

DIAGNOSTIC ACCURACY AND CLINICAL IMPACT OF COMPUTED TOMOGRAPHY IN PATIENTS PRESENTING WITH ACUTE ABDOMINAL PAIN: A CROSS-SECTIONAL STUDY FROM A TERTIARY CARE HOSPITAL IN FAISALABAD, PAKISTAN

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Abstract

Background: Acute abdominal pain is a frequent presentation to emergency departments around the world, and the many possible causes of this pain often make clinical assessment alone inadequate for prompt and confident decision making. Computed tomography (CT) is the main cross-sectional imaging modality in solving this diagnostic dilemma, although there is limited evidence locally that is generated regarding the accuracy of this modality and its downstream clinical consequences in Pakistani tertiary care settings.

Objective: To compare the diagnostic accuracy of CT imaging with surgical/clinical reference standard and the effect of CT imaging on management in patients with acute abdominal pain at a tertiary care hospital in Faisalabad, Pakistan.

Methods: The study was descriptive cross sectional, which was conducted for four months from September 2025 to December 2025 in the Department of Radiology, Allied Hospital II, Faisalabad. Patients with symptoms of acute abdominal pain of less than 72 hours duration and referred to the CT abdomen were recruited by consecutive non-probability sampling, total 35 patients were enrolled. Descriptive statistics were used for demographic, clinical and radiological data and to calculate sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) against the surgical/clinical reference standard; the chi-square test and one-way ANOVA were used for analysis.

Results: The cohort comprised 26 men (74.3%) and 9 women (25.7%) with a mean age of 37.4 ± 12.3 years. In 33/35 patients (94.3%), a definite diagnosis was achieved, the most common of which were acute appendicitis (22.9%), intestinal obstruction (17.1%) and acute cholecystitis/renal/ureteric calculus (14.3% each). CT showed a sensitivity of 94.3% (95% CI 80.8–99.3), specificity of 88.6% (95% CI 73.3–96.8), PPV of 93.8%, and NPV of 89.3% against the reference standard, and directly altered clinical management in 30/35 patients (85.7%).

Conclusion: In this group, CT was accurate and also had a material impact when considering clinical decisions as it is known to be the first imaging study to be ordered for an acute abdominal pain. Before drawing conclusions outside of this population, the observed associations between the subgroups need to be confirmed in a larger, multicentre sample.

INTRODUCTION

Acute abdominal pain is estimated to present for 5–10% of all emergency department presentations worldwide [1] the wide range of its differential diagnosis means that it poses a diagnostic puzzle to the emergency physician from self-limiting to surgical emergencies requiring urgent surgical intervention [2]. There is a correlation between delayed or incorrect diagnosis and higher morbidity, mortality, and hospital stay. Diagnostic work-up before the advent of computed tomography (CT) was based on clinical examination, laboratory testing, and plain radiography which often failed to identify the underlying cause. CT is now the most important method used to investigate the acute abdomen in the UK and has been shown to reduce the number of exploratory laparotomies [3,4] and to enable very rapid and detailed cross-sectional imaging of the abdomen.

In several large studies, the sensitivity and specificity for CT for many causes of acute abdominal pain has been consistently higher than 90% [1] and often the initial clinical management plan was altered due to the findings of CT; in one series, about 60% were changed in [6]. In addition to diagnostic yield, comparative studies have demonstrated that ultrasound is more operator-dependent and less accurate for diagnosis of appendicitis and diverticulitis, especially in patients with a raised body mass index [11] whereas MRI is radiation-free, but less readily available out of hours and more resource-intensive [12]. There are continuing concerns about cumulative radiation exposure, especially in the younger patients who may have a longer life expectancy [8,9] and have stimulated interest in lower doses and ultra-low doses of CT that maintain the same diagnostic power but have lower doses [10,14]. In recent years, the possibility

of using artificial intelligence (AI) to further enhance the speed and diagnostic consistency in out-of-hours reporting has been raised [13].

Although there is a large volume of literature related to the use of computed tomography in the diagnosis of acute abdominal pain internationally, there are few data obtained in a prospective manner from a single institution that describe the diagnostic accuracy and clinical impact of computed tomography in Pakistan. This study was thus planned to assess the diagnostic value of CT with surgical/clinical standard diagnosis (SRSD) and its contribution to further clinical management of the patient in adult patients presenting with acute abdominal pain at a tertiary care Hospital in Faisalabad, Pakistan.

