Sensitivity and Specificity of Investigations for the Diagnosis of Acute Appendicitis and their Correlation with Histopathology Findings

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Abstract

Background: To compare the sensitivity and specificity of various commonly available investigations for the diagnosis of acute appendicitis and their correlation with biopsy reports.

Methods:- In this comparative study, 50 patients, with provisional diagnosis of acute appendicitis, were enrolled. Samples were collected for total leucocyte counts, C-reactive protein (CRP) and urine routine examination. All the patients underwent ultrasound examination. After appendicectomy, specimens were sent for histopathological examination. The results of investigations were compared with the results of histopathology.

Results:- In 38 patients with histopathologically proven acute appendicitis, serum CRP levels was significantly raised in 35 patients, TLC was raised in 20 patients and ultrasound diagnosed to have appendicitis in 12 patients. The sensitivity and specificity of C-reactive protein level was 92% and 80%, TLC was 52% and 41.6%, while ultrasound abdomen had a sensitivity and specificity of 31% and 75% respectively.

Conclusion:- In the presence of a normal pre-operative serum C-reactive protein level, the diagnosis of acute appendicitis is highly unlikely.

Key Words: Acute Appendicitis, CRP, Total Leucocyte Count.

Introduction

Acute appendicitis is the most frequent indication for emergency abdominal surgery. The correct diagnosis of the acute appendicitis is difficult. The diagnosis may be wrongly made or initially overlooked. The first error leads to an unnecessary operation and the second to delay. Ideally an accurate pre-operative diagnosis is required in order to avoid the unnecessary morbidity of a negative appendicectomy. Abdominal pain is the primary presenting complaint with nausea, vomiting, and anorexia occurring in varying degrees. Abdominal examination reveals localized tenderness and rigidity in the right iliac fossa. Risk of rupture in ensuing 12-hour period rises to 5% after 36 hours of untreated symptoms. Laboratory data upon presentation usually reveal an elevated leukocytosis and CRP. The advances in imaginology tend to diminish the false positive or negative diagnosis. Despite all medical advances, the diagnosis of acute appendicitis continues to be a medical challenge, and the rate of negative appendectomies is 15%–30%.

Quality assurance for patients with suspected appendicitis should aim to minimize the negative appendectomy rate without a delay in the treatment of perforated appendicitis. The total and the differential cell counts should be interpreted in the light of physical findings as normal counts do not exclude appendicitis and raised counts and raised neutrophils can occur even in normal patients. CRP is a helpful marker in the management of patients with right iliac fossa pain; the predictive value improves when combined with leukocyte count. A patient with normal CRP and leukocytes has a very low probability of appendicitis and should not undergo surgery. CRP estimation is inexpensive and can significantly reduce the rate of negative appendectomies.

In view of its high sensitivity and specificity, USG abdomen is helpful, non-invasive and can be of particular help in pregnancy but its main disadvantage lies in the fact that it requires special equipment and is operator dependent. In the present era of laparoscopic surgery, diagnostic laparoscopy is a useful tool in evaluating patients with right lower abdominal pain, especially those with equivocal signs of acute appendicitis. It has the added benefit of being therapeutic. Women of childbearing age gain most from the procedure. Nevertheless, the patient undergoes anesthesia and laparoscopy with the diagnosis not being appendicitis, it does not mount to anything less than laparotomy and carries a risk of morbidity too.

CT scan is found to be a safe, reliable and accurate modality in the diagnosis of acute
appendicitis in patients with equivocal presentation, but in a developing country CT scan is not cost effective and also it exposes patients to ionizing radiation.\(^7\,19\)

**Patients and Methods**

This comparative study was conducted over a period of one year in department of Surgery, Rawalpindi General Hospital. Fifty consecutive adults patients with a provisional diagnosis of acute appendicitis were registered. Patients with appendici mass requiring conservative management and abscess requiring drainage were excluded.

After initial evaluation patients samples were collected for TLC, CRP, Urine R/E. All underwent USG examination. The leukocyte count was measured by an automated hematology analyzer. The concentration of serum CRP was measured by latex agglutination slide test for the qualitative and semi-quantitative determination. Ultrasound was done using a probe frequency of 3.5 MHz, RT2800. Final diagnosis of acute appendicitis was based on histological examination of the appendix.

The results of the preoperative laboratory tests and ultrasound were correlated with the histopathology of the excised appendix. The sensitivity and specificity of four variables including positive and negative predictive values were calculated. For correlations of variables with the histopathology Chi square was used. P-value of < 0.05 was considered to be significant.

