DIAGNOSTIC ACCURACY OF ULTRASOUND IN ACUTE APPENDICITIS IN COMPARISON WITH ALVARADO SCORE KEEPING HISTOPATHOLOGICAL CORRELATION AS GOLD STANDARD

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ABSTRACT

Objective: To evaluate the diagnostic accuracy of ultrasound in acute appendicitis in comparison with Alvarado score keeping histopathological correlation as gold standard.

Study Design: Comparative cross-sectional study.

Place and Duration of Study: Departments of Radiology, Surgery and Pathology of PIMS Hospital, Islamabad, from Jan 2018 to Oct 2018.

Methodology: Patients that were Alvarado positive or either ultrasound positive were included in the study followed by appendectomy. Removed appendix was sent for histopathological examination. The results were entered in structured proformas.

Results: Out of 200 patients, 117 (58.5%) were male patients while 83 (41.55%) were females. Mean age of the patients was 22.6 ± 3.1 year with range 9 to 55 years. Mean Alvarado score of patients was found to be 9.1 with maximum score 10 and minimum score of 7. Among ultrasound findings, 192 (96%) patients had appendix with diameter >6mm. Ninety two (46%) patients had free fluid, 186 (93%) patients had peri-appendicular fat and 40(20.0%) patients had appendicolith. Sensitivity of ultrasonography was 80%, sensitivity of Alvarado was 94.1%. Specificity of ultrasound was 60%, specificity of Alvarado was 33.3%. Diagnostic accuracy of ultrasonography was 77.5%, Alvarado score was 85%.

Conclusion: Alvarado score has higher sensitivity as compared to ultrasound, while ultrasound has a higher specificity. Neither tool is superior to the other. Both need to be used together to reduce the negative appendectomy rates.

Keywords: Acute appendicitis, Alvarado score, Comparative study.

INTRODUCTION

Acute appendicitis is one of the most prevalent cases of emergency surgery. It runs a 6-7% life-long risk. Perforation that is associated with increased morbidity and mortality may progress. Therefore, surgeons are more likely to operate when diagnosis is likely rather than wait for it[1]. The accuracy of the clinical examination has been shown to range from 71-97% and varies greatly according to the examiner's experience. However, due to missed perforated appendix, surgeons have traditionally accepted a 20% negative appendectomy rate (removal of the normal appendix in patients with other causes)[2,3].

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The negative appendectomy rate in men is generally less than 20%. Young women, however, are usually experiencing acute gynecological diseases which imitate acute appendicitis. Reported negative rates of appendectomy are therefore disturbingly high and reach from 34% to 46% in ovulation women[4,5].

Accurate diagnosis in patients with acute abdomen is necessary, as 7% of the whole population is likely to suffer from acute appendicitis during their life time with peak incidence at the age of 10-30 years[6]. And failing to make an early diagnosis will lead to grave consequences and complications like peritonitis, abdominal abscess, and even death[7].

Despite technological developments, the diagnosis of acute appendicitis remains primarily

on clinical evaluation of patient that includes detailed history taking with physical examination. Followed by complete blood picture that shows leukocytosis with a typical of "shift to the left" that means increase in the neutrophilic count. A plain radiograph is rarely recommended in now a day's setup. Ultrasound is noninvasive repeatable option among imaging modalities which avoids exposure to ionizing radiations like in computer tomography and is cheap[8,9].

Diverse scoring systems, computer-aided diagnosis, ultrasonography imaging and even radioactive isotope imaging have been included in the attempts to improve acute appendicitis diagnostic precision[10]. Rationale was to compare the diagnostic accuracy of both Ultrasound and Alvarado score in diagnosing acute appendicitis, to reduce mortality and morbidity due to appendicitis and reduce the negative appendectomy rates, so our study concluded that neither is superior to the other. Both need to be used together.

METHODOLOGY

Study design was cross-sectional comparative study. Study was held in radiology, Surgical and Pathology Department of PIMS Hospital, from January 2018 to October 2018.

All the patients that presented to ER department with signs and symptoms of acute appendicitis were clinically assessed. The patients that had Alvarado score of >9 were considered as Alvarado positive and those between 7-8 were considered as Alvarado negative, and were considered for ultrasound examination and those with positive ultrasound findings were included in the study. Alvarado scores the signs, symptoms and complete blood picture (migration of pain to right {1}, nausea {1}, anorexia {1}, tenderness in right iliac fossa {2}, rebound tenderness {1}, elevated temperature {1}, leukocytosis {2} and shift of white cell count towards left neutrophils {1}, with a total count of 10 points).

