

To Assess the Severity of Acute Pancreatitis by Correlating the Levels of Serum Amylase and Lipase with Modified CT Severity Index

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Abstract

Background: Contrast enhanced CT is the investigation of choice for diagnosing acute pancreatitis. It also helps in assessing the severity of acute pancreatitis and is usually done after 72 hours of symptoms of the disease.

Objectives: 1. To correlate the levels of serum amylase and lipase with modified CT severity index in acute pancreatitis. 2. To assess the severity of acute pancreatitis by comparing levels of serum amylase and lipase with modified CT severity index.

Material and Methods: This prospective study was conducted on 50 patients with acute pancreatitis admitted to the surgical wards of M.M.I.M.S.R, Mullana during a period of October 2019 to September 2021. All the patients meeting the inclusion criteria were taken in this study. In these patients, the blood samples were taken before starting any treatment and estimation of serum amylase and lipase was performed within twenty-four hours, and on fifth and tenth day and CECT whole abdomen was done on 3rd day of admission and patients were graded according to the modified CT severity index according to CT findings.

Results: In this study of 50 patients, males were 33 and females were 17. Among these 32% patients were having edematous pancreatitis and 26% had pancreatic necrosis. Other CT findings like focal/diffuse pancreatic enlargement, peri-pancreatic fat stranding and peri-pancreatic fluid collection were present in 72%, 66% and 36% of the patients respectively. In our study most common etiology of acute pancreatitis was alcohol (70%). The diagnostic sensitivity of serum amylase and serum lipase acute pancreatitis were 44% and 72% respectively with CT showing 100% accuracy and sensitivity. In our study according to modified CT severity index majority were mild (58%) while rest were moderate (26%) and severe (16%).

Conclusion: Serial evaluation of biochemical markers (amylase and lipase) was done in acute pancreatitis patients for ten days showed that rise in lipase levels persisted longer than those of amylase. Serum lipase concentration ≥ 3 times the upper limit of the laboratory reference range is highly sensitive for diagnosing acute pancreatitis and corresponding value for amylase is moderately sensitive for the same. Computed tomography is the most sensitive and non-invasive imaging helps to differentiate the type of acute pancreatitis (edematous and necrotizing) which is not possible with serum lipase and amylase levels. The modified CT severity index aids in determining the extent of pancreatic necrosis and predicting the likelihood of local and systemic consequences. MCTSI grading (mild and moderate) correlated well with the serum amylase levels.

Keywords: Computed Tomography; Acute Pancreatitis; Modified CT Severity Index; Pancreatic Necrosis; Sensitivity

Introduction

Exudation of pancreatic fluid carrying proteolytic enzymes into the pancreatic interstitium and adjacent tissues causes acute pancreatitis, which triggers an inflammatory reaction.

Two of the following three characteristics are required for the diagnosis of acute pancreatitis [1]: (1) Epigastric pain that radiates to the back with a sudden onset (2) A rise in blood amylase and/or lipase levels to at least 3 times the upper limit of normal; and (3) Imaging features suggestive of acute pancreatitis on contrast-enhanced computed tomography (CECT), MRI, or transabdominal ultrasonography (US) investigations.

Cholelithiasis is the most prevalent cause in adults, followed by alcohol usage. Hypertriglyceridemia, drug-induced hypertriglycemia, and trauma are among of the other causes [3]. CT has the highest sensitivity and accuracy of all the imaging modalities for identifying acute pancreatitis [2]. CECT is the gold standard for detecting acute pancreatitis because it can detect pancreatic necrosis and extrapancreatic consequences [4]. When the scan is done within 24 - 48 hours of the commencement of the disease, the chances of identifying pancreatic necrosis are the best [5] When an abdominal CT scan reveals an enlarged pancreas (with or without necrosis) with peripancreatic fat stranding, as well as nearby thickening of facial planes and fluid collections, acute pancreatitis is suspected [6].

