

Assessment of the correlation of preoperative ultrasonographic findings and intra operative surgical findings in cases of acute appendicitis

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Abstract

Background: Appendectomy for acute appendicitis is one of the most frequently performed surgical procedures. The development of imaging modalities, especially that of ultrasonography and computed tomography (CT), has enabled more accurate diagnostics with a significant decrease in false positive diagnoses, which has led to lower rates of negative appendectomies. Hence; the present study was conducted for assessing the correlation of preoperative ultrasonographic findings and intra operative surgical findings in cases of acute appendicitis.

Materials & methods: This was a prospective study conducted at Department of General Surgery, Rajindra Hospital, Patiala by including 50 patients presenting with acute appendicitis. A structured pre-prepared proforma was used to enter the complete history, investigations-hematological and ultrasound, intra-operative findings and histopathological report. Data collected was entered into MS-Excel 2013 spread-sheet.

Results: Amongst the 50 patients taken up for surgery, 42 were found to have acute appendicitis, while 8 patients were noted to have some other diagnosis. Based on these findings, the sensitivity and specificity of ultrasound in diagnosing acute appendicitis was calculated to be 92.86% and 87.50% respectively. The positive predictive value of ultrasound, i.e. – its ability to identify acute appendicitis correctly amongst all cases of acute appendicitis diagnosed on ultrasound was 70%. Its negative predictive value, meaning, the ability of ultrasound to accurately exclude the possibility of acute appendicitis amongst all the cases that are negative for acute appendicitis on ultrasound was 97.5%. The accuracy of ultrasound in identifying acute appendicitis was found to be 92% in the current study.

Conclusion: In equivocal cases sonography is better than clinical evaluation, while in unequivocal cases, ultrasound proves helpful in confirming the diagnosis.

Key words: Ultrasound, Appendicitis

Introduction

Appendectomy for acute appendicitis is one of the most frequently performed surgical procedures.¹ Much has been written on appendicitis - since it was described by Fitz more than 100 years ago.² The lifetime incidence of Acute Appendicitis is 6-8%.³ It can be caused by luminal obstruction due to fecolith, lymphoid hyperplasia, rarely by appendiceal or caecal tumor. Infectious, genetic and family factors are also taken into consideration.⁴ Traditionally, the diagnosis of appendicitis was made solely based on clinical symptoms and signs, and later diagnosis included results of inflammatory laboratory variables such as leukocytes, neutrophils, and CRP. This practice in diagnostics led to a false positive diagnosis (negative appendectomy) rates in the range of 15-30%.^{5, 6}

The development of imaging modalities, especially that of ultrasonography and computed tomography (CT), has enabled more accurate diagnostics with a significant decrease in false positive diagnoses, which has led to lower rates of negative appendectomies.^{7, 8} This improvement in diagnostic accuracy has been achieved at the cost of exponentially increased use of imaging studies. Although in some institutions imaging is considered mandatory for suspected acute appendicitis, in other institutions diagnostic imaging is still underused. This kind of difference in diagnostic pathways has led to varying rates of negative appendectomies.^{9, 10}

Hence; the present study was conducted for assessing the correlation of preoperative ultrasonographic findings and intra operative surgical findings in cases of acute appendicitis.

Materials & methods

This was a prospective study conducted at Department of General Surgery, Rajindra Hospital, Patiala by including 50 patients presenting with acute appendicitis. A structured pre-prepared proforma was used to enter the complete history, investigations-hematological and ultrasound, intra-operative findings and histopathological report. Inclusion criteria were as follows:

- All Patients irrespective of age and sex clinically suspected to be having acute appendicitis.
- All patients who agreed to sign the consent form

Exclusion criteria were as follows:

- Moribund patients not fit for surgery
- Complications of appendicitis like abscess, lump etc.
- All patients who refused to sign the consent form.

Data collected was entered into MS-Excel 2013 spreadsheet. The collected data was analyzed using IBM Statistical Package for Social Sciences IBM SPSS (version 22) software and was reported in terms of frequency tables, mean, percentage, bar diagram and pie chart. Sensitivity, specificity, accuracy, PPV and NPV was be calculated for diagnosis of acute appendicitis ultrasound.

