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Contrast enhanced computed tomography for diagnosis of acute appendicitis and its impact in reducing rate of negative appendicectomy

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ABSTRACT:

Context: Acute appendicitis is one of the most common surgical emergency and it poses a significant diagnostic challenge. The diagnosis of appendicitis remains essentially clinical. Contrast enhanced computed tomography(CECT) is significantly effective in confirming the clinical diagnosis**.**

Aims: Our study aims to evaluate the efficacy and accuracy of CECT in diagnosing a case of appendicitis, its sensitivity and specificity. The study also evaluate the significance of CECT in reducing negative appendicectomy rate.

Settings and Design: It is a retrospective review of prospectively collected data on 84 patients operated for sus- pected acute appendicitis in a single surgical unit between August 2018 and June 2020.

Material and Method: The detailed history, clinical examination and preoperative investigations according to protocol were recorded on a proforma. All patients underwent a CECT of whole abdomen including pelvis. Each patient with suspected acute appendicitis was subjected to surgery and appendix was submitted for histopathological examination. The negative rate of appendicectomy, sensitivity and specificity of ultrasonography and positive and negative predictive value of ultrasound were calculated.

Results: The negative appendicectomy rate was 2.38%. In males it was 0% and in females 5.71%. CECT had a sensitivity of 93.34 % and a specificity of 83.34 %. The predictive value of a positive test was 96.55% and the predictive value of a negative test was 71.42%.

Conclusions: The clinical diagnosis of acute appendicitis when supplemented with an CECT, can achieve a very high diagnostic accuracy which results in low negative exploration rates thereby reducing the financial burden and morbidity by avoiding unnecessary appendicectomy.

Keywords: Appendicitis, CECT, Negative appendicectomy

I. INTRODUCTION

Acute appendicitis is one of the most common causes of acute abdominal pain and is considered a surgical emergency. [1-3] The diagnosis of acute appendicitis is made on the basis of history, physical examination and laboratory findings. But things become complicated when patient presents atypically.[4] Also there are many differential diagnosis of acute Appendicitis which if not ruled out correctly may lead to unnecessary removal of a normal healthy appendix which is also known as negative appendicectomy. Negative appendicectomy may occur in 8.3% of patients undergoing appendicectomy.[5-8] The rate of negative appendicectomy can be reduced significantly if accurate diagnosis can be made with the help of modern diagnostic modality like computed tomography(CT).

Abdominal CT is a well-established technique and though is expensive provides a highly sensitive and specific tool for the differential diagnosis in patients complaining of acute abdominal pain. T he pathological conditions exhibiting acute abdominal pain may include acute appendicitis, colitis, diverticulitis, inflammatory bowel disease, bowel obstruction, adnexal cyst, acute cholecystitis, acute pancreatitis, and ureteral obstruction. It has been reported that the rate of accurate diagnosis for acute appendicitis is significantly increased with a help of abdominal CT and the reported sensitivity and specificity are 91-100% and 81-99% respectively (3, 6, 9-12).

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The aim of our study is to assess the usefulness of ultrasound in the diagnosis of acute appendicitis and evaluation of the negative appendicectomy rate in these patients by correlating the clinical and radiological diagnosis with histopathological examination of the resected specimen and to reduce the financial burden and morbidity in patients by avoiding unnecessary appendicectomies.

II. METHODS

Our study comprises of retrospectively study of prospectively collected data of 84 patients admitted to our department between August 2018 to June 2020 with a diagnosis of acute appendicitis. All patients were admitted to single surgical unit in order to maintain uniformity in treatment and management.

The detailed history, general examination, preoperative investigation of each patients were recorded in the decided proforma. Apart from blood investigations, all patients underwent contrast enhanced computed tomography of abdomen. Abdominal CT was performed after administration of contrast with the image thickness of 5-7mm and the table speed of 4mm/rotation.The contrast agent used was Iohexol injection at a dose of 1ml per kilogram body weight. Oral or rectal contrast was not used. The CT findings indicating presence of acute appendicitis included appendiceal thickening greater than 6mm in the outer wall to outer wall transverse diameter, appendiceal wall thickening of more than 3mm and / or appendiceal wall hyperenhancement.(4,13,14) Fecalith, periappendiceal fat stranding, thickening of the lateral conal fascia, abscess, ileocecal lymph node enlargement, focal thickening of terminal ileum or cecum, presence of extra or intra luminal air also suggested presence of acute appendicitis and these findings were especially helpful in the case of undetectable appendix (4, 15). Asymmetric thickening of the cecal wall, pericolonic inflammation, the presence of diverticula, and/or inflamed diverticula indicated the presence of diverticulitis (4, 16). The presence of appendicitis was excluded when normal appendix with no inflammatory signs was detected. The findings indicating normal appendix included visualization of the appendix to its blind ending tip the diameter of less than 6 mm, and the absence of any inflammatory signs.

