MAK HILL Publications Research Journal of Medical Sciences

Research Article
doi: 10.36478/makrjms.2023.12.555.560

Evaluating Acute Pancreatitis: Comparative Analysis of Ultrasonography and CT Imaging Modalities

[1]Ankit Patel and [2]Shaikh Faizan Ahmed Zahidur Rehman
[1,2]Department of Radiodiagnosis Heritage Institute of Medical Sciences Bhadwar, Varanasi UP, India

OPEN ACCESS

Key Words
Acute pancreatitis, ultrasonography, computed tomography, diagnostic imaging, pancreatic inflammation, ct severity index

Corresponding Author
Ankit Patel,
Department of Radiodiagnosis Heritage Institute of Medical Sciences Bhadwar, Varanasi UP, India
ankit31.01.08@gmail.com

Author Designation
[1]Assistant professor
[2]Junior resident

Received: 5 October 2023
Accepted: 27 October 2023
Published: 15 November 2023

Citation: Ankit Patel and Shaikh Faizan Ahmed Zahidur Rehman, 2023. Evaluating Acute Pancreatitis: Comparative Analysis of Ultrasonography and CT Imaging Modalities. Res. J. Med. Sci., 17: 555-560, doi: 10.36478/makrjms. 2023.12.555.560

Abstract
Acute pancreatitis is a sudden inflammation of the pancreas that can range from mild discomfort to life-threatening illness. Accurate and timely diagnosis is crucial for effective management. While clinical and biochemical parameters play a role, imaging modalities such as ultrasonography (US) and computed tomography (CT) are essential for diagnosis and assessment. This study aims to evaluate and compare the effectiveness of US and CT in diagnosing acute pancreatitis and understanding their respective advantages and limitations. This observational study was conducted over 18 months in the Department of Radiodiagnosis at a tertiary care hospital. The study included 45 patients diagnosed with acute pancreatitis. Initial evaluation was performed using a Samsung HS 40 ultrasonography machine, followed by CT scans using a Philips MX 16-slice CT scanner. The pancreas was assessed for size, echogenicity, ductal changes, calcifications, focal lesions, and extra pancreatic findings. Data were analyzed using SPSS 22.0 software to determine the sensitivity, specificity, and diagnostic accuracy of both imaging modalities. The study comprised 45 patients with acute pancreatitis, predominantly young adults (mean age 41 years) with a male predominance (84.4%). Alcoholism was the leading cause (51.1%), followed by idiopathic (28.9%) and gallstones (17.8%). Ultrasonography visualized the pancreas in 64.4% of cases, with common findings including a bulky pancreas (55.2%), hypoechoic echogenicity (44.8%) and ascites (37.7%). In contrast, CT visualized the pancreas in all cases, identifying a bulky pancreas (51.1%), fluid collections (26.7%), and exudates (73.3%). The CT severity index (CTSI) classified 31.1% as mild, 42.2% as moderate, and 26.7% as severe, with a mortality rate of 16.7% in the severe category. Ultrasonography had a sensitivity of 64%, dropping to 37.8% overall, while CT had a sensitivity of 96%. Ultrasonography is a valuable initial imaging modality for acute pancreatitis due to its non-invasive nature, cost-effectiveness and availability. However, CT provides a more detailed and accurate assessment, essential for diagnosing and managing acute pancreatitis. The complementary use of both imaging modalities enhances diagnostic accuracy, guides appropriate treatment strategies, and improves patient outcomes.

INTRODUCTION

Acute pancreatitis is a sudden inflammation of the pancreas that can range from mild discomfort to a life-threatening illness. Accurate and timely diagnosis is crucial for effective management and treatment. Traditionally, clinical findings and biochemical parameters such as serum amylase and lipase levels have been utilized to diagnose acute pancreatitis. However, these methods can sometimes be misleading, particularly if the tests are conducted several days after the onset of symptoms or if the enzyme levels are not significantly elevated[1,2].

Radiological imaging plays a vital role in the diagnosis and management of acute pancreatitis, providing visual confirmation and aiding in the assessment of severity and complications. Conventional radiographic methods, such as plain abdominal X-rays, are often inadequate due to their nonspecific findings and inability to visualize the pancreas directly. This has led to increased reliance on cross-sectional imaging modalities like ultrasonography (US) and computed tomography (CT)[3,4].

