Original Article

DOI: 10.7860/IJARS/2022/51279.2730

Radiology Section

Evaluation of Effect of Fatty Liver on the Severity of Acute Pancreatitis Using Computed Tomography- A Retrospective Study

VENKAT KISHAN TATIKONDA[1], SINDHURA INDURTI[2]

ABSTRACT

Introduction: Fatty Liver (FL) disease is commonly encountered in clinical practice and is frequently seen in patients with Acute Pancreatitis (AP) due to common risk factors such as obesity, alcohol abuse, and insulin resistance among others.

Aim: To evaluate the effect of FL on the severity of AP radiologically using Computed Tomography (CT).

Materials and Methods: This was a retrospective study, conducted from June 2021 to July 2021 in which plain CT images of patients with AP were reviewed to measure the mean attenuation values of the liver and spleen. A ratio of mean hepatic/splenic Hounsfield Units (HU) <1 was considered as FL. The severity of AP was assessed using the Modified CT Severity Index (CTSI) on Contrast Enhanced Computed Tomography (CECT) scan. Data collected was entered into Microsoft Excel datasheet and frequency (n) and percentages were calculated. Chi-square test was used to calculate the level of significance.

Results: A total of 50 patients (44 males and 6 females; mean age 35.58±13.792 years) with AP were included in this study amongst whom FL was found in 23 patients (46%) and non FL in 27 patients (54%). The severity of pancreatitis was significantly greater in patients with FL than patients without FL. AP patients with FL had higher rates of local complications like acute Peripancreatic Fluid Collections (PPFC) (56.5% vs 22.2% p<0.001) and Acute Necrotic Collections (ANC) (26.1% vs 3.7% p<0.001) than those without FL.

Conclusion: Fatty liver plays a significant role in the severity acute pancreatitis and can be used as an indicator for the same. Combined plain and contrast CT scans can be used to assess FL and diagnose and predict the severity of AP.

Keywords: Acute necrotic collections, Hepatic-splenic attenuation ratio, Peripancreatic fluid collections

INTRODUCTION

Acute pancreatitis (AP) is a condition characterised by acute inflammation of the pancreas and peripancreatic tissue. The most common causes are alcohol abuse, gallstones, abdominal surgeries, genetic mutations, infections, hyperlipidemia, hypercalcaemia, autoimmune diseases, pregnancy, and others [1,2]. The CECT is the imaging modality of choice in diagnosing AP and establishing the disease severity [2].

The AP usually has a mild course in most patients. However, few patients might develop a severe course which might lead to organ failure and subsequently to Multiple Organ Dysfunction Syndrome (MODS) which is associated with significant mortality and morbidity. In AP, the presence of necrosis carries a poorer prognosis and infected necrosis necessitates active intervention [3]. Hence, early diagnosis and prognostication of the severity of AP are necessary. Many scoring systems have been developed to assess the severity of AP and the most widely used is the revised Atlanta classification [2].

A common prognostic marker used in AP is serum C-Reactive Protein (serum CRP). Serum CRP level is cheap and easily available, but peaks 72 hrs after onset of symptoms and this delay makes it less useful at admission [4]. The FL disease can be alcoholic fatty liver disease or Non Alcoholic Fatty Liver Disease (NAFLD) which may be simple FL or steatohepatitis and further progress to cirrhosis and ultimately to liver failure.

The FL, frequently seen in patients with AP, is easily detectable on CT as decreased hepatic attenuation on non contrast images [5]. Albeit many studies have been conducted on the same subject, most of them have been conducted in other countries like China [3,6-9], Korea [4], USA [10,11], Mexico [12], Germany [13], and Croatia [14]. No studies have been conducted in India regarding the association between the severity of AP and FL. The present study aimed to assess the effect of FL on the severity of AP using CT scan, in a tertiary care centre in India.

MATERIALS AND METHODS

This was a retrospective study conducted at the Department of Radiodiagnosis, Kamineni Institute of Medical Sciences, Narketpally, Nalgonda, Telangana, India, on 50 patients diagnosed with AP referred for CECT of the abdomen, during a period from May 2019 to May 2021. Data was studied and analysed from June 2021 to July 2021 for a period of 2 months.