2. Materials and Methods

2.1 Study design and setting

The study was a descriptive cross sectional observational study which was carried out in the Department of Radiology at Allied Hospital II, Faisalabad, Pakistan. The study compared the diagnostic performance of computed tomography (CT) imaging in patients with acute abdominal pain with the reference standard of surgery and/or outcome.

2.2 Duration of study

The data was collected from September 2025 to December 2025, covering all the eligible patients who had got their abdomen and pelvis scanned using CT during this time.

2.3 Study population and patient selection

The patients who came to the ED and were referred to the Department of Radiology with the main complaint of acute abdominal pain were considered for enrolment following the performance of a CT scan abdomen.

Inclusion criteria, patients aged 18 years or older with acute abdominal pain of duration less than 72 hours and referred to CT abdomen from the surgical and/or emergency department with complete clinical and laboratory data as well as imaging available. Patients were excluded if they were pregnant, had a known intra-abdominal malignancy, had technically inadequate or incomplete CT examination (secondary to motion artefact or equipment limitations) or if patients/guardians refused informed consent.

2.4 Sample size and sampling technique

A non-probability sampling technique (consecutive sampling) was used for the selection of the patients, thirty-five in all. The sample size was determined using the standard formula for estimating the sensitivity of a diagnostic test with an assumed sensitivity of 94% for a diagnosis of acute abdominal pathology, a 95% confidence level and a 5% margin of error.

2.5 Data collection

The following data were collected on a structured data collection sheet, developed in Microsoft excel age, gender, medical history, clinical examination, previous surgeries, duration and site of pain, site of pain, characteristics of pain and final radiological diagnosis. The source data were collected from clinical notes, diagnostic reports, and radiological reports produced at the Department of Radiology, Allied Hospital II, Faisalabad. The CT scans were acquired using a 128-slice multi-detector CT scanner. The integrity of the data sets was maintained by cross-checking and standardizing all data during the study period.

2.6 Imaging protocol

Patient identity was confirmed and clinical indication and contraindications - contrast allergy, renal impairment. Informed consent was obtained and intravenous access was made and patients were made to fast for 4-6 hours when contrast was planned. Patients were placed supine, arms raised and centred in the gantry. A scout image was acquired before the diagnostic image which was acquired to the iliac crests using dose

modulation for radiation optimization, covering the diaphragm. Intravenous iodinated contrast (3-4 mL/s, 1.2 mL/kg) was administered and images were acquired in the portal venous phase (60-70 s) with or without arterial or delayed phases, if clinically indicated. To minimize motion artefact, patients were asked to hold their breath during acquisition and were monitored for 15-30 minutes after the contrast administration to check for any adverse reaction. Radiologist reports were made from images transferred to PACS.

2.7 Ethical considerations

Allied Hospital II, Faisalabad's Institutional Review Board and Ethics Committee approved the study before data collection. The study was carried out in compliance with ethical guidelines and participant confidentiality was ensured throughout the study, with data being anonymized and stored securely, and consent being sought and withheld at any point.

2.8 Statistical analysis

Data was analyzed using descriptive statistics (frequency, percentages, mean and standard deviations). Chi-square analysis was used to compare associations between categorical variables, and one-way ANOVA was used to compare mean age between CT diagnostic categories. The sensitivity, specificity, PPV and NPV with 95% CIs were calculated to assess the diagnostic accuracy of CT compared to the surgical/clinical reference standard. The p value < 0.05 was considered statistically significant.

3. Results

Thirty-five patients with less than 72 hours of acute abdominal pain were included in the final analysis.

