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DIAGNOSTIC ACCURACY OF CONTRAST-ENHANCED COMPUTED TOMOGRAPHY VERSUS ULTRASOUND IN THE DETECTION OF GANGRENOUS CHOLECYSTITIS

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Abstract

Background: *Gangrenous cholecystitis (GC) is a severe complication of acute cholecystitis characterized by ischemia, necrosis, and potential perforation of the gallbladder wall. Delayed preoperative diagnosis significantly increases morbidity and mortality. Ultrasonography (USG) is the standard first-line imaging modality, while contrast-enhanced computed tomography (CECT) offers superior visualization of gangrenous changes.*

Objective: *To compare the diagnostic accuracy of CECT versus ultrasonography in the detection of gangrenous cholecystitis using histopathological findings as the reference standard.*

Methodology: *A cross-sectional analytical study was conducted at Sheikh Zaid Hospital, Lahore over four months. A total of 70 patients with clinical and histopathological features of cholecystitis were enrolled via convenient sampling. All patients underwent both USG and CECT. Data were analyzed using descriptive statistics, chi-square test, independent samples t-test, Mann–Whitney U test, and diagnostic accuracy measures including sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall accuracy.*

Results: *The majority of patients were male (54.3%) and above 60 years of age (48.6%). Diabetes mellitus was present in 48.6% of cases. All patients presented with right upper quadrant pain and vomiting. USG detected gallbladder distension in 55.7%, wall irregularity in 51.4%, pericholecystic fluid in 40%, and gallstones in 60% of patients. A significant association was observed between biliary sludge on USG and histopathologically confirmed gangrenous change ($p = 0.017$). CECT identified abscess in 47.1% and perforation in 51.4% of cases. CECT demonstrated significantly higher sensitivity and specificity compared to USG in detecting gangrenous cholecystitis.*

Conclusion: *CECT is significantly more accurate than ultrasonography in the preoperative detection of gangrenous cholecystitis. Sequential imaging approach USG as the initial modality followed by CECT when findings are inconclusive or complicated disease is suspected is recommended to improve early diagnosis and patient outcomes*

INTRODUCTION

Gangrenous cholecystitis (GC) is a serious complication of cholelithiasis where progressive vascular insufficiency results in ischemia, necrosis, and eventual perforation of the gallbladder wall. The most common causes of cholecystitis are gallstones, tumor, infection, bile duct blockage, or other severe illness that can

damage blood cells and decrease blood flow. Within the realm of acute cholecystitis, GC presents itself as a formidable challenge, with a higher mortality rate (15 to 50%) compared to uncomplicated cholecystitis (3%) and exclusive preoperative diagnosis[1]. Known risk factors of GC include male gender, advanced age, delayed surgery, cardiovascular disease (CVD), diabetes mellitus (DM), and leukocytosis[2].The most common symptom among the admitted patients was abdominal pain (assessed by the visual pain scale) (300/340, 88.2%), followed by fever (128/340, 37.6%). The presence of fever and vomiting was significantly associated with gangrenous outcomes in the patients. Drug induced cholestasis is uncommon, occurring in less than 20% of the elderly population in the United States, and even less so in younger patient populations[3].

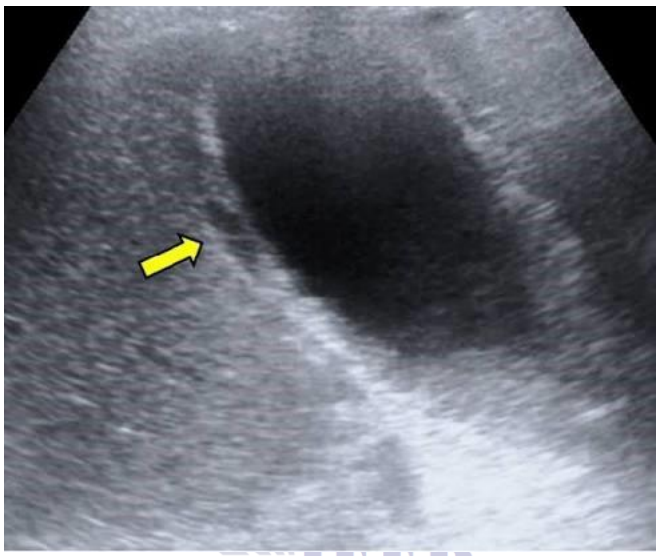


Fig 1. USG image showing marked distension of gallbladder showing calculus in GB neck (green arrow), thickened and irregular walls (yellow arrow) with pericholecystic fluid (blue arrows).