Material and Methods

It is a prospective study done on all clinically and biochemically suspected cases of acute pancreatitis (study sample = 50); referred to Department of General Surgery, MMIMSR in a span of 2 years. Patients were subjected to S. amylase and S. lipase on the day of admission, on 5th and 10th day. CECT whole abdomen was done after 72 hours of admission and scoring was based on MCTSI.

Inclusion criteria

Only adults of age > 18 years of both sexes will be included.

Exclusion criteria

Following cases will be excluded from the study:

- Cases of CKD or AKI who are not fit for CECT with pancreatitis
- Cases of trauma - blunt /penetrating/RTA presenting with pancreatitis
- Pregnant females with acute pancreatitis
- Patients below 18 years of age.

Assessment of severity

Modified CT severity index

Modified severity index = CT grade + percentage necrosis + extrapancreatic complications (points).

Mild (0 - 2), moderate (4 - 6), severe (8 - 10).

CT grade	Points
Normal pancreas	0
Inflammation - pancreas and/or peripancreatic fat	2
Pancreatic or peripancreatic fluid collection or peripancreatic fat necrosis	4

Percentage of pancreatic necrosis	Points
None	0
≤ 30%	2
> 30%	4

Extrapancreatic complications	Points
Pleural effusion, ascites, vascular complication, extrapancreatic parenchymal abnormalities or GI tract involvement	2

Results

In 50 cases of acute pancreatitis mean age was 44.48 ± 12.73 years. Patients aged 46 to 55 years were the most numerous [n = 16 (32%)], followed by those aged 36 to 45 years [n = 11 (22%)]. Patients ranged in age from 23 to 77 years old, with the majority of patients being under the age of 25 years old (Table 1). The majority of the patients (66 percent) were men (Table 2). Alcohol was the most common cause of AP in 35 (70%) patients, followed by GB/CBD calculi in 12 (24%) individuals, and hyperlipidemia in three (6%) patients (Table 3). Oedematous pancreatitis affected 16 of the patients (32%). A total of 13 (26%) patients experienced pancreatic necrosis, with 7 having less than 30 necrosis and 6 having more than 30 necrosis (Table 4). The common CT findings in our study: peripancreatic fat stranding was detected in 33 patients (66%) in our study, diffuse/focal enlargement of the gland was seen in 36 patients (72%), and peripancreatic fluid collection was seen in 18 individuals (36 percent) (Table 5). Serial evaluation of serum amylase and serum lipase were done on Day 1, Day 5 and Day 10 and correlated with MCTSI grading which showed significant decline in the serum amylase level on day 10 was appreciated in mild and moderate CT grade (p value - 0.004), whereas no variation in serum amylase levels was appreciated in severe CT grade (8-10) (Table 6 and 7). No significant change was appreciated in serum lipase levels on day 1, day 5 and day 10 with respect to CT grade (Table 8). Serum amylase has a 44 percent accuracy and sensitivity in diagnosing AP. Serum lipase has a 72 percent accuracy and sensitivity in diagnosing AP (Table 9). CT revealed 100 percent accuracy and sensitivity. The extrapancreatic complications were seen in 38 patients (76%) in our study (Table 10). In our investigation, pseudocyst was found in 18 individuals (36%) (Table 11). One patient (2 percent) had infected necrosis (Table 12). According to modified CT grading of pancreatitis, 29/50 (58%) patients had a score of 2 or 4, which was a major group of patients in our study, and 8/50 (16%) patients had a score of 8 or 10 (Table 13). In our study intervention was needed in the form of radiological guided aspiration of pseudocyst in 10% patients, fluid aspiration (pleural tap) without radiological guidance in 14% patients and major surgical (necrosectomy and cystogastrostomy) intervention in 4% patients (Table 14). In our investigation, there was no death attributable to pancreatitis.