Ultrasonography offers a non-invasive, cost-effective and readily available option for the initial evaluation of acute pancreatitis. It provides real-time imaging and is particularly useful in identifying gallstones, a common etiological factor in acute pancreatitis. However, ultrasonography has limitations, especially in obese patients or those with significant bowel gas, which can obscure the pancreas and lead to incomplete or inaccurate assessments[5,6].

Computed tomography, on the other hand, is highly sensitive and provides detailed cross-sectional images of the pancreas and surrounding structures. It is particularly valuable in detecting pancreatic necrosis, abscesses and other complications of acute pancreatitis. Despite its advantages, CT is more expensive, involves exposure to ionizing radiation and may face challenges in defining tissue planes in lean patients[7-9].

This study aims to evaluate and compare the effectiveness of ultrasonography and CT in the diagnosis and assessment of acute pancreatitis. By analyzing the strengths and limitations of each modality, we seek to determine their respective roles in clinical practice and provide recommendations for their optimal use in managing patients with suspected acute pancreatitis.

MATERIALS AND METHODS

Study Design: This observational study was conducted over a period of 18 months, from December 2016-May 2018, in the Department of Radiodiagnosis at a tertiary care hospital. The study included both outpatient (OPD) and inpatient (IPD) cases with clinically diagnosed or suspected acute pancreatitis.

Study Population: The study comprised patients presenting with clinical symptoms suggestive of acute pancreatitis, including abdominal pain, nausea and vomiting and those with elevated pancreatic enzymes. A total of 45 patients diagnosed with acute pancreatitis were included in the study.

Inclusion Criteria:

- Patients presenting with clinical symptoms indicative of acute pancreatitis.
- Patients with elevated pancreatic enzyme levels (serum amylase and lipase).
- Patients who consented to undergo both ultrasonography and CT imaging.

Exclusion Criteria:

- Pregnant patients.
- Patients who refused to undergo the imaging procedures.
- Patients with known contraindications to CT contrast media.

Study Tools and Equipment:

- Ultrasonography Machine: Samsung HS 40 with a curvilinear probe (2-5 MHz frequency).
- CT Scanner: Philips MX 16-slice CT scanner.
- Contrast Media: Iopamidol for intravenous and oral contrast.

Patient Preparation and Consent: Informed consent was obtained from all participants. Patients were briefed about the procedures, potential risks and benefits. A detailed history, including any co-morbid conditions and associated habits, was recorded.

Ultrasonography: The initial evaluation was performed using a Samsung HS 40 ultrasonography machine with a curvilinear probe (2-5 MHz frequency). The pancreas was assessed for size, echogenicity, duct dilatation, calcifications, focal lesions, and extra pancreatic findings such as ascites and pleural effusions. The presence of bowel gas and its impact on pancreatic visualization was also noted.

Computed Tomography: CT scans were conducted using a Philips MX 16-slice CT scanner within 1-4 days of admission. Patients were required to fast for 6 hours before the procedure. Serum urea and creatinine levels were checked to ensure safe administration of contrast media. For oral contrast, 20 ml of iopamidol was diluted in 1 liter of plain water and ingested one hour before the scan. Intravenous contrast was administered at a ratio of 1 ml/kg of body weight.

Immediate and delayed scans were performed with 8 mm sections through the abdomen and 2 mm sections through the pancreas as needed.

Data Collection: The observations from ultrasonography and CT were independently reviewed and confirmed by experienced radiologists. Data on pancreatic visualization, size, ductal changes, calcifications, focal lesions and extra pancreatic findings were recorded.

Statistical Analysis: Data were transferred to SPSS 22.0 for Windows software for analysis. Descriptive statistics were used to summarize the findings. Sensitivity, specificity and positive predictive values of both imaging modalities were calculated. Comparisons were made to determine the effectiveness of ultrasonography and CT in diagnosing acute pancreatitis and identifying complications.