In India studies have found that GC occurs unexpectedly in a range of 2% to 29.6% of cases of acute cholecystitis[4,5]. The incidence of GC is 5.6% and 31.2% in acute calculus cholecystitis (ACC) and acute calculus cholecystitis (AAC) respectively[6 7].

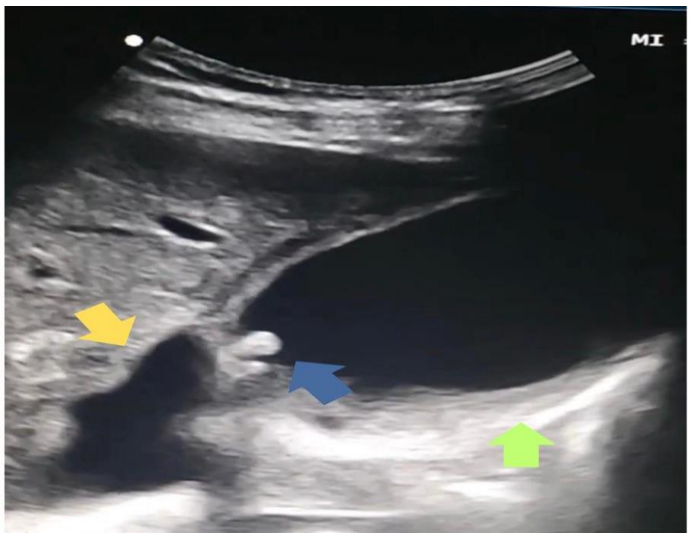


Fig 2. USG image showing calculus on the GB neck (blue arrow), severely thickened and irregular heterogenous walls (green arrow) with pericholecystic fluid (yellow arrow).

Prolonged cystic duct obstruction leads to epithelial injury, causing progressive vascular insufficiency. This ischemia leads to necrosis and potentially perforation of the gallbladder (GB) wall, resulting in GC. This epithelial injury triggers the release of phospholipases, enzymes that degrade nearby cell membranes, leading to a pronounced inflammatory response. The combined effect of increased tension in the GB wall and the heightened inflammatory reaction ultimately leads to either localized or widespread ischemia of the GB wall[8 9].

Diagnosis of GC is difficult preoperatively. Grade II criteria include leukocytosis greater than 18,000/mm3, palpable tender RUQ mass, duration of complaints greater than 72 hours, and marked local inflammation. Grade III criteria include hypotension requiring dopamine or norepinephrine[10], RUQ ultrasound is the preferred initial diagnostic test in suspicion of acute cholecystitis. In cases of GC, RUQ ultrasound and abdominal CT scan typically show gallbladder wall thickening, irregular or absent gallbladder wall, edema, and pericholecystic fluid collections[11]

In addition, analysis of gallbladder imaging with ultrasound and hepatoiminodiacetic acid (HIDA) scanning have been helpful in only the most severe cases[12]. Laparoscopic cholecystectomy is the surgical treatment of choice for grades II (moderate) and III (severe) acute cholecystitis. Grade I (mild) acute cholecystitis does not require urgent surgery, as it does not meet the criteria for grades II and III. Grade I (mild) is associated with a 1.1% mortality rate; grade II with 0.8%; grade III with 5.4%[13].

The aim of our study is that to enhance early diagnosis and improve clinical outcomes in patients with gangrenous cholecystitis. This will be accomplished by analyzing the clinical features, associated risk factors, and diagnostic difficulties of the condition through a comparative assessment of ultrasound and Contrast-Enhanced Computed Tomography (CECT)

MATERIAL AND METHODS

This cross-sectional analytical study was conducted at Multi centers, Lahore, over a period of 4 months following synopsis approval. A total of 70 patients were recruited using convenient sampling. Patients of both genders were included if they presented with ultrasonographic or CT findings of gallstones, pericholecystic fluid, gas in the gallbladder wall, intraluminal membrane, gallbladder distension, irregular wall, or abscess, along with clinical and histopathological features such as gallbladder wall thickness, high morbidity, positive Murphy's sign, and leukocytosis. Patients were excluded if they lacked complete clinical, histopathological, or imaging data, were pediatric cases, or had no evidence of gangrene or necrosis of the gallbladder. For imaging, ultrasound was performed using both curvilinear (3–5 MHz) and linear (7–12 MHz) transducers, while contrast-enhanced CT was done using a multidetector CT scanner with a power injector for intravenous contrast administration.