Irrespective of the CT scan finding all patients with clinical diagnosis of acute appendicitis underwent surgery and the excised specimen sent for histopathological examination. The pathological diagnosis was compared with clinical and radiological diagnosis. The negative rate of appendicectomy was calculated. The sensitivity, specificity, positive and negative predictive value of CT scan was calculated. All Patients with negative appendicectomy are advised regular follow up to look for alternative pathology.

The study was approved by ethical committe of Hitech Medical College & Hospital.

III. OBSERVATION

In our study we included a total of 84 patients of whom 49 were male and 35 were female patients. The male: female ratio was 1.4:1. Most patients complained of right lower quadrant pain. The classic shift of pain from umbilical region to the right lower quadrant was observed only in 5 (5.95%) patients; nausea and vomiting in 68 (80.95%); anorexia in 56 (66.67%) and fever in 35 (41.67%) patients. Urinary symptoms were not observed in any pa- tient and diarrhoea/constipation was present in 2 (2.38%) patients. 27 (32.14%) patients gave a past history of similar pain; and 14 (16.67%) experienced a single attack of such pain in the past. In case of 5 (5.95%) patients it was the first attack. The signs and symptoms of patients is summarised in table-1.

Sl no.	Symptoms/Signs	No. of patients (Total=84)	Percentage
1	Right iliac fossa(RIF) pain	84	100%
	Shifting pain from periumbilical region to RIF	5	5.95%
2	Anorexia	56	66.67%
3	Fever	35	41.67%
4	Diarrhoea/ Constipation	02	2.38%

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5	First attack	05	5.95%
	History of single previous attack	14	16.67%
	History of recurrent attack	27	32.14%
6	Tenderness in RIF	84	100%
7	Guarding	30	35.71%
8	Rebound tenderness	17	20.23%

Table-1. Signs and symptoms in patients diagnosed with acute appendicitis

IV. RESULT

The patient characteristics and the findings of CT images are summarized in Table 2, Of 84 patients examined, 49 cases were male and 35 cases were female. Vermiform appendix was not detected in 14 of 84 patients (14/84, 16.67%). When all (contrast enhanced) CT images were analyzed, the detection rate of vermiform appendix was significantly ($p<0.05$) higher in adult male patients (45/49, 91.83%) than that in the female patient(28/35, 80%) group.

In this study, vermiform appendix was detected in 70 cases of 84 patients; appendiceal thickening in 60 cases, and normal sized appendix in 10 cases respectively. Based on the CT images, the laboratory data, and the clinical findings, 72 cases (72/84, 85.71%) were finally diagnosed to have acute appendicitis and undetectable appendix in 14 cases. The remaining 12 cases were diagnosed to have ascending colon diverticulitis (5 cases), colitis (3 cases), perforation of parts of the gastrointestinal tract other than appendix (1 cases), cecal cancer (1 case), appendiceal tumor (1 case), and unknown etiology (1 cases), respectively. Fecaliths were detected in 27 patients (27/84, 32.14%), and 26 cases of them (26/27, 96.29%) were accompanied with acute appendicitis, indicating the close relationship between fecalith and acute appendicitis (4). The frequency of fecalith was identical in both patient groups (Table 1). There was no case that exhibited significant adverse reactions to intravenous administration of contrast material.

Of 72 patients who were diagnosed to have acute appendicitis, appendectomy was performed in 62 cases (62/72, 86.12%); Of 62 patients who received appendectomy, 3 cases had been initially treated with intravenous administration of antibiotics according to the patient's decision, and exhibited the recurrence of appendicitis within 4 months thereafter. Repeated examination with noncontrast and enhanced CT was performed in these 3 patients, Fecaliths had been detected in 1 case of these 3 patients on the initial CT examination. In considering the close relationship between fecalith and appendicitis, this patient should have received appendectomy at the initial attack to minimize the radiation exposure. The remaining 7 patients (7/72, 9.73%) were successfully treated with intravenous administration of antibiotics, and the decision of this treatment was made by the patients themselves on the informed consent.

So 72 cases of 84 patients were finally diagnosed to have acute appendicitis on the basis of the clinical, laboratory, and CT findings. Of these 72 cases with the final clinical diagnosis of acute appendicitis, vermiform appendix was detected in 70 cases on contrast enhanced CT; appendiceal thickening in 60 cases, and normal-sized appendix in 10 cases, respectively.

