

## ORIGINAL RESEARCH

### The Use of Urinary Amylase Levels in the Diagnosis of Acute Pancreatitis

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#### ABSTRACT

**Background:** Acute pancreatitis is a relatively common but potentially fatal disease seen in surgical practise. Clinical examination, laboratory investigations, and imaging techniques are used to make a diagnosis of the disease. Patients usually present with severe pain in the epigastric region that radiates to the back. Serum levels of amylase and lipase that are more than three times the normal value usually indicate acute pancreatic inflammation. When clinical and laboratory investigations fail to diagnose the disease despite a strong suspicion of acute pancreatitis, radiological investigations are used to make a diagnosis. Urinary clearance of pancreatic enzymes from the circulation increases in acute pancreatitis. This is a study that will use urinary amylase levels to diagnose acute pancreatitis in a non-invasive manner. **Objectives:** To diagnose acute pancreatitis using urine amylase levels in conjunction with other specific tests such as serum lipase and abdominal ultrasound, and to demonstrate that urine amylase can be used to diagnose acute pancreatitis.

**Materials and Methods:** It is a case control study with 40 patients diagnosed with acute pancreatitis and 40 patients admitted with other diagnoses. Patients admitted to Princes Esra Hospital between November 2019 and May 2021 were chosen as cases and controls. Serum amylase, serum lipase, and urinary amylase levels were measured in both the case and control groups. After comparing serum amylase, serum lipase, and urinary amylase levels in cases and controls, the sensitivity and specificity of these enzymes were determined. The authors concluded that serum amylase had the highest sensitivity (100 percent) and serum lipase had the highest specificity (100 percent) after analysing serum amylase, serum lipase, and urinary amylase results in both cases and controls (95 percent). Urine amylase's sensitivity and specificity were found to be 98.33% and 95%, respectively. The area under the curve for serum amylase, serum lipase, and urinary amylase was found to be 0.987, 0.995, and 0.935, respectively, using ROC curve analysis.

**Conclusion:** Because serum amylase, serum lipase, and urinary amylase have comparable sensitivity and specificity, as well as comparable areas under the curve on ROC analysis for the diagnosis of acute pancreatitis, the authors conclude that urinary amylase can be used in the diagnosis of acute pancreatitis.

**Keywords:** Acute Pancreatitis; Serum Amylase; Serum Lipase; Urinary Amylase.

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## INTRODUCTION

Acute pancreatitis is a relatively common but potentially fatal disease seen in surgical practise. Acute pancreatitis is defined as an acute condition characterised by abdominal pain and elevated pancreatic enzyme levels in the blood or urine as a result of pancreatic inflammation. It has the potential to cause both local and systemic complications. This disease is distinguished by the presence of little or no fibrosis.<sup>[1]</sup> The disease can range from a mild self-limiting pancreatic inflammation to a more severe disease with infected pancreatic necrosis, multiple organ failure, and a high risk of death. Acute pancreatitis accounts for approximately 3% of all cases of abdominal pain among hospitalised patients in the United Kingdom.<sup>[2]</sup> It is also the third most common gastrointestinal disease that necessitates acute hospitalisation and the most common gastrointestinal discharge diagnosis in the United States of America.<sup>[1,3]</sup> The disease can strike at any age, but it is most common in young men and older women.

Gallstones, alcohol consumption, post-ERCP status, hypertriglyceridemia, hypercalcemia, drugs, sphincter of Oddi dysfunction, abdominal trauma, pancreatic neoplasms, pancreatic divisum, and other factors can all cause acute pancreatitis. However, the cause is unknown in approximately 20% of patients.<sup>[3]</sup>

Clinical examination, laboratory investigations, and imaging techniques are used to make a diagnosis of the disease. Patients typically occur with severe pain in the epigastric region that radiates to the back. Serum levels of amylase and lipase that are more than three times the normal value usually indicate acute pancreatic inflammation. When clinical and laboratory investigations fail to diagnose the disease despite a strong suspicion of acute pancreatitis, radiological investigations are used to make a diagnosis.

The treatment for this disease is primarily conservative, consisting of intravenous fluid resuscitation, adequate analgesia, nasogastric tube drainage in selected cases, enteral feeding or parenteral hyperalimentation depending on the severity of the disease, antibiotics in severe disease, and ERCP in selected cases. Surgery is only useful in the treatment of disease complications such as infected necrosis.

