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Role of CT in diagnosing appendicitis in ultrasound negative patients

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Abstract

Aim

- To evaluate the accuracy of CT in identifying appendicitis in ultrasound negative cases.
- To assess the efficacy of CT in identifying complications of appendicitis.
- To identify the alternate diagnosis of right lower quadrant pain which mimic appendicitis.
- To determine the average CT thickness of normal appendix in Indian population by measuring the appendix diameter in CT abdomen for other cases.

Methodology: Patients who were admitted within the casualty surgical emergency ward inside the cohort of age 12-55 bestowed with clinical findings and symptoms of acute inflammation like right iliac fossa pain, fever and vomiting were listed within the study. A complete study sample of two hundred was chosen. The clinical history concerning present history was taken within the prescribed proforma.

Informed consent was obtained from every taking part patient and also the protocol was approved by the institutional ethical committee. 64 Patients with negative ultrasound findings or with equivocal findings were proceed with CT examination and results were obtained.

Results: The study after statistical analysis brings to the conclusion of: Out of 200 patients in the study population with right lower quadrant pain and negative ultrasound findings, 77 patients were found to have appendicitis based on CT findings. Based on this study, the patients with CT finding of an appendicular diameter of >6mm (7-8mm in particular) were found to have Appendicitis, which was found in accordance with other corroborative findings, intra operative findings and histopathological correlation.

This brings us to the conclusion of CT having a more accurate role in the diagnosis of Appendicitis in patients with negative ultrasound findings with a significant sensitivity, specificity, positive and negative predictive value.

Conclusion

- The results of the study among patients with right lower quadrant pain, vomiting, fever and low backache and with equivocal /negative ultrasound findings, CT plays the next imaging modality of choice.
- 77 cases were found to have appendicitis in CT among the study population of 200. Among which 50 patients i.e. 25 % of cases have appendix diameter of 7-8mm with periappendiceal fat stranding and appendiceal wall enhancement and diagnosed as appendicitis.
- Due to retrocaecal position of appendix obscured by gas shadows and obesity lead to non-visualization of appendix, thus giving USG negative picture for diagnosing appendicitis.
- CT is the best modality of choice for diagnosing appendicitis with 7-8mm diameter of appendix along with periappendiceal fat stranding and wall enhancement. 7-8 mm diameter of appendix associated with adjacent CT
- changes was one of the findings of a major group of patients diagnosed as appendicitis in this study who had negative ultrasound findings.

Keywords: Ultrasound, Computed tomography, appendix, sensitivity

Introduction

Appendicitis is the most common cause of abdomen pain in patients admitted at the emergency department. It may be associated with vomiting, fever and diarrhoea but the most distressing symptom is the pain. The various cause of the abdomen pain may vary from benign to life threatening disease.

Diagnosing the appendicitis in young male patient is made out easily, but at the same time, it becomes a problem in premenopausal women who presents with similar clinical history and symptoms.

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Few gynaecological symptoms in middle aged women can also present with symptoms mimicking appendicitis, so it becomes a real challenging for treating clinician to exclude the diagnosis.

The timely diagnosis and intervention of acute appendicitis is important due to its grave complication like perforation CT plays a major role in diagnosing appendicitis in ultrasound negative and equivocal cases to reduce the perforation rate and negative appendectomy rate.

Even if there is no proper clinical findings and appropriate diagnosis of appendicitis, few surgeons are in favour of early laparotomy, to minimize the risk of appendiceal perforation.

Methodology

Study design

Hospital based observational study.

Study population

Patients with right lower quadrant pain & negative USG findings.

Sample size: 200

Study duration: March 2022 – June 2023; 15 months.

Methodology

- Observational study to be carried out in the Department of Radiology in collaboration with the Department of Surgery in S.P. Medical College Hospital.
- Those patients suspected to have appendicitis who show negative findings in ultrasound are subjected to non-enhanced and contrast enhanced CT.

Inclusion criteria

All patients suspected to have appendicitis and show negative findings in ultrasound.

Exclusion criteria

- Patients who show typical findings of appendicitis in ultrasound.
- Patients who are medically unfit to undergo contrast study like renal failure patients.
- Patients with hypersensitivity reactions.
- Pregnant patients.

Patients who were admitted within the casualty surgical emergency ward inside the cohort of age 12-55 bestowed with clinical findings and symptoms of acute inflammation like right iliac fossa pain, fever and vomiting were listed within the study. A complete study sample of two hundred was chosen.

The clinical history concerning present history was taken within the prescribed proforma. Informed consent was obtained from every taking part patient and also the protocol was approved by the institutional ethical committee.

USG protocol

A routine USG was done in SONOSCAPE machine for the abdomen and pelvis employing a 3-5-MHz convex transducer to rule out various abnormalities associated with solid organs and to rule out free fluid. Then ranked compression and color Doppler ultrasound of the right lower quadrant giving attention to the location of maximal tenderness was performed employing a linear transducer.