The pathological reports of removed appendices (62 cases) revealed catarrhal appendicitis in 8 cases, phlegmonous appendicitis in 36 cases, gangrenous appendicitis in 15 cases, chronic appendicitis in 1 case, and normal appendix in 2 cases, respectively (Table 3). The appendix was not detected on CT in one case with gangrenous appendicitis, and normal-sized appendix was detected in one case with gangrenous appendicitis (enhanced CT performed). As a result, negative appendectomy, which was defined as unnecessary removal of normal appendices on the clinical diagnosis of appendicitis, was performed in 2 patients (2/62, 3.23%).

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Patient gender	Number of patient	Appendix (thickened)	Normal appendix	Appendix (not detected)	Faecalith	Appendicitis diagnosed	Appendicectomy performed
Male	49	38	6	5	16	45	39
Female	35	22	4	9	11	28	23
Total	84	60	10	14	27	72	62

Table 2- CECT findings in various patients diagnosed with acute appendicitis

V. DISCUSSION

The present study shows that enhanced CT is superior to noncontrast CT in diagnosing appendicitis in all age and any gender groups, and suggests that enhanced CT should be primarily performed for diagnosing acute appendicitis in all patients to minimize the radiation exposure unless intravenous administration of contrast material is contraindicated.

In our study the negative appendicectomy rate was 2.38% (2 out of 84). In males it was NIL (0 out of 49) and in females it was 5.71% (2 out of 35). Negative appendicectomy rates of 10–20% have been accepted in order to minimize the incidence of perforated appendicitis with its increased morbidity. Wide variations in negative appendicectomy rates have been reported with rates ranging from 9% to 85% [9, 10, 11].

A negative rate of 2.38% is certainly acceptable.

Accurate clinical diagnosis is also very important to avoid unnecessary CT examination and to reduce the radiation exposure. In our study, 72 of 84 patients (72/84, 85.71%) with clinically suspected appendicitis were finally diagnosed to have appendicitis. Among them (72 cases), 62 cases received appendectomy, and 60 of them (60/62, 96.77%) were found to have actual appendicitis on the pathological reports. The remaining 10 patients were successfully treated with intravenous administration of antibiotics, suggesting that these patients also had acute appendicitis. The rate of accurate diagnosis in our study with CECT appears to be higher as compared with that of the previous reports involving USG. . Recent studies with CECT show that enlarged appendix, appendiceal wall thickening, periappendiceal fat stranding, and appendiceal wall enhancement are the most useful findings for diagnosing acute appendicitis (1, 15).

This is a retrospective, nonrandomized study and, therefore, has its limitations. We analyzed only the patients who were admitted to our hospital and underwent enhanced CT examination, and this study does not include an analysis of the patients who had CT examination that was interpreted as negative for appendicitis. In addition, not all patients with the final diagnosis of appendicitis received appendectomy.

H/P study finding	CECT finding (Ac. Appendicitis)	CECT (Normal appendix)
Inflammatory	56	02
Normal	04	10

Table-3 Evaluation of CECT results by correlating with Histopathological examination

Overall result	%age
Sensitivity	93.34%
Specificity	83.34%
Positive predictive value	96.55%
Negative predictive value	71.42%

Table-4 Overall results of CECT (84 cases)

The sensitivity of CECT in diagnosing acute appendicitis in our study is 93.34% and specificity is 83.34% which comes under previously observed value. The positive predictive value is 96.55% and negative predictive value is 71.42%.

The alternative tools include ultrasonography and magnetic resonance imaging (MRI), both of which have the great advantage of being radiation free. Although it has been shown that ultrasonography can increase the accuracy of diagnosis, there are still reservations regarding the sensitivity and/or specificity of ultrasonography [1, 2, 17, 18]. It has been recently reported that abdominal MRI is a safe and reliable technique in patients suspected of having appendicitis, especially when used in a selected group of patients in whom ultrasonography is equivocal and CT is contraindicated [19]. We suggest that abdominal CT examination for diagnosing acute appendicitis should be appropriately performed on the balance of benefits and risks, with an effort for minimizing the radiation exposure. Our retrospective study presented here suggest that enhanced CT should be primarily performed for diagnosing acute appendicitis in all patients unless intravenous administration of contrast material is contraindicated.

VI. CONCLUSION

We conclude that the diagnosis of acute appendicitis is still essentially clinical and undue reliance should not be placed on radiological investigation of abdomen to diagnose and treat this condi- tion. The idea of achieving a low negative appendicectomy rate is to avoid unnecessary appendicectomy thereby reduc- ing the morbidity in patients and minimizing the financial burden on patients and society. CECT of the abdomen, however, is recommended in all cases of suspected acute appendicitis, especially in women, to exclude alternative diagnoses. Computed Tomography scan is promising, and should be recommended to reduce negative appendicectomy rates and the morbidity associated with it.

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