

Amylase and lipase in patients with diabetic foot in Baghdad

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ABSTRACT:

Background. Diabetes mellitus (DM) is a prevalent disease that, if not managed properly, can lead to a variety of problems, including diabetic foot. Glycated hemoglobin A1c (HbA1c), FBS, amylase, and lipase are important diabetic management indicators that are now employed as diagnostic tests.

Objective. To evaluate the value of amylase lipase as a predictive marker in diabetic foot

Patients and methods. This study included 30 patients who reported to Baghdad Hospital with diabetic feet between November 2023 and November 2024. All patients had their HbA1c, amylase, lipase, and FBS levels tested. Means, independent t-tests, and the F-test were used in the statistical analysis.

Results. Thirty patients aged 35-75 years were evaluated, with significant differences ($P = 0.001$). People with diabetic feet had a high percentage of HbA1c and FBS, as well as a substantial drop in amylase and lipase measures, with a difference value of ($P=0.001$).

Conclusion. HbA1c amylase lipase is an important prognostic factor in diabetic foot patients. Levels greater than eight were related with a poor prognosis and prolonged hospitalization. Thus, diabetes management is a critical role in preventing and treating diabetic complications.

Keywords: diabetic foot, hemoglobin A1c, FBS, amylase, lipase

Abbreviations (in alphabetical order)

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DFU – diabetic foot ulcer

DM – diabetes mellitus

FBS – fasting blood sugar

HbA1c – hemoglobin A1c

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INTRODUCTION

Diabetes mellitus (DM) is a metabolic disorder with a high global prevalence and is a significant public health concern. According to estimates, 425 million people will have diabetes by 2025, accounting for roughly 10% of the world's population, with type 2 diabetes accounting for 90% [1]. Acute and chronic diabetes complications, including nephropathy, retinopathy, cardiovascular disease, and diabetic foot, are related to hospitalization and death [2,3]. These precautions may generate undue concern, particularly in younger patients [4] and those with neuropsychiatric illnesses [5,6]. Glycated proteins such as HbA1C have been reported to raise serum cortisol levels, salivary cortisol levels, plasma and prolactin levels [7], as well as other assumed diabetes indicators [8]. Salivary indicators include the first glyceemic control enzyme in food digestion (salivary Amylase) [9]. Furthermore, in diabetic patients, fasting blood glucose and salivary glucose test values are significantly correlated [10,11], salivary glucose test values and HbA1c [10,12], and other salivary markers, such as fructosamine glycoprotein, have a significant correlation with HbA1c and blood glucose levels [13]. Diabetic foot problems are the most common long-term complication of diabetes, accounting for roughly half of all diabetes-related hospital days. Diabetic feet are particularly susceptible to issues due to their inability to resist stress. Diabetic foot ulcers (DFUs) are one of the most prevalent and dangerous consequences of diabetes. They affect 15% of all diabetic patients and place a significant financial burden [14, 15]. Diabetic patients account for around 50% of lower extremity amputations. Diabetes-related lower extremities problems have become a significant public health concern in both developing and affluent countries. People with diabetes have a 25% lifetime risk of getting foot ulcers [16], which is mainly caused by vascular insufficiency and peripheral neuropathy. Approximately 20% of diabetic individuals with foot ulcers have primarily arterial insufficiency, 50% have mainly neuropathy, and roughly 80% have both diseases [17], [18]. Neuropathy, peripheral vascular disease, and a decreased resistance to infection are all known risk factors for the development of DFU, which resembles a chronic wound. Hyperglycemia is caused by a negative result and its activity, which might impact external production and secretions. Some generate enzymes such as Amylase, lipase, and protease. [19] When blood is collected from the proximal islets, secretory afferent cells are exposed to high levels of endocrine hormones. Evidence indicates that endocrine pancreatic hormones, particularly insulin, influence pancreatic exocrine function. Insulin negatively impacts secretory cells. Amylase and lipase are among the enzymes found in the secretory acinar

cells that aid in the digestion of specific food components [20]. Amylase is the primary enzyme responsible for breaking down starch into maltose and malt triose while also removing dextrans during digestion. Lipase is a digestive enzyme generated in the pancreas and transferred to the gut, where it converts triglycerides to fatty acids and monoglycerides. A lack of pancreatic enzymes causes poor digestion and hunger. [21] Low serum amylase levels have long been thought to indicate deteriorating pancreatic damage caused by advanced illness. However, recent research has found that low serum amylase levels are connected with metabolic syndrome and diabetes. Hemoglobin A1c (HbA1c) also indicates a patient's glycemic state for the last three months [22].