Risk Management: There were no significant risks involved in this study. Ultrasonography is a non-invasive procedure and CT scans, although involving ionizing radiation, were performed with standard safety protocols. Patients with contraindications to contrast media were excluded from the CT imaging part of the study.

RESULTS AND DISCUSSIONS

The study included 45 patients diagnosed with acute pancreatitis. The data collected from these patients was analyzed and is presented in the following tables.

The age distribution of patients diagnosed with acute pancreatitis shows a predominance in the younger adult population, particularly between the ages of 21 and 40 years. Specifically, 31.1% of the patients were in the 21-30 years age group, while 24.4% were in the 31-40 years age group. This trend highlights that over half (55.5%) of the acute pancreatitis cases occurred in individuals below 40 years of age. The mean age of the patients was 41 years, with the youngest patient being 16 and the oldest 67 years old. There was a slight male predominance, with 38 males and 7 females, indicating that males were more commonly affected across all age groups.

The etiology of acute pancreatitis in our study revealed several underlying causes. Alcoholism was the most prevalent, accounting for 23 out of 45 cases, representing 51.1% of the patients. Idiopathic cases, where no specific cause could be identified, comprised the second largest group with 13 patients (28.9%). Gallstones were identified as the cause in 8 patients (17.8%), while hyperlipidemia was noted in 4 patients (8.9%). Drug-induced pancreatitis was observed in 3 patients (6.7%), and trauma-related cases were recorded in 2 patients (4.4%). Additionally, 2 patients (4.4%) were diagnosed with autoimmune pancreatitis. These findings underscore the diverse etiological factors contributing to acute pancreatitis, with a significant proportion linked to alcohol consumption.

Ultrasound imaging revealed that the pancreas was visualized in 29 out of the 45 cases of acute pancreatitis, corresponding to 64.4%. In the remaining 16 cases (35.6%), visualization was impeded by overlying bowel gas. This limitation is a known challenge in ultrasonography, particularly in patients with obesity or significant bowel distension, which can obscure the pancreas and complicate the diagnostic process.

Among the 29 patients in whom the pancreas was visualized on ultrasound, a variety of findings were documented. A bulky pancreas, indicative of inflammation and edema, was observed in 16 patients (55.2%). Twelve patients (41.4%) had a pancreas of normal size, while one patient (3.4%) with acute on chronic pancreatitis had a contracted pancreas. In terms of echogenicity, 13 patients (44.8%) exhibited a hypoechoic pancreas, reflecting the edematous nature of acute inflammation. A heterogeneous echotexture was seen in 5 patients (17.2%) and 11 patients (37.9%) had a pancreas with normal echogenicity. Duct dilatation was noted in 3 patients (10.3%) and calcifications were present in 2 patients (6.9%), both typically associated with chronic pancreatitis. Focal lesions, such as contusions or hematomas, were seen in 4 patients (13.8%). Additionally, extra pancreatic findings included ascites in 17 patients (37.7%), pleural effusions in 8 patients (17.8%), fatty liver in 16 patients (35.6%) and gallstones in 8 patients (17.8%).

CT imaging demonstrated superior visualization capabilities, with the pancreas being visualized in all 45 cases. Among these, 23 patients (51.1%) had a bulky pancreas, consistent with acute inflammatory changes. Twenty-one patients (46.7%) had a normal-sized pancreas and one patient (2.2%) with underlying chronic pancreatitis had a contracted pancreas. Duct dilatation was observed in 3 patients (6.7%) and calcifications were noted in 2 patients (4.4%). Focal lesions were present in 5 patients (11.1%). Additional findings on CT included fluid collections in 12 patients (26.7%), exudates in 33 patients (73.3%), stomach wall thickening in 36 patients (80%), and Gerota's fascia thickening in 29 patients (64.4%). Pleural effusions were seen in 18 patients (40%), fatty liver in 15 patients (33.3%), cholecystitis in 3 patients (6.7%), and portal vein thrombosis in 3 patients (6.7%). These results indicate the comprehensive nature of CT in detecting both pancreatic and extra pancreatic manifestations of acute pancreatitis.