Results

Table no 1: Age of Patient

Age Group		
	Frequency	Percent
Age Group <40	14	20.0
Age Group 40-50	9	12.9
Age Group 50-60	13	18.6
Age Group > 60	34	48.6
Total	70	100.0

We included a total of 70 patients in this study. The age distribution shows that patients aged less than 40 years have a frequency of 14, and its percentage is 20.0% of the sample. The age group 40—50 years includes 9 patients (12.9%). Patients aged 50—60 years have a frequency of 13, representing 18.6%. The majority of patients belong to the age group above 60 years, with a frequency of 34 and a percentage of 48.6%.

4.1 Pie Chart of Age group

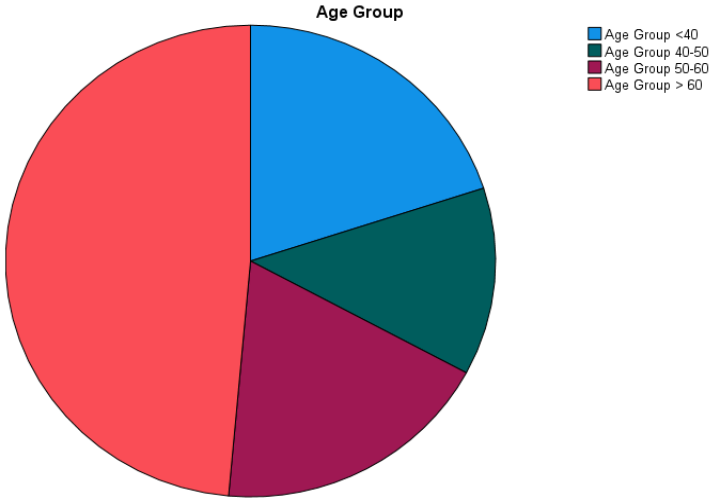
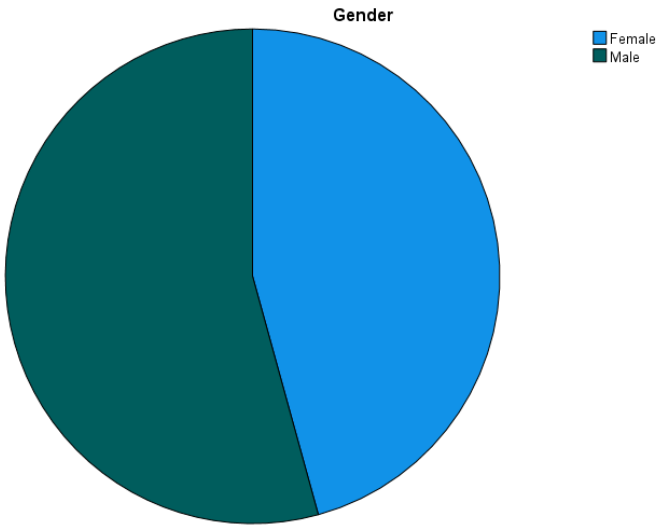


Table no 2: Gender

Gender		
	Frequency	Percent
Female	32	45.7
Male	38	54.3
Total	70	100.0

We included a total of 70 patients in this study. The gender distribution shows that female patients have a frequency of 32, and its percentage is 45.7% of the sample. The male patients included 38 frequency and its percentage is 54.3%.

4.2 Pie Chart of gender



4.3 Table Description about Clinical finding diabetes

In this study, a total of 70 patients were included. Out of these, 36 patients did not have diabetes, while 34 patients were diagnosed with diabetes. This shows that the number of diabetic and non-diabetic patients is almost equal, with a slightly higher number of patients without diabetes.

