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ORIGINAL ARTICLE

Diagnostic Accuracy of Fact in Clinically Suspected Cases of Acute Appendicitis in Adolescents and Adults, Taking Surgical Findings as Gold Standard

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ABSTRACT

Objective: to evaluate the diagnostic accuracy of FACT in clinically suspected cases of Acute Appendicitis in adolescents and adults, taking surgical findings as gold standard.

Methods: A total of 335 patients referred from emergency department with clinical suspicion of acute appendicitis were enrolled at Radiology Department, Services Hospital Lahore, from April, 2016 to October, 2016. FACT was performed using multi-slice CT. The cases underwent surgery and the results were recorded. The results of Focused Abdominal Computed Tomography and surgery were compared taking surgical findings as gold standard.

Results: The mean age of patients in our study was 23.01 ± 5.479. We found 278 true-positives, 50 true-negatives, 04 false-negatives results, with sensitivity of 98.6%, a specificity of 94.3%, a PPV of 98.9%, a NPV of 92.6%, and an accuracy of 98%. An alternate diagnosis was made by FACT in 40 patients (11.9%).

Conclusion: FACT (focused non-enhanced abdominal computed tomography) is a highly accurate imaging modality for diagnosis of acute appendicitis in adolescents and adults.

Keywords: Focused Abdominal CT, Acute Appendicitis, FACT, Diagnostic Acuuracy

INTRODUCTION

Appendicitis is the inflammation of vermiform appendix primarily resulting from closed loop obstruction of the appendix. Appendicitis continues to be the leading cause of acute (non-traumatic) abdomen, making it a common surgical emergency that, if left untreated, can quickly become life threatening. Appendicitis occurs in 9.0% of the population at least once in their lifetimes[1]. The highest frequency is seen in 10 – 19 year age group with rates remaining higher in males[2].

Around 70% of acute appendicitis patients present with a typical history of right lower quadrant pain with tenderness on palpation, making clinical diagnosis relatively straightforward. The presence of atypical disease patterns, such as those seen in patients of extreme age, women of childbearing age, and those in whom the appendix is located in an unusual place, presents a diagnostic challenge[3]. The diagnosis of appendicitis may be missed or delayed due to these unusual presentations resulting in treatment delay and prolonged hospital admissions for observation[4].

One of the most common sequelae of appendicitis is perforation, which can cause peri-appendiceal abscess or widespread peritonitis. Very young patients and the elderly are at the highest risk for perforation. Some studies have found perforation rates as high as 20%, highlighting the importance of rapid diagnosis and surgical intervention[5].

Over the past decade, CT has become the gold standard for evaluating people suspected of having appendicitis. It's a great imaging technique for making a definitive diagnosis of appendicitis, ruling it out when it's unlikely, and pointing to other potential causes of patients' symptoms when it isn't[6].

FACT for acute appendicitis involves imaging of a limited area of abdomen (from L2 vertebral body to symphysis pubis), creating thin cuts without the use of contrast, thus making it relatively cheaper, independent of special operator, free of contrast hazards and well tolerated even by very sick patients, with lower exposure to radiation (reducing the overall radiation exposure by upto 23 %)[7], and minimal time needed for investigation.

A 2015 study by Liu et al. reported FACT as having 98% sensitivity, 96% specificity and 98% accuracy in acute appendicitis[8]. A Meta-analysis of seven prospective studies comprising 845 patients published in 2015 reported the sensitivity, specificity and accuracy of FACT in detecting acute appendicitis as 90%, 94% and 93% respectively[9].

A 2014 local study comprising of 90 patients, examining FACT in the diagnosis of acute appendicitis, yielded a sensitivity of 97%, specificity of 83% and diagnostic accuracy of 96%[10]. A similar local study published in 2006, including 63 patients, reported a sensitivity of 91% and specificity of 100%. This discrepancy in the available local data regarding sensitivity and specificity of FACT warrants further research.

My study aims to determine the role of FACT in clinically suspected cases of acute appendicitis, as it has optimal study yield due to thin cuts, is quick, relatively safe (being a non-contrast study with reduced radiation exposure), and cost-effective (since it prevents delayed or inaccurate diagnoses and lengthy hospital stays). My effort will give local data on this imaging modality, correcting the gap between local studies and helping future researchers.