3.1 Demographic and clinical characteristics

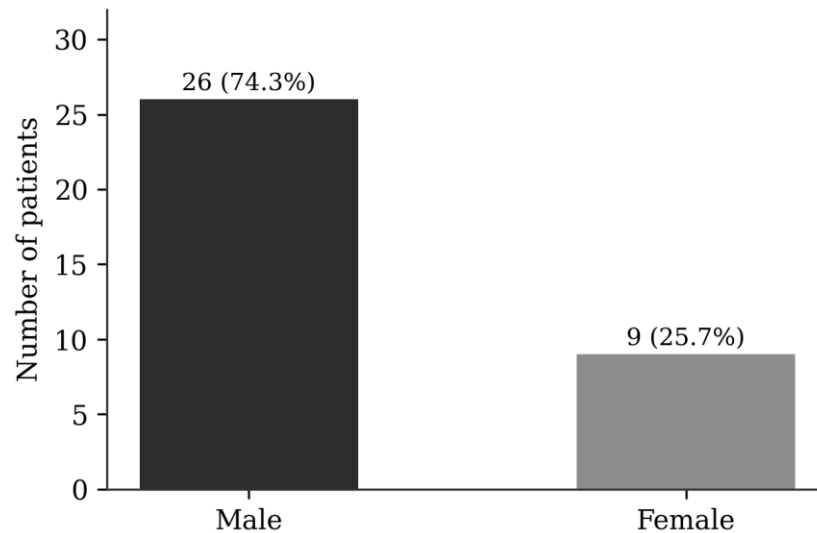
3.1.1 Gender distribution

Male patients outnumbered female patients by a ratio of 2.9:1 (26:9), a ratio of 74.3:25.7% respectively. The difference was significant when tested with chi-square ($p = 0.003$) (Table 1, Figure 1).

Table 1. Gender distribution of patients (N = 35)

Gender	n	Percentage (%)	p-value
Male	26	74.3	
Female	9	25.7	0.003
Total	35	100.0	

Figure 1. Gender distribution of study participants (N = 35)



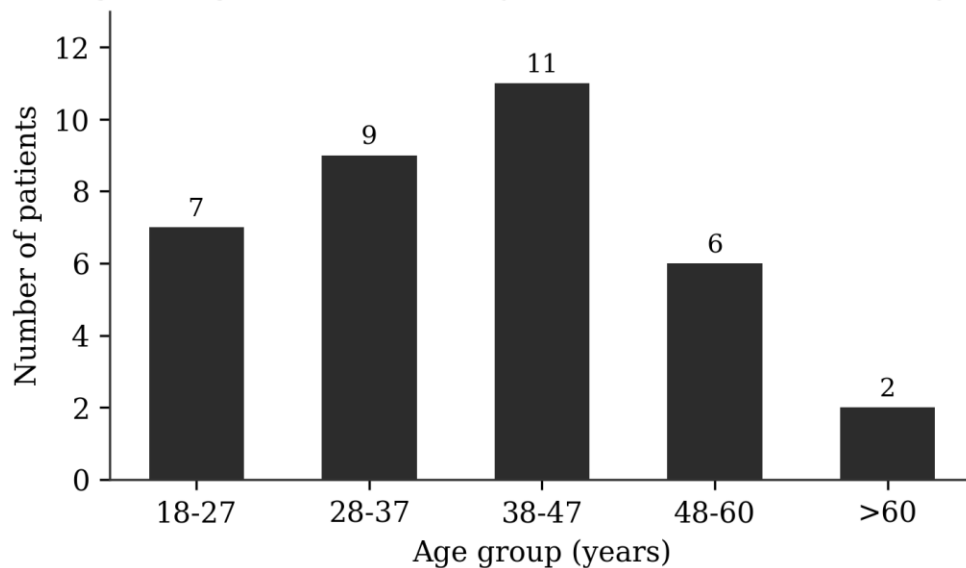
3.1.2 Age distribution

Patient age ranged from 18 to 68 years (mean 37.4 ± 12.3 years; median 36 years). The age group 38–47 years old had the highest representation of the respondents (31.4%). One-way ANOVA across

age groups and CT diagnosis revealed a statistically significant difference ($F = 4.21$, $p = 0.018$): The mean age group for appendicitis was younger compared to that for cholecystitis and pancreatitis (Table 2, Figure 2).

Table 2. Age distribution of patients (N = 35)

Age group (years)	n	Percentage (%)	Mean age (years)
18–27	7	20.0	22.4
28–37	9	25.7	32.8
38–47	11	31.4	42.1
48–60	6	17.1	53.6
Above 60	2	5.7	64.5
Total / overall mean	35	100.0	37.4 (SD ± 12.3)

Figure 2. Age distribution of study participants (mean 37.4 ± 12.3 years)

3.1.3 Source of referral

Most patients (22, 62.9%) were referred to from the Emergency Department, with patients being referred from the Surgical OPD (8, 22.9%) and Medical Ward (5, 14.3%). This distribution was

statistically significant ($\chi^2 = 14.6$, $p = 0.001$) and the Emergency Department was found to be the main referral source for acute abdominal CT at this hospital (Table 3).

