

Diagnostic Accuracy of CT Scan in Necrotizing Pancreatitis Taking Surgical findings as Gold Standard

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Abstract

Objective: To find out diagnostic accuracy of computed tomography (CT) for necrotizing pancreatitis in comparison with surgical findings (gold standard).

Method: This cross-sectional study was conducted in Department of Radiology, Jinnah Hospital, Lahore from January 2019 to December 2019. 165 patients clinically suspected to have necrotizing pancreatitis aged 30-70 of either gender constituted the study population. After taking informed consent, pre and post contrast CT scans of the abdomen were performed. These studies were then assessed by experienced consultant radiologist for presence or absence of necrotizing pancreatitis. These findings were then compared with surgical findings.

Results: Mean age of the study population was 47.45 with standard deviation of 8.34 years having male: female ratio of 1.5:1. Among patients diagnosed with necrotizing pancreatitis on CT, 82 turned out to be True Positive and 11 False Positive. On the other hand, there were 06 False Negative and 66 True Negative patients in those not diagnosed with necrotizing pancreatitis by CT ($p=0.580$). The diagnostic accuracy of computed tomography (CT) in necrotizing pancreatitis came out to be 89.70%.

Conclusion: Computed tomography (CT) has dramatically improved our ability of accurate detection of necrotizing pancreatitis and can improve patient care by guiding pre-operative management plan of these patients.

Keywords: acute pancreatitis, computed tomography, necrotizing pancreatitis

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Introduction

Acute pancreatitis starts with damage to acinar cells of pancreas. This releases activated enzymes into the pancreatic interstitium and surrounding tissue.¹ The ensuing inflammation can lead to a process which

can be classified as either edematous or necrotizing, each of which has different morphological features, disease course, management and prognosis.² The importance of differentiating between these 2 entities can be gauged from the fact that reported mortality rates of 1.5% in patients with mild interstitial pancreatitis³ jump to 15%–40% in patients with necrotizing pancreatitis.⁴ Not only does necrotizing pancreatitis carry a grave prognosis in comparison with interstitial pancreatitis, but within the subset of patients with necrotizing variety, the rate of organ failure and mortality also depends on the degree of necrosis.⁵ Necrosis occurs in a sizeable proportion of patients with pancreatitis seen in upto 20-30% of cases.⁶

Role of imaging in pancreatitis ranges from confirmation of diagnosis to grading the disease severity, detecting complications as well as therapeutic purposes. Albeit its limited diagnostic value, the first imaging undergone

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by most patients is ultrasound.⁷ However, CT scan is standard imaging modality for acute pancreatitis.⁴ Its most important role is in diagnosing necrosis, establishing its extent and detecting complications.⁸ Recently, pancreatic necrosis volume as calculated on CT has been shown to have a prognostic value as well, predicting the chances of readmission and re intervention in these patients.⁹ Takahashi Net al¹⁰ have shown sensitivity and specificity of CT scan in diagnosing necrotizing pancreatitis as 80.0% and 82.2% respectively. On searching the previous literature, we found limited data for using this non-invasive imaging modality in general practice for diagnosing necrotizing pancreatitis particularly in our part of the world. Thus, we planned this study to determine utility of computed tomography in diagnosing necrotizing pancreatitis.

Materials and Methods

This descriptive, cross-sectional study was conducted at Department of Diagnostic Radiology, Jinnah Hospital, Lahore from January to December 2019. Sample size of 165 cases was calculated keeping 95% confidence level, 7% margin of error for sensitivity and 9% margin of error for specificity and taking expected percentage of necrotizing pancreatitis i.e. 70.0%¹¹ with sensitivity 80.0%¹² and specificity 82.2%¹⁰ of computed tomography in diagnosing necrotizing pancreatitis. After taking permission from Ethical Committee, patients who fulfilled the inclusion criteria were selected through non-probability, consecutive sampling. All patients of either gender and aged 30-70 years who presented with clinical suspicion of necrotizing pancreatitis [presence of sudden onset abdominal pain (epigastric pain radiating to the back) and serum amylase > 400 U/L] with duration of symptoms <14 days were included. Patients with history of abdominal trauma or surgery, pregnant patients, those with chronic renal failure and those unwilling to undergo surgery were excluded. Furthermore, those patients who improved on conservative treatment and did not undergo surgery were subsequently excluded from the study.