Diabetes		
	Frequency	Percent
No	36	51.4
Yes	34	48.6
Total	70	100.0

4.3 Pie Chart of clinical finding diabetes

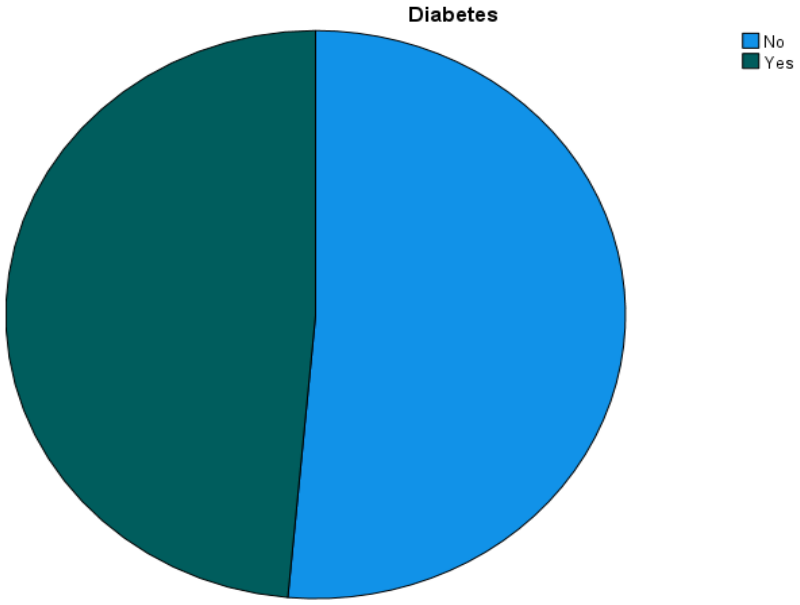


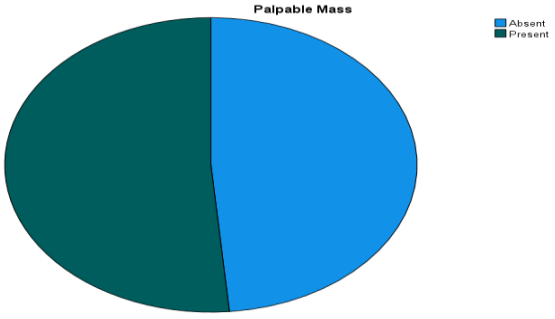
Table no 4: Clinical findings Palpable mass

Palpable Mass		
	Frequency	Percent
Absent	34	48.6
Present	36	51.4
Total	70	100.0

A total of 70 patients were included in this study. Out of these, a palpable mass was present in 36

We included a total of 70 patients in this study. The age distribution shows that patients aged less than 40 years have a frequency of 14, and its percentage is 20.0% of the sample. The age group 40–50 years includes 9 patients (12.9%). Patients aged 50–60 years have a frequency of 13, representing 18.6%. The majority of patients belong to the age group above 60 years, with a frequency of 34 and a percentage of 48.6%.

4.4 Pie Chart of clinical palpable mass

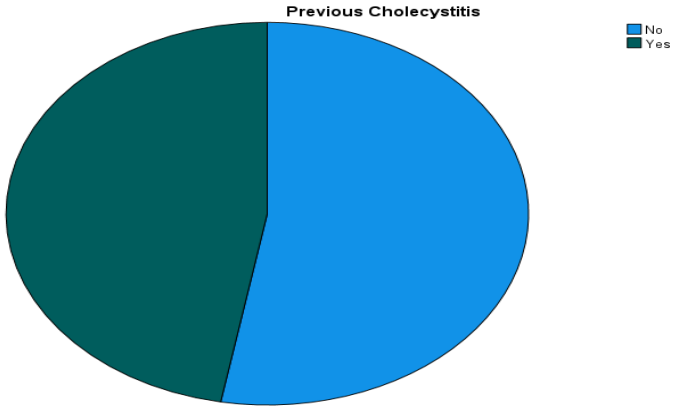


4.5 Table Description about Clinical findings previous cholecystitis

Among the 70 patients studied, 33 patients (47.1%) had a history of previous cholecystitis, while 37 patients (52.9%) had no such history. The distribution shows that slightly more than half of the patients had no prior episode of cholecystitis.

Previous Cholecystitis		
	Frequency	Percent
No	37	52.9
Yes	33	47.1
Total	70	100.0

4.5 Pie Chart of clinical findings previous cholecystitis

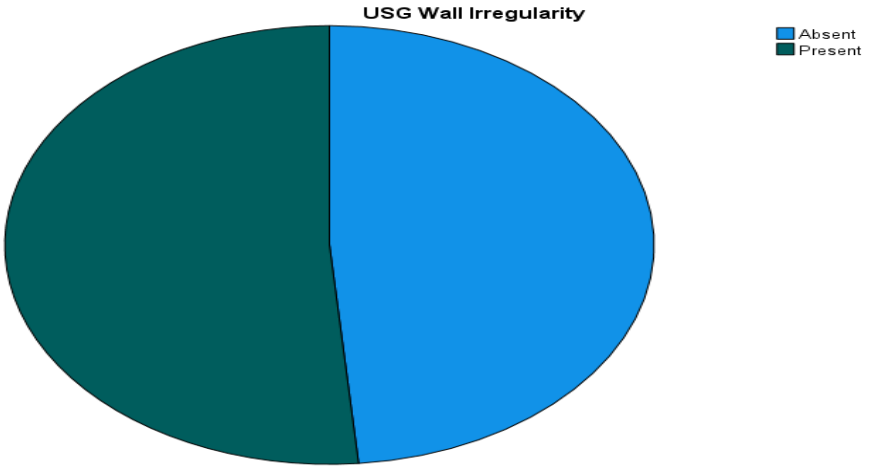


4.6 Table Description about USG wall irregularity

This table shows that USG wall irregularity was detected in 36 patients (51.4%) whereas it was absent in 34 patients (48.6%). The findings show an almost equal distribution, with a slightly higher proportion of patients showing wall irregularity.

