A Study to Assess Diagnostic Accuracy of CT Scan and USG in the Diagnosis of Acute Appendicitis in Tertiary Care Centre

Kamal Nayan Gangey[1], Ujjwal Sourav[2]

[1]Assistant Professor, Department of Radiodiagnosis, Varun Arjun Medical College, Shahjahnpur, UP, India
[2]Assistant Professor, Department of Community Medicine, Saraswathi Institute of Medical Sciences, Hapur, UP, India

Abstract

Introduction: Preoperative imaging is critical in detecting appendicitis and lowering the likelihood of failed appendectomy (NAR). Contrast-enhanced CT is the first-line imaging test for detecting appendicitis in adults, according to the American College of Radiology Appropriateness Criteria. CT is extremely accurate, with sensitivities ranging from 85.7 to 100 percent, specificities from 94.8 to 100 percent, and NARs from 1.7 to 7.7%. Using histopathological findings as the gold standard, sensitivity, specificity, positive predictive value, and negative predictive value for both CT and USG were determined.

Methodology: From June 2021 to April 2022, a prospective observational study was done at Varun Arjun Medical College in Shahjahanpur on patients who were hospitalised to the emergency department with symptoms of acute pain in abdomen and clinical findings strongly suspected of appendicitis. The main criterion was to include individuals who have undergone both CT and USG imaging modalities.

Result: The following is the outcome of our current research on the diagnosis of acute appendicitis. The sensitivity of the USG was 91.21, the specificity was 77.78, the PPV was 87.65, the NPV was 46.67, and the accuracy was 90 percent. The sensitivity of the CT scan was 96.70, the specificity was 88.89 percent, the PPV was 98.88 percent, the NPV was 72.73 percent, and the accuracy was 96 percent.

Conclusion: While CT is the gold standard imaging method for diagnosing AA, there are several advantages to using US, including the fact that it is non-invasive and has a short acquisition time. It is reasonably inexpensive, does not require an iodinized contrast agent or oral preparation, does not expose patients to radiation, and can be conducted on children.

Keywords: USG, CT scan, Appendicitis, pain abdomen.

Introduction

The most prevalent reason for emergency abdominal surgery is acute appendicitis (AA). Early appendicitis can manifest in a variety of ways, making it difficult to identify from a variety of gastrointestinal, genitourinary, and gynaecological problems. A combination of history, physical examination, and laboratory studies, reinforced by selected focused imaging, is utilised to diagnose AA.

Another point of contention is the role of diagnostic imaging, such as ultrasound (US), computed tomography (CT), or magnetic resonance imaging (MRI)[1].

The classic migration of pain as described by Murphy in 1905 is an important predictor in the clinical diagnosis of acute appendicitis; according to medical literature, this alone has a diagnostic accuracy of up to 95%. The presence of McBurney's sign raises the possibility of acute appendicitis. If the presentation is typical, the diagnosis of acute appendicitis can be made based on clinical and laboratory findings alone, with no need for further testing; however, clinical features are nonspecific and unclear in 35-40 percent of cases[2].

According to some studies, clinical and laboratory findings alone are insufficient for diagnosing acute appendix inflammation, and the use of a first-level diagnostic tool is necessary for early diagnosis. Ultrasound and CT imaging are two such tools used to diagnose acute appendicitis[3]. Preoperative imaging is critical in diagnosing appendicitis and lowering the rate of failed appendectomy (NAR). Contrast-enhanced CT is the first-line imaging test for diagnosing appendicitis in adults, according to the American College of Radiology Appropriateness Criteria. CT is extremely accurate, with sensitivities ranging from 85.7 to 100 percent, specificities from 94.8 to 100 percent, and NARs from 1.7 to 7.7%. The main disadvantage of CT is that it exposes patients to ionising radiation, which is especially dangerous in children and pregnant women. CT is also more expensive than US and has a small but quantifiable risk of contrast medium allergy[4].