		Frequency	Percent
Age	<= 25	4	8.0%
	26 - 35	10	20.0%
	36 - 45	11	22.0%
	46 - 55	16	32.0%
	> 55	9	18.0%
	Total	50	100.0%

Table 1: Distribution of patients according to age group.

		Sex					Chi-Square	p-value	
		Male	Female	Total					
Age	<= 25	2	6.1%	2	11.8%	4	8.0%	4.825	0.306
	26 - 35	4	12.1%	6	35.3%	10	20.0%		
	36 - 45	8	24.2%	3	17.6%	11	22.0%		
	46 - 55	12	36.4%	4	23.5%	16	32.0%		
	> 55	7	21.2%	2	11.8%	9	18.0%		
	Total	33	100.0%	17	100.0%	50	100.0%		

Table 2: Distribution of patients according to sex.

	Sex						Chi-Square	p-value
	Male	Female	Total					
Primary Causes Alcohol	32	97.0%	3	17.6%	35	70.0%	33.618	.0001**
GB/CBD Calculus	1	3.0%	11	64.7%	12	24.0%	23.399	.0001**
Hyperlipidemia	0	0.0%	3	17.6%	3	6.0%	6.195	.013*
Total	33	100.0%	17	100.0%	50	100.0%		

Table 3: Distribution of cases according to primary cause for acute pancreatitis.

		Sex					Chi-Square	p-value	
		Male	Female	Total					
Edematous Pancreatitis		11	33.3%	5	29.4%	16	32.0%	.079	.778
Necrotising Pan-creatitis	<30	4	12.1%	3	17.6%	7	14.0%	3.578	0.167
	>30	6	18.2%	0	0.0%	6	12.0%		
Total		33	100.0%	17	100.0%	50	100.0%		

Table 4: Types of acute pancreatitis.

	Sex						Chi-Square	p-value
	Male		Female		Total			
Peri-pancreatic fat stranding	19	57.6%	14	82.4%	33	66.0%	3.070	.080
Diffuse pan enlargement	16	48.5%	10	58.8%	26	52.0%	.480	.488
Peri-pancreatic fluid collection	12	36.4%	6	35.3%	18	36.0%	.006	.941
Total	33	100.0%	17	100.0%	50	100.0%		

Table 5: CT findings.

		N	Mean	Std. Deviation	F-value	p-value
AM-D1	< = 25	4	363.25	548.94	.940	.450
	26 - 35	10	777.80	975.69		
	36 - 45	11	590.09	551.26		
	46 - 55	16	305.94	623.28		
	> 55	9	637.00	456.33		
AM-D5	< = 25	4	215.75	274.05	.579	.679
	26 - 35	10	420.60	503.07		
	36 - 45	11	433.45	419.92		
	46 - 55	16	278.00	471.66		
	> 55	9	498.67	369.97		
AM-D10	< = 25	4	62.25	39.50	.974	.431
	26 - 35	10	92.70	45.49		
	36 - 45	11	148.00	160.49		
	46 - 55	16	115.50	174.34		
	> 55	9	203.67	187.00		

Table 6: Variation of serum amylase with age on day 1, day 5, and day 10.

Sex		N	Mean	Std. Deviation	t-value	p-value
AM-D1	Male	33	518.42	573.28	.126	.900
	Female	17	543.65	834.81		
AM-D5	Male	33	395.85	427.53	.461	.647
	Female	17	335.88	451.18		
AM-D10	Male	33	147.61	162.59	1.180	.244
	Female	17	94.94	119.25		

Table 7: Variation of serum amylase with sex on day 1, day 5, and day 10.