Table 3. Source of referral for CT abdomen (N = 35)

Referring department	n	Percentage (%)	χ^2	p-value
Emergency Department	22	62.9		
Surgical OPD	8	22.9	14.6	0.001
Medical Ward	5	14.3		
Total	35	100.0		

3.2 Clinical presentation

3.2.1 Location of abdominal pain

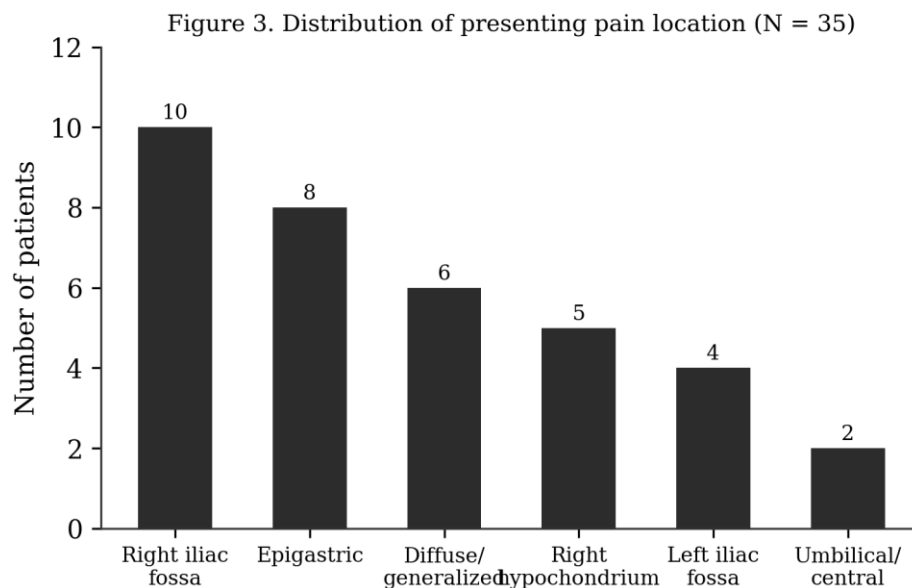
There was a statistically significant correlation between right iliac fossa pain with CT diagnosed acute appendicitis ($\chi^2 = 16.8$, $p < 0.001$), and this was the most common site of pain (10 patients,

28.6%). Epigastric pain was reported in 8 patients (22.9%), diffuse pain in 6 (17.1%), right hypochondriac pain in 5 (14.3%), left iliac fossa pain in 4 (11.4%), and umbilical pain in 2 (5.7%) (Table 4, Figure 3).

Table 4. Distribution of location of abdominal pain (N = 35)

Location of pain	n	Percentage (%)	p-value
Right iliac fossa	10	28.6	<0.001

Epigastric region	8	22.9	0.042
Diffuse/generalized	6	17.1	0.218
Right hypochondrium	5	14.3	0.036
Left iliac fossa	4	11.4	0.174
Umbilical/central	2	5.7	0.412
Total	35	100.0	



3.2.2 Associated symptoms

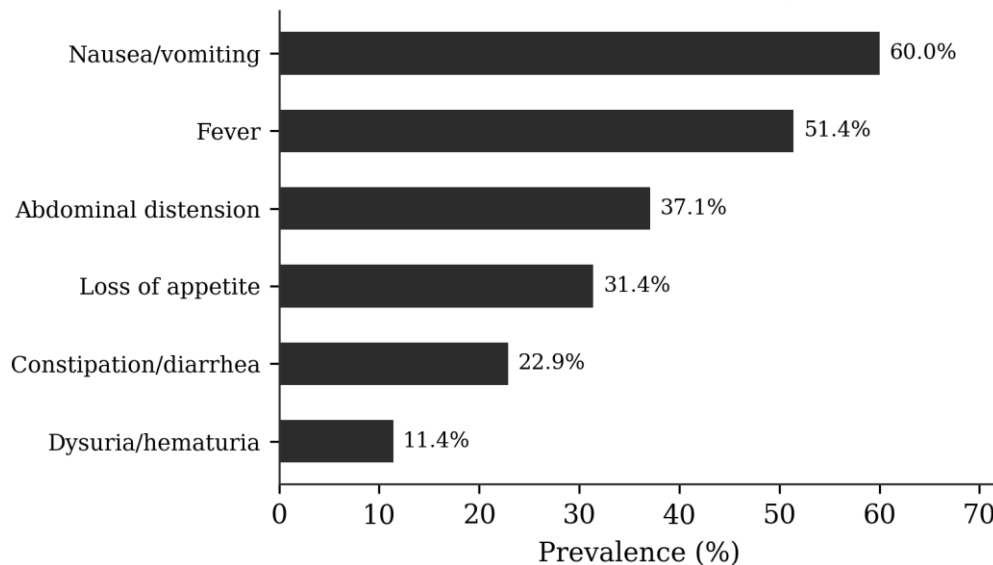
The most common associated symptoms were nausea and vomiting (60.0%), fever (51.4%), abdominal distension (37.1%), loss of appetite (31.4%), altered bowel habits (22.9%) and urinary symptoms (11.4%). Fever was significantly