Ultrasound was performed by senior resident of minimum 2 years' experience, on Toshiba Aplio 500 machine, using both curvilinear and linear probes. All the patients with either of the following ultrasound findings on ultrasound examination; 1) a non-compressible, blind-ending, non-peristaltic tubular structure of more than 6mm in transverse diameter in vicinity of right iliac fossa, 2) probe tenderness 3) free intraperitoneal fluid, 4) increased peri appendiceal fat echogenicity and 5) presence of appendicolith were considered as ultrasound positive and were included in the study. All the patients that either had positive ultrasound findings or were Alvarado positive were included in the study, and then were referred to surgical department and willingly underwent appendicectomy. Patients with appendicular mass/abscess were excluded from the study. The removed appendix was sent for histopathological examination in all cases. The histopathological reports were collected. Sample size was calculated with WHO sample size calculator keeping sensitivity of 88.6% and specificity of 66.6% for ultrasound and prevalence 7%[11].

The results were entered in structured proformas which included detailed history with clinical examination (signs and symptoms), findings on laboratory examination (Alvarado score) and ultrasound findings. Data was collected after the informed consent. All the data was entered and analyzed using SPSS version-23. This entire process of patient selection and data collection was done after permission from ethical review committee.

RESULTS

Two hundred patients of both genders were included in the study. A total of 117 (58.5%) were male patients while 83 (41.55%) were females. Mean age of the patient was 22.6 ± 3.1 year with range 9 to 55 years. Mean Alvarado score of patients was found to be 9.1 ± 1 with maximum score 10 and minimum score 7. As far as ultrasound findings were concerned, 192 (96%) patients had appendix with diameter >6 mm. Ninety two (46%) patients had surrounding free fluid, 186 (93%) patients had peri-appendicular fat and 40 (20.0%) patients had appendicolith. Age group distribution of the patients are shown in figure.

Table-I shows us values of true positive, false positive, false negative and true negatives of both Ultrasound and Alvarado score.

Sensitivity of ultrasonography was found to be 80% while sensitivity of Alvarado score was more 94.1%. Likewise, the diagnostic accuracy of ultrasonography was 77.5% and that of Alvarado score was 85% as shown in table-II.

Table-I: Comparison of ultrasonography with histopathology findings.

	Histopathology Positive	Histopathology Negative
Ultrasonography		
Positive	140 (70.0%)	10 (5.0%)
Negative	35 (17.5%)	15 (7.5%)
Alvarado Score		
Positive	160 (80.0%)	20 (10.0%)
Negative	10 (5.0%)	10 (5.0%)

Table-II: Diagnostic variable of ultrasonography and Alvarado score.

Diagnostic Variables	Ultrasono-graphy	Alvarado Score
Sensitivity; TP/(TP+FN)	80%	94.1%
Specificity; TN/(TN+FP)	60%	33.3%
Positive Predictive Value; TP/(TP+FP)	93.3	88.8
Negative Predictive Value; TN/(TN+FN)	30	50
Diagnostic Accuracy; (TP+TN)/All Patients	77.5%	85%

DISCUSSION

The differential diagnosis of almost everyone who has acute abdomen, is appendicitis. In these patients, early diagnosis remains the most important target and is usually only done on a history and clinical basis[6]. Typical appendicitis starts with dull periumbilical pain because of visceral nervous irritation. It is followed by a feeling of loss of appetite, nausea and vomiting[12]. The pain then localizes to the right lower quadrant as inflammatory process involves parietal peritoneum overlying the appendix. The patient then develops fever followed by leukocytosis in complete blood picture[12].

A clinical score system used for the diagnosis of appendicitis is Alvarado Score (AS). The score consists of 6 clinical and 2 laboratory components with a total of 10 points. It was introduced in 1986[13]. Ultrasound results in line with acute appendicitis include, a 7 mm or more appendix of anteroposterior diameter, an adynamic, non-compressible, tubular structure with edematous walls seen as a target lesion in transverse plane, or appendicoliths presence[13].