		N	Mean	Std. Deviation	F-value	p-value
LI-D1	< = 25	4	147.25	24.68	1.283	.291
	26 - 35	10	1144.20	793.35		
	36 - 45	11	1157.91	624.23		
	46 - 55	16	1106.31	1012.31		
	> 55	9	1138.33	908.23		
LI-D5	< = 25	4	134.50	20.81	1.250	.304
	26 - 35	10	1073.60	730.92		
	36 - 45	11	1064.09	586.64		
	46 - 55	16	1032.50	949.03		
	> 55	9	1054.56	888.05		
LI-D10	< = 25	4	114.25	22.87	1.227	.313
	26 - 35	10	998.40	692.51		
	36 - 45	11	996.36	557.78		
	46 - 55	16	954.13	909.57		
	> 55	9	980.67	832.28		

Table 8: Variation of serum lipase with age on day 1, day 5, and day 10.

Sex		N	Mean	Std. Deviation	t-value	p-value
LI-D1	Male	33	1140.88	897.98	1.008	.319
	Female	17	886.18	733.10		
LI-D5	Male	33	1070.97	849.21	1.129	.265
	Female	17	802.82	675.70		
LI-D10	Male	33	994.15	807.20	1.098	.278
	Female	17	746.24	642.72		

Table 9: Variation of serum lipase with sex on day 1, day 5, and day 10.

		N	Mean	Std. Deviation	F-value	p-value
AM-D1	Mild	29	386.345	699.535	2.110	.133
	Moderate	13	834.000	624.530		
	Severe	8	512.500	486.741		
AM-D5	Mild	29	291.897	440.259	1.905	.160
	Moderate	13	568.692	428.383		
	Severe	8	369.250	350.445		
AM-D10	Mild	29	112.414	142.028	6.245	.004**
	Moderate	13	362.077	333.479		
	Severe	8	171.750	174.929		

Table 10: Variation of serum amylase with MCTSI grading on day 1, day 5, and day 10.

Multiple Comparisons						
Dependent Variable: AM-D10 LSD						
(I) MCTSI		Mean Difference (I-J)	Std. Error	p-value	95% Confidence Interval	
					Lower Bound	Upper Bound
Mild	Moderate	-249.663	70.780	.001**	-392.053	-107.273
	Severe	-59.336	84.686	.487	-229.702	111.030
Moderate	Mild	249.663	70.780	.001**	107.273	392.053
	Severe	190.327	95.290	.052	-1.372	382.025
Severe	Mild	59.336	84.686	.487	-111.030	229.702
	Moderate	-190.327	95.290	.052	-382.025	1.372

*. The mean difference is significant at the 0.05 level.

Table 11: Least significant difference test among mild, moderate and severe MCTSI on day-10 amylase.

		N	Mean	Std. Deviation	F-value	p-value
LI-D1	Mild	29	860.76	711.22	2.338	.108
	Moderate	13	1453.38	1037.93		
	Severe	8	1107.25	833.27		
LI-D5	Mild	29	796.41	666.31	2.272	.114
	Moderate	13	1345.00	990.40		
	Severe	8	1051.13	778.03		
LI-D10	Mild	29	729.76	612.90	2.470	.095
	Moderate	13	1271.85	962.78		
	Severe	8	974.50	739.69		

Table 12: Variation of serum lipase with MCTSI grading on day 1, day 5, and day 10.

	Positive	Negative	Accuracy/Sensitivity	z-proportion	p-value
Serum amylase	22	28	44.0%	1.21	0.227
Serum lipase	36	14	72.0%	4.9	.0001**
CT	50	0	100.0%		.0001**

Table 13: Sensitivity of serum amylase, serum lipase and CT in diagnosing acute pancreatitis.

		Frequency	Percent
Extra-pancreatic Complication	Ascites	32	64.0%
	Bilateral pleural effusion	9	18.0%
	Left pleural effusion	7	14.0%
	Right pleural effusion	2	4.0%
	Splenic vein thrombosis	3	6.0%
	None	12	24.0%
	Total	50	100.0%

Table 14: Number of patients with extra-pancreatic complications on CT.

		Frequency	Percent
Pseudocyst	Present	18	36.0%
	Absent	32	64.0%
	Total	50	100.0%

Table 15: Number of patients with pseudocyst on CT.