The American College of Radiology recommends US as the first-line imaging modality in children and pregnant women since it is affordable and does not expose the patient to ionising radiation. However, it is operator dependant and may make visualising the appendix difficult in obstetric patients, obese patients, and retrocecal appendixes. According to previous studies, up to 40% of children with suspected appendicitis received a nondiagnostic screening in the United States, with 15% of this subset having confirmed appendicitis[5].

Mesenteric lymphadenitis is a confusing condition related with AA. When it comes to diagnosing AA, ML can be problematic for emergency department (ER) physicians and surgeons. ML is a painful condition caused by an inflammatory response of the abdominal lymph nodes, most commonly the para-aortic and ileo-cecal nodes. ML is a common occurrence in people with AA and can be caused by a viral (rotavirus or norovirus) or bacterial (Yersinia enterocolitica) gastroenteritis[6].

The use of ultrasound as a diagnostic method has various advantages, including safety (no ionising radiation), low cost, and real-time imaging. Graded compression ultrasonography, on the other hand, has shown varying degrees of accuracy in diagnosing patients with acute appendicitis. The results for sensitivity and specificity range from 44% to 100% and 47 percent to 99 percent, respectively. This variation could be explained by the sonographer's expertise and skill level[7]. The goal of the study was to compare the diagnostic accuracy of ultrasound and CT scan in acute appendicitis cases in a tertiary medical centre in Uttar Pradesh to that of histopathology, which is the current gold standard, and to see if there was a link between the accuracy of ultrasound and CT scan in acute appendicitis.

Aim and objective

1. To assess the sensitivity, specificity, positive predictive value, and negative predictive value for both CT and USG Using histopathological findings as the gold standard.

2. To determine the diagnostic accuracy of both imaging techniques in diagnosing acute appendicitis.

Methodology

From June 2021 to April 2022, a prospective observational study was done at Varun Arjun Medical College in Shahjahanpur on patients who were hospitalised to the emergency department with symptoms of acute abdominal pain and clinical findings strongly suspected of appendicitis. The main criterion was to include individuals who have undergone both CT and USG imaging modalities.

Inclusion criteria

- The patients who had undergone both USG and CT imaging procedures with clinical findings suggestive of acute appendicitis
- Patients with age group 15-45 years

Exclusion criteria

- Patient with an inflammatory focus, such as mesenteric adenitis, discovered on initial USG screening and history
- Non-specific enterocolitis (PID).
- Patients who need immediate surgery and had no time for imaging.

Methodology

The study included patients aged 15 to 45 who were admitted to the causality surgical emergency room with clinical findings and symptoms of acute appendicitis such as right iliac fossa pain, fever, and vomiting. A total of 100 people were chosen for the investigation. In the specified proforma, the clinical history regarding current clinical symptoms was obtained. Each patient who took part in the study gave their informed consent.

USG Protocol

To rule out alternative anomalies connected to solid organs and to rule out free fluid, a routine USG was performed in the SONOSCAPE machine for the upper abdomen and pelvis using a 3-5–MHz convex transducer. A linear transducer was then used to perform graded compression and colour Doppler sonography of the right lower quadrant, focusing on the site of greatest tenderness. The natural appendix was depicted as a closed loop with no peristalsis. The intestine loops are displaced using a graded compression approach, which allows for the distinction between an incompressible inflammatory appendix and compressible normal intestinal loops. A blind-ended tubular formation anterior to the iliac vessel with a diameter higher than 6mm indicated the existence of appendicitis. Due to the mural inflammation, there is an increase in peripheral vascularity in the appendix wall on Doppler. Other discoveries included an appendicolith, peritoneal fluid, periappendicular fat stranding, and others. A total of 10-15 minutes was spent on average. The USG findings for acute appendicitis were classified as positive, negative, or inconclusive. Alternative diagnoses were also noted when they were made.

