International Journal of Medical Science and Clinical Inventions 4(9): 3198-3205, 2017
DOI:10.18535/ijmsci/v4i9.05 **ICV 2015: 52.82**
e-ISSN:2348-991X, p-ISSN: 2454-9576

Original Article

A Study on Determination of Biochemical Variations Of Serum Amylase And Lipase As Diagnostic Markers For Acute And Chronic Pancreatitis.

Dr. M.Kaleemullah khan. MD[1], Dr. Nooruddin Owaisi. (M.B.B.S)[2], Dr. Mohd Nasir Mohiuddin. PharmD[3]

[1]MD, General Medicine, Professor, Dept. of General medicine, Owaisi Hospital & Research Center, Deccan College Of Medical Sciences, Hyderabad, Telangana. INDIA

[2](M.B.B.S), Deccan College of Medical Sciences, Hyderabad, Telangana. INDIA

[3]Pharm-D, (MHM), Head of Operations , Pinnacle Cancer Centers Indian & International – Sunnah Hospital, Corp. office: Bannerghatta, Bengaluru.

Corresponding Author: DrM.Kaleemullah khan.MD

General Medicine, Professor, Dept. of General medicine, Owaisi Hospital & Research Center, Deccan College Of Medical Sciences, Hyderabad, Telangana

Abstract:

Introduction:

Acute pancreatitis is a standout amongst the most widely recognized cause for hospitalization in the United States, representing around 220,000 cases for each year. Among the new cases, 80% are interstitial and 20% are necrotizing.

Methodology

The study was conducted From March to May 2016, in Owaisi Hospital, a 1000 bedded teaching hospital, situated in Hyderabad, providing specialized tertiary level health care services to all strata of people. Patients visiting the outpatient department of general medicine in owaisi hospital were selected for the present study, the patients selected has a history of pancreatic enzymes elevation for more than a year.

Aims And Objectives : This planned study has been attempted with the accompanying targets, to concentrate on the predominance of amylase and lipase levels in acute pancreatitis patients and to assess the etiologic proof as diagnostic marker in patients with acute pancreatitis.

Results: the total of 60 patients were included in the study with the history of pancreatitis, which includes 37 females and 23 males, along with the inter group evaluation of serum lipase, amylase and hemoglobin levels.

Conclusion: it can be concluded that the serum amylase , lipase , SGOT and SGPT levels are increased which is associated with the decreased hemoglobin levels in both males and women, hence we conclude that the Males are more prone to acute and chronic pancreatitis than female.

Keywords: Pancreatitis, Males, Serum amylase, Lipase.

INTRODUCTION:

Acute pancreatitis is a standout amongst the most widely recognized cause for hospitalization in the United States, representing around 220,000 cases for each year. Among the new cases, 80% are interstitial and 20% are necrotizing. Pancreatitis reveals a general mortality of around 5% and as high as 47% in patients with multiorgan failure. Necrotizing pancreatitis is the major cause of all mortalities allocate to acute pancreatitis. Liquor use, gallstones, hypertriglyceridemia, hypercalcemia, medications, endoscopic retrograde cholangiopancreatography and injury represent most instances of intense pancreatitis, nearly 20% remain idiopathic[5].the range of acute pancreatitis differs from interstitial pancreatitis in pathologic spectrum, which is typically a mild and self-restricted disorder, to necrotizing pancreatitis, in which the level of pancreatic putrefaction associates with the risk of the attack. Pancreatitis comes about when proteolytic proteins are active in the pancreas instead of in the intestinal lumen. Endotoxins, exotoxins, viral contaminations, ischemia, anorexia, and direct injury are accepted to enact these proenzymes. Initiated proteolytic proteins, digest pancreatic and peripancreatic tissues and realize an extreme harm. Increased levels of serum amylase and lipase build up the determination of acute pancreatitis[1]. In the finding of acute pancreatitis, serum amylase and lipase are generally used as a diagnostic tests, accessible to clinicians in South Africa (SA). Despite the fact that the global litrature has indicated serum amylase to be a less reactive and particular test for pancreatitis than serum lipase, serum amylase remains the most prominent first-line examination for suspected Pancreatitis attributable to the observation that the test is less

