

The Correlation Between Elevated Serum Lipase Levels and Computed Tomography Findings in the Patients with Acute Pancreatitis

 Rasime Pelin Kavak,¹  Nezhil Kavak,²  Nurcan Ertan,¹  İlkey Güler,³
 Nurgül Balci,⁴  Ahmet Seki⁵

¹Department of Radiology,
University of Health Sciences,
Dışkapı Yıldırım Beyazıt Training and
Research Hospital, Ankara, Türkiye

²Department of Emergency
Medicine, University of Health
Sciences, Dışkapı Yıldırım Beyazıt
Training and Research Hospital,
Ankara, Türkiye

³The Republic of Turkey, Ministry of
Health, General Directorate of Public
Hospitals, Ankara, Türkiye

⁴The Republic of Turkey, Ministry
of Health, General Directorate of
Public Hospitals, Home Health Care
Services Unit, Ankara, Türkiye

⁵Department of General Surgery,
University of Health Sciences,
Dışkapı Yıldırım Beyazıt Training and
Research Hospital, Ankara, Türkiye

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Correspondence: Rasime Pelin Kavak,
Sağlık Bilimleri Üniversitesi Dışkapı
Yıldırım Beyazıt Eğitim ve Araştırma
Hastanesi Radyoloji, Ankara, Türkiye
E-mail: drrpelindemir@hotmail.com



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ABSTRACT

Objective: This study was evaluation of the relationship between serum lipase elevation and computed tomography (CT) findings in patients with acute pancreatitis (AP).

Methods: Patients who received AP diagnosis in the emergency department were divided into two groups according to their serum lipase values that were three (group 1) and 10 times (group 2) higher than the normal upper limit, respectively. Demographic characteristics (age and gender), nature of abdominal pain (typical and atypical), duration of presentation, and CT findings were compared between groups in terms of present and absent.

Results: About 53.3% of 122 cases were female. The mean value of patient age in the study was 62.17±6.74 (min 35–max 75) years. About 63.1% of the patients were in Group 2. The mean ED admission interval of the patients was 14.42±10.11 (min 4–max 72) h. The nature of abdominal pain was atypical in 63.9% of the patients. CT findings were present in 56.6% of the patients. Pancreatic necrosis was detected in 3.7% of the patients. Dissimilarities between the two groups were identified in respect of the presence or absence of CT findings ($p<0.05$). The present rate of CT findings was greater in Group 2. Furthermore, the rates of typical/atypical nature of abdominal pain between patients whose CT findings were present and absent had significant distinction ($p<0.001$). The rate of atypical nature of abdominal pain was higher in patients with present CT findings ($p<0.001$).

Conclusion: As the serum lipase value increases in patients with AP, the probability of CT findings being present increases.

INTRODUCTION

Acute pancreatitis (AP) is an acute inflammatory disease characterized by autodigestion of the pancreatic parenchyma.^[1] It is a common cause of emergency department (ED) admissions and hospitalizations due to gastrointestinal system problems.^[2] Although rates differ in each country, there is an increase in the incidence of AP-related ED

admissions worldwide.^[3,4] The most common etiologies are alcohol abuse and gallstones.^[5]

AP presents a wide clinical picture ranging from mild interstitial pancreatic to serious types of local and systemic complications which are correlated with morbidity and mortality. Therefore, early diagnosis and treatment are of critical importance.^[6,7] The Revised Atlanta Classification is the most prominent and applied classification system in

the clinical diagnosis of AP. This classification states that two out of the following three conditions must be met in order to diagnose AP, which are the presence of abdominal pain, measurement level(s) of serum amylase/serum lipase, or both being at least three the upper threshold level of normal, radiological traits indicative of AP.^[8] Although there is no distinction between high serum amylase and lipase levels in this classification, it is recommended to use serum lipase level as the first diagnostic test in AP due to its high diagnostic accuracy.^[9,10] Imaging methods are used for diagnosis when serum amylase and lipase values are incompatible with pain.^[11] Among these methods, computed tomography (CT) is the most comprehensively applied method for the diagnosis of AP and is the gold standard for the confirmation of AP.

Studies examining the relationship between high serum lipase levels, which are among the diagnostic criteria, and AP imaging findings are inadequate in quantity. We aimed to evaluate the correlation concerning serum lipase elevation and CT findings in patients with AP.