		Frequency	Percent
Infected necrosis	Present	1	2.0%
	Absent	49	98.0%
	Total	50	100.0%

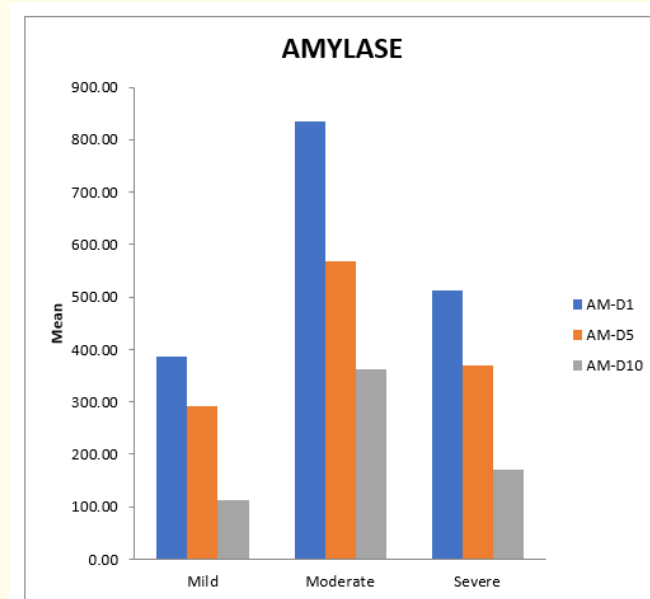
Table 16: Number of patients with Infected necrosis on CT.

		Frequency	Percent
MCTSI	Mild	29	58.0%
	Moderate	13	26.0%
	Severe	8	16.0%
	Total	50	100.0%

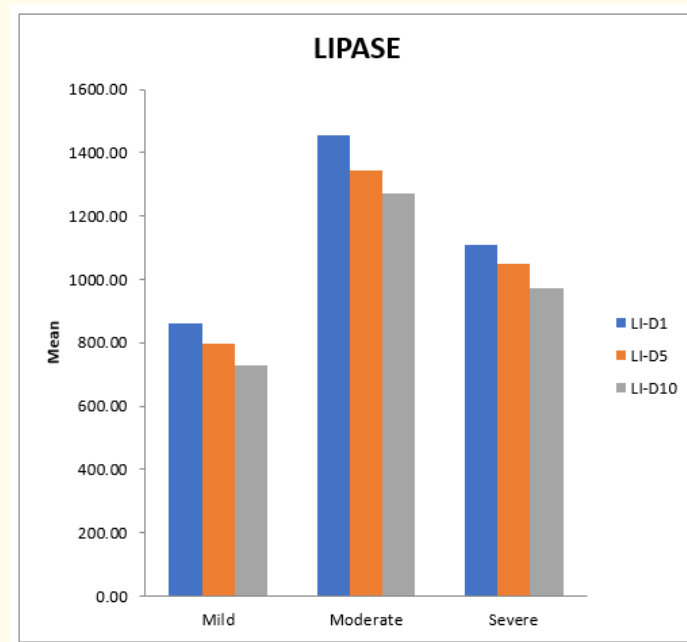
Table 17: Distribution of CT grade when AP is classified as mild, moderate and severe.

		Frequency	Percent
Intervention	Radiological guided-A, PC	5	10.0%
	Fluid Tap-A, PE	7	14.0%
	Surgery	2	4.0%
	None	36	72.0%
	Total	50	100.0%

