

Evaluation of Noncontract computed tomography in diagnosing acute appendicitis

Chavan A¹, Jamdade PT²

¹Dr Aashish R. Chavan, Assistant Professor, Department of Surgery, ²Dr P.T. Jamdade, Professor and Head, Department of Surgery, Both authors are affiliated with Dr Shankarrao Chavan Government Medical College Nanded, Maharashtra, India.

Address for Correspondence: Dr Aashish R. Chavan, Email: aashish.chavan85@gmail.com

Abstract

Introduction: Appendicitis is a common disease, having a lifetime incidence of 7%. Surgeons have traditionally accepted negative appendectomy rate up to 20%. It is because of clinical myriad. Objectives of study were to determine the role of Noncontract Computed Tomography (NCCT) imaging in the detection of suspicious case of appendicitis. To estimate negative appendectomy rate (NAR) in preoperative evaluation of computed tomography (CT). Evaluate significance of Clinical, radiological and intraoperative parameters for diagnosing appendicitis. **Material and Method:** This is evaluation of diagnostic test of 450 patients coming to Emergency Department with suspicion of acute Appendicitis have undergone NCCT. The study will be carried out in the Department of surgery Dr Shankarrao Chavan Government Medical College Nanded over a period of 24 months. **Result:** An appendectomy was performed in 367 patients. All 367 patients underwent surgery their clinical and radiological correlation and intra-operative finding noted and surgical specimen sent for histopathological correlation. Clinically right iliac fossa pain, vomiting, temperature, RIF Tenderness, were found to be more consistent with acute appendicitis with significant p values. On establishing role of NCCT abdominal scan in diagnosing acute appendicitis significant parameters are Enlarged Appendix, Periappendicial fat stranding, Focal cecal apical thickening, Intra luminal Air these parameter are significant with p values. Omentum in right iliac fossa, Inflamed appendix, Periappendicular free fluid/pus is more consistent intra-operatively during appendectomy with significant p values 0.028, 0.045, 0.026 respectively. Negative appendectomy rate in our study is 3.81%. **Conclusion:** There was a significant reduction in the Negative Appendectomy Rate in patients undergoing NCCT for diagnosis. Uses of specific clinical radiological and intra-operative parameters become significant in diagnosing appendicitis. NAR might have medico legal importance to debate for difficult in diagnosing appendicitis preoperatively.

Keyword: Negative appendectomy rate, Noncontract computed tomography, Appendicitis

Introduction

Appendicitis is a common disease, having a lifetime incidence of 7% [1]. In patients presenting to the emergency department, acute appendicitis is one of the most common causes of acute lower abdominal and right lower quadrant pain. Appendectomy is one of the most common surgical procedures.

However, the preoperative clinical diagnosis of acute appendicitis remains challenging even for experienced surgeons. In 20-30% of the cases myriad gastrointestinal, genitourinary, and gynaecologic conditions can have similar presentations [2,3,4]. Despite the high prevalence of appendicitis, the diagnosis is still problematic and

perforation can occur within 24 hours of the onset of symptoms [5]. To avoid additional morbidity from getting missed or diagnosis of acute appendicitis getting delayed, surgeons have traditionally accepted that up to 20% of patients undergoing appendectomy for suspected acute appendicitis will have a normal appendix. This has come to be accepted as negative appendectomy rate [2].

A significant number of patients without acute appendicitis who have equivocal clinical presentations could be spared the expense and morbidity of surgery by improved diagnosis with judicious use of preoperative imaging. Conversely, patients with atypical presentations of acute appendicitis could be spared the morbidity and burden on health care resources associated with missed or

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late diagnosis and consequent delay in appropriate treatment besides the risk of complications [5].

Non contrast Computerized Tomography (NCCT) is viable option available in the emergency diagnosis of acute appendicitis which is attractive for several reasons.

Administration of oral contrast consumes valuable time in today's fast-paced and overcrowded Emergency Department. The contrast may taste unpleasant, and may get aspirated in patients who are actively vomiting. Moreover the administration of oral contrast can also be a concern of delaying the scheduling of surgery. On the other hand, intravenous contrast carries the risk of contrast induced nephropathy and allergic reactions.