USG Wall Irregularity		
	Frequency	Percent
Absent	34	48.6
Present	36	51.4
Total	70	100.0

4.6 Pie Chart of USG wall irregularity

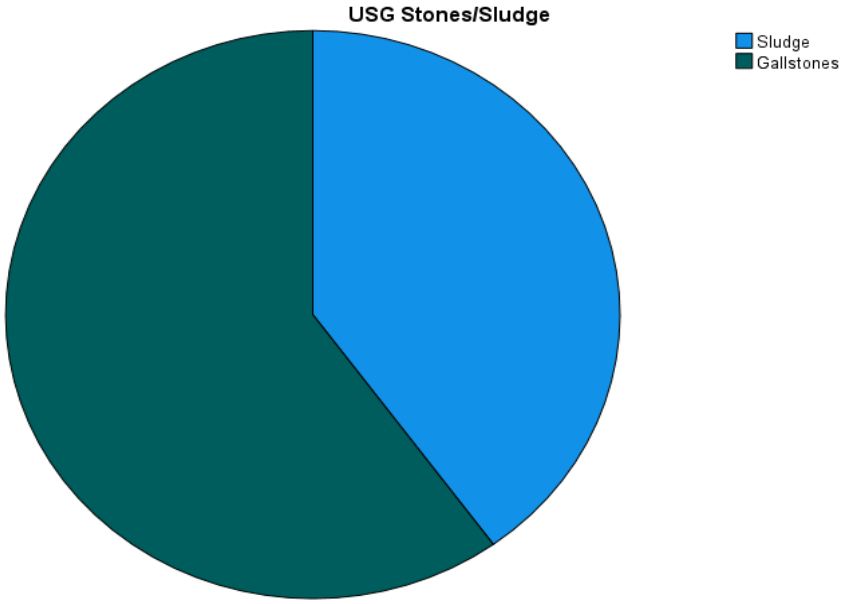


4.7 Table Description about USG stones/sludge

This table shows that we included total 70 patient in our study. Out of 70 patients, 42 (60%) had gallstones on ultrasound while 28 (40%) showed sludge. So gallstones were more common than sludge in this group, with a clear 60:40 split.

USG Stones/Sludge		
	Frequency	Percent
Sludge	28	40.0
Gallstones	42	60.0
Total	70	100.0