After taking informed consent, patients underwent CT scans of the abdomen with administration of intravenous contrast on 16 slice CT scanner. All studies were read by a consultant radiologist having 5 years' experience of interpreting CT scans. Presence of pancreatic necrosis was specifically documented - this was defined as the presence of non-enhancing areas within the pancreatic parenchyma, having density of less than 30 HU on post

contrast images (Figures 1 and 2). Pancreatic necrosis was further graded as less than 30 % or more than 30% based on the extent of percentage of parenchyma showing density less than 30 HU. The patients were then followed up and those who did not undergo surgery were excluded. Those who underwent surgery according to the management decision based on their clinical status, were followed for their per operative findings. Then CT scan findings of patients were compared with surgical findings. Collected data was analyzed through computer software SPSS 20.0. Frequency and percentages were tabulated and used to calculate sensitivity, specificity and diagnostic accuracy.

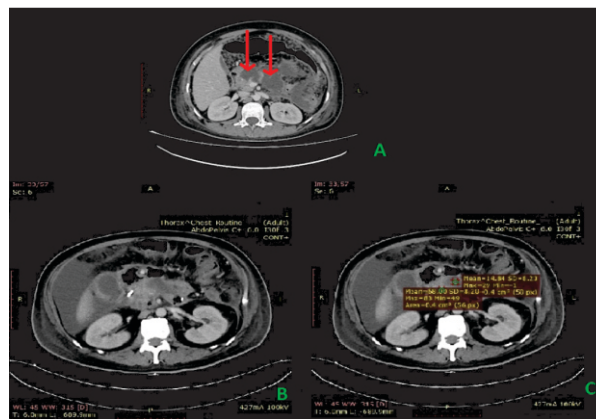


Fig-1: A) Axial CT scan section showing typical findings of non-enhancing areas in pancreas in necrotizing pancreatitis (red arrows) B) Axial CT scan in another patient shows areas of non enhancing pancreatic parenchyma in pancreatic head and neck which on drawing ROI show density of 14 HU as compared to 68 HU of normal enhancing pancreatic parenchyma (E)

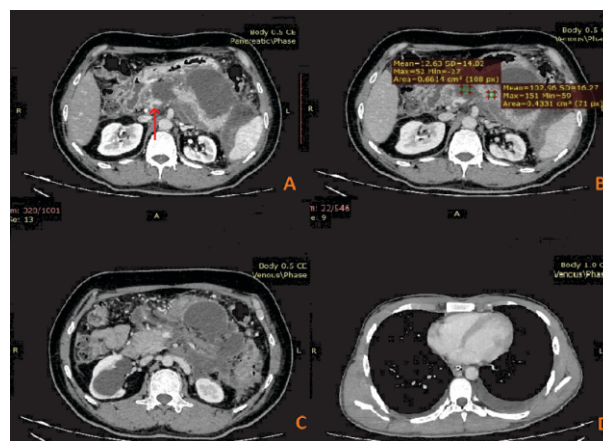


Fig-2: Axial CT sections in another patient show non enhancing areas in pancreas in a patient with necrotizing pancreatitis show A) thrombosis in portal vein B) non enhancing pancreatic parenchyma having density of less than 30 HU

12 HU as compared to 102 of normal enhancing pancreas
C) Extensive peripancreatic collections D) Bilateral pleural effusions

Results

The mean age of patients was 47.45 years with standard deviation of 8.34 years and range of 30-60 years. Majority (40.61%) were aged 41 to 50 years. 100 (60.61%) of them were male and 65 (39.39%) were females. Mean duration of disease was 6.76 ± 3.29 days. 68 (41.2%) had less than 30% pancreatic necrosis while 97 (58.8%) had more than 30% pancreatic necrosis. CT scan findings favoured diagnosis of necrotizing pancreatitis in 93 (56.36%) patients. Surgical findings confirmed necrotizing pancreatitis in 88 (53.33%) cases. Considering the findings on CT scan, there were 82 True Positive, 11 False Positive, 06 False Negative and 66 True Negative ($p=0.580$) (Table 1). Overall sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of computed tomography (CT) in diagnosing necrotizing pancreatitis was 93.68%, 85.71%, 88.17%, 91.67% and 89.70% respectively. Further analysis revealed no significant effect of age,

Table 1: 2 x 2 table comparing the findings of CT scan and surgery.

	Positive on CT	Negative on CT	Total	P-value
Positive on surgery	82	06	88	0.580
Negative on surgery	11	66	77	
Total	93	72		
Sensitivity = 93.68%				
Specificity = 85.71 %				
PPV = 88.17%				
NPV = 91.67%				
Accuracy = 89.70%				

gender, duration of disease or extent of pancreatic necrosis on the sensitivity, specificity, PPV, NPV and diagnostic accuracy of CT scan (p value ≥ 0.05).