Aim and Objectives

To determine the role of Noncontract Computed Tomography (NCCT) imaging in the detection of suspicious case of appendicitis. To estimate negative appendectomy rate (NAR) in preoperative evaluation of computed tomography. Evaluate significance of Clinical, radiological and intra-operative parameters for diagnosing appendicitis.

Material and Methods

Study design: evaluation of diagnostic test.

Study setting: Department of surgery, Dr Shankarrao Chavan Government Medical College, Nanded.

Inclusion criteria: All Patients presenting in emergency department, outdoor/indoor department or referred from other department with right side abdominal pain with a clinical, radiological diagnosis of acute Appendicitis.

Exclusion criteria: Women who are pregnant or preparing for pregnancy, patients with appendicular lump, NCCT interpreted as showing normal findings & Patients who failed to return for a follow-up visit.

Participants: Patients for this study was selected from the patients who undergone appendectomy for suspicious case of acute appendicitis at Department of surgery, Dr Shankarrao Chavan Government Medical College, Nanded.

Variables

Clinical finding- Right iliac fossa pain, vomiting, temperature, RIF Tenderness,

Radiological - Enlarged Appendix, Periappendiceal fat stranding, Focal cecal apical thickening, Intra luminal Air

Intra-operative- Omentum in right iliac fossa, inflamed appendix, Periappendicular free fluid / pus,

Data Source: Predesigned Proforma.

Time frame to address the study: From June 2014-May 2016

Sample size: The sample size was calculated by using 94% sensitivity and 95% specificity of NCCT for diagnosing appendicitis[14], the outcome of sample size calculation was 310 for sensitivity and 20 for specificity by using 7% prevalence of appendicitis[1], 10% absolute precision and 95% confidence level. The higher value i.e.310 was selected as sample size for study. The 10% non-response was added in the sample size so it became 343. But we had decided to enroll maximum number of patients in our study in two year duration of study. The 450 patients have undergone NCCT abdomen for the evaluation of acute abdomen in Emergency Department with suspicion of acute Appendicitis. After the follow up of two weeks, 367 patients have undergone appendectomy on the basis of clinical and radiological diagnosis and 83 patients were loss to follow up or NCCT is not suggestive of appendicitis.

Methodology

Before starting the study, an Ethical Clearance certificate was taken from the Ethical Committee of our Medical College. The informed consent was obtained from every patient after explaining the purpose of study.

Patients for this study was selected from the patients who undergone appendectomy, there Clinical parameters, NCCT findings and intraoperative finding are noted and evaluated its significance in diagnosing appendicitis. After removal, the surgical specimen was sent for histopathological examination and final diagnosis.

We determined the NAR by reviewing pathology records to determine whether removed appendices were acutely inflamed. All acutely inflamed appendices were categorized as positive, whereas all other findings were categorized as negative. Negative appendectomy rate (NAR)— defined as the portion of pathologically normal appendices removed surgically in patients suspected of having acute appendicitis

Statistical Methods- Descriptive statistical analysis was performed to calculate the means with corresponding standard deviations (S.D.). The chi-square (X^2) test was used to compare the difference between proportions. The p value <0.05 was taken to be statistically significant. The sensitivity, specificity and predictive value of the NCCT were calculated.

Results

All 367 (81.4%) patients who underwent surgery after surgical consent suspecting acute appendicitis on the basis of clinical and radiological correlation and intraoperative finding noted and surgical specimen sent for histopathological correlation. Our study population consisted of 243 men (66%) and 124 women (34%) (Table 2), who ranged in age from 11 to 50 years; the average age was 28 years (Table 1).

Table-1: Percentage of demographic profile

Age Groups	Number of Patients	%	Sex	Number of Patients	%
11 – 20	88	24%	Male	243	66%
21 – 30	117	32%	Female	124	34%
31 – 40	110	30%	Total	367	100%
41 – 50	52	14%			
Total	367	100%			
Mean ± SD	28.60 ± 9.17				

Clinically right iliac fossa pain, vomiting, temperature, RIF Tenderness (table 2), were found to be more consistent with acute appendicitis with significant p values 0.007,0.017,0.038,0.045 respectively. Similarly Total leukocyte count (table 4) was significant (p value 0.046) criteria in diagnosing appendicitis.

