

Ultrasound Scan in the Evaluation of Acute Appendicitis in the Tropics

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Abstract

Background

Surgery for pain in the right lower quadrant of the abdomen remains a clinical dilemma. Acute appendicitis is considered one of the commonest surgical emergencies. Correct diagnosis and prompt treatment are required to reduce the development of complications. Ultrasound has been shown to be of value in the diagnosis of acute appendicitis with sensitivity varying from one study to another.

Aim

This retrospective cross-sectional study assessed the accuracy of preoperative ultrasound scan in the evaluation of patients with suspected acute appendicitis.

Patients and Methods

One hundred-and-three adult patients with suspected acute appendicitis who underwent preoperative ultrasound scan of the abdomen and subsequently appendectomy; had the histopathology reports compared with their operative findings.

Results

103 patients whose ages ranged from 15 to 65 years with a mean age of 30.6 ± 18 were retrospectively reviewed. Male to female ratio was 1.5:1. Seventy-five patients had ultrasound diagnosis of acute appendicitis, 68 of which correlated with histopathology. There were 16 patients with equivocal ultrasound findings while ten patients had normal scans and two patients had a misdiagnosis of ovarian cyst. Of the ten, eight had histopathological features of acute appendicitis. Sensitivity of ultrasound in this study was 90.2% while specificity was 85.6%.

Conclusions

Ultrasound scan in patients with suspected acute appendicitis provides a high sensitivity and specificity in the diagnosis and therefore a formidable tool for diagnosing acute appendicitis in low resource center.

Introduction

Acute appendicitis (AA) is one of the most common surgical emergencies, the incidence rate is almost 10% [1,2]. The diagnosis is often challenging and of utmost importance to the surgeons providing care, hence preoperative imaging is now widely accepted by most surgeons and emergency medicine physicians in the workup of AA [1,2]. Imaging studies, either Ultrasound Scan (US) or Computerized Tomographic Scan (CT), are used in conjunction with clinical examination, the primary method for diagnosis. In patients with AA early diagnosis and prompt intervention is imperative especially because of some possible array of life threatening complications [3,4]. While in some instances clinical diagnosis can be made correctly, it is not infrequent to require other supportive investigations to make a correct diagnosis. This helps to reduce the rate of negative appendectomy which has been reported to be as high as 15-30% [5]. It also helps to avoid subjecting patients to unwarranted surgery with the attendant risks. Imaging modalities such as Ultrasound and Computerized Tomography have been shown to play important roles in the diagnosis of appendicitis. Ultrasonography is considered the first line imaging modality in the evaluation of AA [5,6]. It was first introduced by Puylaert in 1986 when he described the “graded compression ultrasonography” in the diagnosis of AA [7]. An inflamed appendix usually measures greater than 6mm in diameter, is non-compressible and tender, with focal compression. Many of the earlier studies have shown that the sensitivity of Ultrasound scan in the diagnosis of AA range between 55% and 98%; while the specificity of Ultrasound scan in the diagnosis of AA range between 78% and 100% [6-14]. This study set out to evaluate the diagnostic value of Ultrasound in the diagnosis of AA by comparing pre-operative ultrasound diagnosis with the histopathological diagnosis of the removed specimen in a tropical mission hospital.

Methods

Study Design and Setting

This retrospective cross-sectional study was conducted in department of surgery at a single center referral Mission Hospital, Northwestern region of Cameroon, over a two year period from January 2015 to December

2016. The hospital is a 200-bedded mission hospital in Kumbo, a rural community in Northwestern region of Cameroon which is located at about 100 kilometers from the regional Headquarter city of Bamenda. The hospital serves principally as referral center to an estimated three million people in the sub-region.

Study Population and Procedure

The studied population included patients with age 15 years and above who had appendectomy, with pre-operative ultrasound examination and histo-pathological report of the removed appendix. The exclusion criteria were the following:

- i. Patients who did not have pre-operative Ultrasound scan.
- ii. Patients with any other causes of peritonitis such as ruptured appendix, traumatic perforations, tuberculosis enteric perforations, etc., were excluded from the study.
- iii. All patients with suspected acute appendicitis for whom a laparotomy and histopathological assessment was not performed.
- iv. All patients whose case file did not contain follow-up data.

Details of patients' socio-demographic characteristics, pre-operative ultrasound diagnosis, intra-operative diagnosis and histopathological diagnosis were obtained from their records. Ultrasound report was characterized as negative, equivocal or in keeping with Appendicitis. The Ultrasound machine used during the period of the study was Mindray DC- 6 scanner with probe frequency range of 2.5 to 6MHz. Ultrasound diagnosis was compared with the histopathology report and the sensitivity and specificity of ultrasonography in diagnosing acute appendicitis were calculated using histopathology report as the gold standard. Equivocal cases were not included in the calculation of sensitivity and specificity but included as negatives in the calculation of overall accuracy

Statistical Analysis

All data were entered in an excel database (Excel 2007, Microsoft corporation®) and analyzed using the Statistical Package for the Social Sciences (SPSS) version 22 (IBM Corp, Armonk, NY, USA). Absolute numbers and simple percentages were used to describe categorical variables. Similarly, quantitative variables were described using measures of central tendency mean and measures of dispersion such as range or standard deviation as appropriate. Statistical significance was set at $p < 0.05$.

Reporting

The STROBE Guidelines was used in reporting this clinical research [15].