METHODS AND MATERIALS

Study design

Patients with diabetes mellitus and foot ulcers were seen at the outpatient clinic of Baghdad Teaching Hospital, Medical City, between November 2023 and November 2024. A total of 30 diabetic foot ulcer patients and 20 healthy individuals. The patients ranged in age from 35 to 75 years (mean age 52); a specialist physician detected the presence of foot ulcers after a physical and x-ray examination. Documenting the patient's medical history.

Blood sampling

Venous blood was taken from all participants with disposable syringes. The blood was gently expelled and separated into two portions. The first was discharged into a tube containing an anticoagulant used in hematological assays, such as HBA1C. The second part was emptied into plain tubes, allowing the blood to coagulate before being centrifuged to separate the serum components. The first was utilized immediately for a regular test, which comprised serum FBS, amylase, and lipase.

Outcome measurements

Fasting blood sugar, amylase, and lipase levels were measured using a fully automated chemistry analyzer, the BS240Pro instrument. Using an EDTA tube. HBA1C was measured using a Clover device, which uses an immunological assay approach.

Statistical analysis

A statistical application, SPSS version 24.0, was used. The variations in variable means between the control and sick groups were analyzed using a one-way ANOVA test. The data were expressed as mean \pm SD. Pearson's correlation coefficient (r) was used to examine correlations between all variables under research, and data analytic methods included linear regression analyses. Statistics were considered significant when the p-value was less than 0.001. The study variables' cut-off values, sensitivity,

specificity, and area under the curve were displayed using the receiver operating characteristic (ROC) curve.

RESULTS

Table (1) shows the incidence rates of diabetic foot ulcers in patients aged less than 70 and over 35. While Table (2) shows diabetes patients who are most impacted by the foot, Table (3) reveals that the most significant areas of foot ulcers are at the bottom of the big toe and the least at the ball of the foot. There is a substantial difference between FBS and HbA1c amylase lipase levels in diabetic foot ulcer patients and the control group. Problems caused the gap between healthy people and patients. A. Retinopathy (reduced vision, exudation, and retinal hemorrhage). To Neuropathy (pain, numbness, loss of feeling) C. Nephropathy (pleural effusion, ascites, subcutaneous edema in the legs, increased amylase levels, blood, and albuminuria). D - Gastropathy. The figure depicts the percentage difference in ages between them. Table (4) represents the distribution of the average percentage of HbA1c, FBS, amylase, and lipase among patients with foot ulcers.

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Table 1: Age distribution

Age group	Percentage of diabetic foot ulcer
35-45	11.5 %
46-55	23.5 %
56-65	29.5 %
66-75	35.5 %
Total	100 %

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Table 2: The site of foot ulcers distribution

Site	Number of patients	Percent
Ball of the foot	13	40%
Bottom of the big toe	17	60%
Total	30	100%

Table 3: Fasting blood sugar levels Hemoglobin, glycosylated amylase and lipase in control subjects and diabetic foot ulcers

	Control (n=20)	Diabetic foot ulcer (n=30)
FBS (mg/dL)	51.23 ± 6.25	310.5 ± 8.09
HbA1c %	3.89 ± 1.26	10.78 ± 2.37
Amylase (U/L)	13.52 ± 3.14	2.13 ± 0.41
Lipase (U/L)	15.34 ± 1.99	3.01 ± 1.19

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Table 4: Distribution of mean HbA1c, FBS, amylase and lipase among the patients with foot ulcer

Age group	HbA1c%	FBS (mg/dl)	Amylase (U/L)	Lipase (U/L)
35-45	8.18 ± 0.12	205 ± 5.25	15.79 ± 3.87	12.5 ± 2.97
46-55	8.56 ± 0.13	218.66 ± 6.67	13.78 ± 2.79	9.18 ± 3.21
56 - 65	9.79 ± 0.29	275.5 ± 13.07	9.72 ± 1.24	7.14 ± 1.45
66 - 75	11.01 ± 0.27	354.5 ± 41.07	7.85 ± 0.26	3.98 ± 1.64

