.

Table 7

	Alvarado Score	Ultrasonography
Sensitivity	95.8%	79.2%
Specificity	50%	50%
Positive Predictive Value	88.5%	86.4%
Negative Predictive Value	75%	37.5%

As is seen in the table, Alvarado Score has high sensitivity for Acute Appendicitis. It also has high positive predictive value for the disease.

Ultrasonography on the other hand is moderately sensitive for Acute Appendicitis but has high positive predictive value. However, Ultrasonography has very low negative predictive value.

Discussion

In this study, as in others (eg. Green and Watkins⁷, 1946; Love⁸, 1947), there were only a few cases of appendicitis noted in children ≤ 10 years. The disease is relatively common in age group >10 years and <40 years. It has been suggested that the peak in development of lymphoid tissue which occurs during adolescence leads to an increased liability of appendix to obstruct, and so accounts for high incidence of the disease⁹. In the absence of any clear evidence as to how anatomy of appendix itself changes with age, the above hypothesis most satisfactorily

explains the increased incidence of the disease in adolescents and young adults. Also to be noted is that it is not the frequency, but the seriousness of the condition in age group <10 years that is significant. It has been seen in various studies that proportion of cases complicated by peritonitis in this age group is more than in age group >10 years.⁹ This has been commented on often, and ascribed, among other things, to the difficulties of diagnosis, the proportionately greater length of appendix, and the lack of development of omentum in young children. (Hudson and Chamberlain¹⁰, 1939; Boyce¹¹, 1949a and b; Bunton¹², 1953; Searle AR¹³, 2013) In this study, as in others (Addiss¹⁴, 1990; Stein¹⁵, 2012) appendicitis is seen more commonly in males than in females. However there seems to be even less anatomical knowledge, of changes with sex on appendix, on which to base this finding, than of ones with age. It has been reported that the proportion of lymphoid tissue was higher in male appendices than in female, and that this difference persisted at all ages. (Hwang and Krumbhaar¹⁶, 1949). This might be the reason for higher incidence of appendicitis observed in males. Both Alvarado Score and Ultrasonography are found to be correlated with presence of appendicitis. Alvarado Score is highly sensitive whereas Ultrasonography is moderately sensitive for presence of appendicitis. Alvarado Score has both high positive and negative predictive value whereas Ultrasonography while having high positive predictive value has low negative predictive value. Gwaynn et al¹⁷ used Alvarado score ≥ 5 for diagnosis of appendicitis and found sensitivity was 91.6%, specificity 84.7%, PPV 93% and NPV 83.6%. the identification rate of appendix by Ultrasonography had a wide range from 24.4% to 82% in various studies. (Trout¹⁸, 2012; Wiersma¹⁹, 2005; Rioux²⁰, 1992), limited by sonographers' experience and patients' weight. Many studies including this one have classified the non-visualized appendix by US as normal appendix (Trout¹⁸, 2012; Rioux²⁰, 1992; Sivit²¹, 2000; Pacharn²², 2010). However, appendicitis is

found in significant percentage in non-visualized appendix and therefore this group should be classified separately. We suggest observation for this group patients having low Alvarado score and CT in this group patients with high Alvarado score. Most of the literature has shown a high NPV of US up to 95-98% when used in overall patients presenting with acute abdomen. However, when focusing only on surgical patients group (patients who underwent surgery), most studies including this one has shown low NPV (Limchareon²³, 2014). We agree with previous literature to use US as screening tool for appendicitis specially in children (Parcharn²², 2010; Tiu²⁴, 2004). One limitation of our study was its retrospective design, other being limited number of total patients in study. We interpreted US findings independent of other clinical information. It is generally accepted that US is operator dependent. The question is how many years experience is enough? A further study to validate the effect of radiologists' experience in efficacy for diagnosis of appendicitis is suggested.

Conclusion

Acute appendicitis is the most common cause of an 'acute abdomen' in young adults. Diagnosis of appendicitis remains essentially clinical, requiring a mixture of observation, clinical acumen and surgical science. Alvarado score is a useful adjunct in predicting the presence of appendicitis. Imaging is vital to accurate and prompt diagnosis when the clinical presentation is equivocal. Incidence of appendicitis is definitely higher in adolescents and young adults. The disease is more common in males than in females. Alvarado score is highly sensitive while US is moderately sensitive in diagnosing appendicitis. Alvarado score has good PPV and NPV for appendicitis. US while having good PPV, has low NPV for diagnosing appendicitis. Both Alvarado Score and US can be used as a good screening tool for diagnosing appendicitis. However, appendicitis is found in significant percentage in non-visualized appendix and therefore this group should be

classified separately. We suggest observation for this group patients having low Alvarado score and CT in this group patients with high Alvarado score.

No Conflicts of Interest Exists

No Financial Disclosure

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