Results

Age of patients ranged from 5 to 65 years, the disease was commonest amongst those in the 2nd to 5th decades of their life, which was 86% total cases. Only 2 patients with clinical acute appendicitis with an age above 50 years were encountered (4%). 76% patients were male, thus predominating the study with a 3:1 sex ratio. Right lower quadrant tenderness was present ubiquitously in all the patients. The commonest accompanying symptom was fever, present in 92% of the patients. Nausea and vomiting were the next most common symptoms, present in 90% patients, while anorexia was not as predominant, present in only 27% patients. The commonest clinical sign elicited was rebound tenderness, present in 92% of the patients.

While ultrasound diagnosed acute appendicitis in 40 patients (80%), 42 patients (84%) were diagnosed to have acute appendicitis on surgical exploration and this was confirmed on histopathology. Amongst the total 50 patients suspected to have acute appendicitis and thus taken up for appendicectomies, ultrasound gave a diagnosis of acute appendicitis for 40 patients (80%). Amongst these, it was accurate in 39 patients, while it gave a false positive diagnosis in 1 patient. In the 10 patients with an inconclusive diagnosis on ultrasound, 3 patients were false negative, in which acute appendicitis was noted to be present on surgery, while the rest 7 cases were true negatives. Amongst the 50 patients taken up for surgery, 42 were found to have acute appendicitis, while 8 patients were noted to have some other diagnosis. Based on these findings, the sensitivity and specificity of ultrasound in diagnosing acute appendicitis was calculated to be 92.86% and 87.50% respectively. The positive predictive value of ultrasound, i.e. – its ability to identify acute appendicitis correctly amongst all cases of acute appendicitis diagnosed on ultrasound was 70%. Its negative predictive value, meaning, the ability of ultrasound to accurately exclude the possibility of acute appendicitis amongst all the cases that are negative for acute appendicitis on ultrasound was 97.5%. The accuracy of ultrasound in identifying acute appendicitis was found to be 92% in the current study.

Graph 1: Signs and symptoms

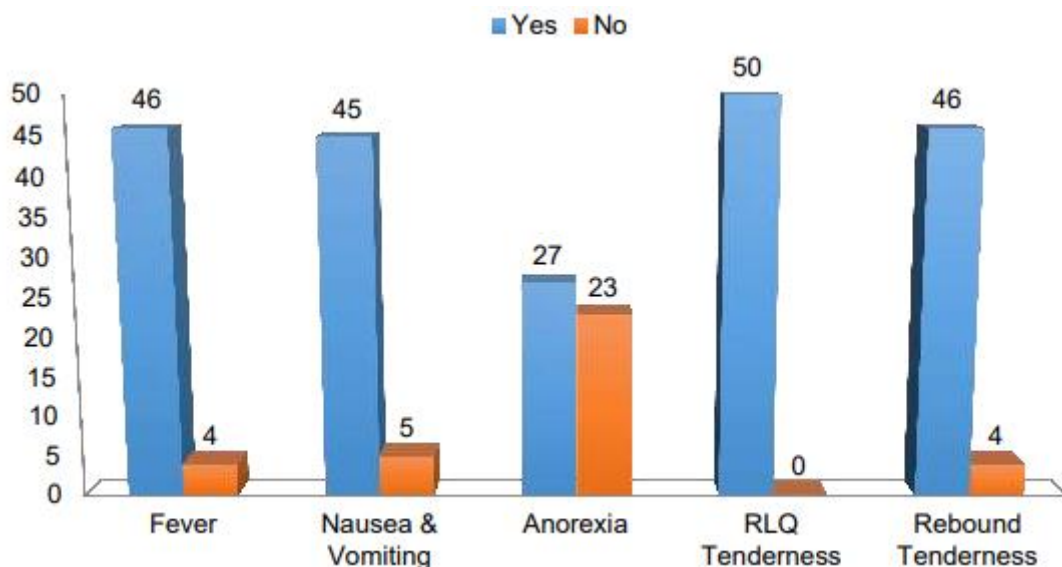


Table 1: Comparison of ultrasound, surgical findings and histopathological diagnosis

Acute Appendicitis	Ultrasound	Surgical Exploration	Histopathology
	40	42	42
Non acute appendicitis	10	8	8
Total	50	50	50

Table 2: Comparison of ultrasound versus operative findings

Ultrasound	Surgical Findings		Total
	Acute Appendix	Non Acute Appendix	
Acute Appendix	39 (TP)	1 (FP)	40
Non Acute Appendix	3 (FN)	7 (TN)	10
Total	42	8	50
P value	<0.001		
Significance	High		

Table 3: Sensitivity and specificity of ultrasound

Ultra sound	
Sensitivity	92.86 %
Specificity	87.50 %
NPV	97.50 %
PPV	70.00%
Accuracy	92.00 %