4.7 Pie Chart of USG stones/sludge

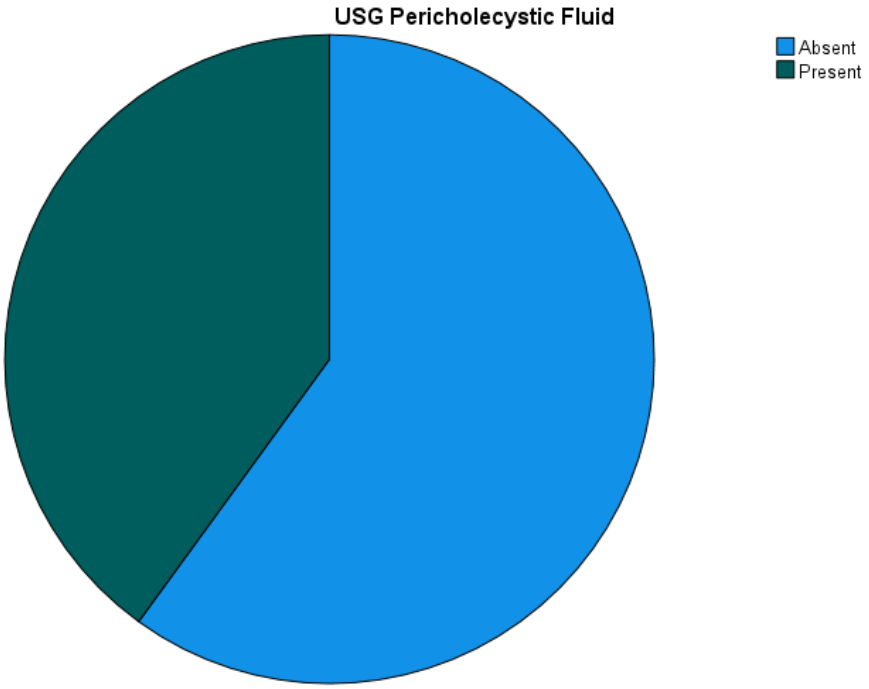


4.8 Table Description about USG pericholecystic fluid

Pericholecystic fluid was absent in 42 patients (60%) and present in 28 patients (40%). This means most patients in the study did not have pericholecystic fluid on USG

USG Pericholecystic Fluid		
	Frequency	Percent
Absent	42	60.0
Present	28	40.0
Total	70	100.0

4.8 Pie Chart of USG Pericholecystic Fluid

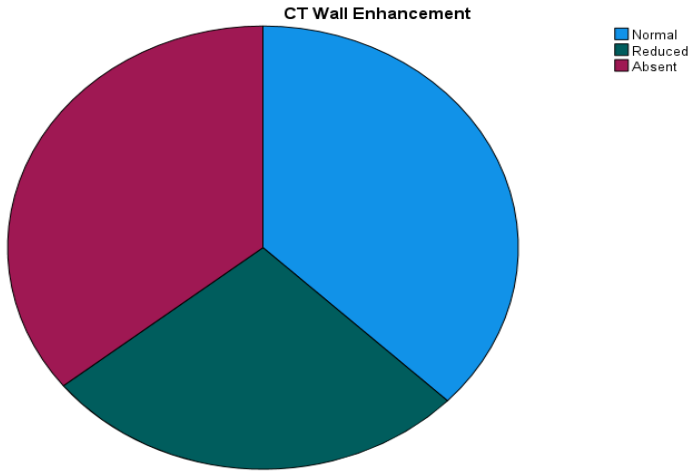


4.9 Table Description about Clinical findings CT wall enhancement

On CT scan, wall enhancement was normal in 26 patients (37.1%), absent in 25 patients (35.7%), and reduced in 19 patients (27.1%). The distribution is fairly spread out, but "normal" enhancement was seen most often, followed closely by "absent" enhancement.

CT Wall Enhancement		
	Frequency	Percent
Normal	26	37.1
Reduced	19	27.1
Absent	25	35.7
Total	70	100.0

4.9 Pie Chart of CT Wall Enhancement

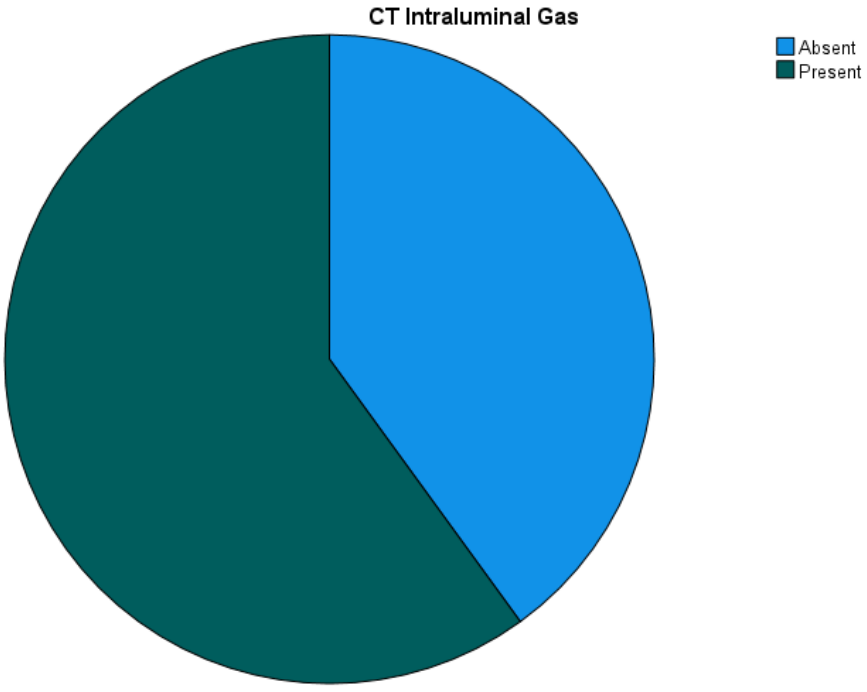


4.10 Table Description about CT findings Intraluminal gas

On CT imaging, intraluminal gas was present in 42 out of 70 patients (60%) and absent in 28 patients (40%). So a majority of the cases in this study showed intraluminal gas.