costly. Key to the analysis of pancreatitis are stomach pain steady with Acute Pancreatitis, serum pancreatic compound higher more than three times the furthest reaches of ordinary (ULN), and cross-sectional imaging. The last is generally differentiating improved through tomography (CECT)/Triphasic CECT. The availability of any two is viewed as diagnosis of pancreatitis. Of the two non-clinical criteria for a conclusion of AP, as far as accommodation and cost-control it is consistent to support the lab test in front of the tomography (CT) examine, which gave that dependence can be set on the exactness of serum lipase or amylase levels[2]. Elevated serum levels of amylase and lipase are great markers for acute and repetitive pancreatitis. Be that as it may, typical amylase levels can be seen in a significant extent of patients with pancreatitis in this manner, lipase remains a more profitable enzyme. These pancreatic proteins may likewise elevate in various conditions, incorporating into non-threatening hepatobiliary and gastrointestinal diseases, pneumonic failure, sepsis, subdural bleeding, renal failure, and pancreatic disease. Low levels of pancreatic compounds, then again, especially serum lipase, have once in a while been tended to alternately connected with clinical conditions[3]. Serum amylase and lipase levels triple or more than average are found in intense pancreatitis and in the suitable clinical setting, utilized for analysis. Average serum amylase levels have been accounted for now and again of intense pancreatitis, yet serum lipase levels are typically elevated .and also Serum amylase and lipase fixations are elevated in subjects with fructose malabsorption contrasted. In this manner, fructose malabsorption ought to be considered as a differential

determination in respectably raised serum amylase[4,6]. As indicated by practice guidelines for acute pancreatitis by peter .A Banks et al ,the determination of pancreatitis requires two of the accompanying three elements:

1) attributed with abdominal pain.

2) serum amylase or lipase more than or equal to 3 times the maximum of normal range,
3) CT scan is another precise tool for evaluation of pancreatitis[7].

Similarly serum and peritoneal amylase and lipase levels have all the earmarks of being solid and basic markers in the early visualization of AP[8].Pancreatitis is a typical clinical issue and the standard enzymatic markers of pancreatitis can be untrue usual, moreover their levels don't reflect the seriousness of the illness and the clinician is left with less options , for example, acute physiologic and chronic health evaluation (APACHE) or ransons criteria. The more current enzymatic markers, for example, Pancreatitis related protein (PAP), Trypsinogen activated peptide, Serine Protease inhibitor Kazal Type 1 and Human pancreatic secretory trypsin inhibitor. An ordinary serum amylase and lipase does not debar pancreatitis, in the meantime, remember that these compounds can be lifted in various other conditions such as Renal failure, Salivary diseases, Acute cholecystitis, Diabetic ketoacidosis, Macroamylesemia, Duodenal ulceration, Intestinal ailments, Pancreatic calculus, Female reproductive tract diseases[9].A study by AnithaDevanath, demonstrated that there was noteworthy distinction in serum amylase and lipase values when alcoholic AP was contrasted with non-alcoholic AP. Despite the fact that the amylase and lipase levels were lower in alcoholic AP when contrasted with biliary group yet the levels were higher in alcoholic AP in contrast with random group that was similar to past studies[10]. A study by sarfaraz et al uncovers the Use of lipase for the analysis of AP was initially portrayed in the mid-1930s by Cherry and Crandall[11]. estimation of serum lipase will be a better choice over serum amylase in diagnosis of acute pancreatitis[12].Liquor addiction is in charge of around 35% of instances of intense pancreatitis,Hypertriglyceridemia causes around 2% of instances of intense pancreatitis,Gallstones cause around 40%, Obstructive reasons for pancreatitis, periampullary tumors, addition to gallstones, incorporate pancreas divisum, sphincter of Oddi stenosis, , pancreatic malignancy, parasites, and clots. Hypertriglyceridemia causes around 2% of instances of intense pancreatitis. A serum triglyceride level more noteworthy than 1000 mg/dL recommends this conceivable cause and a triglyceride level more noteworthy than 2000 mg/dL is indicative marker for AP[13]. Around 2% of instances of pancreatitis are brought on by ERCP. Pancreatitis is the most widely recognized cause of ERCP. Pancreatitis happens in around 5% of ERCPs, with a reach from 2% to 7% contingent upon the Criteria for characterizing the pancreatitis, the sort of strategy, and the experience of the endoscopist. Some medications too also responsible for 2% of the AP which involves medications such as: 5-Aminosalicylic corrosive/sulfasalazine,Azathioprine.6-Mercaptopurine, Metronidazole, Antibiotic medication, etc.