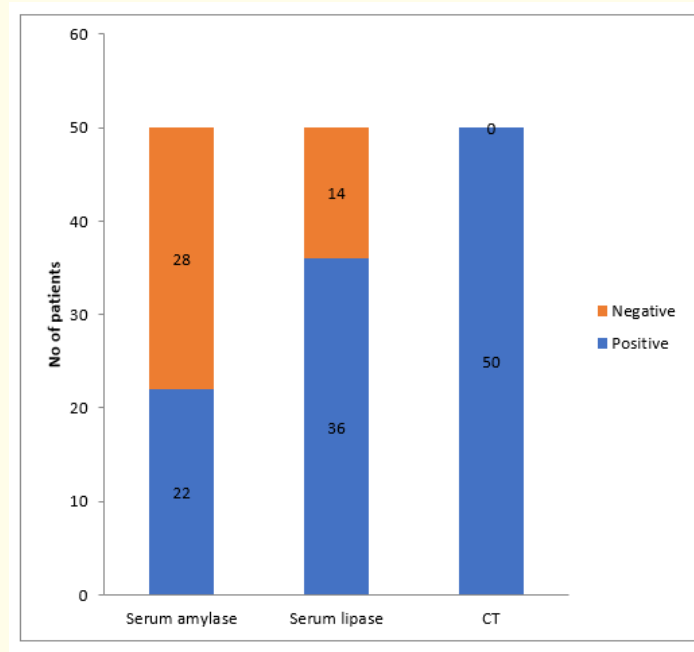
Table 18: Patients who needed Intervention in AP.



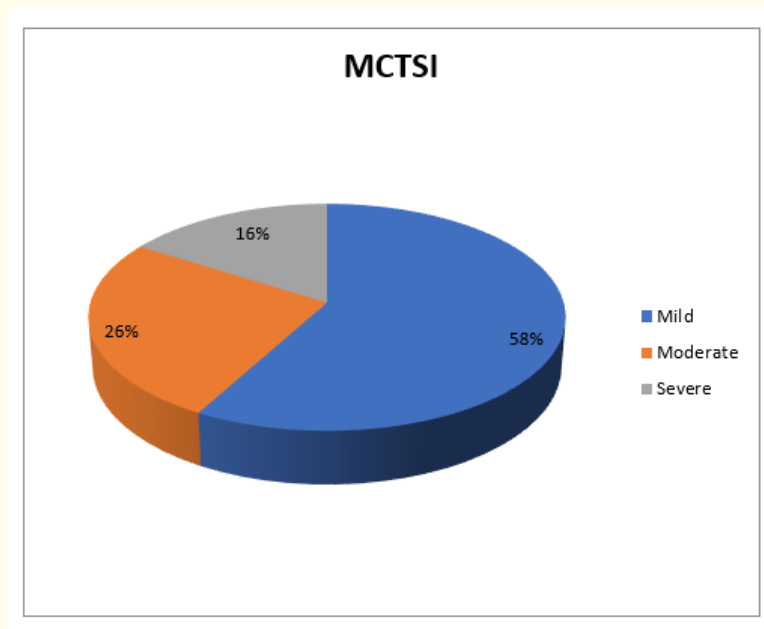
Graph 1: Variation of serum amylase with MCTSI grading on day 1, day 5, and day 10.



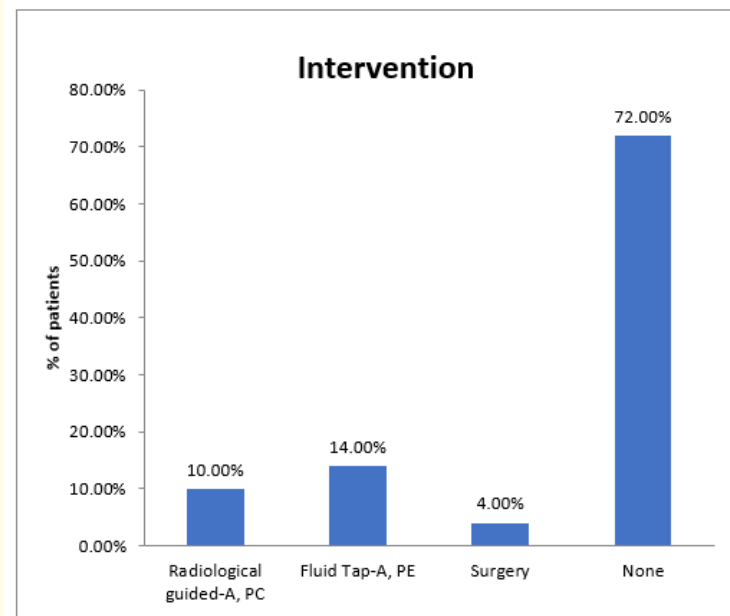
Graph 2: Variation of serum lipase with MCTSI grading on day 1, day 5, and day 10.