Inclusion criteria: All male and female patients, aged 5 years to 75 years, diagnosed with AP referred to the Department of Radiodiagnosis were included in the study. The presence of at least two of the following criteria was considered diagnostic for AP [6]: (i) acute abdominal pain consistent with AP (ii) raised serum lipase and/ or serum amylase levels more than three times the upper limit of normal and (iii) CT findings typical of AP.

Exclusion criteria: Those patients with history of pancreatic disease or with chronic liver disease, splenectomised patients or those with any history of malignancy were excluded from the study.

Study Procedure

The Modified Computed Tomography Severity Index (CTSI) used to assess the severity of pancreatitis was based on the Revised Atlanta classification for pancreatitis [Table/Fig-1] [15]. AP was classified into Acute Interstitial Edematous Pancreatitis (AIEP) and Acute Necrotising Pancreatitis (ANP), based on CECT findings and the existence of pancreatic necrosis [16]. Local complications included were acute Peripancreatic Fluid Collections (PPFC), Acute Necrotic Collections (ANC), Walled-Off Necrosis (WON), and Pancreatic Pseudocyst (PP). Other local complications considered were vascular complications like splenic or portal vein thrombosis. Systemic complications that were included were ascites and pleural effusion.

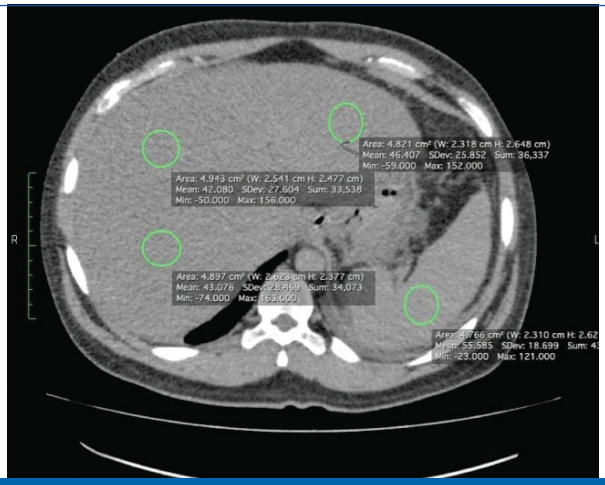
Plain CT images of the study population were retrospectively reviewed. The hepatic attenuation was normally higher than the

Prognostic indicator		Score
Pancreatic inflammation	Normal pancreas	0
	Intrinsic pancreatic abnormalities with or without inflammatory changes in peripancreatic fat	2
	Pancreatic or Peripancreatic Fluid Collection or peripancreatic fat necrosis	4
Pancreatic necrosis	No necrosis	0
	<30% necrosis	2
	>30% necrosis	4
Extrapancreatic complications	One or more of pleural effusion, ascites, vascular complications, parenchymal complication, or gastrointestinal complications	2
Maximum score		10

[Table/Fig-1]: Modified CT severity index (CTSI) for Acute Pancreatitis (AP).
Total Modified CTSI: 0-2- mild pancreatitis, 4-6: moderately severe pancreatitis, 8-10: severe pancreatitis [15].

splenic attenuation. Reversal of hepatic-splenic attenuation ratio is seen in patients with FL [5,17].

The mean attenuation values (HU) were measured for Regions Of Interest (ROIs) of area 400-500 mm^2 in the liver and spleen in two contiguous axial plain CT sections. In each section, three ROIs were placed in the liver (two in the right lobe of the liver and one in the left lobe) and one ROI was placed in the spleen [Table/Fig-2]. The mean hepatic HU and the mean splenic HU were calculated by averaging the values from both slices. The mean hepatic-splenic attenuation ratio was calculated and a ratio of less than 1 was regarded as FL.



[Table/Fig-2]: Plain Computed Tomography (CT) images of a patient with acute pancreatitis. The mean hepatic attenuation (43 HU) is significantly lower than the splenic attenuation (55 HU).

STATISTICAL ANALYSIS

Data was entered into a Microsoft Excel datasheet and was analysed using Statistical Software for Social Sciences (SPSS) version 22.0 (IBM SPSS Statistics, Somers NY, USA) software. Categorical data was represented in the form of Frequencies and proportions. The Chi-square test was used as a test of significance for qualitative data. Continuous data was represented as mean and standard deviation. The p-value (probability that the result is true) of <0.05 was considered as statistically significant after assuming all the rules of statistical tests.