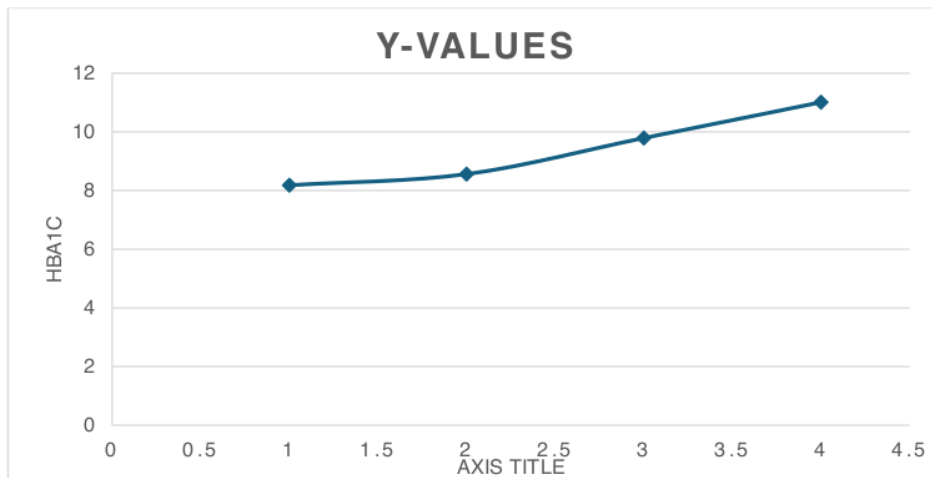


Figure 1: The relationship between Hba1c and Age

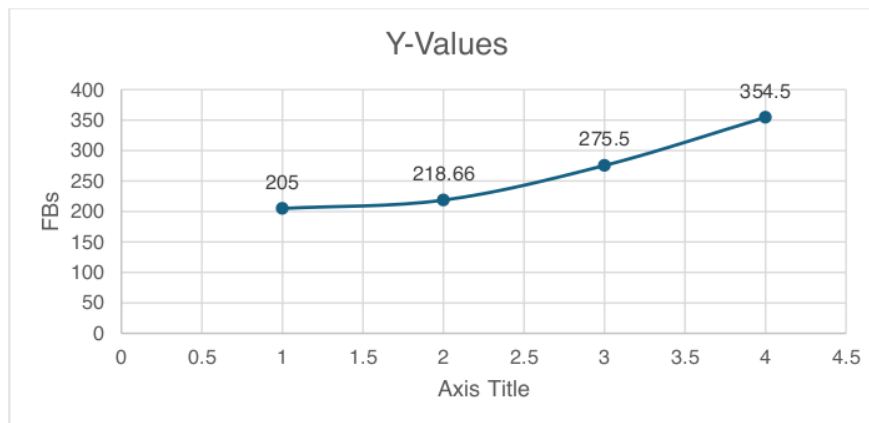


Figure 2: The relationship between FBS and Age

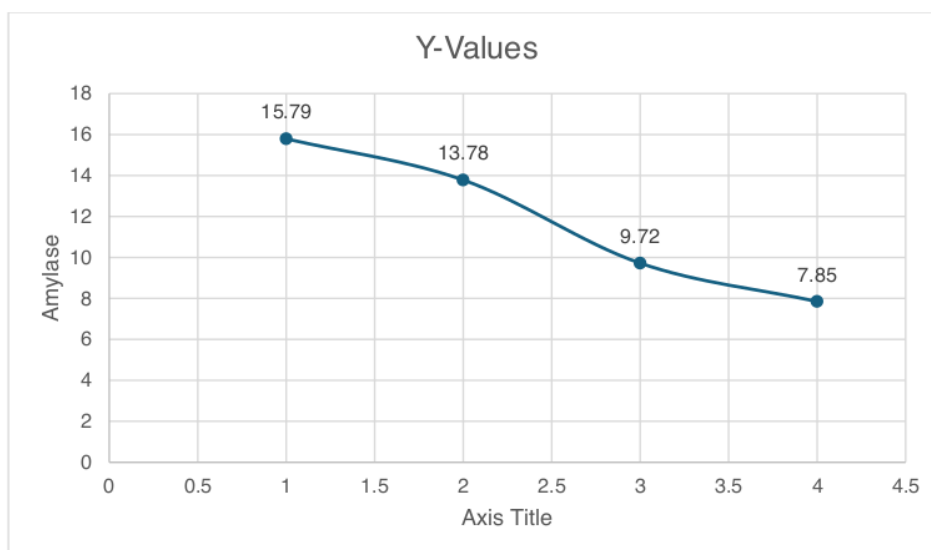


Figure3: The relationship between Amylase and Age

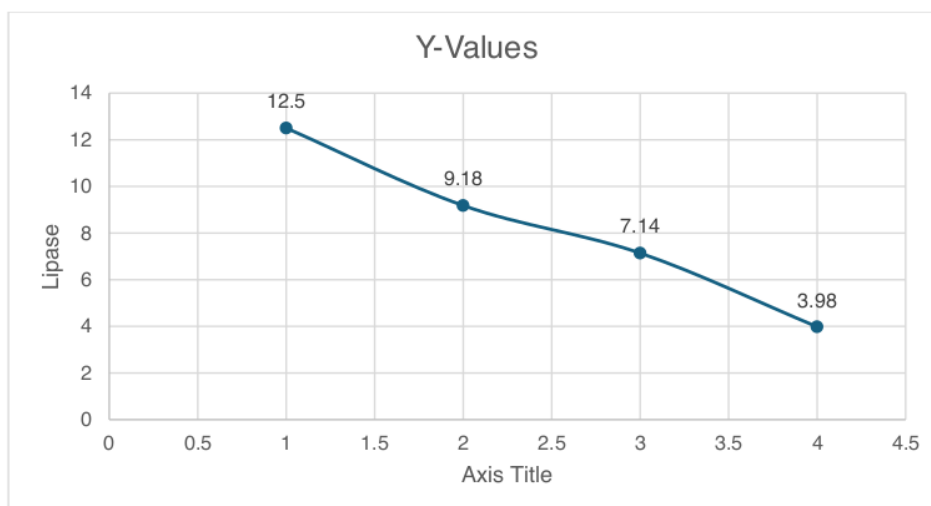


Figure 4: The relationship between lipase and Age

DISCUSSION

This study found a linear association between HbA1c levels and Wagner classification grades: patients classified as grades 0-2 had somewhat higher HbA1c levels, while those classified as grades 3-5 had the highest HbA1c values. Diabetic foot syndrome

comprises a variety of diabetic foot lesions, such as infections, neuropathic osteoarthritis, and diabetic foot ulcers. Diabetic foot lesions comprise roughly 15% of all diabetic foot lesions. They are expected to rise to 25% in the future, making it the most serious disorder that can result in limb amputation [23]. Diabetic foot is caused by tiny injuries that people with diabetes may overlook for a long period owing to peripheral nerve damage. Furthermore, peripheral nerve dysfunction is frequently coupled with peripheral artery disease, resulting in insufficient blood supply to the extremities, a condition known as diabetic vasculopathy, which can lead to diabetic foot. Thus, the diabetic foot might be neuropathic, neuroischemic, or ischemic [24]. Zubair et al. and Ozenc et al. found inconsistent associations between HbA1c levels and the Wagner classification; Zubair et al. found a statistically significant correlation, but Ozenc et al. found a statistically negligible link [25,26]. Sarinnapakorn et al. discovered that whereas HbA1c levels and fasting blood glucose values are not substantially associated with diabetic foot, nearly half of DM patients are at moderate or high risk for diabetic foot. Almost all of the patients in this study had uncontrolled diabetes, as shown by a mean HbA1c of 8.55% and a mean FBS of 292 mg/dl. However, no significant link was found between amputation risk and numerous parameters, including cumulative blood glucose levels, FBS, and other variables. First, FBS and HbA1c levels did not differ across study participants with modest amputations, large amputations, or DFU. All individuals (dead or living) had poorly managed diabetes with different degrees of complications at the time of admission to an orthopedic unit [27]. Fungal infections of the foot can be