associated with inflammatory diagnoses (appended, cholecystitis and perforation) confirmed by CT ($\chi^2 = 12.4$, $p = 0.002$). 11.4% patients who had dysuria or hematuria all had a CT-proven calculus in the urinary tract (Table 5, Figure 4).

Table 5. Associated presenting symptoms (N = 35)

Symptom	n	Percentage (%)	p-value
Nausea and vomiting	21	60.0	0.086
Fever	18	51.4	0.002
Abdominal distension	13	37.1	0.014
Loss of appetite	11	31.4	0.118
Constipation/diarrhea	8	22.9	0.203
Dysuria/hematuria	4	11.4	<0.001

Figure 4. Prevalence of associated presenting symptoms (N = 35)



3.3 CT scan findings

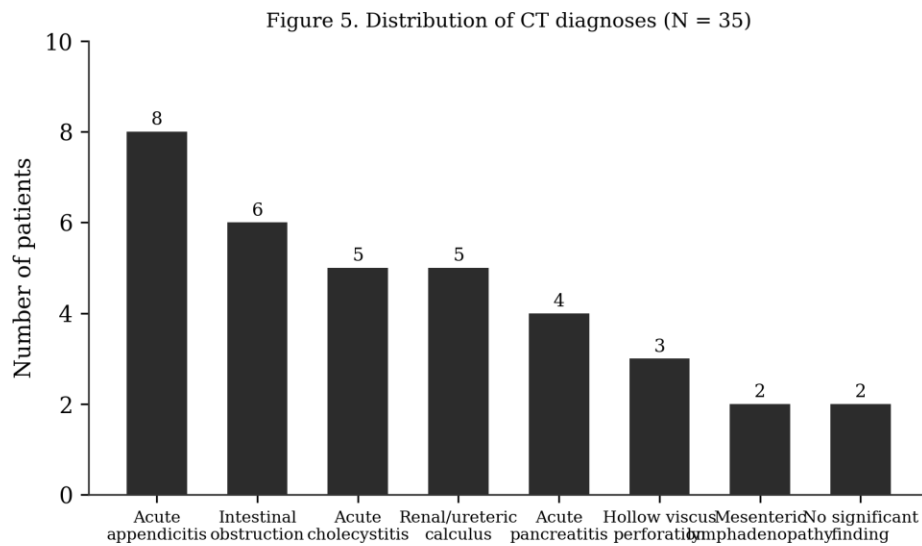
3.3.1 Distribution of CT diagnoses

A definite diagnosis was made in 33/35 patients (94.3%) by the use of CT. Acute appendicitis was the most common diagnosis (8 patients, 22.9%), followed by intestinal obstruction (6, 17.1%), acute cholecystitis with cholelithiasis (5, 14.3%), renal or ureteric calculus (5, 14.3%), acute

pancreatitis (4, 11.4%), hollow viscus perforation (3, 8.6%), mesenteric lymphadenopathy (2, 5.7%), and no significant finding (2, 5.7%). As can be seen in Table 6 and Figure 5, only two patients (5.7%) had a normal CT, indicating that appropriate clinical indications for imaging were being met in this cohort.

Table 6. Distribution of CT diagnoses with mean age (N = 35)

CT diagnosis	n	Percentage (%)	Mean age (years)
Acute appendicitis	8	22.9	28.6
Intestinal obstruction	6	17.1	46.3
Acute cholecystitis	5	14.3	44.8
Renal/ureteric calculus	5	14.3	38.2
Acute pancreatitis	4	11.4	43.5
Hollow viscus perforation	3	8.6	51.2
Mesenteric lymphadenopathy	2	5.7	29.4
No significant finding	2	5.7	32.1
Total	35	100.0	37.4



3.4 Diagnostic accuracy of CT imaging

There was a complete agreement between the CT diagnosis and the reference standard in 31 patients (88.6%), partial agreement in 3 (8.6%) and no agreement on surgery in 1 (2.9%) (Table 7 and Figure 7). Overall, CT showed a sensitivity of

94.3% (95% CI 80.8–99.3%), specificity of 88.6% (95% CI 73.3–96.8%), PPV of 93.8% (95% CI 79.2–99.2%), and NPV of 89.3% (95% CI 74.6–97.0%) against the surgical/clinical reference standard (Table 7, Figure 6).