in Organ phosphorus poisoning acute pancreatitis is not a rare condition[14].

Lipase is delivered basically in the pancreas, with a little sum in the liver, digestive system, tongue, and stomach. Amylase is produced fundamentally from the pancreas and salivary organs; it is likewise present in the ovaries, small and large intestines, and skeletal muscle.

Serum amylase is most usually utilized lab test. Serum lipase is accepted to be more particular and will stay raised for a more drawn out timeframe, as hyperlipasemia holds on for 7 days and amylase ought to standardize within 4 days[15].Patients with only a little elevation in amylase/lipase levels can also develop extraordinary pancreatitis[16].

Materials And Methodology:

The present analysis was part of a prospective, Briefly, 50 patients with elevated levels of amylase and lipase were enrolled in the study. Patients between 18 and 70 years old, with amylase and lipase levels more than 5.0 mIU/L and good general health were included. The study was conducted From March to May 2016, in Owaisi Hospital & Research Center, a 1000 bedded teaching hospital, situated in Hyderabad, providing specialized tertiary level health care services to all

strata of people. Patients visiting the outpatient department of general medicine in Owaisi Hospital & Research Center were selected for the present study, the patients selected has a history of pancreatic enzymes elevation for more than a year. A total of 50 participants were enrolled in the study. Blood samples were collected from 50 selected pancreatitis patients on the basis of a history of a pancreatitis and persistent Anemia, patients with both genders were included. Details of the patients like history of pancreatitis and other laboratory parameters were recorded in the predesigned and pretested Performa which consists amylase, lipase, total bilirubin, direct bilirubin, SGOT, SGPT and Hemoglobin. All these parameters were investigated, recorded and tabulated. Finally a comparison was made between the age of patients correlating with amylase lipase levels in contrast with hemoglobin, SGOT, SGPT, Tot. Bilirubin and direct bilirubin. Later the results were calculated and recorded in terms of means ± standard deviation.

Inclusion criteria:

1)Patient with initially normal ultrasound examination of pancreas.
2) Patient with iron insufficiency frailty

3) Patient with negative history for clear blood misfortune and negative finding for viral profile.

Exclusion criteria:

1) Patients matured beneath 18 years or more 65
2) Patients displaying to crisis division with cardiovascular crises were rejected.
3) Patients who have not experienced cardiovascular catheter Surgeries.

Statistical analysis: Using Microsoft word, Microsoft excels and Epi Info 7 Statistical analysis was done. Ethical Approval: approval from institutional review board was obtained before the study was initiated.

AIMS AND OBJECTIVES

This planned study has been attempted with the accompanying targets, to concentrate on the predominance of amylase and lipase levels in acute pancreatitis patients and to assess the etiologic proof as diagnostic marker in patients with acute pancreatitis.

Results:

the total of 60 patients were included in the study with the history of pancreatitis, which includes 37 females and 23 males, which was sub-divided in three sub groups, i.e. Group1 , Group 2, Group 3. And the relationship between the groups is being evaluated. along with the inter group evaluation of serum lipase, amylase and hemoglobin levels.

Table 1: Group 1-Age 20-40 years.