MATERIALS AND METHODS

Following Institutional Review Board approval, hospital medical records of the patients who had been admitted to ED and had received a diagnosis of AP between January 1, 2015, and September 1, 2021, were retrospectively evaluated. The inclusion criteria were as follows: (1) aged 18 years and over; (2) serum lipase levels are 3 times higher than the normal upper limit (normal range: 13–60 U/L); and (3) patients with contrast-enhanced abdominal CT in the hospital's radiology medical records database. The exclusion criteria were as follows: (1) history of acute traumatic injury; (2) malignancy; (3) metastasis; and (4) items precluding a proper CT scan.

All CT scans were performed using the standard protocol on the same device with a 128-slice CT scanner (Optima CT 660, GE Health-care System, Milwaukee, USA). CT technical parameters are as follows; 120 kV; 150 mAs; collimation 0.625 mm; slice thickness ≤ 2 mm; rotation time 0.5 s; and pitch 1.014. Non-ionic intravascular iodinated contrast agents (1.5–2 ml/kg) at the portal venous phase (65–70 s), while the patient directed to take a single breath, used to acquire CT images. All images reviewed on a diagnostic and Extreme Picture Archiving and Communications System (Ankara, Turkey).

CT scanning of AP utilized to observe the qualitative evaluation of focal or dispersed pancreatic gland swelling, peripancreatic fat and adjacent inflammatory stranding, peripancreatic fluid accumulations, and pancreatic necrosis (Figs. 1 and 2).^[12] The imaging was reviewed by radiologists, and a diagnosis was obtained with mutual consensus. CT findings were evaluated as present in patients with these findings, and CT findings were evaluated as absent in those who did not.

A typical pain was regarded to have an immediate onset, be intense or continuous in character, and radiate to the



Figure 1. In the axial computed tomography (CT) section, the signs of acute pancreatitis are present; diffuse pancreatic gland swelling, peripancreatic fat stranding (red arrow), and peripancreatic fluid accumulations (green arrow).

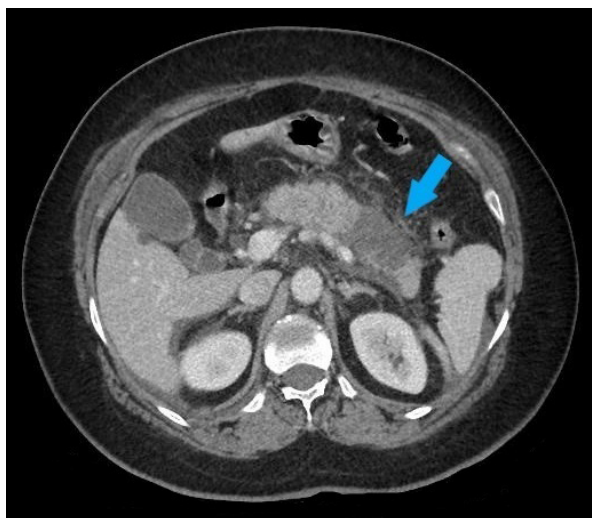


Figure 2. In the axial CT section, a hypodense area compatible with necrosis is observed in the body and tail of the pancreas (blue arrow).

back from the epigastric region. Any symptoms associated that does not involve abdominal pain that is referred to be atypical AP.^[13]

The patients were divided into two groups with serum lipase levels three (Group 1) and 10 times higher (Group 2), respectively, of the common upper limit.^[14]

Demographic characteristics (age and gender), nature of abdominal pain (typical and atypical), duration of presentation, and CT findings of the groups were evaluated in terms of being present and absent.

Statistical analysis

IBM SPSS for Windows 20.0 (SPSS Inc. Chicago, IL) program was used to evaluate the results. Mean standard deviation (SD), median, minimum, and maximum values

were included in descriptive statistics for continuous data, where number and percentage values were in discrete data. Continuous variables were described as mean values \pm SD, and minimum and maximum values. Shapiro–Wilk test was used to examine the compliance of continuous data to normal distribution. The Chi-square test was utilized in comparison of nominal variables among the groups. Mann-Whitney U test was applied for the comparison of continuous data amongst the groups. Factors affecting presence of CT findings were analyzed by univariate and multivariate logistic regression analysis. $P<0.05$ was accepted as the statistical significance limit.