Results

A total of 103 patients who had pre-operative evaluation with Ultrasound and subsequently underwent surgery with histo-pathological examination of the removed appendix were analyzed. Their ages ranged

from 15 to 65 years with a mean age of 30.6 ± 18 were retrospectively reviewed. There were 62 males and 41 females with a ratio of 1.5:1. Of the 103 patients, (n=90; 87.4%) cases were diagnosed as AA by histopathology while (n=9; 8.7%) cases were negative. Ultrasound was positive in (n=75; 72.8%) cases, equivocal in (n=16; 15.5%), and negative in (n=10; 10.4%) cases.

Of the 75 with positive ultrasound findings, 68 correlated with histopathology while of the sixteen patients who had equivocal ultrasound findings, 12 had histopathological diagnosis of AA with only four being negative. There were ten patients whose ultrasound was either reported as normal (10 cases), or misdiagnosed as Ovarian cyst (2 cases). When compared with the histopathology report, only two of the patients were truly negative while the remaining eight had histo-pathological diagnosis of AA. Sensitivity of ultrasound from this study when compared with ultrasound as the gold standard was 90.2% with a specificity of 85.6%; while Overall accuracy was 72.4%. Age and gender had no significant relationship with the accuracy of ultrasound in this study (p value=0.2 and 0.7 respectively).

Discussion

There have been concerns about the use of US because of operator dependency outcome [1, 2]. Results from this study show that we may be underestimating the value and benefit of ultrasound in the preoperative workup in appendicitis especially in the developing countries. Ultrasonography continues to play an important role in the evaluation of patients with acute abdominal pain [3]. Its peculiar advantages of ready availability, low cost, and absence of ionizing radiation makes it an attractive initial imaging modality in such situations [4]. The robust role of the US is in reinforcement of the clinical diagnosis of AA [5]. There have however been variations in the results obtained from various studies that have assessed its role in diagnosing AA. This is not unconnected with the differences in the levels of experience and the technique used by the Sonologists [5].

The studied population represents only a fraction of those who had appendectomy during the study period as there were several patients who had appendectomy only on clinical grounds. The age and gender characteristics of the patients in this study agree well with what has been generally documented in literature. It is known to be a disease of young adults more common in males with a male to female ratio of 1.4:1 which is in the range of what is observed in this study [6]. The sensitivity of 90.2% recorded in this study fairly compares well with some earlier studies [7,8]. Values that have been documented in literature range from 80% to 100%. Differences in technique, resolution of the ultrasound machines and level of experience are believed to be responsible for this [7-9]. Of particular note are those with equivocal US findings, majority of who eventually had histopathological confirmation of acute appendicitis. The decision to operate on this group of patients was based on the clinical symptoms which became compelling while the patients were on admission. This suggests that patients with equivocal findings on ultrasound should be closely monitored in order to avoid complications [10-12]. When there are no challenges of cost and availability, such patients are ideal candidates for further evaluation with abdominal computerized tomography scan [13-16]. When this is not available or affordable, hospital admission and close monitoring is an appropriate option in order to prevent development of complications. Similarly, eight of the ten patients who had negative scans but had appendectomy on clinical grounds had the diagnosis confirmed on histopathology. Several factors have

been attributed to missed diagnosis of AA by ultrasound scan and some of these include presence of excessive intestinal gas, obesity or a deeply buried appendix [3]. Other factors include failure to assess the entire length of the appendix including its distal tip as well as coexisting pathological conditions such as ovarian cyst, multiple adenitis and pelvic inflammatory disease which may mask or cause attention to be shifted from appendicitis to other pathologies [3]. The level of experience of the Sonologists is also an important factor. These limitations should therefore be borne in mind when taking management decisions on patients with obvious clinical features of AA when ultrasound findings are negative [17-19].

It is noteworthy that all but one of the patients diagnosed by USS to have AA were confirmed histologically. This suggests the high predictive value of ultrasound in diagnosing AA and as such USS diagnosis of AA can be relied upon most of the time particularly regarding operative decision. Some reports have varied ultrasound accuracy with age, gender and body mass index (BMI) [20-23]. The effect of body weight is with regard to the influence of excessive abdominal wall fat in the obese obscuring adequate visualization by USS while that of gender owes largely to the wide array of gynecological conditions such as ovarian cyst, pelvic inflammatory disease and ectopic pregnancy that may either mimic, obscure or coexist with AA [23-26]. In this study, although BMI was not taken into cognizance, age and gender did not seem to influence the accuracy of USS in diagnosis of AA. A larger sample size in a prospectively designed work may however be able to evaluate this better. The follow up detail of patients who had negative ultrasound scans and were not operated was not available to us in the study. This would have been utilized in determining the negative predictive value of ultrasound in this study. A prospective study to include randomized controlled trial is required to assess whether US replaces CT as a diagnostic tool for acute appendicitis. Therefore, we recommend this prospective study to evaluate ultrasound as the basic imaging modality for AA in the Tropics.

Conclusion

Ultrasound scan in patients with suspected AA provides a high sensitivity and specificity in the diagnosis and therefore a formidable tool for diagnosing AA in low resource center.

Declarations

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Availability of Data and Materials

Availability of data and materials confirmed by the Author.

Disclosures

This Clinical Research is an Extract from the Author's Doctorate Dissertation.

Authors' Contributions

The Author conceived of the study and participated in its design and coordination as well as helped to draft the manuscript; the author also read and approved the final manuscript.

Ethics Approval and Consent to Participate

Ethical approval was obtained from the Institutional Ethical Committee. Confidentiality was ensured by not writing the names of patients on proforma. A copy of the written Approval is available for review by the Editor-in-Chief of this journal.

Consent for Publication

Written informed consent was obtained from the patients for publication of this clinical research study and any accompanying images. A copy of the written consents is available for review by the Editor-in-Chief of this journal.

Competing Interests

The Author declares that he has no competing interests.

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