Table-2: Relation of RIF pain, vomiting, temperature, RIF Tenderness with Acute Appendicitis

		Histopathology Result		X ² /P value	Sensitivity	Specificity	PPV	NPV	Accuracy
		Positive cases	Negative Cases						
Right Iliac fossa pain	Yes	308 (91.3%)	7 (25%)	98.546 1/0.007	91.3%	75.0%	97.7%	42.9%	90.0%
	No	30 (8.7%)	22 (75%)						
	Total	338 (100%)	29 (100%)						
Vomiting	Yes	228 (67.4%)	0 (0%)		67.4%	100.0%	100.0%	21.1%	70.0%
	No	110 (32.6%)	29 (100%)						
	Total	338 (100%)	29 (100%)						
Temperature	Yes	271 (80.4%)	8 (25%)	43.66/ 0.038	80.4%	75.0%	97.4%	25.0%	80.0%
	No	66 (19.6%)	22 (75%)						
	Total	337 (100%)	30 (100%)						
RIF Tenderness	Yes	315 (93.5%)	14 (48.27)	58.059/ .045	93.5%	50.0%	95.6%	40.0%	90.0%
	No	23 (6.5%)	15 (51.72%)						
	Total	338 (100%)	29 (100%)						

Table-3: Relation of haematological parameters with Acute Appendicitis

	Positive cases		Negative Cases		p value
	Mean ± SD	Min-Max	Mean ± SD	Min-Max	
TLC	9448 ± 2843	4568 – 18354	12600 ± 4173	7730 - 17900	0.046

On establishing role of NCCT abdominal scan in diagnosing acute appendicitis parameters considered are (table 4) Enlarged appendix, Appendiceal thickening, Periappendiceal fat stranding, Focal cecal apical thickening, Appendicolith, Intraluminal air, Extraluminal air it is found that (table 4) these are significant in diagnosing acute appendicitis with p values 0.045,0.016,0.0320,0.029 respectively(table 4).

Table-4: Relation of NCCT abdomen parameters with Acute Appendicitis

Enlarged Appendix		Total	Histopathology Result				X ² / P value 60.2331/0.045	Sensitivity	93.5%
			Positive cases	%	Negative Cases	%		Specificity	50.0%
	Yes	330	316	93.5%	14	48.27%	PPV	95.6%	
	No	37	22	6.5%	15	51.72%	NPV	40.0%	
	Total	367	338	100%	29	100%	Accuracy	90.0%	
Periappendiceal fat stranding		Total	Histopathology Result				X ² / P value 71.51/0.016	Sensitivity	87.0%
			Positive cases	%	Negative Cases	%		Specificity	75.0%
	Yes	301	294	87.0%	7	24.13%	PPV	97.6%	
	No	66	44	13.0%	22	75.86%	NPV	33.3%	
	Total	367	338	100%	29	100%	Accuracy	86.0%	
Focal cecal apical thickening		Total	Histopathology Result					Sensitivity	60.9%
			Positive cases	%	Negative Cases	%		Specificity	100.0%
	Yes	206	206	60.9%	0	0%	PPV	100.0%	
	No	161	132	39.1%	4-29	100%	NPV	18.2%	
	Total	367	338	100%	4-29	100%	Accuracy	64.0%	
Intraluminal Air		Total	Histopathology Result				X ² / P value 52.97/0.029	Sensitivity	82.6%
			Positive cases	%	Negative Cases	%		Specificity	75.0%
	Yes	286	279	82.6%	7	24.13%	PPV	97.4%	
	No	81	59	17.4%	22	75.86%	NPV	27.3%	
	Total	367	338	100%	29	100%	Accuracy	82.0%	

Omentum in right iliac fossa, Inflamed appendix, Periappendiceal free fluid / pus are more consistent intra-operatively during appendectomy with significant p values 0.028,0.045,0.026 respectively (Table 5)

Table- 5: Relation of Intra-operative finding with Acute Appendicitis.