RESULTS

Out of 122 patients, who were involved in the study, 53.3% were female. The mean value of patient age was 62.17 ± 6.74 (min 35–max 75) years. The mean serum lipase level was 536.92 ± 204.48 (IU/L). About 63.1% of the patients were in Group 2. The mean ED admission interval was 14.42 ± 10.11 (min 4–max 72) h. The nature of abdominal pain was atypical in 63.9% of patients. CT findings were present in 56.6% of patients (Table 1). Pancreatic necrosis was detected in 3.7% of the patients.

No difference was observed between the patients with CT findings present and absent in terms of age, ED admission interval, and gender ($p>0.05$). However, dissimilarities were observed among the groups in terms of CT

findings being present and absent ($p<0.05$). In Group 2, the rate of CT findings being present was higher. In Group 2, the CT findings were present that rate was higher. A significant difference was detected in the rates of typical/atypical nature of abdominal pain between patients, whose CT findings were present and absent ($p<0.001$). The rate of atypical nature of abdominal pain was higher in patients with present CT findings ($p<0.001$) (Table 2).

Distinction among the groups in terms of age was observed ($p<0.05$). The patients in Group 2 were older ($p<0.05$). No significant variance among the groups was observed in terms of ED admission interval, gender, and typical/atypical nature of abdominal pain ($p>0.05$) (Table 3).

Outcome of univariate logistic regression analysis showed that the age of the patients was an effective factor for the CT findings to be present ($p<0.05$). An increase in the patient's age by 1 year increases the present factor by 1.076 times. Subsequently, the ED admission interval of patients was also observed to be an effective factor for CT findings to be present ($p<0.001$). A 1-h increase in the ED admission interval time increases the factor by 1.588 times. Serum lipase levels of the patients were found to be an effective factor for the CT findings to be present ($p<0.05$). The fact that the serum lipase levels of the patients are 10 times higher than the normal upper limit increases the present factor of CT findings 2.187 times compared to the patients with the CT findings higher than 3 times. The nature of abdominal pain was found to be an effective factor for the CT findings to be present ($p<0.001$). Patients with atypical nature of abdominal pain increase the factor 5.124 times compared to typical ones.

Table 1. Characteristics of the patients

	Mean \pm SD Median (Min-Max)	
	Age (year)	62.17 ± 6.74 62 (35–75)
ED admission interval (hour)	14.42 ± 10.11 11 (4–72)	
Serum lipase level (IU/L)	536.92 ± 204.48 662.5 (188–1200)	
	n	%
Gender		
Female	65	53.3
Male	57	46.7
Serum lipase group		
Group 1 (serum lipase-2 times higher)	45	36.9
Group 2 (Serum lipase-10 times higher)	77	63.1
Nature of abdominal pain		
Typical	44	36.1
Atypical	78	63.9
Computed tomography findings		
Present	69	56.6
Absent	53	43.4

ED: Emergency department.

Table 2. Comparison of patients with present and absent computed tomography findings

	Present	Absent	p-value
Age (year)	63.49 ± 5.00	60.45 ± 8.22	0.122 ^a
Mean \pm SD, median (min-max)	62 (38–75)	62 (35–72)	
ED admission interval (hour) mean \pm SD	18.30 ± 11.97	9.37 ± 2.05	$<0.001^a$
Median (min-max)	16 (8–72)	9 (4–19)	
Gender, n (%)			
Female	36 (52.2)	29 (54.7)	0.780 ^b
Male	33 (47.8)	24 (45.3)	
Groups, n (%)			
Group 1 (serum lipase-3 times higher)	20 (29)	25 (47.2)	0.039 ^b
Group 2 (Serum lipase-10 times higher)	49 (71)	28 (52.8)	
Nature of abdominal pain, n (%)			
Typical	14 (20.3)	30 (56.6)	$<0.001^b$
Atypical	55 (79.7)	23 (43.4)	

ED: Emergency department; a: Mann–Whitney U test; b: Chi-square test.

Table 3. Comparison findings according to the groups

	Group 1 (Serum lipase-3 times)	Group 2 (Serum lipase-10 times)	p-value
Age (year)	60.17±8.21	63.33±5.44	0.032 ^a
Mean±SD, median (min-max)	62 (35–70)	64 (43–75)	
ED admission interval (hour)	15.64±12.60	13.71±8.32	0.831 ^a
Mean±SD, median (min-max)	11 (7–72)	10 (4–65)	
Gender, n (%)			
Female	21 (46.7)	44 (57.1)	0.263 ^b
Male	24 (53.3)	33 (42.9)	
Nature of abdominal pain, n (%)			
Typical	12 (26.7)	32 (41.6)	0.098 ^b
Atypical	33 (73.3)	45 (58.4)	

ED: Emergency department; a: Mann–Whitney U-test; b: Chi-square test.