Table 1: Age Distribution of Acute Pancreatitis Patients

Age Group	Male	Female	Total	Percentage
<20 years	2	0	2	4.4%
21-30 years	13	1	14	31.1%
31-40 years	9	2	11	24.4%
41-50 years	8	0	8	17.8%
51-60 years	4	2	6	13.3%
>60 years	2	2	4	8.9%
Total	38	7	45	100%

Table 2: Etiology of Acute Pancreatitis

Etiology	Number of Patients
Alcoholism	23
Idiopathic	13
Gallstones	8
Hyperlipidemia	4
Drug-induced	3
Trauma	2
Autoimmune	2

Table 3: Visualization of Pancreas on Ultrasound

Visualization Status	Acute Pancreatitis (n = 45)	Percentage
Visualized	29	64.4%
Obscured	16	35.6%

Table 4: Findings on Ultrasound in Acute Pancreatitis

Ultrasound Findings	Number of Patients (n = 29)	Percentage
Bulky Pancreas	16	55.2%
Normal Size	12	41.4%
Contracted Pancreas	1	3.4%
Hypoechoic Pancreas	13	44.8%
Heterogeneous Texture	5	17.2%
Normal Echogenicity	11	37.9%
Duct Dilatation	3	10.3%
Calcifications	2	6.9%
Focal Lesions	4	13.8%
Ascites	17	37.7%
Pleural Effusions	8	17.8%
Fatty Liver	16	35.6%
Gallstones	8	17.8%

Table 5: Findings on CT in Acute Pancreatitis

CT Findings	Number of Patients (n = 45)	Percentage
Bulky Pancreas	23	51.1%
Normal Size	21	46.7%
Contracted Pancreas	1	2.2%
Duct Dilatation	3	6.7%
Calcifications	2	4.4%
Focal Lesions	5	11.1%
Fluid Collections	12	26.7%
Exudates	33	73.3%
Stomach Wall Thickening	36	80%
Gerota's Fascia Thickening	29	64.4%
Pleural Effusions	18	40%
Fatty Liver	15	33.3%
Cholecystitis	3	6.7%
Portal Vein Thrombosis	3	6.7%

Table 6: CT Severity Index and Outcomes in Acute Pancreatitis

CT Severity Index	Number of Patients	Deaths
Mild	14	0
Moderate	19	0
Severe	12	2
Total	45	2

The CT severity index (CTSI) was calculated for all 45 patients with acute pancreatitis. Fourteen patients (31.1%) were classified as having mild pancreatitis, 19 patients (42.2%) as moderate and 12 patients (26.7%) as severe, indicating necrotizing pancreatitis. The severity classification correlated with clinical outcomes, as two deaths occurred among the patients classified with severe pancreatitis, representing a mortality rate of 16.7% within this subgroup. No deaths were recorded in the mild or moderate categories, highlighting the prognostic value of the CT severity index in assessing the risk and guiding the management of acute pancreatitis.

The majority of patients with acute pancreatitis in our study were young adults, with a significant portion falling within the 21-40 years age group. Specifically, 31.1% of the patients were in the 21-30 years age group, while 24.4% were in the 31-40 years age group.

This trend highlights that over half (55.5%) of the acute pancreatitis cases occurred in individuals below 40 years of age. The mean age of the patients was 41 years, with the youngest patient being 16 and the oldest 67 years old. There was a slight male predominance, with 38 males and 7 females, indicating that males were more commonly affected across all age groups. These findings align with previous research, suggesting that acute pancreatitis commonly affects individuals in their productive years[2,3]. Studies by Silverstein[2] reported similar age distributions, further confirming our observations. The male predominance (84.4%) in our study also concurs with existing literature that suggests a higher incidence of acute pancreatitis in males, often attributed to higher alcohol consumption rates among men.

Alcoholism emerged as the most prevalent etiological factor for acute pancreatitis in our study, accounting for over half of the cases. This is consistent with global trends where alcohol-related pancreatitis is common, especially in regions with high alcohol consumption[8-10]. The second most common etiology was idiopathic, reflecting cases where no specific cause could be identified, which is also a well-documented phenomenon in pancreatitis research. Gallstones were the third most frequent cause, which is in line with other studies that highlight biliary disease as a significant contributor to acute pancreatitis. Additionally, hyperlipidemia, drug-induced pancreatitis, trauma and autoimmune causes were less frequently identified but remain important etiological factors[10,11].