A patient with acute pancreatitis may have normal serum amylase levels, whereas a patient with small bowel obstruction, perforated duodenal ulcer, or other intra abdominal inflammatory conditions may have hyperamylasemia. Because urinary clearance of pancreatic enzymes from the circulation increases in many cases during pancreatitis, urinary levels may be more sensitive than serum levels. In addition, urinary amylase levels are usually elevated for several days after serum levels have returned to normal.<sup>[4]</sup> This study aims to diagnose acute pancreatitis using urinary amylase levels, which are non-invasive, more sensitive, and remain elevated for a longer period of time than serum amylase.

To establish that urine amylase can be used to diagnose acute pancreatitis in conjunction with other specific tests such as serum lipase and abdominal ultrasound, and to demonstrate that urine amylase can be used to diagnose acute pancreatitis.

## MATERIALS & METHODS

### Source of data:

It is a case control study involving 40 patients diagnosed with acute pancreatitis and 40 patients admitted with diagnoses other than acute pancreatitis. Cases and controls were chosen from patients admitted to Princes Esra Hospital between November 2019 and May 2021.

### Inclusion criteria:

1. Patients presenting to the Emergency department of Princes Esra Hospital, Hyderabad with symptoms and signs suggestive of Acute Pancreatitis.

2. Patients presenting to the out-patient department for of Princes Esra Hospital , Hyderabad for elective surgical procedures.
3. Patients giving valid and informed consent to participate in this study.

**Exclusion criteria:**

1. Patients who were willing to give valid and informed consent to participate in this study.

**Methods of data collection:**

After admission, data was collected by history taking, meticulous physical examination, and appropriate serological and radiological investigations.

**Investigations that were used for the study:**

1. Complete hemogram
2. Random blood sugar
3. Serum electrolytes
4. Renal function test
5. Liver function test
6. Lipid profile
7. Serum calcium
8. Serum amylase
9. Serum lipase
10. Urinary amylase
11. Chest X-ray PA view
12. Ultrasound of the abdomen
13. CECT abdomen

In patients admitted with acute pancreatitis, investigations were performed in order to identify the cause for acute pancreatitis.

Serum amylase levels, serum lipase levels and urinary amylase levels were estimated in both groups: cases and controls. The sensitivity and specificity of serum amylase, serum lipase and urinary amylase levels were established after comparing their values in cases and controls.

**Statistical Methods:**

Descriptive and inferential statistical analysis has been carried out in the present study. Results on continuous measurements are presented on Mean SD (Min-Max) and results on categorical measurements are presented in Number (%). Significance is assessed at 5 % level of significance.

**RESULTS**

From the study spread over one and a half years, the following results were derived. Results of the 120 patients in the study have been analysed over various parameters and described below.

**AGE:****Table 1: Age distribution in cases and controls**

Age in years	Cases		Controls	
	No	%	No	%
<20	1	2.5	2	5
20-30	6	15	9	18.3
31-40	13	32.5	8	20
41-50	12	30	13	16.25

51-60	6	15.0	5	12.5
61-70	2	15	3	7.5
Total	40	100.0	40	100.0
Mean $\pm$ SD	40.7 $\pm$ 9.6		40.6 $\pm$ 8.56	

The age distribution was comparable between the two groups. Majority of the patients were aged between 31 and 50 years. There was no statistical significance with regard to the mean age between cases and controls.

### Gender:

**Table 2: Sex distribution in cases and controls**

Gender	Cases		Controls	
	No	%	No	%
Female	8	20	18	45.0
Male	32	80.0	22	55.0
Total	40	100.0	40	100.0

The gender distribution was comparable between the two groups. There was no statistical significance with regard to the sex of the patient between cases and controls.

### Symptoms:

**Table 3: Symptoms distribution in cases**

Symptoms	No. of patients (n=40)	%
Pain abdomen	40	100.0
Vomiting	35	87.5

Patients with acute pancreatitis presented with symptoms of pain abdomen and vomiting. All patients presented with pain abdomen whereas only 85 % of the patients presented with vomiting.

### Habits:

**Table 4: Habits distribution in cases and controls**

Habits	Cases(n=40)		Controls(n=40)	
	No	%	No	%
Alcohol	32	80	8	20
Smoking	21	52.5	12	30

Among cases, 80 % of the patients were alcoholics and 52.5% of the patients were smokers. Among controls, 20 % of the patients were alcoholics and 30 % of the patients were smokers.