		Histopathology Result		P value	Sensitivity	Specificity	PPV	NPV	Accuracy
		Positive cases	Negative Cases						
Omentum in RIF	Yes	323 (95.7%)	15(50%)	0.028	95.7%	50%	95.6%	50%	92%
	No	5(4.3%)	15(50%)						
Inflamed Appendix	Yes	316 (93.5%)	14 (48.27%)	0.045	93.5%	50%	95.5%	40%	90%
	No	22(6.5%)	15(51.72%)						
Periappendiceal Free Fluid	Yes	213(63%)	0 (0%)	0.026	63.0%	100%	100.0%	19%	66%
	No	125(37%)	29 (100%)						

HPE reports of 14 appendectomy specimen showed normal appendix. Negative appendectomy rate in our study is 3.81%.

Discussion

Six studies in this systematic review included radiologists as investigators and all support the use of noncontrast CT scans for the diagnosis of appendicitis [6-11]. Ashraf et al [7] state that a “certain level of experience is required for skilful interpretation” of noncontrast CT and have established an imaging protocol at their institution that includes noncontrast CT for evaluating the appendix.

Lane et al [12] mention that as a result of their study on noncontrast CT for suspected appendicitis; their institution now considers noncontrast CT as an alternative to ultrasonography for diagnosing appendicitis. Therefore, it appears that there is already some degree of acceptance for using noncontrast CT scans among radiologists for the diagnosis of appendicitis.

Two recently published meta-analyses comparing CT and ultrasonography in the diagnosis of appendicitis reported similar results to ours, with respect to the ability of CT to rule out appendicitis. The negative likelihood ratio of 0.08 according to our SROC analysis was consistent with that reported by van Randen et al [13]. Terasawa et al [14] reported summary estimates of 94% (95% CI 91 to 95%) for sensitivity, 95% (95% CI 93 to 96%) for specificity, and 0.09 for the negative likelihood ratio.

Terasawa et al [14] observed that the test characteristics among the individual studies were similar despite variation in the use of contrast and CT technology but methodological limitations may have inflated estimates of diagnostic accuracy. Our systematic review is unique in that it specifically focuses on the diagnostic accuracy of noncontrast CT in adult patients suspected of having acute appendicitis.

Reviews by Terasawa et al [14], Weston et al [15], and van Randen et al [16] compare the use of CT to ultrasonography in diagnosis of acute appendicitis but include only 2 to 3 studies that assess the accuracy of noncontrast CT and also include paediatric populations.

As with any diagnostic test that does not have perfect sensitivity or specificity, CT cannot exclude appendicitis with 100% certainty and must be interpreted within the clinical context. Depending on the individual patient's condition and circumstances, clinical judgment must be used when deciding to perform contrast-enhanced or unenhanced CT for suspected appendicitis. The ultimate goal of CT imaging in patients presenting with abdominal pain suspicious for appendicitis is to make a prompt diagnosis and decrease the rate of appendectomies performed on patients without appendicitis. Although

some authors have reported a decrease in the rate of appendectomies performed on patients without appendicitis with the use of helical CT [17], others argue that there has been little change in the rate of surgical intervention or rate of perforation [18].

There was a significant reduction in the NAR in a patients undergoing NCCT for diagnosis. Use of specific clinical radiological and intraoperative parameters becomes significant in diagnosing appendicitis. NAR might have medico legal importance to debate for difficulty in diagnosing appendicitis preoperatively.

Conclusions

We found the diagnostic accuracy of noncontrast CT for the diagnosis of acute appendicitis in the adult population to be adequate for clinical decision making in the ED setting.

Potential advantages of noncontrast scanning in today's overcrowded ED include rapid diagnosis, early disposition, cost savings, and higher patient satisfaction, as well as the elimination of contrast-related adverse affects.

Recommendations- On the basis of the finding of this study the following recommendations may be considered for inclusion in the protocol for management of acute appendicitis.

1. In suspected case of acute appendicitis NCCT abdomen should be done as the patient presents in the emergency room.
2. If NCCT abdomen findings do not categorically support the clinical suspicion of acute appendicitis then the patient should be managed conservatively and followed up diligently.
3. CECT abdomen should be considered as a next line of investigation if the earlier clinical or radiological findings are at variance in a patient with myriad presentations.
4. A comprehensive Scoring system for diagnosing acute appendicitis should be develop based model of study extended to involve a larger cohort.
5. The reliance on ultrasound scanning as an investigative tool for diagnosing acute appendicitis should be placed only in conjunction with NCCT findings.

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