MATERIAL AND METHODS

A total 335 patients fulfilling the inclusion criteria, referred by clinician from emergency department of Services Hospital Lahore were included in the study. Cases that present with symptoms of pain in right lower abdominal quadrant, nausea/vomiting, anorexia and low grade fever (upto 101^0F) lasting ≥2 hours and ≤5 days, along with examination findings of tenderness in right lower abdominal quadrant, guarding and rebound tenderness, with laboratory findings of raised TLC (more than 11,000), were labeled as suspected patients of acute appendicitis.

All patients of either gender of age 14 to 40 years meeting the operational definition of the suspected case of acute appendicitis were enrolled after written informed consent. While all the patients with history of abdomino-pelvic surgery in the past or having pregnancy were filtered.

Criteria for diagnosis of acute appendicitis was presence of one or more of the following findings on FACT was taken as positive acute appendicitis: Appendiceal diameter ≥ 6mm; Appendiceal wall thickening ≥ 2mm; Peri-appendiceal fat

stranding; Absence of intraluminal air; Presence of Appendicolith. Surgical findings were defined in terms of the Disease Severity Score (DSS)[11]- and determined, in each case, from the surgeon's operative notes. Presence of any of the following grades was taken as positive acute appendicitis. Grade I: Inflamed appendix Grade II: Gangrenous appendix; Grade III: Perforated appendix with localized free fluid. Grade IV: Perforated appendix with a regional abscess; Grade V: Perforated appendix with diffuse peritonitis.

Demographic data like age and sex were recorded. All patients were subjected to Focused Abdominal CT scan using Toshiba Multislice CT, volume zoom. 3-5 mm axial images were obtained at a pitch of 1.5, from L2 vertebra till the pubis, without any IV contrast. CT findings reported by a consultant radiologist suggestive of the diagnosis of acute appendicitis were recorded. Surgical findings of all the patients undergoing subsequent surgery were also recorded and taken as the reference standard for comparison with FACT findings. Mean with standard deviation was calculated for quantitative variable like age, while frequency and percentage were calculated in the case of categorical variable like gender. A 2x2 table was used to calculate sensitivity, specificity, PPV and NPV of FACT. The main outcome variable that is Diagnostic accuracy of FACT was described as frequency and percentage.

RESULTS

The mean age in the sampled population was 23.01 years (range = 14 – 40, SD = 5.479). 191 (57 %) patients were males and 144 (43 %) were females.

Out of the 335 patients, 282 patients (84.2%) had acute appendicitis on FACT, while 53 patients (15.8%) had no acute appendicitis on FACT. Surgical findings revealed acute appendicitis in 281 patients (83.9%), and no acute appendicitis was found in 54 patients (16.1%).

Table 1: Distribution of subjects by Alternative Diagnosis on FACT

Diagnosis	Number	Percentage
Pelvic inflammatory disease	07	2.08 %
Ectopic pregnancy	07	2.08 %
Ovarian cyst	06	1.79 %
Urinary tract calculus with infection	06	1.79 %
Small Bowel Obstruction	05	1.49 %
Colonic Diverticulitis	04	1.19 %
Perforated Duodenal Ulcer	02	0.59 %
Cecal neoplasm	02	0.59 %
Primary Peritonitis	01	0.29 %
TOTAL	32	11.9 %

Table 2: Cross tabulation between FACT and Surgical findings (Sensitivity, Specificity, PPV, NPV)

		Appendicitis on Surgery		
		No	Yes	Total
Appendicitis on FACT	No	50 (NPV) 92.6% (Spec) 94.3%	04 7.0% 1.3%	54 100% 15.8%
	Yes	03 0.9% 4.8%	278 (PPV) 98.9% (Sens) 98.6%	281 100% 84.2%

Using chi square test, p value= 0.0005 (significant)

Table 3: Diagnostic Accuracy of FACT for clinically suspected cases of Acute Appendicitis