Baidya *et al*[14] conducted a prospective study in which they had two groups; 103 patients in group 1 underwent surgery and 101 had acute appendicitis. In group 2; 24 patients underwent delayed surgery where 6 patients had appendi-

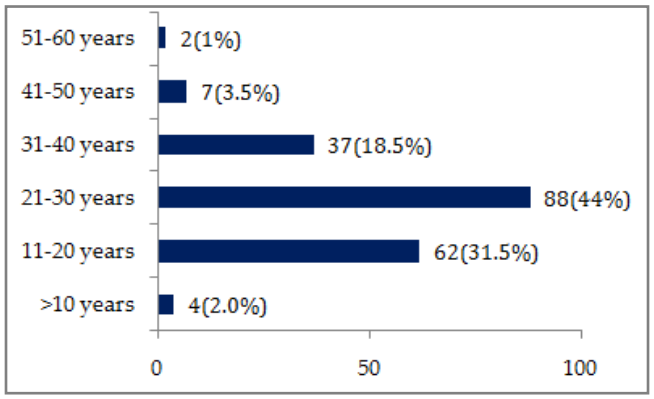

Figure: Age distribution of the patients.

citis on histological examination. Ultrasonography diagnosed acute appendicitis in 110 patients out of which 107 had appendicitis, proven histologically. Three patients were over diagnosed to have appendicitis by ultrasonography. Negative appendicectomies were seen more in females than in males (6:2). The Alvarado score had an overall sensitivity of 88.8% and specificity of 75%. Just like our study concluded that Alvarado score (94.1%) has a higher sensitivity than ultrasound (80%), making it a better tool for identifying appendicitis[14]. Owen *et al* and Williams conducted a prospective study in a period of 12 months in 1990. Study was conducted on 215 patients in University of Wales hospital, Cardiff. 94% men, 78% women and 88% children had final diagnosis both on Alvarado and histopathological examination. The study shows that use of a simple scoring system in patients suspected of having acute appendicitis provides a high degree of sensitivity

and specificity. It has an easy application since it relies purelyon clinical history, examination, and few simple investigations. With the use of scoring system, the high negative appendectomy rate was significantly reduced in the year prior to the study without increasing morbidity or mortality[15]. Just like our study concluded that based on Alvarado score out of 180 patients, 160 (80%) were positive on histopathological examination making it a more sensitive tool for identifying acute appendicitis.

A study conducted by Bilbey *et al* using high frequency ultrasound for diagnosing appendicitis, concluded that ultrasound had a high specificity 95% than sensitivity 87%, just like our study concluded. Diagnostic accuracy of 92%, while our study concluded with the diagnostic accuracy of 77.5%, making it a reliable tool with better ability to rule out and diagnose acute appendicitis than Alvarado score[16].

Marilyn *et al* conducted a study on children that had signs and symptoms of acute appendicitis, which concluded that 82% of patients were diagnosed correctly on ultrasound, making it a reliable tool in ruling out acute appendicitis, just like our study. Ultrasound scans are useful for both the diagnosis of appendicitis and the diagnosis of other causes of acute abdomen pain[17].

Hussain *et al* conducted a study in Military Hospital and Combined Military Hospital Rawalpindi from July 2007 to june 2008. Study was aimed compare the diagnostic accuracy of ultrasound keeping histopathological correlation as gold standard. The study concluded that ultrasound had sensitivity of 88%, specificity of 92%, positive predictive value of 94%, negative predictive value of 86%, and overall accuracy of 90%, just like our study concluded higher specificity than sensitivity for ultrasound with the positive predictive value and negative predictive value of 93.3 & 30%. Making it a reliable tool for ruling out and confirming acute appendicitis. The most common and accurate finding on ultrasound for diagnosing acute appendicitis according to this study was enlarged and inflamed appendix with a diameter of >6 mm 96.7%, just like in our study, inflamed and enlarged appendix is the most common finding on ultrasound 96%[18]. However, at the time of surgery 24% of patients with absent positive ultrasound findings were found to have appendicitis, which emphasized that ultrasound cannot be solely relied on, careful and repeated evaluation by surgeon needs to be carried out[19-23]. The results were nearly identical in comparing diagnostic accuracy, the histopathologic results and the ultrasound. Ultrasound is a precise, safe, reliable modality of imaging with higher specificity of 60% as compared to Alvarado 33.3%, significantly contributing in minimizing negative appendectomy rates[24-25].

CONCLUSION

Alvarado score has higher sensitivity i.e.it has a better ability to identify appendicitis as compared to ultrasound, while ultrasound has a higher specificity i.e. it has a better ability to rule out appendicitis and confirm it than Alvarado score. Neither tool is superior to the other. Both need to be used together to reduce the negative appendicectomy rates.

CONFLICT OF INTEREST

This study has no conflict of interest to be declared by any author.

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