Table 4. Univariate and multivariate logistic regression analysis for factors affecting the present status of computed tomography

Parameter	Univariate			Multivariate		
	OR	95% CI	p-value	OR	95% CI	p-value
Age (year)	1.076	1.011–1.145	0.021	1.064	0.964–1.174	0.218
ED admission interval	1.588	1.290–1.954	<0.001	1.556	1.240–1.954	<0.001
Gender (male)	1.108	0.540–2.271	0.780	1.301	0.472–3.580	0.611
Serum lipase (10 times higher)	2.187	1.034–4.627	0.041	4.146	1.333–12.895	0.014
Nature of abdominal pain (atypical)	5.124	2.303–11.399	<0.001	3.512	1.136–10.859	0.029

ED: Emergency department; OR: Odds ratio; CI: Confidence interval.

Outcome of multivariate logistic regression analysis showed that the dependent variable was the present CT findings, and the independent variables were age, ED admission interval, gender, serum lipase level, and nature of abdominal pain. In addition, as a result of the multivariate logistic regression model; ED admission interval, serum lipase level, nature of abdominal pain, and present CT findings were significant. Furthermore, the factor of CT findings being present was observed to increase by 1.556, 3.512, and 4.146 times in cases of 1-h increase in patients' ED admission interval, atypical nature of abdominal pain, and serum lipase levels 10 times greater than the normal upper limit, respectively (Table 4).

DISCUSSION

AP, which is one of the most common causes of ED admissions due to gastrointestinal system problems, is a life-threatening disease with high morbidity.^[2] Therefore, early diagnosis is important for the general health and treatment of the patient. The clinical diagnosis is often made by abdominal pain, serum amylase and/or lipase levels more than 3 times the normal upper limit, and the presence of two of the characteristic imaging features.^[8] In this study, in which the correlation between high lipase concentrations and the present status of CT findings in AP diagnosed patients was evaluated; the occurrence of CT findings was more common in Group 2 than in group 1 (71% vs. 29%).

Elevated serum lipase level in patients with AP occurs earlier than amylase and remains elevated for a longer period of time. For these reasons, the use of serum lipase is recommended as the first diagnostic test.^[9,10] Imaging methods facilitate the detection of subclinical patients in patients with serum lipase levels 3 times above the upper limit of normal.^[15] In addition, imaging methods are used to investigate the etiology of AP, and to evaluate its severity and the presence of complications.^[1] The most important factor affecting laboratory values, which is the most common cause of pancreatitis development, is cholelithiasis/cholecyst.^[16] The imaging modality includes CT as most commonly practiced and magnetic resonance imaging (MRI) or transabdominal ultrasonography, which are less common.^[17] Although the application of CT for diagnosis elevates the effective radiation dose, health-care cost, and causes contrast agent-related risks, the current modality of choice for evaluating patients with AP is CT with intravenous contrast.^[17,18] Indication of AP through CT scanning includes focal or diffuse pancreatic gland swelling, peripancreatic fat and adjacent inflammatory stranding, peripancreatic fluid accumulation, and necrosis of the pancreas.^[12]

It is generally recommended that the first CT scan should be performed at least 72–96 h after the onset of symptoms in patients with AP.^[19] However, Lohse et al.^[2] reported in their study that CT scan performed in the early period of ED played a role in confirming the diagnosis of patients and changing their treatment at a rate of 14.5%.

The rate of atypical nature of abdominal pain was higher in patients with present CT findings. The nature of abdominal pain was atypical in approximately 3/5 of the patients in our study. The reason for this observation is thought to be due to the fact that more CT scans were performed in these patients to provide etiological exclusion.

One of the studies conducted by Glazer et al.^[14] concluded that in ED patients with AP with serum lipase concentrations 3 times greater than the normal upper limit, 16% of patients had imaging findings (CT or MRI). In this study, this rate was 56.6%, which was higher. The high rate in this study may be due to the following patient acceptance criteria; the mean time between abdominal pain and ED admission interval was 14 h, certain conditions causing the elevation in serum lipase were excluded, and only a patient with CT scan.