Variable	Label	N	Minimum	Maximum	Mean	Std Dev	t Value	Pr > |t|
serum_amylase	serum_amylase	20	42.000	346.000	148.350	71.177	9.32	<.0001
serumlypase	serumlypase	20	12.000	149.000	58.250	36.385	7.16	<.0001
hemoglobin	hemoglobin	20	1.000	15.000	9.385	3.534	11.88	<.0001
total_bilirubin	total_bilirubin	20	0.400	27.800	4.110	8.355	2.20	0.0404
direct_Bilirubin	direct_Bilirubin	20	0.100	16.900	2.385	5.233	2.04	0.0557
SGOT	SGOT	20	14.000	1210.000	115.500	274.116	1.88	0.0749
SGPT	SGPT	20	8.000	769.000	76.000	173.254	1.96	0.0646

There was a significant difference between serum amylase, serum lipase and hemoglobin in the group 1 representing the P-value of <.0001 in all three parameters, which was considered to be highly significant. But the total bilirubin, direct bilirubin,SGOT and SGPT values show no significant difference in the group s shown in table 1.

Table 2 : Group 2-Age 41-60 years.

Variable	Label	N	Minimum	Maximum	Mean	Std Dev	t Value	Pr > |t|
serum_amylase	serum_amylase	20	28.000	634.000	140.250	142.505	4.40	0.0003
serumlypase	serumlypase	20	2.000	735.000	100.700	204.666	2.20	0.0403
hemoglobin	hemoglobin	20	7.000	15.500	11.440	2.675	19.13	<.0001
total_bilirubin	total_bilirubin	20	0.400	27.800	4.785	8.331	2.57	0.0188
direct_Bilirubin	direct_Bilirubin	20	0.100	16.900	2.360	5.243	2.01	0.0585
SGOT	SGOT	20	14.000	1210.000	95.000	263.767	1.61	0.1237
SGPT	SGPT	20	8.000	275.000	39.500	57.863	3.05	0.0065

The values of serum amylase and lipase show no significant difference in the group 2 but hemoglobin showsnthen significant difference with the p-value of <.0001. But the total bilirubin, direct bilirubin, SGOT and SGPT values show no significant difference in the group as represented by table 2.

Table 3: Group 3 –Age 61- 80 years

Variable	Label	N	Minimum	Maximum	Mean	Std Dev	t Value	Pr > |t|
Serum amylase	Serum amylase	20	28.000	298.000	107.800	60.670	7.95	<.0001
serum lypase	serumlypase	20	2.000	131.000	41.400	34.209	5.41	<.0001
hemoglobin	hemoglobin	20	1.000	15.000	9.635	3.649	11.81	<.0001
total_bilirubin	total bilirubin	20	0.400	27.800	2.975	6.440	2.07	0.0527
direct_Bilirubin	directBilirubin	20	0.100	16.900	1.190	3.750	1.42	0.1721
SGOT	SGOT	20	14.000	102.000	27.650	19.712	6.27	<.0001
SGPT	SGPT	20	8.000	58.000	22.150	11.306	8.76	<.0001

There was a significant difference between serum amylase, serum lipase, SGOT, SGPT and hemoglobin in the group 3 representing the P-value of <.0001 in all three parameters, which was considered to be highly significant. But the total bilirubin, direct bilirubin values show no significant difference in the group as shown in table 3.

Table 4 : Change in Pancreas Group 1 vs Group 2

T-Tests					
Variable	**Method**	**Variances**	**DF**	**t Value**	**Pr > |t|**
serum_amylase	**Pooled**	Equal	38	0.23	0.8213
serum_amylase	**Satterthwaite**	Unequal	27.9	0.23	0.8218
serumlypase	**Pooled**	Equal	38	-0.91	0.3669
serumlypase	**Satterthwaite**	Unequal	20.2	-0.91	0.3719

The change in pancreas between the group 1 vs group 2, in according with the T-test with parameters taken i.e. Serum amylase and serum lipase shows no significant difference between the group1 and group 2 as shown in table 4.

