Research Article

Acute appendicitis: Role of USG and colour Doppler in establishing a preoperative diagnosis

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Abstract

Background: Acute appendicitis is one of the most common clinical diagnoses that comes to mind when a patient presents to the emergency department with acute onset of pain in abdomen. **Aims:** to evaluate the efficacy and usefulness of USG and color Doppler in the diagnosis of acute appendicitis. **Material and Method:** This prospective study, involving 78 patients was carried out in the Emergency department and the surgical outpatient department of NIMS university Hospital between October 2012 and October 2013. All the patients suspected of having acute appendicitis, based on history, clinical examination, laboratory investigations and USG of the abdomen. **Result:** A total of 78 patients underwent abdominal USG and colour Doppler, appendix was visualized in only 51 patients. Findings were positive in 22 patients and negative in 29 patients. Total 23 patients underwent surgery and consequent Histopathological examination, which revealed acute appendicitis in 21 patients. The histopathology specimens of 2 patients were negative for acute appendicitis. Overall 30 patients did not have acute appendicitis. **Conclusion:** USG can be performed quickly and is relatively easy to correlate the USG findings with the patients' anatomical site pain. A complete examination of the pelvis and the upper abdomen should be performed followed by "graded compression USG" for the assessment of appendicitis. Diagnosis of acute appendicitis should not be established or excluded solely on the basis of Colour Doppler findings.
Keywords: USG and colour doppler

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INTRODUCTION

Acute appendicitis is one of the most common clinical diagnoses that comes to mind when a patient presents to the emergency department with acute onset of pain in abdomen. It is also one of the most frequent indications of abdominal surgery[1]. It is most common in 10-19 year old age group, although it can occur at any age and creates a difficulty in the diagnosis, especially in the elderly. The classical presentation of periumblical pain migrating to the right iliac fossa is many times absent[2] and hence the clinical diagnosis is difficult, particularly in women of child bearing age in whom gynaecological problems may mimic acute appendicitis. Delay in diagnosis or a false negative result can lead to complications like perforation and peritonitis, pelvic abscess etc. A lot of appendectomies are performed to avoid one of the most dreaded complication of appendicitis i.e. Perforation peritonitis. The appendices of elderly and young children are at high risk of perforation (40%-57% and 55%-70% respectively)[3]. Due to the increased morbidity, it is very importance to early and accurately diagnosis acute appendicitis before it perforates. In such clinically confusing instances, radiological imaging modalities come into play. Ultrasonography (USG) is easily available, inexpensive and free of harmful radiations and hence is widely used for the diagnosis of acute appendicitis. The protocol is to examine the whole abdomen to rule out other conditions that resemble acute appendicitis and then perform a graded compression USG for diagnosing acute appendicitis[4]**.** When combined with Doppler it makes the interpretation of conventional USG findings easier[5]. We conducted this study to evaluate the efficacy and usefulness of USG and color Doppler in the diagnosis of acute appendicitis.

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PATIENTS AND METHODS

This prospective study, involving 78 patients was carried out in the Emergency department and the surgical outpatient department of NIMS university Hospital between October 2012 and October 2013. The study protocol was approved by the ethical committee and a written consent was taken from the patients explaining the study and their part in it. All the patients suspected of having acute appendicitis, based on history, clinical examination and laboratory investigations (leukocytosis and increased neutrophil counts) underwent USG of the abdomen i.e. graded compression sonography and color Doppler for appendicitis. All sonographic examinations were performed using the available machine with a high frequency probe 5-12MHz. A complete examination of the upper and the lower abdomen was performed first, followed by graded compression technique as described by Puylaert[4]. The USG scans were performed and interpreted by a radiologist of at least 2 years of experience. Preoperative criteria for the diagnosis of acute appendicitis was clinical suspicion supported by USG demonstration of a blind ending, non-compressible appendix (outer anteroposterior diameter) $\geq$ 6mm and/or loculated periappendiceal mass with or without of probe tenderness. Color Doppler sonography was done for both normal and abnormal appendices but the findings were not used to diagnose or rule out Appendicitis. Demonstration of increased vascularity in the appendiceal wall or hyperaemic right lower quadrant mass was noticed. In patients undergoing surgery, the appendices were sent for histopathological examination which was considered as standard. Sensitivity, specificity, negative predictive value and positive predictive value for USG and color Doppler were also calculated.