RESULTS

A total of 66 patients underwent CECT for pancreatitis at the study centre during the given study period. Sixteen patients were excluded from the study: 7 patients had a previous history of pancreatitis or pancreatic disease, 4 patients had a history of chronic liver disease, 3 patients had undergone chemotherapy for malignancy and 2 patients were splenectomised.

Out of the 50 patients examined, 44 patients were male and 6 were female. The mean age of subjects was 35.58±13.792 years. The majority of subjects were in the age group 31 to 40 years (36%) [Table/Fig-3].

Age group (Years)	Male	Female	Total
≤20	3	3	6 (12.0%)
21-30	13	1	14 (28.0%)
31-40	18	0	18 (36.0%)
41-50	5	1	6 (12.0%)
51-60	3	0	3 (6.0%)
>60	2	1	3 (6.0%)
Total	44 (88%)	6 (12%)	50 (100%)

[Table/Fig-3]: Age and gender distribution of study population.

A total of 33 patients (66%) had AIEP, and 17 patients (34%) had ANP based on the revised Atlanta classification [Table/Fig-4]. Based on the modified CT severity score, patients were classified into mild disease, moderately severe disease, and severe disease. Mild pancreatitis was seen in 15 patients (30%), moderately severe pancreatitis in 21 patients (42 %), and severe pancreatitis was seen in 14 patients (28%).

Type of pancreatitis	Patients with fatty liver		Patients without fatty liver		Total	
	Number (n) of patients	%	Number (n) of patients	%	Number (n) of patients	%
Acute interstitial edematous pancreatitis (AIEP)	13	39.4%	20	60.6%	33	100%
Acute necrotising pancreatitis (ANP)	10	58.8%	7	41.2%	17	100%
Total	23	46.0%	27	54.0%	50	100%

[Table/Fig-4]: Distribution of type of pancreatitis among patients without FL and patients with FL (n=50).
χ^2=1.705, df=1, p=0.192

Of the total study population, FL was found in 23 patients (46%) of which 13 patients had AIEP (56.5%) and 10 had ANP (43.5%). A higher incidence of severe acute pancreatitis (OR 4.42, 95% CI) was found in patients with FL than those without FL. In the FL group, two patients had mild disease (8.6%), 11 patients had moderately severe disease (47.8%) and 10 had severe disease (43.5%). In the non FL group, 13 patients had mild disease (48.2%), 10 had moderately severe disease (37%) and four patients had severe disease (14.8%) [Table/Fig-5].

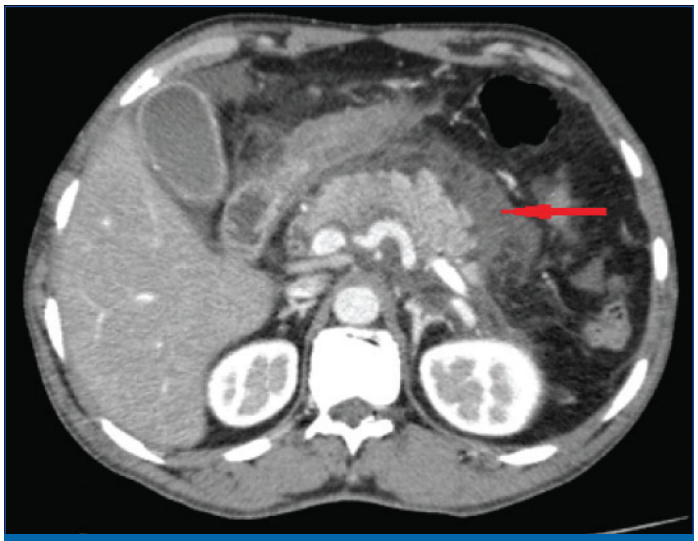
Severity of pancreatitis	Patients with fatty liver		Patients without fatty liver		Total		p-value
	Number of patients	%	Number of patients	%	Number of patients	%	
Mild pancreatitis	2	13.3%	13	86.7%	15	30.0%	**0.002***
Moderately severe pancreatitis	11	52.4%	10	47.6%	21	42.0%	0.441
Severe pancreatitis	10	71.4%	4	28.6%	14	28.0%	**0.024***
Total	23	100%	27	100%	50	100%	