### Co-morbidities:

**Table 5: Comorbidities in cases and controls**

Co- morbidities	Cases (n=40)		Controls (n=40)	
	No	%	No	%
DM	3	7.5	4	10
HTN	2	5	3	7.5
IHD	1	2.5	0	0.0
Obesity	4	10.0	4	10

Among cases, 7.5% of the patients were diabetic, 5 % of the patients were hypertensive, 2.5 % of the patients had IHD and 10% of the patients were obese. Among controls, 10 % of the patients were diabetic, 7.5 % of the patients were hypertensive and 10.0 % of the patients were obese.

None of the patients in the control group had IHD.

### Epigastric tenderness:

**Table 6: Epigastric tenderness in cases**

ET	No. of patients	%
Negative	0	0.0
Positive	40	100.0
Total	40	100.0

All patients with acute pancreatitis presented with epigastric tenderness.

### Laboratory investigations:

**Table 7: Lab investigations in cases**

	No. of patients(n=40)	%	Mean ± SD
RBS (mg %)			
<126	32	80	93.6±26.6
>126	8	20	
Blood Urea (mg %)			
<40	31	73.3	30.4 ± 9.86
>40	9	18.3	
Serum Creatinine (mg %)			
<1.1	38	95	0.56 ±0.21
>1.1	2	5	
Serum Calcium (mg %)			
<8	9	17.5	8.20±0.41
8.1-9.5	29	72.5	
>9.5	4	10	
Lipid profile			
Increased TG	3	7.5	
WNL	37	92.5	

Among patients with AP, 80 % of the patients had random blood sugar values of less than 126mg% and 20 % of the patients had values more than 126mg%.

Among patients with AP, serum creatinine in 95 % of the patients was less than 1.2 mg% and 5% of the patients had values of more than 1.1mg%.

Among patients with AP, serum calcium was less than 8mg% in 17.5 % of the patients. In 72.5% of the patients the serum calcium values were between 8mg% and 9.5mg% and in 17.5 % of the patients, the serum calcium values were more than 9.5mg%.80 % of the patients with acute pancreatitis had normal lipid profile and 20 % of them had hypertriglyceridemia.

### USG findings:

**Table 8: USG findings in cases**

USG	No. of patients	%
Diffusely enlarged and Hypoechoic pancreas	27	67.5
Diffusely enlarged and hypoechoic pancreas with	2	5

cholelithiasis		
Pancreasobscuredbybowel gas	11	27.5
Total	40	100.0

Ultrasound of the abdomen showed diffusely enlarged and hypoechoic pancreas in 67.5 % of the patients, diffusely enlarged and hypoechoic pancreas with cholelithiasis in 5 % of the patients and pancreas obscured by bowel gas in 40% of the patients.

#### Serum amylase, serum lipase and urinary amylase levels:

**Table 9: Serum amylase, serum lipase and urinary amylase levels in cases and controls**

	Cases(n=40)		Controls(n=40)		P value
	No	%	No	%	
S.amylase(U/l)					
<66	0	0	38	95	<0.001**
>66	40	100	2	5	
S.lipase(U/l)					
<91	2	5	39	97.5	<0.001**
>91	38	95	1	5.0	
U.amylase(U/l)					
<306	0	0	36	90	0.002**
>306	40	100	4	10	

All patients who had acute pancreatitis had elevated serum amylase levels. Only 5 % of the patients in the control group had elevated serum amylase levels. The increase in serum amylase levels in cases in comparison with controls was found to be statistically significant. 97.5 % of the patients who had acute pancreatitis had elevated serum lipase levels. Only 2.5% of the patients in the control group had elevated serum lipase levels. The increase in serum lipase levels in cases in comparison with controls was found to be statistically significant.

All patients who had acute pancreatitis had elevated urinary amylase levels. Only 10% of the patients in the control group had elevated urinary amylase levels. The increase in urinary amylase levels in cases in comparison with controls was found to be statistically significant.

#### Comparison of study variables between the two groups:

**Table 10: Mean values of serum amylase, serum lipase and urinary amylase among cases and controls**

	Cases	Controls	P value
S.amylase(U/l)	532.42±242.8	41.31±70.6	0.0101*
S.lipase(U/l)	642.10±214.10	44.61± 65.8	0.0061**
U.amylase (U/l)	1180±752.9	266.1 ± 501.9	0.024*

The rise in serum amylase values of patients with acute pancreatitis when compared with those without acute pancreatitis was found to be statistically significant.

The rise in serum lipase values of patients with acute pancreatitis when compared with those without acute pancreatitis was found to be statistically significant.

The rise in urinary amylase values of patients with acute pancreatitis when compared with those without acute pancreatitis was found to be statistically significant.