RESULTS

A total of 78 patients underwent abdominal USG to establish a diagnosis of acute appendicitis. An attempt to visualize the appendix was made and appendix was visualized in only 51 patients and these patients formed our study group. Compressibility and maximum outer antero-posterior diameter of the appendix was measured. A USG diagnosis of acute appendicitis was established in the presence of incompressibility or if the maximum outer antero-posterior diameter of appendix was found to be $\geq$ 6mm. These findings were positive in 22 patients and negative in 29 patients. Total 23 patients underwent surgery and consequent Histopathological examination, which revealed acute appendicitis in 21 patients. The histopathology specimens of 2 patients were negative for acute appendicitis. Overall 30 patients did not have acute appendicitis. All the patients undergoing USG, in whom appendix was visualized, were subjected to colour Doppler studies. The findings of the appendiceal wall hyperaemia (suggested by increased flow to the appendix wall) were noted. This finding was not employed to make a diagnosis of acute appendicitis. Appendicular wall hyperaemia was found in 17 patients. Out of these 14 patients were proved to have acute appendicitis on Histopathology report.

Table 1: showing the number of patients diagnosed as acute appendicitis on the basis of USG findings and on histopathological examination

	HPE –ve for Appendicits	HPE +ve for Appendicits	
USG +ve for Appendicits	2	20	22
USG -ve for Appendicits	28	1	29
Total	**30**	**21**	**51**

HPE: Histopathology Examination. +ve: Positive -ve: Negative

Table 2: Showing the number of patients in which Colour Doppler showed appendicular wall hyperaemia

	HPE –ve for Appendicits	HPE +ve for Appendicits	
Doppler showing wall Hyperaemia	3	14	17
Doppler not showing wall Hyperaemia	27	7	34
Total	**30**	**21**	**51**

HPE: Histopathology Examination. +ve: Positive -ve: Negative

The sensitivity, specificity, Negative predictive value and the Positive predictive value for USG and Colour Doppler study are compared in table below.

Table 3: Showing the calculated data in parentheses are 95% CIs.

	USG	Colour Doppler
Senstivity	95% (74%-100%)	67% (43%-84%)
Specificity	93% (76%-99%)	90% (72%-97%)
NPV	96.5% (80%-100%)	79% (62%-91%)
PPV	91% (69%-99%)	82% (55%- 95%)

DISCUSSION

Acute appendicitis is one of the most common acute surgical conditions that present in the emergency department. The classical symptoms and signs are present in approximately 70% of the patients[2]. Radiological diagnostic modalities are useful in patients with equivocal clinical findings and to exclude alternative diagnosis that mimic acute appendicitis. For many years Ultrasonography (USG) and Computed Tomography (CT) have been used as primary imaging modalities for the diagnosis of acute appendicitis[6]. As compared to USG, CT has a higher sensitivity and specificity but it exposes the patients to harmful ionizing radiations and it is costly too. Hence many surgeons advocate the use of

USG for the confirmation of the diagnosis of acute appendicitis[7]. The sensitivity of USG for diagnosing acute appendicitis ranges between 80% - 95%, the specificity from 89% - 100% and the accuracy from 90% - 96%[8-12]. S Limchareon *et al*[13] report: sensitivity 71.2% and specificity 97.7%. Adrienne V R *et al*[14] report: sensitivity 78% and specificity 83%. Andrea S D *et al*[15] report: sensitivity 83% and specificity 93%. In our study the sensitivity and specificity of USG was 95% and 93% respectively. With such high sensitivity and specificity we would like to stress that – USG being relatively less costly, free from harmful ionizing radiations and contrast injection, should be the primary means of imaging modality in patients suspected to have acute appendicitis, especially in children. Because radiation exposure in childhood can increase the subsequent risk for developing cancer later in life[16] This can be further aided by colour Doppler study of the Appendix. Colour Doppler in the diagnosis of acute appendicitis is useful because it gives us an idea about the blood flow in the appendiceal wall. Detection of hyperaemia i.e. increased blood flow is highly sensitive for acute appendicitis. Previous studies have shown that absence of blood flow may indicate a normal[17] or a necrotic appendix[18]. Studies have reported sensitivity and specificity of color Doppler approximately 90% and 95% respectively [15,18]. Although color Doppler does not increase the sensitivity of USG examination, its high specificity makes the interpretation of conventional USG findings easier[5]. The sensitivity and specificity of Colour Doppler in our study was 67% and 90%. We did not use the findings if colour Doppler to make the diagnosis of acute appendicitis. The limitations of our study were the comparatively smaller study group and also we did not include the patients in whom appendix was not visualized.

CONCLUSION

USG plays an important role in the evaluation of patients with acute appendicitis. USG can be performed quickly and is relatively easy to correlate the USG findings with the patients' anatomical site pain. A complete examination of the pelvis and the upper abdomen should be performed followed by "graded compression USG" for the assessment of appendicitis. Colour Doppler should be used to identify wall hyperaemia and will aid in the diagnosis of acute appendicitis. Diagnosis of acute appendicitis should not be established or excluded solely on the basis of Colour Doppler findings.

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