Table 5 : Change in Pancreas Group 2 vs Group 3

T-Tests					
Variable	**Method**	**Variances**	**DF**	**t Value**	**Pr > |t|**
serum_amylase	**Pooled**	Equal	38	0.94	0.3547
serum_amylase	**Satterthwaite**	Unequal	25.7	0.94	0.3575
serumlypase	**Pooled**	Equal	38	1.28	0.2090
serumlypase	**Satterthwaite**	Unequal	20.1	1.28	0.2158

The change in pancreas between the group 2 vs group 3, in according with the T-test with parameters taken i.e. Serum amylase and serum lipase shows no significant difference between the group 2 and group 3 as shown in table 5.

Table 6: Change in Pancreas Group 1 vs Group 3

T-Tests					
Variable	**Method**	**Variances**	**DF**	**t Value**	**Pr > |t|**
serum_amylase	**Pooled**	Equal	38	1.94	0.0600
serum_amylase	**Satterthwaite**	Unequal	37.1	1.94	0.0601
serumlypase	**Pooled**	Equal	38	1.51	0.1396
serumlypase	**Satterthwaite**	Unequal	37.9	1.51	0.1396

The change in pancreas between the group 1 vs group 3, in according with the T-test with parameters taken i.e. Serum amylase and serum lipase shows no significant difference between the group 1 and group 3 as shown in table 6.

Table 7 : Disease Distribution Of Group 1.

Group I (20 to 40 years)				
Disease Distribution			Gender Distribution	
Disease state	No. of Patients		Gender	No. Of patients
	Male 5(25%)	Female 15 (75%)		
Acute Pancreatitis			Male	5 (25%)
Amylase : ≤ 120 U/L	2(40%)	4(27%)		
Lipase : ≤ 100 U/l	5(100%)	12(80%)		
Chronic Pancreatitis			Female	15 (75%)
Amylase : ≥ 121 U/L	3(60%)	11(73%)		
Lipase : ≥101 U/L	-	3(20%)		
Anemia				
Gender	Males		Female	
HB : ≤ 13 gm/dl	4(80%)		HB :≤ 12 gm/dl	13(87%) Anaemic
HB : more than 13gm/dl	1(20%)		HB : More than 12 gm/dl	2(13%)Non-anaemic

The hemoglobin levels in group 2 reveals of 80% of the male patients with high amylase and lipase levels are anemic and 87% of the females are anemic with pancreatitis as shown in table 7.Disease distribution in group 1 includes a total of 25% males and 75% females, among 25% males the patients having high amylase levels indicating the acute pancreatic level are 40% and representing 60% of the patients with chronic pancreatitis. Parallel to the amylase, the lipase level in group 1 was high considering the 100% of the group 1 population in acute pancreatitis. While on the other hand among the 75% female shows a amylase level in acute pancreatitis segment was 27% and in chronic 73%, and in the serum lipase levels the 80% falls in acute phase and 20% comes under chronic pancreatitis phase, as shown in table 7.

Table 8: Disease Distribution Of Group 2

Group II (41 to 60 years)				
Disease Distribution			Gender Distribution	
Disease state	No. of Patients		Gender	No. Of patients
	Male 12(65%)	Female 8(35%)		
Acute Pancreatitis			Male	12 (65%)
Amylase : ≤ 120 U/L	6(50%)	6(75%)		
Lipase : ≤ 100 U/l	8(67%)	7(87.5%)		
Chronic Pancreatitis			Female	8(35%)
Amylase : ≥ 121 U/L	6(50%)	2(25%)		
Lipase : ≥101 U/L	4(33%)	1(12.5%)		
Anemia				
Gender	Males		Female	
HB : ≤ 13 gm/dl	8(67%)		HB :≤ 12 gm/dl	5(62.5%) Anaemic
HB : more than 13gm/dl	4(33%)		HB : More than 12 gm/dl	3(37.5%)Non-anaemic

Disease distribution in group 2 includes a total of 65% males and 35% females, among 65% males the patients having high amylase levels indicating the acute pancreatic level are 50% and representing 50% of the patients with chronic pancreatitis. Parallel to the amylase, the lipase level in group 1 in acute level was 67% and 33% in chronic phase. While on the other hand among the 35% female shows a amylase level in acute pancreatitis segment was 75% and in chronic 25%, and in the serum lipase levels the 87.5% falls in acute phase and 12.5% comes under chronic pancreatitis phase,as shown in table 7.