Protocol For CT

The examinations were done on an MDCT with a 4-slice C scanner (TOSHIBA) at 120 kVp and 100 mAs with a pitch of 1. 80 mL of non-ionic contrast material Iohexol 350 (Omnipaque 350) was injected through an 18-gauge cannula implanted in the volar aspect of the cubital vein at a flow rate of 4 ml/s and a delay of 50 seconds during a CT scan of the lower abdomen and pelvis from the xiphoid to the pubic symphysis. Axial reconstructions from raw data were obtained in 3 mm thick increments at 2 mm intervals. The second data set was coronalized with a thickness of 3 mm and increments of 3 mm. There was no oral contrast employed. When viewed, the appendix was found to be normal. The CT scan resulted in a favourable, negative, or inconclusive result. The appendicitis criteria are identical to those used by the USG. When

alternative diagnoses were made, they were reported.

Results

This prospective observational study includes 100 study subjects with mean age of 24.79 years with SD- 8.77 years, majority of study subjects were in the range 15-30 years.
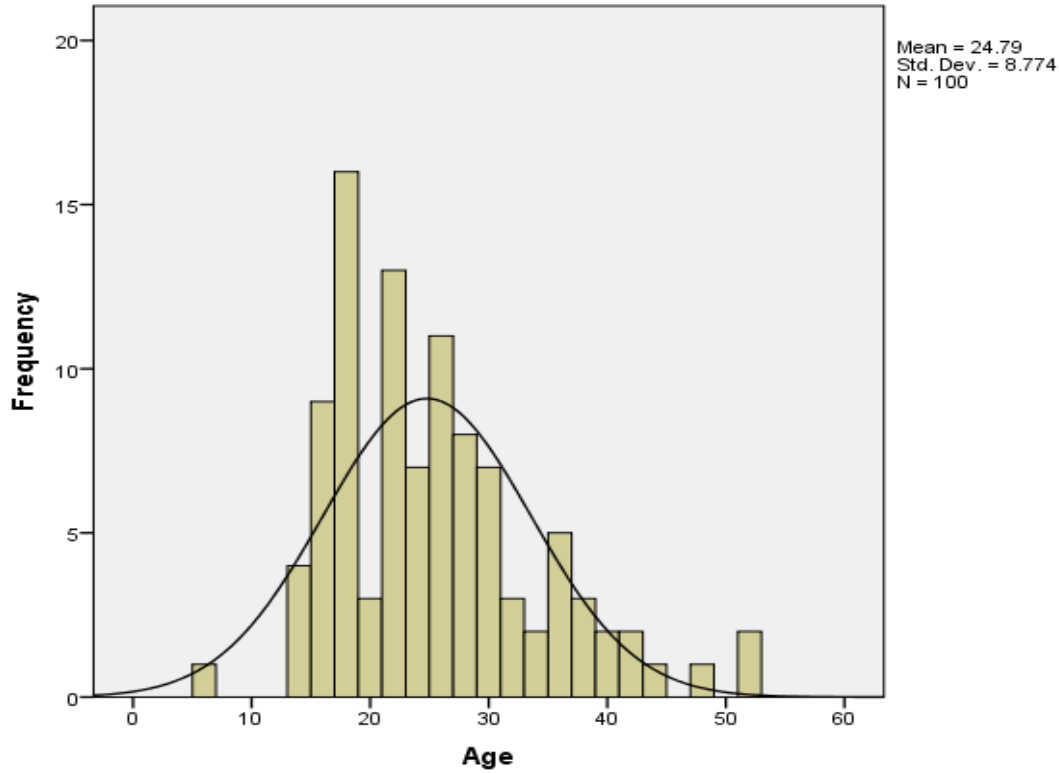
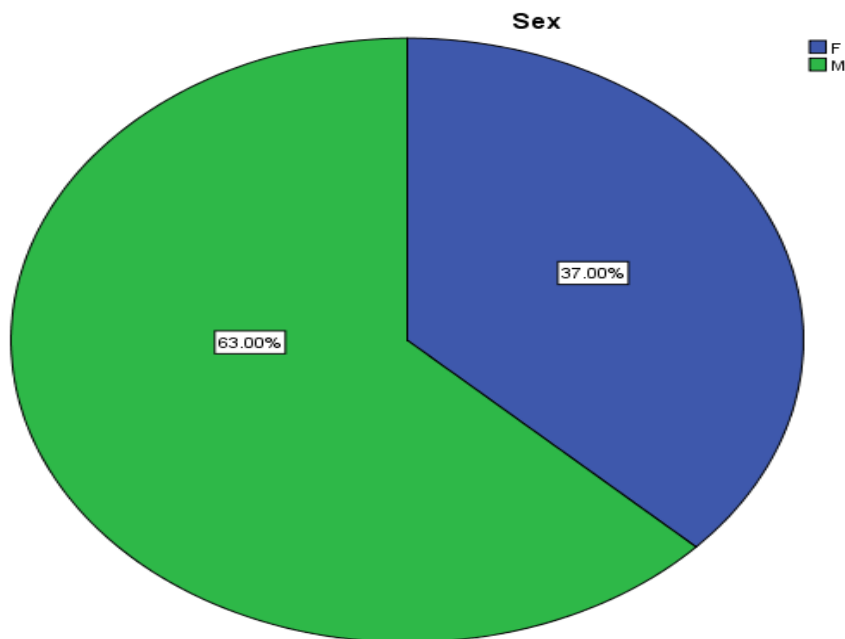**Figure 1: Distribution of study subjects as per age**