Graph 3: Sensitivity of serum amylase, serum lipase and CT in diagnosing acute pancreatitis.



Graph 4: Distribution of CT grade when AP is classified as mild, moderate and severe.



Graph 5: Patients who needed Intervention in AP.

Discussion

This was a prospective study conducted in rural settings over a period of 2 years in MMIMSR Mullana Ambala Haryana. In this investigation, 50 cases of acute pancreatitis were considered. These patients underwent serial evaluation of serum amylase and lipase on day 1, 5 and 10, and CECT of the abdomen and pelvis, were graded according to the modified CT severity index. The patients in this study were 44.48 ± 12.73 years old on average. Patients ranged in age from 23 to 77 years old, with the majority falling between the ages of 46 and 55 (32 percent). This observation was comparable to one made in a previous study by Sambasivarao K., *et al.* [7] reported mean age of 33 years and higher incidence of acute pancreatitis between the ages of 20 - 40 years.

The majority of the patients in this study were male (66 percent) as opposed to female (34 percent). In our study, there was no link between age and gender and the severity of pancreatitis. Gonapati S., *et al.* [8] found similar results in his study i.e. male (62.5%).

Alcohol was the most common cause of AP in this study, with 35 (70.0%) patients having it, 12 (24%) patients having GB/CBD calculi, and 3 (6.0%) patients having hyperlipidemia. This finding was similar to previous study by Kiranmai R and Naidu YT [9].

In the present study we found alcohol as the predominant etiological factor in males, whereas gall stones and hyperlipidemia in females. Lankisch PG., *et al.* [10] found similar results in his study.

In the present study 16 (32.0%) patients had edematous pancreatitis. Thirteen patients (26%) experienced pancreatic necrosis, with seven having less than 30 necrosis and six having more than 30 necrosis. This observation matched that of a study done by Sambasivarao K., *et al.* [7] found that 30% patients had edematous pancreatitis and 24% patients showed evidence of pancreatic necrosis out of which 5 had < 30 of necrosis and 7 had > 30 of necrosis.

In the current study, 72.0 percent of patients had diffuse/focal pancreatic enlargement, 66 percent of patients had peri-pancreatic fat stranding, and 36 percent of patients had peri-pancreatic fluid collection. Sambasivarao K., *et al.* [7] showed diffuse/focal pancreatic enlargement was seen in 75.0% patients, peri-pancreatic fat stranding was seen in 64% and peri-pancreatic fluid collection was seen in 40% patients.

In the present study, there is no variation in biochemical markers (amylase and lipase) on day 1, day 5 and day 10 with respect to age and sex. This finding was similar to previous study by Sharma RG., *et al* [11].

Significant decline in the serum amylase level on day 10 was appreciated in mild and moderate CT grade (p value - 0.004), whereas no variation in serum amylase levels was appreciated in severe CT grade. No significant change was appreciated in serum lipase levels on day 1, day 5 and day 10 with respect to CT grade. Gwozdz GP., *et al.* [12] in 1989 on 39 patients of AP stated that following hospitalization, serum lipase level remains higher than the amylase level for a longer period of time. which is in concordance to our study. Sharif MM., *et al.* [13] in 2015 conducted a prospective study on 59 patients of acute pancreatitis and concluded that MCTSI had statistically significant relation with serum amylase and lipase. During discharge, reduction in various markers was less in moderate pancreatitis and in severe pancreatitis serum amylase and lipase remained almost unchanged which is in concordance to our study.