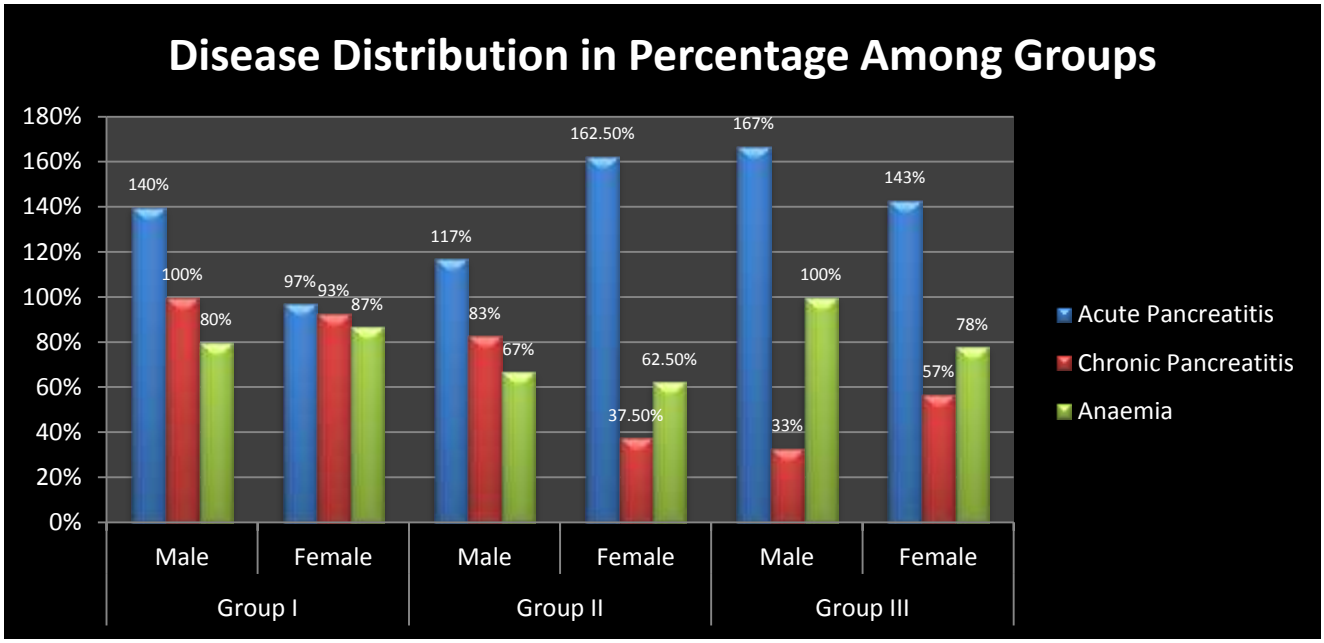
The hemoglobin levels in group 2 reveals of 67% of the male patients with high amylase and lipase levels are anemic. 62.5% of the females are anemic with pancreatitis as shown in table 7.

Table 9: Disease Distribution Of Group 3

Group III (61 to 80 years)				
Disease Distribution			Gender Distribution	
Disease state	No. of Patients		Gender	No. Of patients
	Male 6(30%)	Female 14(70%)		
Acute Pancreatitis			Male	6(30%)
Amylase : ≤ 120 U/L	4(67%)	8(57%)		
Lipase : ≤ 100 U/l	6(100%)	12(86%)		
Chronic Pancreatitis			Female	14(70%)
Amylase : ≥ 121 U/L	2(33%)	6(43%)		
Lipase : ≥101 U/L	-	2(14%)		
Anemia				
Gender	Males		Female	
HB : ≤ 13 gm/dl	6(100%)		HB :≤ 12 gm/dl	11(78%) Anaemic
HB : more than 13gm/dl	-		HB : More than 12 gm/dl	3(22%)Non-anaemic

In group 3 there were 100% of the males and 78% of the female are anemic as shown above. The 30% of the males representing the male population of the group 3, falls 67% with raised amylase levels in acute phase and 33% under the chronic phase. While on the other end 100% of the males having the high serum lipase in acute pancreatitis phase. Among the females which constitute 70% of the group 3 population. 57% and 43% with raised serum amylase levels falls under acute and chronic phase of pancreatitis, parallel to amylase, the serum lipase is having 86% of the females in acute while 14% in chronic phase. The hemoglobin level shows 100% of the males are anemic in group 3 while 78% of the females are anemic in the same group as shown in table 9.