Diagnostic Accuracy	278 + 50 278 + 50 + 3 + 4	X	100	98%

Among the 53 patients with no appendicitis on FACT, an alternative pathology was found in 40 patients (11.9%). All of these alternate diagnoses proved to be correct on subsequent surgery. These included 07 patients (2.08%) with pelvic inflammatory disease, 07 patients (2.08%) having ectopic pregnancy, 06 (1.79%) patients with ovarian cysts, 06 patients (1.79%) with urinary tract calculus with infection, 05 (1.49%) patients of small bowel obstruction, 04 (1.19%) patients with colonic diverticulitis, 02 patients (0.59%) having perforated duodenal ulcer, 02 patients (0.59%) of cecal neoplasm and 01 patient (0.29%) diagnosed as primary peritonitis on FACT. On cross tabulating FACT findings with surgical outcome, we found that 278 patients were true positive; 50 patients were true negative; 03 patients were false positive and 04 patient were false negative. The sensitivity of FACT was 98.6%, specificity 94.3%, diagnostic accuracy 98%, 98.9% and NPV 92.6%

DISCUSSION

Acute appendicitis is considered one of the most common surgical emergency worldwide[12,13,14]. Traditionally, a clinical diagnosis has been made, but its appearance can be so unusual that even a seasoned surgeon could mistakenly remove a healthy appendix or sit on a perforated one. Therefore, in recent years, various diagnostic modalities have been incorporated in diagnosing acute appendicitis, to achieve low negative appendectomy rates without increase in the risk of perforation.[5,15] Computed tomography is invaluable as an imaging tool in the diagnostic evaluation of acute appendicitis, being the most accurate imaging modality for this purpose[16,17]. In the examination of adults with suspected appendicitis, Focused abdominal computed tomography (FACT) has emerged as the most effective among the several CT modalities used.

In this particular study, we evaluated the diagnosis accuracy of FACT in clinically suspected cases in both adolescents and adults, with the findings of surgery as the gold standard. Our study showed that out of 335 patients, 191 (57 %) were males and 144 (43%) were females. This is in accordance with international literature available favoring slight male predilection for this disease[18,19]. We found that FACT has a high sensitivity of 98.6%, specificity of 94.3% and an accuracy of 98%. Other studies have also shown similar results, further supporting our findings.

K. H. in't Hof and colleagues[20], in a similar prospective study, assessed 103 adult patients and concluded that FACT allows for an accurate diagnosis of acute appendicitis while avoiding the drawbacks of contrast enhancement. Their study showed sensitivity of FACT as 95.4% and specificity of 100%. Similarly, Lane et al[21], evaluated 109 adult patients, and found sensitivity 90%, specificity 97% and diagnostic accuracy 94%. Another prospective study by Michael J. Lane and colleagues, showed that FACT is a highly accurate for excluding acute appendicitis, yielding sensitivity 96%, specificity 99%, and accuracy 97%[22]. Similarly, Meta-analysis of seven prospective studies comprising 845 cases published in 2015, proved FACT to be superior in detecting acute appendicitis (90%, 94% and 93% respectively).[9]

In our study, the PPV of FACT was 98.9% and NPV was 92.6 %. These results are also supported by other studies which proved positive predictive values of FACT ranging from of 92%–98%, and negative predictive values of 83%–100%[23,24,25]. We found that FACT established an alternative diagnosis in 40 out of total 335 patients (11.9%) with no signs of acute appendicitis on CT. During surgery, no new pathological abnormality was found, and all of the alternative diagnoses were shown to be correct. The most common of these were pelvic inflammatory illness, ectopic pregnancy, ovarian cysts, ureteric calculi with infection, small bowel blockage, and colonic diverticulitis.

One local study published in 2006 by Kashif Ashraf and colleagues[26], determining the accuracy of FACT in clinically equivocal acute appendicitis, with sample size of 63, reported sensitivity of 91% and specificity of 100%. Our study results show similarity to this study.

Another local study by Besham Kumar Shahini and colleagues,[10] showed 97.61% sensitivity, 83.3% specificity and 96.6% accuracy. We found similar and better results in our study.

We feel the need for further local studies with larger sample sizes to increase the experience with this technique, and to develop a standard protocol for FACT, which can be employed for the assessment of adults with acute appendicitis in emergency

setting, for FACT has got a definite role in the treatment of acute appendicitis as depicted by the excellent results achieved by this study

CONCLUSION

It is concluded that FACT has a high accuracy (98%) in the diagnosis of acute appendicitis in adolescents and adults. This rapid, non-operator dependent, relatively safe and convenient imaging modality is valuable for deciding treatment approach to be adopted as early as possible thereby decreasing patient's morbidity. It also accurately differentiates other co-morbid conditions from acute appendicitis, thus reducing the number of unnecessary surgeries.

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