[Table/Fig-5]: Severity of acute pancreatitis among patients without Fatty Liver (FL) and patients with FL (n=50).
χ^2=10.43; df=2; p=0.005*

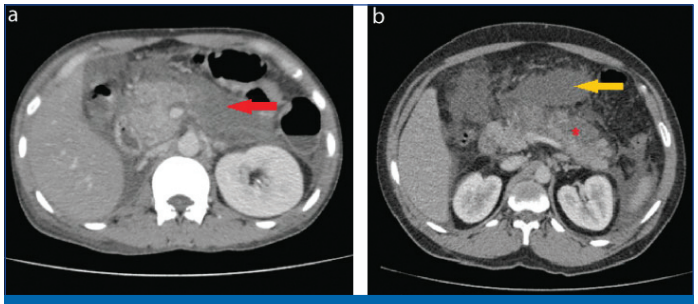
The number of patients with PPFC [Table/Fig-6], ANC [Table/Fig-7], WON [Table/Fig-8], and PP [Table/Fig-9] were 19 (38%), 7 (14%), 1 (2%), and 2 (4%), respectively in the study population [Table/Fig-10].

In the present study, the number of patients with ascites, pleural effusions, splenic vein thrombosis and portal vein thrombosis

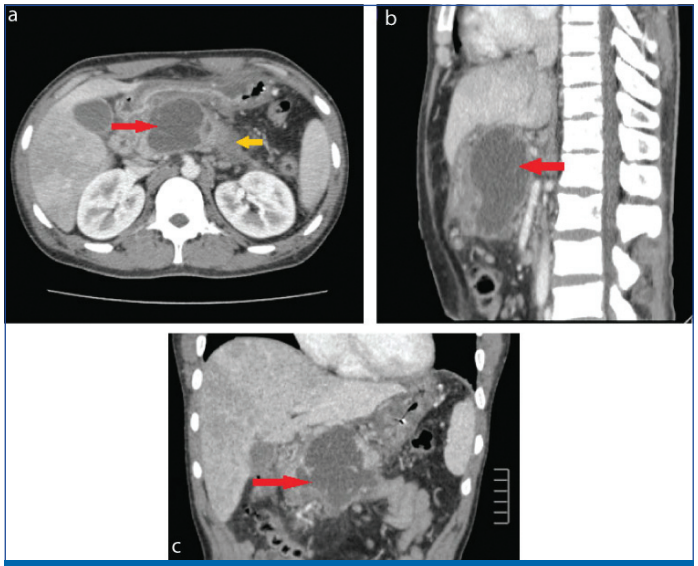
[Table/Fig-11] were 29 (58), 19 (38%), 9 (18%), and 1 (2%), respectively. In patients with FL, 17 patients (73.9%) had ascites, 12 (52.2%) patients had pleural effusions and 7 patients (30.4%) had splenic vein thrombosis. In patients without FL, 12 patients (44.4%) had ascites, seven patients (25.9%) had pleural effusions, one patient (3.7%) had portal vein thrombosis, and two patients (7.4%) had splenic vein thrombosis.



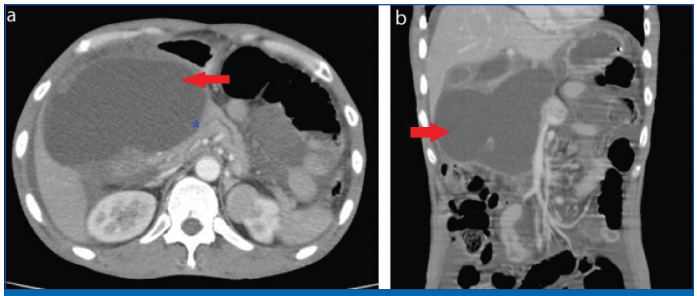
[Table/Fig-6]: CECT abdomen of a 45-year-old male with Acute Interstitial Edematous Pancreatitis (AIEP). Bulky and edematous pancreas with diffuse peripancreatic inflammatory changes with acute Peripancreatic Fluid Collection (PPFC) (red arrow).