Discussion

The diagnosis of pancreatitis requires a combination of clinical assessment and laboratory investigations particularly measurement of serum amylase and lipase levels. Once the diagnosis of acute pancreatitis has been established, role of imaging comes into play which further confirms the diagnosis, helps in detecting complications and assesses the disease severity. This includes classification of the disease into necrotizing and non-

necrotizing or interstitial edematous subtypes. It is an established fact that presence and extent of necrosis directly correlates with mortality rate in acute pancreatitis.¹³ The mortality rate has been shown to increase by 10-25 % if necrosis develops as compared to non-necrotizing acute pancreatitis. If this necrosis becomes secondarily infected, the mortality rate increases further. Hence there is a need for establishing the presence of necrosis as early as possible. Patient management, disease course and progression, therapeutic strategies all depend on presence and extent of necrosis. Assessment of necrosis has prognostic implications as well since there is an incidence of 2%–10% potentially lethal attacks in acute necrotizing pancreatitis.⁸ Thus, the early detection of pancreatic necrosis is crucial for this as well. Noninvasive investigations for pancreatitis have evolved rapidly in the last decade. An ideal test should be able to detect necrosis early, provide rapid results with high sensitivity, be easily available and be cost effective¹⁴ Different clinical criteria and laboratory investigations satisfy this criterion to a variable extent, each having its own advantages as well as limitations. With the advancements in imaging technology, it has come to the forefront for diagnosis of pancreatitis, particularly necrotizing variety. The role of imaging is not only limited to establishing diagnosis of necrotizing pancreatitis but also to determine underlying cause, grade the disease severity and identify complications. Additionally, therapeutic interventions can also be performed under image guidance.¹⁵ The decision to perform intervention in initial uncomplicated necrotizing pancreatitis is based on clinical condition, CT imaging or laboratory investigations.¹⁶

CT is the main diagnostic tool in acute necrotizing pancreatitis since it can determine the extent and severity of necrosis.¹⁷ Furthermore it is a prognostic tool because its findings have been shown to correlate well with outcome¹⁸ CT severity index established by Balthazar et al¹⁹ and later on modified by Morteale et al²⁰ have been found to correlate well with disease outcomes. Nevertheless, a CT scan performed earlier than 72 hours has limited accuracy in delineating necrotic areas.²¹ However, CT scan has a role in follow up too as well as for planning therapy.²² In a series,¹² length of hospital stay and development of complications showed an excellent correlation with pancreatic necrosis as detected on CT. Morbidity rates in necrotic vs non necrotic pancreatitis as defined on CT were 82 % and 6 % respectively. Similarly, there was 23 % mortality in case with necrosis

in comparison with no death in those without necrosis. Not only this, but extent of necrosis also correlated well with prognosis. Other investigators^{5,18} later confirmed the validity of these findings.

While it has been found that presence of necrosis correlates with prognosis, it does not predict percutaneous intervention success or failure.²³ Yet, it has been established that imaging modalities should be employed for detecting necrosis and pancreatic ductal disruption before minimally invasive procedures.²⁴ In fact, in certain special situations, CT has been found to detect pancreatitis even before serum lipase levels.²⁵ This study provided similar results showing that CT is a highly accurate technique for establishing diagnosis of necrotizing variety of acute pancreatitis.

Conclusion

This study concluded that computed tomography (CT) can dramatically improve our ability to accurately detect necrotizing pancreatitis and improve patient care by pre-operatively planning the proper management of patients.