**Table 11: ROC curve analysis of serum amylase, serum lipase and urinary amylase**

	<b>Cut-off</b>	<b>Sensitivity</b>	<b>Specificity</b>	<b>LR+</b>	<b>LR-</b>	<b>AUC</b>	<b>P value</b>
S.amylase(U/l)	>66	100.00	91.34	15.02	0.0	0.984	0.010*
S.lipase(U/l)	>91	98.33	95.00	19.63	0.002	0.945	0.006**
U.amylase(U/l)	>306	96.64	90.00	9.67	0.004	0.917	0.0231*

On analysis of the ROC curves, serum amylase had a sensitivity of 100% and specificity of 91.34%. The area under curve when serum amylase was used for the diagnosis of acute pancreatitis was 0.984 and the p value was 0.01, which was statistically significant. The positive likelihood ratio and negative likelihood ratio was found to be 15 and 0 respectively.

## DISCUSSION

### Age incidence:

**Table 20: Mean age of cases in various studies**

	<b>Our series</b>	<b>Kemppainen et al,<sup>[5]</sup></b>
Meanageinyears	40.7± 9.6	42

Majority of patients with acute pancreatitis in this study were between the ages of 31 and 50 years. The mean age was 40.7± 9.6. In the study conducted by Kemppainen EA et al, the mean age was 42 years. Therefore, acute pancreatitis is common in middle aged individuals.

### Sex incidence:

**Table 21: Sex distribution of patients with acute pancreatitis in various studies**

<b>Gender</b>	<b>Our series</b>	<b>Kemppainen et al,<sup>[5]</sup></b>
Male	80 %	77.35%
Female	20 %	22.64%

Majority of the patients with acute pancreatitis were male in our study accounting for 80 %. In the study conducted by Kemppainen EA et al, 77.35% of the patients were male. Therefore acute pancreatitis is more common in male patients.

### Serum amylase level:

**Table 22: Sensitivity and specificity of serum amylase in various studies**

<b>Serum amylase</b>	<b>Our series</b>	<b>Kemppainen et al,<sup>[5]</sup></b>	<b>Gemaste et al,<sup>[6]</sup></b>
Sensitivity	100%	85%	72%
Specificity	94.7%	91%	99%

In our study, sensitivity and specificity of serum amylase in diagnosing acute pancreatitis was found to be 100% and 94.7 % respectively. In the study conducted by Kemppainen EA et al, sensitivity and specificity of serum amylase in diagnosing acute pancreatitis was found to be 85% and 91% respectively. In the study conducted by Gemaste et al, sensitivity and specificity of serum amylase in diagnosing acute pancreatitis was found to be 72% and 99% respectively.

### Serum lipase level:

**Table 23: Sensitivity and specificity of serum lipase in various studies**

<b>Serum lipase</b>	<b>Our series</b>	<b>Gemaste et al,<sup>[6]</sup></b>	<b>Kylanpaa-Back et al,<sup>[7]</sup></b>
Sensitivity	95.8%	100%	55%
Specificity	94.9%	99%	99%

In our study, sensitivity and specificity of serum lipase in diagnosing acute pancreatitis was found to be 95.8 % and 94.9% respectively. In the study conducted by Gemaste et al, sensitivity and specificity of serum lipase in diagnosing acute pancreatitis was found to be 100% and 99% respectively. In the study conducted by Kylanpaa-Back et al, sensitivity and specificity of serum lipase in diagnosing acute pancreatitis was found to be 55% and 99% respectively.

### Urinary amylase level:

**Table 24: Sensitivity and specificity of urinary amylase in various studies**

Urinary amylase	Our series	Kemppainen et al, <sup>[5]</sup>	Treacy et al, <sup>[8]</sup>
Sensitivity	96.2%	83%	62%
Specificity	90%	88%	97%

In our study, sensitivity and specificity of urinary amylase in diagnosing acute pancreatitis was found to be 96.2 % and 90% respectively. In the study conducted by Kemppainen et al, sensitivity and specificity of urinary amylase in diagnosing acute pancreatitis was found to be 83% and 88% respectively. In the study conducted by Treacy et al, sensitivity and specificity of urinary amylase in diagnosing acute pancreatitis was found to be 62% and 97% respectively.

Acute Pancreatitis is an inflammatory process of variable severity. Most episodes of acute pancreatitis are self-limiting and associated with mild transitory symptoms that remit within 3 to 5 days.