[Table/Fig-7]: a) CECT abdomen of a 27-year-old male with severe Acute Necrotising Pancreatitis (ANP) with necrosis of the body and tail of pancreas and a poorly encapsulated collection in the region of body and tail of pancreas- Acute Necrotic Collection (ANC). (red arrow); b) CECT abdomen of a 29-year-old male with Acute Necrotising Pancreatitis (ANP) with heterogeneous enhancement of the pancreatic parenchyma with Non enhancing areas (*) and a poorly defined Acute Necrotic Collection (ANC) (yellow arrow).



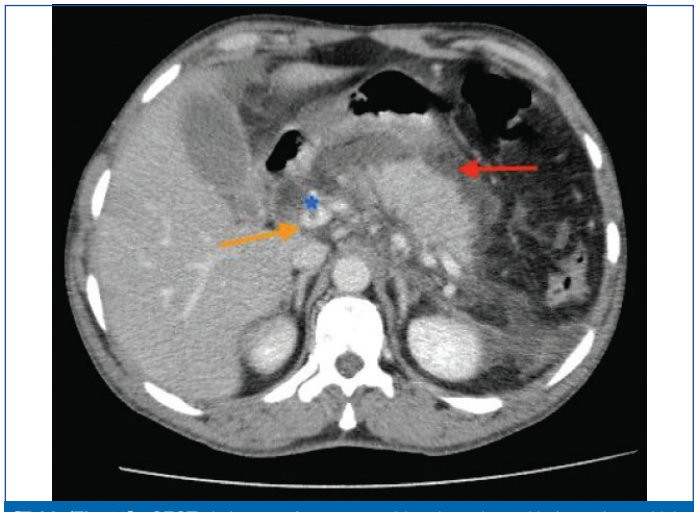
[Table/Fig-8]: CECT abdomen of a 27-year-old male patient with acute pancreatitis axial (a), sagittal (b), and coronal sections (c) showing a well-encapsulated heterogeneous collection with incomplete internal septations in the head and body of pancreas (red arrows) and extending to involve the extrapancreatic region inferiorly- suggestive of Walled Of Necrosis (WON). Significant peripancreatic fat stranding is seen (yellow arrow).



[Table/Fig-9a,b]: CECT abdomen of a 50-year-old patient with Acute Interstitial Edematous Pancreatitis (AIEP) showing a large, thin-walled peripherally enhancing multiloculated septate collection (red arrows) which is communicating with the MPD (*)- pseudocyst of pancreas (PP).

Presentations in study subjects	Fatty liver						p-value
	Patients with fatty liver (n=23)		Patients without fatty liver (n=27)		Total		
	Number of patients	%	Number of patients	%	Number of patients	%	
None	2	8.7%	19	70.4%	21	42.0%	**<0.001**
Peripancreatic Fluid Collection (PPFC)	13	56.5%	6	22.2%	19	38.0%	**0.01**
Acute Necrotic Collection (ANC)	6	26.1%	1	3.7%	7	14.0%	**0.02**
Pancreatic Pseudocyst (PP)	1	4.3%	1	3.7%	2	4.0%	0.9
Walled off necrosis (WON)	1	4.3%	0	0	1	2.0%	0.2
Total	23	100%	27	100%	50	100%	

[Table/Fig-10]: Local complications of acute pancreatitis among patients without Fatty Liver (FL) and patients with Fatty Liver (FL).
χ^2=20.72; df=4; p <0.001*



[Table/Fig-11]: CECT abdomen of a 45-year-old male patient with Acute Interstitial Edematous Pancreatitis (AIEP) showing a Non enhancing Non occlusive hypodense thrombus (*) in the extrahepatic portion of the portal vein (yellow arrow). Note the oedematous pancreas with significant Peripancreatic Fluid Collection (PPFC) (red arrow) and left perinephric collection.

DISCUSSION

The present study was done to analyse the effect of fatty liver on the severity of acute pancreatitis radiologically using CT and depicted a significant association between the two. Patients with FL had a higher incidence of severe acute pancreatitis (OR 4.42, 95% CI) than those without FL which is similar to studies conducted by Xu C et al., Yoon S et al., Wu D et al., and Mikolasevic I et al., [3,4,6,14].