The normal appendix was envisioned as a blind ended loop with no vermication. The graded compression technique is employed to displace the intestine loops, permitting differentiation between incompressible inflamed appendix and compressible normal intestine loops. The presence of appendicitis is diagnosed as a tubular blind-ended structure seen anterior to the iliac vessel and it is non compressible with diameter greater

than 6mm. Increased peripheral vascularity seen in the wall of the appendix on doppler study due to the mural inflammation.

Periappendicular fat stranding, appendicolith and peritoneal fluid and someother additional findings were also identified. On average of total time of 15-20 min was taken for a single study. The USG findings was reported as positive or negative for acute appendicitis. Other findings or diagnosis when achieved, was also reported.

CT Protocol

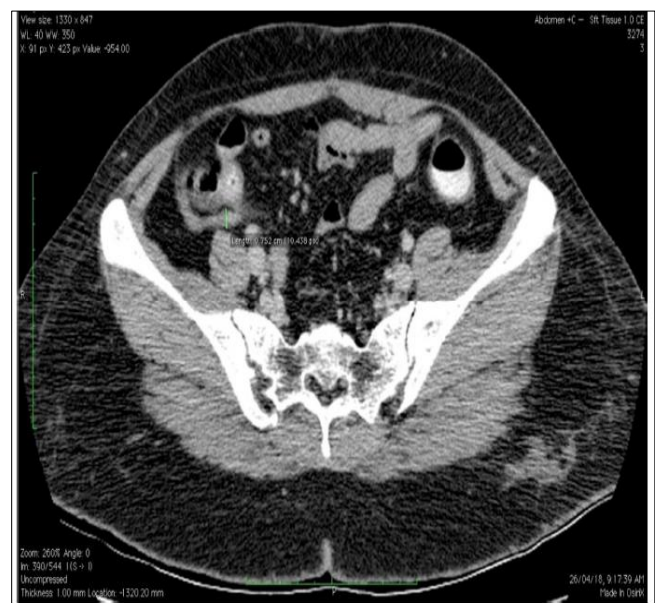
Examinations were performed on a 16 – slice MDCT using (TOSHIBA) at 120 kVp and 100 mAs. CT abdomen and pelvis were taken from xiphoid process to the pubic symphysis, with 80 mL of non-ionic contrast material Iohexol 350 (Omnipaque 350). The contrast material was injected in the volar aspect elbow in the cubital vein through a 18- gauge cannula at a flow rate of 4 ml/s and delay of 50 sec. Axial reconstructions from the raw data were done at 3 mm thickness. No oral contrast was used.

In reporting format normal appendix when visualised was reported. The CT report was positive, negative, or inconclusive. The criteria for appendicitis is similar to that of USG. Alternative diagnoses or otherfindings if any when achieved were reported.

Case

54 year old male with H/O abdominal pain for 4 days with H/O fever, total counts were 14,000 cells/cumm.

USG - shows right lower quadrant probe tenderness with other findings CT showed an appendix of 7 -8mm(7.52mm) with periappendiceal fat stranding and is retrocaecal in position.