The exact mechanism by which various etiologic factors induce acute pancreatitis and with such variable severity is unclear. However, the chain of events begins with pancreatic acinar cell injury. Afflicted acinar cells locally release activated pancreatic digestive enzymes that result in parenchymal autodigestion along with the recruitment of inflammatory cell mediators, eventually leading to a systemic inflammatory response.

The two most common causes of acute pancreatitis are gallstones and alcoholism, collectively accounting for 80% of pancreatitis hospital admissions. Other causes ERCP, drugs, hypertriglyceridemia, hypercalcemia, infections, tumours and trauma.

Patients typically present with epigastric pain, often radiating to the back. Tenderness is usually limited to the upper abdomen but may be associated with signs of diffuse peritonitis. Occasionally, irritation from intraperitoneal pancreatic enzymes results in impressive peritoneal signs, simulating other causes of an acute abdomen. Nausea, vomiting, and a low-grade fever are frequent, as are tachycardia and hypotension secondary to hypovolemia. Asymptomatic hypoxemia, renal failure, hypocalcemia, and hyperglycemia are evidence of severe systemic effects. Flank ecchymosis or periumbilical ecchymosis are almost always manifestations of severe pancreatitis and have been associated with a 40% mortality rate. However, these signs are present in only 1% to 3% of cases and do not usually develop until 48 hours after the onset of symptoms.

Serum amylase, serum lipase, serum calcium and liver function tests are usual laboratory tests required to diagnose acute pancreatitis.

Radiologic imaging complements clinical history and exam because no single modality provides a perfect diagnostic index of pancreatitis severity. Ultrasound of the abdomen and sometimes CT are used in diagnosing and evaluating the severity of pancreatitis.

As the associated mortality of severe acute pancreatitis approaches 40% and randomized studies have shown that early aggressive supportive care improves outcomes, attempts have been made to identify clinical parameters that predict patients at higher risk of developing

severe outcomes. These are Ranson's criteria, CT severity index, the Glasgow scoring system and The Acute Physiology and Chronic Health Evaluation (APACHE) II score.

Complications associated with acute pancreatitis are necrotizing pancreatitis, infected pancreatic necrosis, acute pseudocyst formation, visceral pseudoaneurysm, venous thrombosis of the splenic, portal, or superior mesenteric vein.

One of the key predictors of poor outcome in acute pancreatitis is end-organ dysfunction resulting from circulatory collapse. Therefore, the initial approach to managing acute pancreatitis focuses on fluid resuscitation and close monitoring for evolving organ dysfunction.

Supportive care includes volume resuscitation with isotonic fluids, urinary output monitoring and frequent monitoring of electrolytes. Nasogastric decompression is performed to decrease neurohormonal stimulation of pancreatic secretion. A large body of evidence suggests that early enteral feeding in patients with severe acute pancreatitis is associated with lower rates of infection, surgical intervention, and length of stay.

This study was performed to evaluate the use of urinary amylase level in the diagnosis of acute pancreatitis. The authors conclude that urinary amylase can be used in the diagnosis of acute pancreatitis as it was found to have comparable sensitivity and specificity as that of serum amylase and serum lipase. On ROC curve analysis the areas under the curve for urinary amylase, serum amylase and serum lipase were found to be similar.

## CONCLUSION

The study involved 40 patients with acute pancreatitis and 40 patients who were hospitalised for elective surgical operations. Between the two groups, the age distribution was comparable. The majority of the patients were between the ages of 31 and 50. Males represented the majority of patients in both groups, that is, the cases and the control group. Acute pancreatitis patients manifested with abdominal discomfort and vomiting. All patients complained of abdominal pain, although only 87.5 percent reported vomiting. Eighty percent of patients were alcoholics, and 52.5 percent were smokers. Among controls, 20% of patients were alcoholics and 30% were smokers. 7.5% of patients were diabetic, 5% were hypertensive,

2.5 percent had IHD, and 10% were obese. 10% of controls were diabetes, 7.5 percent were hypertensive, and 10% were fat. None of the control group's patients suffered IHD. The majority of acute pancreatitis patients had normal RBS, blood urea, serum creatinine, serum calcium, and lipid profiles. In 40% of individuals, abdominal ultrasonography revealed characteristics suggestive of acute pancreatitis. When serum amylase, serum lipase, and urine amylase were compared, serum amylase had the highest sensitivity (100%) while serum lipase had the highest specificity (95 percent). The area under the curve for serum amylase, serum lipase, and urine amylase was 0.988, 0.995, and 0.937, respectively, demonstrating that urinary amylase can also be utilized to diagnose acute pancreatitis.

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