**Results**

In 38 patients with histopathologically proven acute appendicitis, serum CRP levels were significantly raised in 35 patients, TLC was raised in 20 patients and ultrasound diagnosed appendicitis in 12 patients. The sensitivity and specificity of C-reactive protein level was 92\% and 80\%, TLC with 52\% and 41.6\% and ultrasound abdomen had a sensitivity and specificity of 31\% and 75\% respectively (Table 1).

The negative exploration rate was 24\% (12/50) and 76\% (38/50) patients had histologically proven acute appendicitis. Seven of the above twelve patients had a final diagnosis of non specific abdominal pain. Two patients had a final diagnosis of pelvic inflammatory disease, two had ruptured ovarian cyst and one had mesenteric lymphadenitis.

When analyzed retrospectively, of those who had uninfammed appendix on histopathology, 66\% had a raised T.L.C >10,000, 25\% had a raised C-reactive protein level, 16.6\% had both T.L.C and C-reactive protein level raised, 25\% had both the T.L.C and C-reactive protein levels normal preoperatively. Out of those who had histopathologically proven acute appendicitis, 52.6\% had raised T.L.C, 92\% had raised C.R.P, 47\% had both T.L.C and C.R.P raised and 2.6\% had normal T.L.C & C.R.P levels preoperatively. CRP had a PPV and NPV of 92.1\% and 80\%, Ultrasonography had 80\% and 25.7\% and T.L.C had 74\% and 21.7\% respectively (Table 1).

Out of 50 patients operated upon with the diagnosis of acute appendicitis 33 patients had an acutely inflamed appendix removed with a normal urine R/E, 3 patients had <5 pus cells and 2 patients with histological proven acute appendicitis had >5 pus cells in urine.

**Table 1: Comparison of Sensitivity, Specificity, Positive Predictive Value (PPV) and Negative Predictive Value (NPV) of various investigations in Acute Appendicitis**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Sensitivity (%)</th>
<th>Specificity (%)</th>
<th>PPV*</th>
<th>NPV**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Leucocyte Count</td>
<td>52%</td>
<td>41.6%</td>
<td>74%</td>
<td>27%</td>
</tr>
<tr>
<td>Ultrasound Examination</td>
<td>31%</td>
<td>75%</td>
<td>80%</td>
<td>25.7%</td>
</tr>
<tr>
<td>C-Reactive Protein</td>
<td>92%</td>
<td>80%</td>
<td>92.1%</td>
<td>80%</td>
</tr>
</tbody>
</table>

*PPV: Positive Predictive Value; NPV: Negative Predictive Value

**Discussion**

Despite a large number of tests available for the diagnosis of appendicitis, still negative appendicectomies have been performed. The present study indicates that out of the four commonly available investigations, i.e. TLC, CRP, abdominal ultrasound and urine R/E, the most sensitive and specific test to reduce the rate of negative appendicectomy is CRP level. TLC count may be used as the supporting diagnostic investigation.

In diagnosing acute appendicitis C.T scan has a sensitivity and specificity of 98.5\% and 98.0\% respectively. C.T utilization has been shown to reduce the negative appendicectomy rate from 7.5\% to 4.1\%.\(^{20}\) Availability and affordability of CT scan are important impediments.

The inability to visualize the normal appendix is considered a major weakness in using USG in the assessment of patients suspected of having appendicitis. Sonography is operator-dependent, and the importance of technique and experience is equal to the resolution power of sonography.\(^5\)

The presence of pus cells in the urine or haematuria does not exclude the occurrence of appendicitis. Irritation of the ureter or urinary bladder by inflamed appendix may cause microscopic haematuria or pyuria. Although urine R/E can
rule out a cause of right iliac fossa pain but still its not an accurate diagnostic modality for acute appendicitis. This was also noted in our study.

CRP increases in response to both infectious as well as non-infectious conditions. Its concentration increases within 8 hours of the onset of tissue injury, peaks in 24-48 hours and remains high as long as the tissue insult is present. Bacterial infection is the most potent and biologically the most important stimulator of increased C-reactive protein.

If clinical symptoms and signs indicate acute appendicitis in a fertile-aged woman with right lower abdominal pain, it can be excluded if leucocyte count and CRP values are not elevated. In our patients, 24% of unnecessary appendectomies could have been avoided by trusting in this finding.

Patients with clinically diagnosed acute appendicitis and an elevation in neutrophil count and CRP level must be considered candidates for early surgery as they are likely to have an appendicular perforation. Otherwise continued observation is recommended.

**Conclusion**

There is no single investigation that clearly outweighs the other, but CRP has shown to be superior in aiding diagnosis especially in cases where clinical examination is equivocal.

**References**