CT Intraluminal Gas		
	Frequency	Percent
Absent	28	40.0
Present	42	60.0
Total	70	100.0

4.10 Pie Chart of CT findings Intraluminal gas

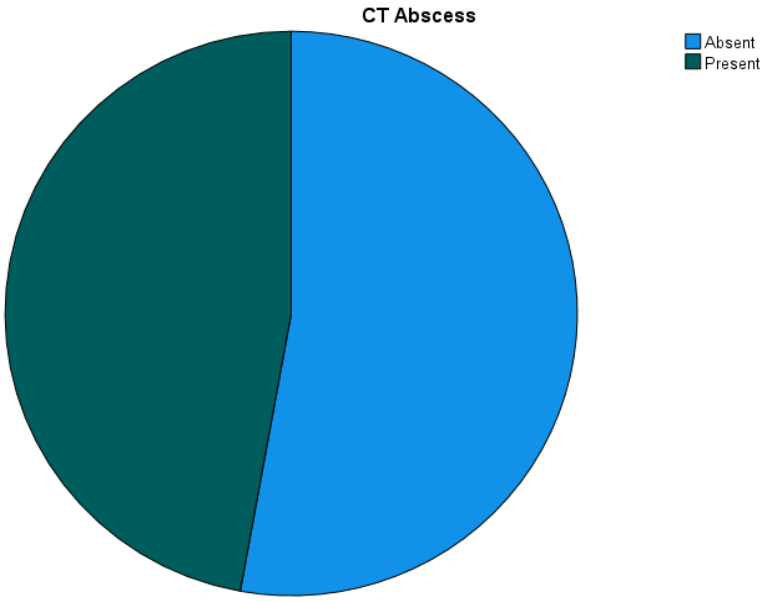


4.11 Table Description about CT finding Abscess

An abscess was identified on CT in 33 patients (47.1%), while it was absent in 37 patients (52.9%). The numbers are very close, with slightly more than half of patients showing no abscess.

CT Abscess		
	Frequency	Percent
Absent	37	52.9
Present	33	47.1
Total	70	100.0

4.11 Pie Chart of CT Abscess

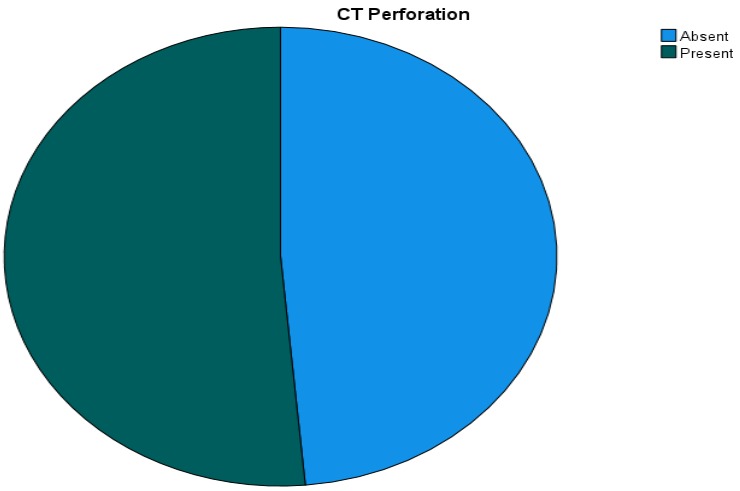


4.12 Table Description about CT perforation

The frequency and percentage distribution of CT perforation among the 70 patients included in this study. CT perforation was absent in 34 patients, representing 48.6% of the total study population.CT perforation was present in 36 patients, accounting for 51.4% of the total study population.

CT Perforation		
	Frequency	Percent
Absent	34	48.6
Present	36	51.4
Total	70	100.0