In the present study, acute pancreatitis patients with FL also had higher rates of local complications like acute PPFCs (56.5% vs 22.2% p<0.01) and ANC (26.1% vs 3.7% p<0.02) than patients without FL which is similar to findings by Yoon S et al., who found that acute PPFCs (52.9% vs 24.1%, p<0.001) and ANC (20.9% vs 10.5%, p=0.046) were higher in the FL group than the Non FL group

[4]. However, there was no significant difference in the occurrence of PP (4.3% vs 3.7%, p>0.05) in this study between the patients with FL and the patients without FL which differs from the findings of Yoon S et al., who found significantly higher rates of PP (44.8% vs 20.3%, p<0.001) and WON (14.9% vs 3%, p=0.006) in the FL group than the Non FL group [4].

In a meta-analysis conducted by Váncsa S et. al., [18] the authors found that the odds of moderately severe acute pancreatitis and severe acute pancreatitis (OR=3.14, CI 1.87-5.25) and severe acute pancreatitis alone (OR=2.67, CI 2.01-3.56)were higher in the FL group compared to the Non FL group [18]. The authors also found that the proportion of acute PPFCs (44.55% vs 17.73%) and ANC (34.83% vs 15.75%) were higher in the FL group than the Non FL group. These findings are identical to the findings of the current study.

The pathophysiology as to why FL is associated with a more severe course of acute pancreatitis is yet to be studied. Raised levels of CRP have been found in patients with FL [19,20]. Hence, patients with FL are in a chronic pro-inflammatory state which might aggravate the course of AP. In the early stage of AP, FL can be diagnosed by CT scan, thus predicting the delayed peak of serum CRP, which can lead to early intervention and thereby help in decreasing morbidity and mortality.

Limitation(s)

Firstly, the current study being a retrospective study, the sample size was small. Second, it was a single centre study and there is a need for further research and verification in the future.

CONCLUSION(S)

Fatty liver is associated with a severe course of disease in acute pancreatitis patients and is also associated with a higher incidence of local complications, thereby increasing morbidity and mortality. CT scans are routinely performed in patients with acute pancreatitis, and fatty liver which can be detected in unenhanced phase images could serve as a useful prognostic marker.