Figure 2: Distribution of study subjects as per sex

Figure 2 shows Distribution of study subjects as per sex, 63% subjects were male, and 37% subjects were female.

Table 1: Distribution of study subjects as per the ultrasound findings

Ultrasound findings		Frequency	Percent
Valid	N	15	15.0
	P	85	85.0
	Total	100	100.0

Table1 shows distribution of study subjects as per the ultrasound findings, in 85% cases on USG shows positive findings for appendicitis whereas in 15% it shows negative results.

Table 2: Distribution of study subjects as per the CT Scan findings

		Frequency	Percent
Valid	N	11	11.0
	P	89	89.0
	Total	100	100.0

Table 2 shows distribution of study subjects as per the CT Scan findings, In 89% cases on CT Scan shows positive findings for appendicitis whereas in 11% it shows negative results.

Table 3: Association of ultrasound and histopathology in the study subjects

		HPE		Total
		p	N	
Ultrasound	P	83	2	85
	N	8	7	15
Total		91	9	100

Table 3 shows Association of ultrasound and histopathology in the study subjects, out of 100 subjects 91 subjects were positive on histopathology whereas 85 subjects were positive on ultrasound. 7 subjects were negative for both ultrasound and histopathology. Sensitivity for USG was 91.21, specificity was 77.78, PPV- 87.65, NPV- 46.67, Accuracy- 90%

Table 4: Association of CT scan with histopathology

		HPE		Total
		P	N	
CT Scan	P	88	1	89
	N	3	8	11
Total		91	9	100

Table 4 shows Association of CT scan with histopathology, 88 subjects were positive for both CT scan and histopathology, 8 subjects were negative for both CT scan and histopathology. Sensitivity of CT scan 96.70, specificity- 88.89%, PPV- 98.88%, NPV- 72.73%, Accuracy- 96%

Discussion

The research was conducted in tertiary medical centre of Uttar Pradesh. Patients with abdominal discomfort and classic acute appendicitis symptoms such as fever, right quadrant pain, and vomiting who were checked by surgeons and recommended for surgery based on clinical symptoms were included in the study. The study's sex distribution revealed that male patients outnumbered female patients. There were 37 females and 63 males among the 100 patients in our study.

Ahmed F. El-Deek et al.[1] studied 107 patients suspected of having acute

appendicitis and found that males (58.9%) were more impacted than females (41.4 percent). Male preponderance in AA is a major feature, with estimates ranging from 60 to 72 percent in numerous studies (Estey et al., 2013)[8]; Nshuti et al., 2014[9].