In the present study levels of serum amylase and lipase more than 3 fold above the upper limit are considered as positive for acute pancreatitis i.e. > 420 IU/L for amylase and > 150 units/L for lipase. Serum amylase has a 44 percent accuracy and sensitivity in diagnosing AP. Serum lipase has a 72 percent accuracy and sensitivity in diagnosing AP. When compared to these patient's CT data, it exhibited 100 percent accuracy and sensitivity, allowing for early identification and prediction of AP severity. Similar results were shown by the studies done by Sutton PA., *et al.* [14], Amogh VN., *et al.* [15], Kiranmai R and Naidu YT [9] and Sambasivarao K, *et al* [7].

The majority of the patients had a mild CT severity (58%) and only a few had a severe grade (16 percent). In 26% of the patients, moderate pancreatitis was detected. This observation matched that of a study done by Sambasivarao K., *et al.* [7] categorised mild in 64%, moderate in 22% cases and severe in 14% cases.

Extra-pancreatic problems were found in 38 participants (76 percent) in the current investigation. Ascites was observed in 32 patients (64%), bilateral pleural effusion in seven patients (14%), left pleural effusion alone in nine patients (18%), right pleural effusion alone in two patients (4%), and splenic vein thrombosis in three patients (6 percent). This finding matched that of a study done by Amogh VN., *et al.* [15] extra-pancreatic complications were seen in 43 individuals (71.6 percent) in our study. 38 patients (63.3%) had ascites, ten patients (16%) had bilateral pleural effusion, nine patients (15%) had left pleural effusion alone, and two patients had right pleural effusion alone (3.3%) vascular thrombosis in 4 patients (6%).

In the present study pseudocyst was seen in 18 patients (36%). This finding was similar to one made by Kiranmai R and Naidu YT [9]. Infected necrosis was seen in 1 patient (2%). This observation matched that of a study done by Amogh VN., *et al.* [15] found that infected necrosis was detected in 3.3%.

In our study, two patients one with necrotic pancreas and other with significant pseudocyst caused to AP required surgery in the form of necrosectomy and cysto-gastrostomy respectively. In 5 patients (10%) of grade 6, 8, and 10 pancreatitis, radiological intervention was required for pseudocyst aspiration. In 7 patients (14 percent) with grade 4 and 6 pancreatitis, a fluid tap of the pleural effusion was required. As a result, individuals who require intervention have CT grades that are more moderate and severe.

This is comparable to the study conducted by Kiranmai R and Naidu YT [9] showed laparotomy was done in 2 patients. Radiological intervention aspiration of pseudocyst was needed in 4 patients (8%). Fluid tap of pleural effusion was needed in patients 6 (12%).

There was no mortality attributable to pancreatitis in our study comparable to the study conducted by Kiranmai R and Naidu YT [9].

Conclusion

- Alcohol is the predominant etiological factor in males, whereas gall stones and hyperlipidemia in females for acute pancreatitis.
- CECT is a sensitive, non-invasive imaging method for demonstrating and characterizing acute pancreatitis.
- CECT aids in the staging of acute pancreatitis severity, which aids in the prognosis of the condition.
- Serum lipase concentration ≥ 3 times the upper limit of the laboratory reference range is highly sensitive for diagnosing acute pancreatitis and corresponding value for amylase is moderately sensitive for the same.
- Acute pancreatitis patients were tracked for 10 days and the changes in their serum enzyme levels were similar; however the lipase elevations lasted longer than the amylase elevations.
- MCTSI grading (mild and moderate) correlated well with the serum amylase levels.
- MCTSI aids in determining the extent of pancreatic necrosis.
- MCTSI can be used to predict the likelihood of local and systemic problems occurring.
- MCTSI grading shows a strong correlation with the clinical outcome when compared to serum amylase and lipase levels.
- MCTSI can predict the need for interventions.

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