REFERENCES

[1] Frossard J, Steer M, Pastor C. Acute pancreatitis. The Lancet. 2008;371(9607):143-52.
[2] Lankisch P, Apte M, Banks P. Acute pancreatitis. The Lancet. 2015;386(9988):85-96.
[3] Xu C, Qiao Z, Lu Y, Zhang D, Jia Z, Zhuang X, et al. Influence of fatty liver on the severity and clinical outcome in acute pancreatitis. PLOS ONE. 2015;10(11):e0142278.
[4] Yoon S, Lee I, Choi M, Lee K, Ham H, Oh H, et al. Impact of fatty liver on acute pancreatitis severity. Gastroenterology Research and Practice. 2017;2017:01-07. https://doi.org/10.1155/2017/4532320.
[5] Boyce C, Pickhardt P, Kim D, Taylor A, Winter T, Bruce R et al. Hepatic Steatosis (Fatty Liver Disease) in Asymptomatic Adults Identified by Unenhanced Low-Dose CT. American Journal of Roentgenology. 2010;194(3):623-628.
[6] Wu D, Zhang M, Xu S, Wu K, Wang N, Wang Y et al. Nonalcoholic Fatty Liver Disease Aggravated the Severity of Acute Pancreatitis in Patients. BioMed Research International. 2019;2019:4532320.
[7] Jia J, Wu Q, Kou J, Yang M. Relationship between fatty liver and pancreatitis. International Journal of Clinical Medicine. 2018;09(04):243-48.
[8] Xiao B, Zhang X, Jiang Z, Tang W, Huang X, Yang L, et al. Fatty liver in acute pancreatitis. Journal of Computer Assisted Tomography. 2012;36(4):400-05.
[9] Yuan L, Tang M, Huang L, Gao Y, Li X. Risk factors of hyperglycaemia in patients after a first episode of acute pancreatitis. Pancreas. 2017;46(2):209-18.
[10] Jasdanwala S. NAFLD diagnosed with abdominal ultrasound is a marker of severity in acute pancreatitis. Journal of Gastrointestinal & Digestive System. 2015;05(03). Doi: 10.4172/2161-069X.1000293.
[11] Satapathy S, Friedman B, Bittman M, Aronson S, Kwak N, Novak S, et al. Hepatic steatosis a novel marker for severe outcomes in patients with acute pancreatitis: 2011 ACG presidential poster. American Journal of Gastroenterology. 2011;106:S115-16.
[12] Morel-Cerda EC, Velarde-Ruiz VJA, Álvarez-López F, García-Jiménez ES, Rangel-Orozco MF, González-Álvarez R, et al. Prevalence of fatty liver in patients with acute pancreatitis. Rev Med MD. 2018;10(2):113-18.
[13] Suchsland T, Aghdassi A, Kühn K, Simon P, Lerch M, Mayerle J, et al. Predictive factors for and incidence of hospital readmissions of patients with acute and chronic pancreatitis. Pancreatology. 2015;15(3):265-70.
[14] Mikolasevic I, Orlic L, Poropat G, Jakopcic I, Stimac D, Klanac A et al. Nonalcoholic fatty liver and the severity of acute pancreatitis. European Journal of Internal Medicine. 2017;38:73-78. Doi: 10.1016/j.ejim.2016.10.019. Epub 2016 Nov 5.
[15] Banks P, Bollen T, Dervenis C, Gooszen H, Johnson C, Sarr M, et al. Classification of acute pancreatitis—2012: Revision of the Atlanta classification and definitions by international consensus. Gut. 2012;62(1):102-11.
[16] Garip G. Effects of disease severity and necrosis on pancreatic dysfunction after acute pancreatitis. World Journal of Gastroenterology. 2013;19(44):8065.
[17] Kodama Y, Ng C, Wu T, Ayers G, Curley S, Abdalla E, et al. Comparison of CT methods for determining the fat content of the liver. American Journal of Roentgenology. 2007;188(5):1307-12.
[18] Váncsa S, Németh D, Hegyi P, Szakács Z, Hegyi P, Pécsi D, et al. Fatty liver disease and non alcoholic fatty liver disease worsen the outcome in acute pancreatitis: A systematic review and meta-analysis. Journal of Clinical Medicine. 2020;9(9):2698.
[19] Oruc N, Ozutemiz O, Yuce G, Akarca U, Ersoz G, Gunsar F, et al. Serum procalcitonin and CRP levels in Non alcoholic fatty liver disease: A case-control study. BMC Gastroenterology. 2009;9(1). https://doi.org/10.1186/1471-230X-9-16.
[20] Yoneda M, Mawatari H, Fujita K, Iida H, Yonemitsu K, Kato S, et al. High-sensitivity C-reactive protein is an independent clinical feature of nonalcoholic steatohepatitis (NASH) and also of the severity of fibrosis in NASH. Journal of Gastroenterology. 2007;42(7):573-82.

PARTICULARS OF CONTRIBUTORS:
1. Associate Professor, Department of Radiodiagnosis, Kamineni Institute of Medical Sciences, Narketpally, Nalgonda, Telangana, India.
2. Resident, Department of Radiodiagnosis, Kamineni Institute of Medical Sciences, Narketpally, Nalgonda, Telangana, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Venkat Kishan Tatikonda,
1-2-234/25, Plot No: 12g, SBH Colony, Domalguda, Hyderabad, Telangana, India.
E-mail: venkatkishanresearch@gmail.com

PLAGIARISM CHECKING METHODS: [Jain H et al.]
- Plagiarism X-checker: Aug 18, 2021
- Manual Googling: Oct 14, 2021
- iThenticate Software: Oct 25, 2021 (12%)

ETYMOLOGY: Author Origin

AUTHOR DECLARATION:
- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? NA
- For any images presented appropriate consent has been obtained from the subjects. NA

Date of Submission: **Aug 17, 2021**
Date of Peer Review: **Sep 14, 2021**
Date of Acceptance: **Oct 15, 2021**
Date of Publishing: **Jan 01, 2022**