Figure 1



The estimated percentage of the total population with acute pancreatits among groups is shown according to the disease state such as acute pancreatitis, chronic pancreatitis and anemia as shown in figure 1.

Discussion:

The absence of specificity of these enzymes for AP, which identifies with the capacity to bar AP in patients with abdominal pain. It is notable that other intra-abdominal issue, for example, peptic ulcer perforation, mesenteric ischemia and intestinal obstruction, may give raised to serum lipase/amylase values[2]. In our study representing the amylase and lipase are non significant between groups than compare to intra group values, shows a significant difference in Amylase , lipase and hemoglobin.

In some studies, the serum amylase and lipase concentrations were not able to establish either etiology or to predict the severity of acute pancreatitis[1].in our study the serum amylase and lipase levels are considered to be the good parameters for detecting the pancreatitis. As the level of amylase and lipase levels are raised in pancreatitis inflammation. A study by İlhami Gültepe et al shows that raised serum amylase and lipase are the good biomarkers of the acute and chronic pancreatitis, although the serum lipase sometimes associated

with other clinical conditions[3].

A study by Amita Diwakar et al shows serum amylase and lipase are three times more than the normal in acute pancreatic inflammation could be used as the diagnostic tool[4]. The current study reveals that increases level of serum amylase and lipase levels with low level of haemoglobin could be used as the diagnostic biomarker for acute and chronic pancreatitis.

According to the therapeutic experts, the diagnostic imaging in evidence of acute pancreatitis , helps in diagnosis when laboratory parameters are not compatible[5]. In the current study the patients with normal ultrasound of pancreas was enrolled but the perceptive is that, the ultrasound could be one of the best source to diagnose and evaluate the stage of the pancreatic inflammation if the serum amylase and lipase are not compatible on clinical grounds.

A study by M. Ledochowski et al shows a high levels of the serum amylase levels in males at an age of 40 years is (75.6 ± 29.4) and for females (53.1 ± 16.5) P=0.049.And for serum lipase levels which was significantly higher in fructose malabsorbers i.e. (122 ± 100.3)[6].Our study reveals of serum amylase levels in an age group of 40 years is (140.2 ± 142.5) which was significantly higher than the study by M. Ledochowski et al. the lipase levels in our study was (100.7 ±204.6) which was lower than the study by M. Ledochowski et al[6].Higher the Serum amylase and serum lipase levels, higher the mortality rate of the patients, higher the mortality results in having the low prognosis.A study by Peter A. Banks et al tells in general that both amylase and lipase levels are raised during acute pancreatitis and the lipase levels may remain higher longer than amylase. Our study reveals that there was no lipase levels at all or a normal lipase level is observed when the amylase is raised in the study population as shown in table 3 and 1. But considering the peter a bank study there may be raised amylase levels in acute or chronic phase with lipase levels remains elevated for longer periods[7].

Conclusion:

In Acute Pancreatitis serum amylase, lipase, SGOT and SGPT levels are increased which is associated with decreased haemoglobin levels.

From the findings of the present study it can be concluded that the serum amylase , lipase , SGOT and SGPT levels are more increased in males than in females which is also associated with the decreased hemoglobin levels in males in contrast with females, hence we conclude that the occurrence of acute and chronic phases of pancreatitis is more associated with males than in females.

Limitations: However, the risk of pancreatitis is reduced when a routine checkup of serum amylase and lipase are monitored in the patient with high risk of pancreatitis.