Source of Funding

None

Conflict of Interest

None

References

1. Busireddy KK, AlObaidy M, Ramalho M, Kalubowila J, Baodong L, Santagostino I, et al. Pancreatitis-imaging approach. *World J Gastrointest Pathophysiol.* 2014; 5(3): 252–70.
2. Foster BR, Jensen KK, Bakis G, Shaaban AM, Coakley FV. Revised Atlanta classification for acute pancreatitis: a pictorial essay. *RadioGraphics.* 2016;36(3):675-87.
3. Chatila AT, Bilal M, Guturu P. Evaluation and management of acute pancreatitis. *World journal of clinical cases.* 2019 Jun;7(9):1006-20.
4. Bugiantella W, Rondelli F, Boni M, Stella P, Polistena A, Sanguinetti A, et al. Necrotizing pancreatitis: A review of the interventions. *International Journal of Surgery.* 2016;28.
5. Pal KM, Kasi PM, Tayyeb M, Mosharraf SM, Fatmi Z. Correlates of morbidity and mortality in severe necrotizing pancreatitis. *ISRN surgery.* 2012 ;2012:1-5.
6. Hughey M, Taffel M, Zeman RK, Patel S, Hill MC. The diagnostic challenge of the sequelae of acute pancreatitis on CT imaging: a pictorial essay. *Abdominal Radiology.* 2017 Apr 1;42(4):1199-209.
7. Shah AP, Mourad MM, Bramhall SR. Acute pancreatitis: current perspectives on diagnosis and management. *Journal of inflammation research.* 2018;11:77.
8. Freeman ML, Werner J, Van Santvoort HC, Baron TH, Besselink MG, Windsor JA, Horvath KD, Bollen TL, Vege SS. Interventions for necrotizing pancreatitis: summary of a multidisciplinary consensus conference. *Pancreas.* 2012 Nov 1;41(8):1176-94.
9. Liao Q, Ding L, Xu X, Yu C, Deng F, Xiong H, He W, Xia L, Zeng X, Lu N, Zhu Y. Pancreatic necrosis volume for predicting readmission and reintervention in acute necrotizing pancreatitis. *European Journal of Radiology.* 2022 Jun 22:110419.
10. Takahashi N, Papachristou GI, Schmit GD, Chahal P, LeRoy AJ, Sarr MG, et al. CT findings of walled-off pancreatic necrosis (WOPN): differentiation from pseudocyst and prediction of outcome after endoscopic Therapy. *Eur Radiol.* 2008;18:2522–29.
11. Chishty IA, Bari V, Haider Z, Rafique Z, Pasha S, Burhan D. Role of computed tomography in acute pancreatitis and its complications among age groups. *J Pak Med Assoc.* 2005;55:431.
12. Balthazar EJ, Robinson D, Megibow A. Acute pancreatitis: Value of CT in establishing prognosis. *Radiology* 1990; 174:331-6.
13. Maheshwari R, Subramanian RM. Severe acute pancreatitis and necrotizing pancreatitis. *Critical care clinics.* 2016;32(2):279-90.
14. Beger HG, Isenmann R. Diagnosis, Objective Assessment of Severity, and Management of Acute Pancreatitis: Santorini Consensus Conference. *International Journal of Gastrointestinal Cancer.* 1999;26(1):1–4.
15. Zerem E, Imamović G, Sušić A, Haračić B. Step-up approach to infected necrotising pancreatitis: a 20-year experience of percutaneous drainage in a single centre. *Dig Liver Dis.* 2011;43:478–83.
16. Dong X, Mao W, Ke L, Gao L, Zhou J, Ye B, Li G, Phillips A, Tong Z, Windsor J, Li W. The Diagnosis and Treatment of Local Complications of Acute Necrotizing Pancreatitis in China: A National Survey. *Gastroenterology research and practice.* 2021 Jul 10;2021.
17. Zerem E. Treatment of severe acute pancreatitis and its complications. *World Journal of Gastroenterology.* 2014;20(38):13879.
18. Brand M, Götz A, Zeman F, Behrens G, Leitzmann M, Brännler T, Hamer OW, Stroszczyński C, Heiss P. Acute necrotizing pancreatitis: laboratory, clinical, and imaging findings as predictors of patient outcome. *American Journal of Roentgenology.* 2014; 202(6): 1215-31.

19. Balthazar EJ. Acute pancreatitis: assessment of severity with clinical and CT evaluation. *Radiology* 2002; 223 (3): 603–13.
20. Mortelet K, Zou K, Banks P, Silverman S. A Modified Ct Severity Index For Evaluating Acute Pancreatitis: Improved Correlation With Patient Outcome. *Pancreas*. 2004;29(4):363.
21. Sahu B, Abbey P, Anand R, Kumar A, Tomer S, Malik E. Severity assessment of acute pancreatitis using CT severity index and modified CT severity index: Correlation with clinical outcomes and severity grading as per the Revised Atlanta Classification. *The Indian journal of radiology & imaging*. 2017;27(2):152.
22. Mortelet KJ, Ip IK, Wu BU, Conwell DL, Banks PA, Khorasani R. Acute pancreatitis: imaging utilization practices in an urban teaching hospital—analysis of trends with assessment of independent predictors in correlation with patient outcomes. *Radiology* 2011; 258(1):174–81.
23. Maatman TK, Mahajan S, Roch AM, Ceppa EP, House MG, Nakeeb A, Schmidt CM, Zyromski NJ. Disconnected Pancreatic Duct Syndrome Predicts Failure of Percutaneous Therapy in Necrotizing Pancreatitis. *Pancreatology*. 2020 Jan 28.
24. Sugimoto M, Sonntag DP, Traverso LW. Necrotizing Pancreatitis. In *The SAGES Manual of Acute Care Surgery* 2020 (pp. 235-246). Springer, Cham.
25. Tsai R, Sanchez LA, Yano M. CT identifies clinically unsuspected acute necrotizing pancreatitis complicating abdominal aortic repair. *Annals of Vascular Surgery*. 2020 Jan 7.

Authors Contribution

RS, AM: Conceptualization of Project

RS, AM, SA: Data Collection

ZI, AA: Literature Search

ZI, AA: Statistical Analysis

RS, AM, SA: Drafting, Revision

AM, SA, MM: Writing of Manuscript