The majority of the study subjects was between the ages of 15 and 30. According to Ahmed F. El-Deek et al.[1], the peak incidence of acute appendicitis is between the ages of 10 and 30 (Nshuti et al., 2014[9] and Chaudhari and Jawale, 2015.[10] Acute appendicitis is common in young adults with a mean age of 24.79 years in our study. CT scans revealed acute appendicitis in 89 of the 100 patients and were negative in 11 study subjects. One of the nine patients who tested negative for HPE had a CT showing of minor fat stranding and a normal-sized appendix measuring 6 mm, which was interpreted as a positive.

CT

In our present study The Sensitivity of CT scan 96.70, specificity- 88.89%, PPV-98.88%, NPV-72.73%, Accuracy- 96% When the parameters are compared to other studies, the results are very similar. Many investigations have shown sensitivity and PPV of about 96 percent and 96 percent, which are similar to ours. The sensitivity, specificity, positive predictive value, negative predictive value, and overall accuracy of CT in diagnosing AA were 98.8 percent, 88.9 percent, 88.9 percent, and 97.8 percent, respectively, in a research by Ahmed F. El-Deek et al.[1]. Candice Crocker et al.[4] found that CT had high accuracy and almost always definite performance in diagnosing or denying appendicitis, and that the sensitivity (98.9%) and specificity (98.9%) are both high. The high sensitivity and specificity of CT scans are consistent with our findings. Our findings provide a compelling rationale for a CT-first strategy in non-obstetric adults with suspected appendicitis, given the fact that worry

about radiation-induced carcinogenesis is significantly lower in the adult population than in the paediatric and obstetric groups.

USG

In our current study USG sensitivity was 91.21, specificity was 77.78, PPV was 87.65, NPV was 46.67, and accuracy was 90%. When the parameters are compared to other studies, the results are very similar. Many more research found in the literature have similar findings. According to Ahmed F. El-Deek et al.[1], the sensitivity, specificity, positive predictive value, negative predictive value, and overall accuracy of US in diagnosing AA were 91.7 percent, 77.8%, 94.3 percent, 70.0 percent, and 88.9%, respectively. Other studies have indicated sensitivity of 75 percent to 98 percent, specificity of 86 percent to 100 percent, and positive and negative predictive values of 91 percent to 100 percent and 89 percent to 99 percent, respectively (Summa, 2007; Ayaz, 2009 and Al-Ajerami, 2012). Alessia Ferrarese et al.[3] found 22 false negative cases when the appendix was not visible and the entire diagnostic was abnormal. Clinical and laboratory investigations in all 22 instances revealed a positive diagnosis of acute appendicitis, which was confirmed following surgery. Giljaca et al.[11] reported a sensitivity of 69 percent and a specificity of 81 percent, which was not the case in this investigation. In comparison to Giljaca et al.[11], the current study had a higher sensitivity rate, indicating a better ability to identify acute appendicitis patients. Orr et al.[12] conducted a similar meta-analysis, with sensitivity and specificity of 84.7 and 92.1 percent, respectively; however, the specificity of Orr et al. was very high when compared to the current meta-analysis, indicating a high ability to identify patients without acute appendicitis, which differs from the current analysis. Orr et al.[12] concluded that the US should not be utilised to diagnose acute appendicitis when clinical

signs and symptoms are clear. They suggest Ultrasound should be employed in cases where patients have an intermediate risk of acute appendicitis after a clinical evaluation.

Conclusions

Although CT is the gold standard imaging tool for diagnosing Acute appendicitis, there are some advantages to using US, including the fact that it is non-invasive and has a short acquisition time. Is relatively inexpensive, requires no iodinized contrast agent or oral preparation, does not expose patients to radiation, can be performed on children with some motion, and is considered safe during pregnancy, has a high potential for diagnosing alternative conditions that mimic acute appendicitis, and is available in most institutions.

Fundings: NA

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