Discussion

In this study 50 patients with clinical diagnosis of acute appendicitis (Alvarado score >7) were selected and examined ultrasonographically with a scanner. Acute appendicitis can occur in all age groups but it is the most frequent in the 2nd and 3rd decades of life. The disease is rare in the very young and the very old. In this study, 80% cases were below 40 years of age and the youngest patient was 5 years old. 72% patients were male, which suggests a significant predominance in amongst males. These observations are consistent with most of the published reports for acute appendicitis from India (Lohar et al, 2014).¹¹ The male predominance (M:F,2.5:1) observed in our study population was also reported by Chamisa (2009)¹², who describe a sex ratio of 3.6:1. The male to female ratio was roughly 1 in the study by Lohar et al.¹¹ 92% patients had fever, which was the most common symptom

followed by nausea and vomiting (90% patients). Anorexia was present in 54% patients. On examination, 100% patients had RLQ tenderness and 92% patients had rebound tenderness. In contrast to our observations, Chamisa (2009)¹² reported vomiting in 57.4% patients, anorexia in 49%, and fever in 41% patients only. They observed that localized tenderness was present in 19.4% patients. The clinical accuracy in making the diagnosis of the acute appendicitis varies, which is mainly based on history and examination of the patient.

The mean Alvarado score was noted to be 7.9, with a standard deviation of 0.68. Clinical diagnostic accuracy was found to be 84% in our current series. Chong (2011)¹³ and Memon (2013)¹⁴ reported the diagnostic accuracy to be 68.3% and 89.8% for Alvarado scoring respectively. Recently ultrasonography has proved effective in the diagnosis of appendicitis, and also other conditions in the right iliac fossa (Puylaert, 1986, Abu-Yousef, 1987).^{15, 16}

The present study was carried out with a high frequency transducer and by graded compression technique as used by Puylaert. The specificity, sensitivity, accuracy and positive predictive value of ultrasound in diagnosing acute appendicitis in this study was 87.5%, 92.6%, 92%, and 70% respectively. These findings are well consistent with Puylaert et al (1986)¹⁷ who gave the specificity, sensitivity, accuracy and PPV as 100%, 89%, 95%, 89%. Zeidan et al (1997)¹⁷ gave the specificity, sensitivity, accuracy and PPV of ultrasound for diagnosing acute appendicitis in their study as 93.7%, 74.2%, 87.2% and 92% respectively, while Ida Chan et al (2005)¹⁸ specificity, sensitivity, accuracy and PPV of ultrasound for diagnosing acute appendicitis in their study as 95%, 83%, 92%, 86% respectively. Hussain et al (2014)¹⁹ found the specificity, sensitivity, accuracy and PPV of ultrasound for diagnosing acute appendicitis in their study to be 92%, 88%, 90%, and 94% respectively. In our study, there was one false positive case and 3 false negative cases. Exact explanation for these cases could not be made out, but in majority, the appendix was lying retro-caecally, with congestion present. Thus, these cases may have been atypical cases of acute appendicitis.

Another reason might be the inexperience of the ultrasonologist in the field to take notice of the tiny structure hidden behind the caecum. All the cases were surgically explored immediately or after investigations. 84% cases were found to have acute appendicitis as compared to 80% conclusively diagnosed by ultrasound, thus giving a negative appendectomy rate of 16%. The rates of negative appendectomy as described by Lane et al (1999) and Oguntola et al (2014) were 8-30% and 8.2% respectively.^{20, 21} The other cases in our study were found to have mesenteric lymphadenitis (3%), and PID (8%). One case was found to have a Meckel's diverticulum. Chamisa (2009) reported that amongst the patients with other underlying pathologies (3.1% in their study), the most common pathology was pelvic inflammatory disease.¹²

In our study 26% appendices were observed to be empty. Thus it can be noted that along with a high specificity and sensitivity of ultrasound in diagnosing acute appendicitis, findings of the sonographic study correlate with intraoperative findings in the same. Role of ultrasound in excluding acute appendicitis and in providing alternative diagnoses may also be noted. Findings of ultrasound may also thus aid in clinical diagnosis in suspicious cases and challenging scenarios.

Conclusion

In equivocal cases sonography is better than clinical evaluation, while in unequivocal cases, ultrasound proves helpful in confirming the diagnosis. The benefit of a sonography increases directly with the experience of the ultrasonologist, and may help reduce the false negatives, thus further increasing the sensitivity.

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