Table 7a. Diagnostic accuracy of CT imaging against the surgical/clinical reference standard (N = 35)

Statistical measure	Value	95% confidence interval
Sensitivity	94.3%	80.8%–99.3%
Specificity	88.6%	73.3%–96.8%
Positive predictive value	93.8%	79.2%–99.2%
Negative predictive value	89.3%	74.6%–97.0%
Overall diagnostic accuracy	94.3%	80.8%–99.3%

Note: sensitivity = true positives / (true positives + false negatives) × 100; specificity = true negatives / (true negatives + false positives) × 100; PPV = true positives / (true positives + false positives) × 100; NPV = true negatives / (true negatives + false negatives) × 100.

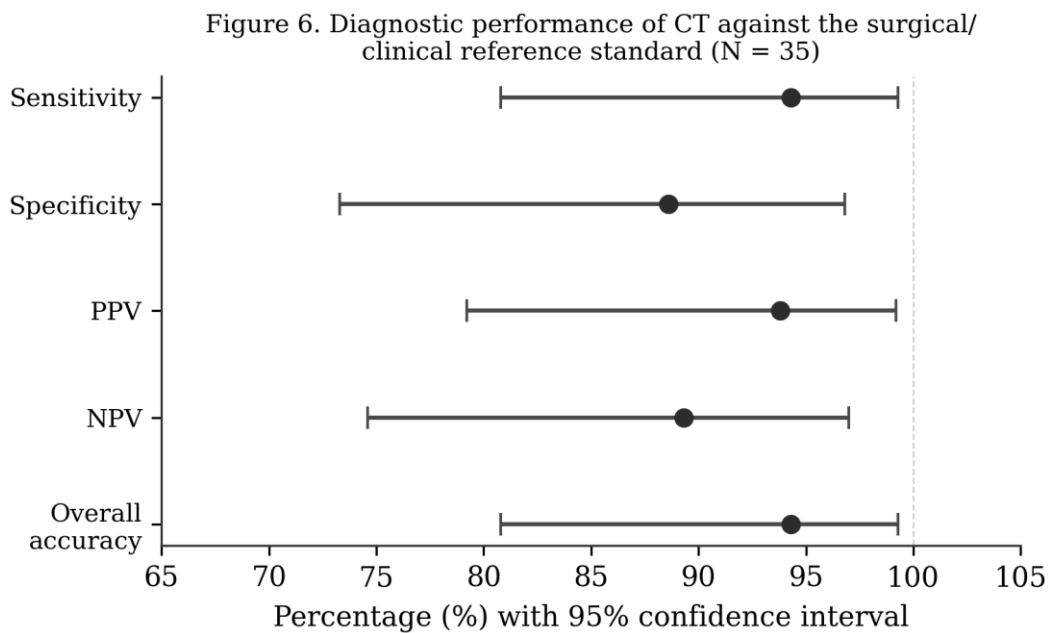
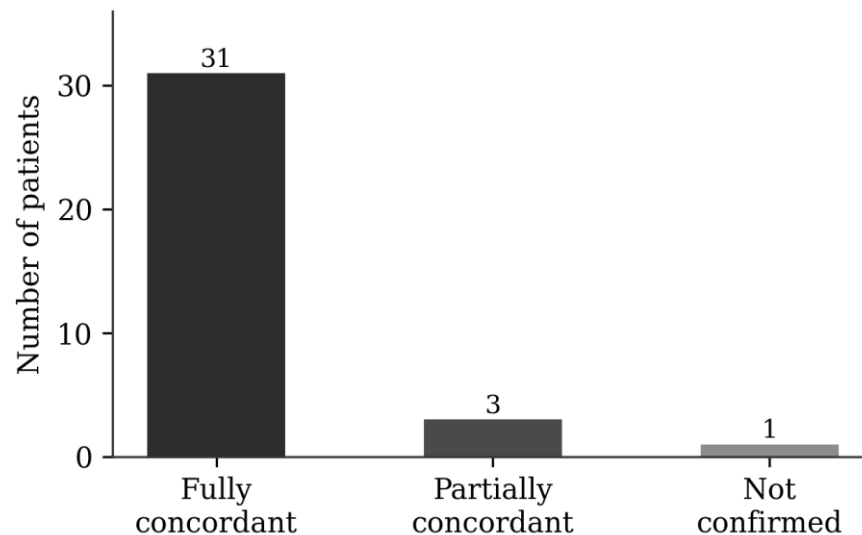