References:

1) Usha S Adiga, Vickneshwaran V, and Sanat Kumar Sen. (2013), Biochemical Variations in Acute Pancreatitis, RJPBCS, Vol 4 Issue 2, pp.1610-1614.

2) Hofmeyr S, Meyer C, Warren BL.(2014), Serum lipase should be the laboratory test of choice for suspected acute pancreatitis, S Afr J Surg, Vol 8;52(3), pp.72-5. doi: 10.7196/sajs.2003.

3) Gültepe İ, Başaranoğlu M, Zorlu M, Şenyiğit A, Taşkale EZ, Zaralı S, Atay K, Köroğlu E, (2016), Low lipase levels as an independent marker of pancreatic cancer: a frequently neglected condition in clinical setting, Turk J Gastroenterol, Mar;27(2), pp. 197-200. doi: 10.5152/tjg.2016.16056. PubMed PMID: 27015625.

4) Diwakar A, Kumar N, Srivastva N, Tiwar R, Parashar V, (2015), Acute Pancreatitis in a Patient With Enteric fever and Normal Lipase Levels ; CASE REPORT, Natl J Med Res, Vol 5(3): pp. 262-264.

5) Shah AM, Eddi R, Kothari ST, Maksoud C, DiGiacomo WS, Baddoura W, (2010), Acute pancreatitis with normal serum lipase: a case series, l5;11(4), pp. 369-72.

6) PMID: 20601812.

7) Ledochowski M, Murr C, Lass-Flörl C, Fuchs D, (2001), Increased serum amylase and lipase in fructose malabsorbers, Clin Chim Acta, 311(2), pp.119-23.

8) PubMed PMID: 11566171.

9) Banks PA and Freeman ML, (2006), Practice Parameters Committee of the American College of Gastroenterology - Practice guidelines in acute pancreatitis, Am J Gastroenterol. 101(10), pp.2379-400. PubMed PMID: 17032204.

10) Robert JH, Meyer P, Rohner A, (1986), Can serum and peritoneal amylase and lipase determinations help in the early prognosis of acute pancreatitis, Annals of Surgery. 203(2), pp 163-168.

11) Rao EMM, Ganga V, Moore M, Medarametla S, (2015), A Case of Acute Pancreatitis without Enzyme Elevation – A Rare Presentation of a Common Condition. Clin Med Rev Case Rep 2(6) pp.1-3

12) Devanath A, Kumari J, Joe J, et al, (2009), Usefulness of lipase / amylase ratio in acute pancreatitis in South Indian population. Indian Journal of Clinical Biochemistry, 24(4), pp.361-365. doi:10.1007/s12291-009-0065-3.

13) Jasdanwala S, Babyatsky M (2015) A critical evaluation of serum lipase and amylase as diagnostic tests for acute pancreatitis. Integr Mol Med 2: DOI: 10.15761/IMM.1000137

14) Batra, H., Kumar, A., Saha, T. et al. Ind J Clin Biochem (2015) 30: 230. doi:10.1007/s12291-013-0416-y

15) Cappell MS. (2008), Acute pancreatitis: etiology, clinical presentation, diagnosis, and therapy, Med Clin North Am, 92(4): pp.889-923, doi: 10.1016/j.mcna.2008.04.013.

16) Dr. Abhay Nath Chaturvedi, Dr. Soumyakanti Dutta, Dr. Sanjay Sarkar, Dr. Tushar Kanti Saha, Dr. Subhajyoti Adhikary, Dr. Sukdeb Das, Dr. Mitali Basu. (2014), Prevalence of Hyper Amylasemia and Acute Pancreatitis in Organophosphate Poisonings.13(1), PP 59-62.

17) Ranson JH.(1990), The role of surgery in the management of acute pancreatitis. Annals of Surgery. 211(4). pp:382-393.

18) Lankisch PG, Burchard-Reckert S, Lehnick D. Underestimation of acute pancreatitis: patients with only a small increase in amylase/lipase levels can also have or develop severe acute pancreatitis. Gut. 1999 Apr;44(4):542-4. PubMed PMID: 10075962; PubMed Central PMCID: PMC1727444.