4.12 Pie Chart of CT Perforation

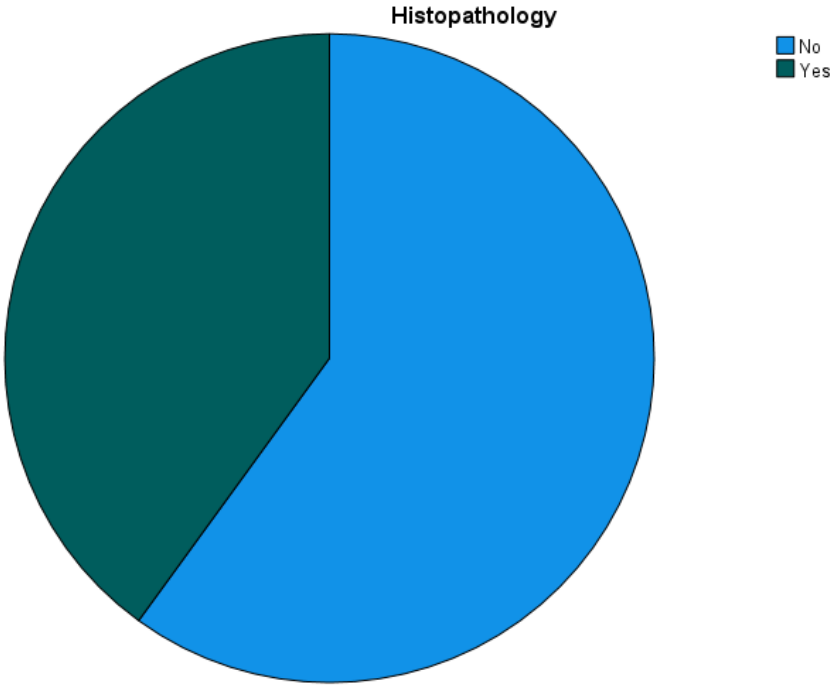


4.13 Table Description about Histopathology

This table shows the frequency and percentage distribution of histopathological findings among the 70 patients included in our study. No Histopathological evidence was absent in 42 patients, representing 60.0% and Histopathological evidence was present in 28 patients, accounting for 40.0% of the total study population. The table demonstrates that the absence of histopathological evidence was observed more frequently than its presence.

Histopathology		
	Frequency	Percent
No	42	60.0
Yes	28	40.0
Total	70	100.0

4.13 Pie Chart of Histopathology

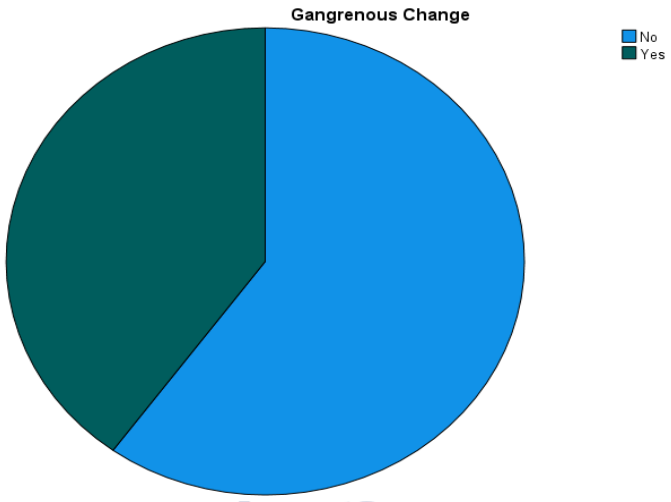


4.14 Table Description about gangrenous change

Table summarizes the distribution of gangrenous change observed in our study population of 70 patients. Among the total cases, 42 patients (60.0%) did not show evidence of gangrenous change. Gangrenous change was identified in 28 patients, which corresponds to 40.0% of the study.

Gangrenous Change		
	Frequency	Percent
No	42	60.0
Yes	28	40.0
Total	70	100.0

4.14 Pie Chart of gangrenous change



Limitation:

The present study contributes valuable evidence from a local Pakistani healthcare setting, where data on the comparative diagnostic performance of USG and CECT for gangrenous cholecystitis remains limited. The findings reinforce the need for integrating CECT into the diagnostic workup of patients with clinically suspected gangrenous cholecystitis, particularly when ultrasound findings are equivocal, and support the development of standardized imaging protocols to improve early diagnosis and patient outcomes.

Recommendation:

Combined clinical and imaging assessment is recommended, especially in high-risk patients due to limited sample size and operator dependence of ultrasound, further large-scale studies are needed before establishing a standardized diagnostic protocol for routine clinical practice.

CONCLUSION:

This study of 70 gangrenous cholecystitis patients, mostly elderly diabetic males with RUQ pain and vomiting, compared USG vs CECT. USG showed distension, wall irregularity, and sludge with sludge significantly linked to GC ($p = 0.017$) but was limited by operator dependence and low sensitivity. CECT had superior diagnostic accuracy, reliably detecting abscess and perforation. Thus, CECT is recommended for definitive diagnosis when GC is suspected, USG as first-line screening, and combined use is most effective.

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