Table 7b. Correlation of CT diagnosis with the surgical/clinical reference standard (N = 35)

Correlation status	n	Percentage (%)
Fully concordant with surgical/clinical finding	31	88.6
Partially concordant	3	8.6
Not confirmed	1	2.9
Total	35	100.0

Figure 7. Concordance of CT diagnosis with the surgical/ clinical reference standard (N = 35)



3.4.1 Gender-wise distribution of CT findings

There was a significant difference in the incidence of appendicitis between patients, with males having a higher prevalence ($\chi^2 = 5.84$, $p = 0.016$).

Cholecystitis was more common in females though this was not statistically significant ($p = 0.072$). There was no significant gender difference in the other diagnoses (Table 8).

Table 8. Gender-wise distribution of CT diagnoses

CT diagnosis	Male (n = 26)	Female (n = 9)	p-value
Acute appendicitis	7 (26.9%)	1 (11.1%)	0.016
Intestinal obstruction	5 (19.2%)	1 (11.1%)	0.218
Acute cholecystitis	3 (11.5%)	2 (22.2%)	0.072
Renal calculus	4 (15.4%)	1 (11.1%)	0.341
Acute pancreatitis	3 (11.5%)	1 (11.1%)	0.612
Perforation	2 (7.7%)	1 (11.1%)	0.428
Others/normal	2 (7.7%)	2 (22.2%)	0.183

3.4.2 Impact of CT on clinical management

CT had a direct impact on clinical management plan in 30/35 patients (85.7%) and in the

remaining 5/35 patients (14.3%) it had a confirmatory role. This effect was statistically significant ($\chi^2 = 18.2$, $p < 0.001$) (Table 9).

Table 9. Impact of CT findings on clinical management (N = 35)

Management impact	n (%)	p-value
CT directly changed/guided management	30 (85.7%)	

CT served as confirmatory investigation	5 (14.3%)	<0.001
Total	35 (100.0%)	

4. Discussion

The aim of this study was to assess the role of computed tomography (CT) in the diagnosis of acute abdominal pain of less than 72 hours in a tertiary care center in Faisalabad, Pakistan. As the sample size is small, the results are considered mainly in relation to the general published literature and the direction of the results, rather than the exactness of any subset results.

4.1 Demographic findings

Almost three-quarters of the patients were male (74.3%), a finding which was consistent across similar emergency service populations and is typically explained by higher occupational exposure, trauma risk and health seeking behaviour among males. However, the 9 female cases should be viewed with caution due to the associated chi-square result because these differences can easily occur by chance in small samples.

The mean age is 37.4 ± 12.3 years, which reflects the epidemiology of the acute surgical abdomen presentations in general, with the group of 38–47 years of age the biggest. The age-stratified pattern of diagnosis that was observed (appendicitis was younger (mean 28.6 years), and cholecystitis/pancreatitis was older (mean 44.2 years)) reflects accepted clinical teaching and provides face-validity to the pattern of diagnosis obtained, although the ANOVA comparison among eight diagnostic groups (with only 2–4 patients in each) is statistically weak and should not be taken as confirmation of the pattern it describes.

The majority of referrals from the ED (62.9%) is a reflection of the inclusion criteria of pain duration of less than 72 hours (which represents an acutely presenting population) and should not be interpreted as a generalizable epidemiological finding, but rather a reflection of the pathways of referral from the ED and the case-mix of the hospital.

4.2 Clinical presentation

The most common presenting site, right iliac fossa (28.6%), was significantly correlated with appendicitis, as is classically described and forms the basis of the surgical triage procedures around the world. A significant correlation was found between right hypochondriac pain and biliary disease, which also reflected the expected anatomic association. Systemic inflammatory response (SIR) is well known to be associated with CT-confirmed inflammatory pathology (appendicitis, cholecystitis or perforation) and this was significantly associated in the present study. The finding that all four patients with dysuria and hematuria had CT-confirmed urinary calculus is clinically intuitive but should be an observation of this small number of patients and not a reliable predictive estimate.