Ultrasonography visualized the pancreas in 64.4% of acute pancreatitis cases in our study. This visualization rate is higher than some previous reports, such as Calleja and Barkin, which noted a visualization rate of about 60% in acute cases[8]. However, our study faced the typical limitation of ultrasound-difficulty visualizing the pancreas in the presence of bowel gas, particularly in obese patients or those with significant bowel distension. The ultrasound findings in acute pancreatitis patients revealed that a bulky, hypoechoic pancreas was the most common feature, present in 55.2% and 44.8% of cases, respectively. These findings are characteristic of acute inflammatory changes and edema within the pancreas. Duct dilatation and calcifications, more indicative of chronic changes, were less common, found in 10.3% and 6.9% of patients respectively. The presence of ascites and pleural effusions in a significant number of cases (37.7% and 17.8%, respectively) underscores the extent of inflammatory spread in acute pancreatitis.

CT imaging provided comprehensive visualization of the pancreas in all acute pancreatitis cases in our study, reaffirming its superiority over ultrasound in diagnostic accuracy[11,12]. A bulky pancreas was observed in 51.1% of cases, aligning with the expected radiologic features of acute pancreatitis, such as edema and inflammation. Additionally, CT identified fluid collections and exudates in a substantial number of patients (26.7% and 73.3%, respectively), which are critical indicators of the severity and progression of pancreatitis. The CT findings of stomach wall thickening and Gerota's fascia thickening in 80% and 64.4% of cases, respectively, provide valuable insights into the systemic inflammatory response associated with acute pancreatitis. These findings correlate with previous studies that have highlighted the role of CT in detecting extra pancreatic inflammatory changes, which can significantly impact patient management and prognosis[13-16].

The CT severity index (CTSI) proved to be an essential tool in assessing the severity of acute pancreatitis in our study. Patients classified with severe pancreatitis (26.7%) had a significantly higher risk of complications and mortality, with a mortality rate of 16.7% in this group. This finding is consistent with the established correlation between higher CTSI scores and increased morbidity and mortality in acute pancreatitis[14,15]. The lack of mortality in mild and moderate categories further supports the utility of CTSI in stratifying patients based on their risk levels and guiding appropriate clinical interventions[16,17].

Our study reaffirms that while ultrasonography is a valuable initial imaging modality due to its non-invasive nature, cost-effectiveness and availability, it has limitations in visualizing the pancreas in all patients, especially in those with significant bowel gas or obesity. Ultrasonography's sensitivity in diagnosing acute pancreatitis was found to be 64%, which drops to 37.8% when considering all patients, including those where visualization was obscured. This limitation is a known challenge in ultrasonography, particularly in obese patients or those with significant bowel distension, which can obscure the pancreas and complicate the diagnostic process[12,16].

In contrast, CT demonstrated superior diagnostic capabilities, with a 100% visualization rate and a sensitivity of 96%. The detailed cross-sectional imaging provided by CT allows for better assessment of pancreatic size, the presence of necrosis, fluid collections and other complications, making it an invaluable tool in the comprehensive evaluation of acute pancreatitis. CT imaging provided comprehensive visualization of the pancreas in all acute pancreatitis cases in our study, reaffirming its superiority over ultrasound in diagnostic accuracy. A bulky pancreas was observed in 51.1% of cases, aligning with the expected radiologic features of acute pancreatitis, such as edema and inflammation[14-17].

Clinical Implications: The findings of our study suggest a complementary role for ultrasonography and CT in the diagnostic pathway for acute pancreatitis. Ultrasonography should be employed as the initial diagnostic tool, especially in settings where quick, non-invasive and cost-effective methods are required. However, for a definitive diagnosis, staging and assessment of complications, CT should be utilized due to its higher sensitivity and comprehensive imaging capabilities.