Acute necrotizing pancreatitis is a type of AP with high morbidity and mortality, characterized by necrosis in and around the pancreatic parenchyma. It has been reported that imaging fails to show necrosis in the first 24 h after symptom onset.^[19] However, in the study of Shinagare et al.,^[20] 1.6% pancreatic necrosis was detected in the early stage of AP. In this study, the rate of pancreatic necrosis was higher, and all of these patients had atypical nature of abdominal pain.

The strength of this study is the inclusion of patients who underwent CT, whose imaging method is considered the gold standard. There are some limitations of our study and these are; in this single-center retrospective study, only patients with ED were included, the time interval concerning the beginning of symptoms and CT scan was unknown, and the present status of CT findings was determined by the consensus of radiologists, and intra- and inter-observer reliability was not evaluated. Therefore, the diagnosis of these patients may have been delayed.

CONCLUSION

Early onset of AP with the indications of CT findings could play a key role in patients with AP. In clinical diagnosis, abdominal pain is diagnosed with serum lipase and/or amylase 3 times higher than normal upper limit and the presence of two of the radiological findings. Imaging methods are generally used when the enzyme elevation and pain are incompatible. In this study, it was determined that the elevated level of serum lipase has a significant correlation with the present status of CT scan results. As the serum lipase level increases in patients with AP, the probability of CT findings being present also increases.

Conflict of Interest and Financial Disclosure Statements

The authors declare that they have no conflicts of interest. They also declare that they have not engaged in any financial relationship with any company whose product might be affected by the research described or with any company that makes or markets a competing product.

Ethics Committee Approval

This study approved by the University of Health Sciences, Dışkapı Yıldırım Beyazıt Training and Research Hospital-Clinical Research Ethics Committee (Date: 18.10.2021, Decision No: 122/12).

Informed Consent

Retrospective study.

Peer-review

Externally peer-reviewed.

Authorship Contributions

Concept: R.P.K., N.K.; Design: N.E., İ.G., N.B.; Supervision: R.P.K., N.E.; Materials: N.K., R.P.K, N.E.; Data: R.P.K, N.E.; Analysis: N.B., A.S.; Literature search: N.B.; Writing: R.P.K., N.K., İ.G.; Critical revision: A.S, N.B.

Conflict of Interest

None declared.

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Akut Pankreatit Tanılı Hastalarda Serum Lipaz Yüksekliği ile Bilgisayarlı Tomografi Bulguları Arasındaki İlişki

Amaç: Amacımız akut pankreatit tanılı (AP) hastalarda serum lipaz yüksekliği ile bilgisayarlı tomografi (BT) bulguları arasındaki ilişkiyi değerlendirmektir.

Gereç ve Yöntem: Acil serviste AP tanısı alan hastalar serum lipaz değerlerine göre, normal sınırın üç katı (grup 1) ve on katı (grup 2) olarak iki gruba ayrıldı. Gruplar arasında demografik özellikleri (yaş, cinsiyet), karın ağrısının vasfı (tipik, atipik), başvuru süresi ve BT bulgularının var ve yok olması açısından karşılaştırıldı.

Bulgular: Yüz yirmi iki hastanın %53.3'ü kadın idi. Hastaların yaş ortalaması 62.17 ± 6.74 (min 35-max 75) yıl idi. Hastaların %63.1'i grup 2'de yer almaktaydı. Hastaların başvuru süresi ortalaması 14.42 ± 10.11 (min 4-max 72) saat idi. %63.9 hastada karın ağrısı atipik vasıfta idi. Hastaların %56.6'sında BT bulguları mevcuttu. Hastaların %3.7'sinde pankreas nekrozu saptandı. Gruplar arasında BT bulgularının var ve yok olması açısından farklılıklar saptandı ($p < 0.05$). Grup 2'de BT bulgularının var olma oranı daha fazla idi. BT bulguları olan ve olmayan hastalar arasında karın ağrısı tipik/atipik vasıfta olması oranları arasında fark saptandı ($p < 0.001$). BT bulguları var olan hastalarda karın ağrısının atipik vasıfta olma oranı daha yüksek idi ($p < 0.001$).

Sonuç: AP tanılı hastalarda serum lipaz değeri arttıkça BT bulgularının var olma olasılığı artmaktadır.

Anahtar Sözcükler: Acil servis; akut pankreatit; bilgisayarlı tomografi; lipaz.