Discussion

- Acute appendicitis is one of the most common causes of right inferior quadrant abdominal pain. About 200 patients with right lower quadrant pain and negative ultrasound findings were subjected to plain CT and contrast enhanced CT. The efficacy and accuracy of CT in identifying appendicitis and its complications were assessed in these patients.
- Of the total 200 patients, majority belonged to the age group of 20-24 years (45.5%). The second most common age group affected was more than 25 years (31.5%).
- Appendicitis was found to affect males more than females. About 133 patients were males in our study with a significant P value of 0.001.
- There was no significant relation between age and sex.
- The patients presented to the outpatient/casualty department with abdominal pain, fever, vomiting, painful micturition and backache. A few also had altered bowel habits.
- Though the USG findings did not show inflamed appendix, 53 patients were found to have mesenteric lymphadenitis and 34 patients had free fluid.
- Retrocaecal position of appendix was the commonest position found on CT (77.5%). This could explain the difficulty in detection in USG due to overlying bowel gas shadow.
- The diameter of appendix (measured from outer to outer wall) was assessed in all patients. A diameter of more than 8mm was found in 18 patient and a diameter of 7-8mm was found in about 50 patients.
- Nuno pinto Leite *et al.* on September, 2004 proposed that: Appendix diameter < 6mm or > 6mm diameter with gas filled appendix or 6 – 10 mm appendix without any other CT signs mentioned as “possible appendicitis”.
- 6 – 10 mm appendix with wall thickening (i.e. >3mm of wall thickness) and wall hyperenhancement with or without fat stranding as “Probable appendicitis”.
- Appendix diameter greater than 10mm or 6 to 10mm with wall thickening and wall hyperenhancement and fat stranding as “Definite appendicitis”.
- In our study also 25 % patients (i.e. 50 patients) diagnosed as appendicitis had an appendix diameter of 7 – 8 mm with periappendiceal fat stranding and wall enhancement in contrast enhanced CT.
- Periappendiceal fat stranding was present in 77 of our patients (approximately 38.5%). On contrast study, wall enhancement was present in these 77 patients.
- Complications like appendicular perforation, abscess were found 6 in study population, who initially had only free fluid in ultrasound, on proceeding to CT were found to have perforated appendix/abscess and were treated surgically.
- In a study done by Martin *et al.* on CT relevance in diagnosing appendicular mass, concluded CT had a pivotal role in diagnosis and management of appendicular mass. CT features used to diagnose inflammatory appendix mass is walled off appendicular perforation, periappendiceal phlegmon and joining of adjacent bowel loops like caecum and terminal ileum and at times other viscera.
- The management ideally advised is Oschner method followed by interval appendectomy 6 to 12 weeks later which is considered as the gold standard method. This method is found to reduce the surgical complications.
- In our study 3 patients with free fluid in right iliac fossa in Ultrasound, when proceeded with CT were found to have an inflammatory appendix mass in the right iliac fossa. The appendix was in the centre of the inflammatory pseudo mass, the diameter of the appendix in these cases were between 6 to 7mm and were managed conservatively.
- Choi *et al.* proposed complication of appendicitis like appendicular perforation/ abscess, peritonitis, bowel obstruction, gangrenous appendicitis is mostly assessed by ultrasound but in few equivocal cases CT helps to come diagnosis.
- Choi *et al.*, also stated that “Visualisation of appendicolith on CT increases the probability of appendiceal perforation. This is due to appendicolith increases the rate of appendicular perforation. Thus, presence of one or few appendicolith with periappendiceal inflammation is virtually diagnostic of perforation.
- Differential diagnosis in patients with RIF pain were mesenteric adenitis, caecal diverticulitis, epiploic appendagitis, omental infarction, crohn’s disease, infectious terminal ileitis, perforated caecal and appendiceal carcinoma, appendiceal mucocele.
- Rendon C nelson *et al.* in August, 2009 proposed that “Though CT has its own risk of radiation exposure, the estimated lifetime attributable risk of death from cancer has been estimated to be between 0.05 % to 0.06 % for a 25-year-old patient undergoing abdominal CT with current sitting of 240m As.”
- But the average mortality for negative appendectomy is 0.14%, for acute appendicitis appendectomy is 0.24%, and appendectomy for perforated appendicitis is 1.66 %. Here we believe that the risk of unnecessary surgery and mortality justifies the use of CT in equivocal cases or case in which diagnosis is uncertain.
- Wagner *et al.* (From 1995- 1999 and 2000-2007) found that CT imaging before appendectomy decreases negative appendectomy rate from 16% to 5% in both adults and children without increase in perforation rate.
- In our study Surgery was done in 49 patients of acute appendicitis among 77 diagnosed cases and also for 6 cases who had appendicular perforation and abscess. A diagnosis of appendicitis was also further confirmed by
- Histopathological Examination of the appendectomy specimens.
- Rest of the 21 cases of appendicitis were managed conservatively of which 3 cases were found to be inflammatory appendix mass.
- 117 cases other than appendicitis cases showed normal appendix. This includes appendix diameter <6mm or 6-7 mm diameter without periappendiceal fat stranding or appendiceal wall thickening or appendiceal wall enhancement or gas filled lumen. Among these 112 cases were appendix diameter < 6mm.
- Here findings other than appendicitis among these 117 cases were detected in CT. The most common mimicker of acute appendicitis was mesenteric lymphadenitis which was found to be in 18% of patients. Therefore, a diagnosis made with use of CT decrease the incidence of unnecessary appendectomy/surgery there by reducing negative appendectomy rate.

- In our study, 112 patients who were diagnosed other than appendicitis like mesenteric lymphadenitis, colitis, iliocecal thickening found to have normal appendix in CT. The average CT thickness of the appendix in this group excluding inflamed appendix was found to be 5.7 mm.

Conclusion

- The results of the study among patients with right lower quadrant pain, vomiting, fever and low backache and with equivocal /negative ultrasound findings, CT plays the next imaging modality of choice.
- 77 cases were found to have appendicitis in CT among the study population of 200. Among which 50 patients i.e. 25 % of cases have appendix diameter of 7-8mm with periappendiceal fat stranding and appendiceal wall enhancement and diagnosed as appendicitis.
- Due to retrocaecal position of appendix obscured by gas shadows and obesity might havelead to non-visualization of appendix, thus giving USG negative picture for diagnosing appendicitis.
- CT is the best modality of choice for diagnosing appendicitis with 7-8mm diameter of appendix along with periappendiceal fat stranding and wall enhancement. 7-8 mm diameter of appendix associated with adjacent
- CT changes was one of the findings of a major group of patients diagnosed as appendicitis in this study who had negative ultrasound findings.
- Other mimics of appendicitis were mesenteric lymphadenitis, right distal ureteric calculus, ileo-caecal thickening, colitis, which were also made in CT images.
- Normal appendix diameter in patients with right lower quadrant pain and diagnosed as conditions other than appendicitis like mesenteric lymphadenitis, iliocecal thickening were 5.7mm in CT.

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