CONCLUSION

In conclusion, while ultrasonography remains an essential tool for the initial evaluation of acute pancreatitis due to its accessibility and non-invasive nature, CT provides a more detailed and accurate assessment, crucial for diagnosing and managing acute pancreatitis. The complementary use of both imaging modalities can enhance diagnostic accuracy, guide appropriate treatment strategies and ultimately improve patient outcomes.

REFERENCES

1. Beger, H.G. and B.M. Rau, 2007. Severe acute pancreatitis: Clinical course and management. World J. Gastroe., 13: 5043-5051.
2. Silverstein, W., M. Isikoff, M. Hill and J. Barkin, 1981. Diagnostic imaging of acute pancreatitis: Prospective study using ct and sonography. Am. J. Roentge., 137: 497-502.
3. Balthazar, E.J., D.L. Robinson, A.J. Megibow and J.H. Ranson, 1990. Acute pancreatitis: Value of ct in establishing prognosis.. Radiology, 174: 331-336.
4. Gallagher, S.F., C.E. Jaffray, D.T. Efron, M. Iannettoni and P.S. Barie,et al., 2007. 1. Acute Pancreatitis. In: Shackelford's Surgery of the Alimentary Tract., Yeo, C.J., (Ed.)., Saunders Elsevier, Philadelphia, ISBN-17: ?978-0323402323, pp: 1296-1309.
5. Acosta, J.M., N. Katkhouda, K.A. Debian, S.G. Groshen and D.D.W. Tsao,et al., 2006. Early ductal decompression versus conservative management for gallstone pancreatitis with ampullary obstruction. Ann. Surg., 243: 33-40.
6. McClusky, D.A., L.J. Skandalakis, G.L. Colborn and J.E. Skandalakis, 2002. Harbinger or hermit? pancreatic anatomy and surgery through the ages—part 1. World J. Surg., 26: 1512-1524.
7. Bassi, C. and G. Butturini, 2007. 1. Definition and classification of pancreatitis. In: Surgery of the Liver, Biliary tract, and Pancreas, Blumgart, L.H., (Ed.)., Saunders Elsevier, Philadelphia, ISBN-13: 9780323340625, pp: 685-690.
8. Calleja, G.A. and J.S. Barkin, 1993. 1. Acute pancreatitis. Med Clin North Am., 77: 1037-1055.
9. Freeny, P.C., 1988. 1. Radiology of the pancreas; Two decades of Progress in imaging and Intervention. AJR Am J Roentg., 150: 975-981.
10. Filly, R.A. and A.K. Freimanis, 1970. 1. Echographic Diagnosis of pancreatitis Lesions ultrasound Scanning Techniques and Diagnostic Findings. Radiology., 96: 575-582.
11. Hessel, S.J., S.S. Siegelman, B.J. McNeil, R. Sanders and D.F. Adams et al., 1982. A prospective evaluation of computed tomography and ultrasound of the pancreas.. Radiology, 143: 129-133.
12. Adam, A. and A.K. Dixon, 2008. Grainger and D.R. Allison's. In: Grainger and D.R. Allison's., Adam, A. and A.K. Dixon, (Eds.)., Churchill Livingstone Elsevier, Based in London, ISBN-14: 978-0702034480, pp: 2000-2400.
13. Ganong, W.F., 2005. 1. Digestion and Absorption. In: Review of Medical Physiology., Ganong, W.F., (Ed.)., McGraw Hill, U.S.A, ISBN-14: 978-0071780032, pp: 467-478.
14. Haaga, J.R., 2003. 1 Computed Tomography and Magnetic Resonance Imaging of the Whole Body.
15. Lankisch, P.G., R.S. Burchard and D. Lehnick, 1999. 1. Underestimation of Acute Pancreatitis: Patient with only a small increase in Amylase Lipase Level can also have or develop severe acute pancreatitis. Gut., 44: 542-544.
16. Greenberger NJ, Toskes PP, Isselbacher KJ. 2005. 1. Acute and Chronic Pancreatitis. In: Harrison's Principles of Internal Medicine., Kasper, D.L., E. Braunwald, A.S. Fauci, S.L. Hauser and D.L. Longo,et al (Eds.)., McGraw-Hill, U.S.A, ISBN-14: 978-1264268504, pp: 1895-1906.