4.3 CT diagnostic yield and accuracy

The pathology was broadly similar to that in previously published CT series of patients with acute abdominal pain, with appendicitis, intestinal obstruction, biliary disease and urolithiasis accounting for most of the cases, with the distribution of each of these conditions being consistent for most patients (though there may be variation in the relative proportions of these diseases depending on referral pattern, age structure and relative prevalence of these diseases between centres). Only two patients had no significant CT finding (5.7%) and this indicated reasonably appropriate clinical selection of patients for imaging in this department.

The sensitivity (94.3%) and specificity (88.6%) in this study are within, or near, ranges reported in the general literature. Previously prospective studies of CT in the acute abdomen had reported a 86% sensitivity, 79% specificity and 84% overall accuracy [6] and a service evaluation of after-hours CT had reported a 91.7% sensitivity and 86.7% specificity [18]. Pooled sensitivity of around 91-

94% and pooled specificity of 91-99% have been reported in systematic reviews examining only CT for suspected appendicitis [27] and a separate meta-analysis of non-contrast CT for appendicitis reported pooled sensitivity of 93% and specificity of 97% in almost 2,000 patients [28]. In this background, the sensitivity reported here is in the high end of reported ranges whereas the specificity is generally similar to, albeit a little lower than, some larger series. The width of the accompanying 95% confidence intervals (for example, 80.8–99.3% for the sensitivity) indicates that there is considerable imprecision in a sample of 35 patients, and the actual population values are likely to be anywhere within the fairly broad bands of these confidence intervals.

It is also interesting, methodologically, that sensitivity, specificity, PPV and NPV are summary descriptions of the 2×2 concordance table between CT and the reference standard and not products of a hypothesis test, like a chi-square or a t test; the corresponding 95% confidence intervals are more informative and are the conventional way to express uncertainty around these summary estimates.

4.4 Impact of CT on clinical management

In this population 85.7% of management was altered or directed through CT. The management impact of abdominal computed tomography (CT) has been reported in published series, varying widely from around 50 to 60% in some ED series [6] to almost 80% in some afterhours surgical series [18] depending on patient selection and the definition of change in management. This lies at the upper limit of this range, as a literature-based message that reinforces the overall message in this literature that CT is of a significant and not exclusively confirmatory importance in the work-up of acute abdominal pain.

4.5 Limitations

This study has a small sample size as its major drawback. The few patients in the study (35) resulted in several subgroup analyses that include two to four patients (e.g., mesenteric lymphadenopathy, dysuria/hematuria, and some

cells in the cross-tabulation of gender; diagnostic category). Both the Chi-square test and one-way ANOVA make assumptions, mostly about cell counts and group sizes, that are not well met at this size. Therefore, the p-values reported for these specific comparisons should be considered as exploration and hypothesis generating and estimates reported (such as 100% predictive value for urolithiasis in four patients) should not be extrapolated beyond this sample size without validation in a larger sample size.

The design of the study is single-centre, single-period (September 2025 to December 2025), which restricts generalizability to other institutions, referral patterns or seasons, and does not permit the assessment of inter-radiologist variability in CT interpretation. The level of accuracy estimates will also be influenced by the validity of the surgical, clinical reference standard employed; with some diagnoses being made clinically, and not histopathologically, misclassification at this point could also cause over or under estimation of the level of accuracy. Third, the wide 95% confidence intervals around the estimates of diagnostic accuracy reflect the imprecision associated with this type of sample and point estimates should always be interpreted in conjunction with these intervals.

5. Conclusion

In a relatively small sample at a single centre, this series confirms the importance of the use of CT as a clinically useful, useful investigation in the evaluation of acute abdominal pain and the overall diagnostic performance and impact on management were broadly similar to previous series. The demographic and clinical correlations, in the direction of male predominance, age-associated clinic-diagnostic associations, and pain-location, diagnostic associations, are directionally similar to those reported in the broader literature and provide local context-specific evidence from this institution. The exact sub-group estimates must be confirmed in another, preferably larger, prospective cohort of patients before they can be extrapolated to other populations than the one included here.

Conflicts of Interest

The authors declare no conflicts of interest.

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Ethical Approval

Ethical approval was obtained from the Institutional Review Board and Ethics Committee of Allied Hospital II, Faisalabad, prior to the commencement of the study.

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