superficial or intricate deep tissue lesions. *Candida* species and *Fusarium solani* are both commonly affected. [28]. In this study, fungus-positive patients had a mean diabetes duration of 7.89 ± 6.14 years. While Al-Rubeaan et al. [29] found a link between diabetic foot ulcers and diabetes duration, no significant correlation was found between fungal infection and diabetes duration in the current study. Fungal infections in the foot can range from superficial to deep tissue diseases. *Candida* species and *Fusarium solani* are both commonly affected. The incidence of fungal infections is directly proportional to the length of diabetes. Patients had an average duration of diabetes of 7.7 years. had fungal infections [28]; Al-Rubeaan et al. [29] showed a tight relationship between diabetic foot ulcers and diabetes duration, while our investigation revealed no significant link between fungal infection and diabetes length. The authors ascribe these levels to hormonal and metabolic alterations in diabetes patients, including microvascular problems and

autonomic neuropathy, both of which can impact salivary secretions [30]. Hertz [31], using mass spectrometry data, proposed that poor buildup of α -amylase speckles in diabetes patients may be connected to alterations in oral anti-inflammatory status. They also imply that diabetes will only impact a subset of alpha-amylase isoforms. These apparent disparities might be attributed to the manner of saliva collection and other variables that can influence salivary amylase levels, such as diabetes duration [32] and comorbidities [33], such as Parkinson's disease [34]. Other illnesses that affect saliva flow include gastroesophageal reflux [35]. Other relevant variables include the use of parasympathetic system-active drugs such as pilocarpine, muscle relaxants, and antiepileptic and antipsychotic medications. Anticholinergic medications, for example, interfere with acetylcholine's activity. antihistamines and cytostatics. In studies with identical saliva sample collecting conditions, salivary amylase, and blood glucose were found to be positively associated. Salivary amylase has a high connection with total salivary proteins [36] and serum amylase [37]. It should be noted that, according to the studies mentioned above, not all parameters show a good correlation between saliva and blood, as well as differences in concentration depending on saliva flow in the case of polar or ionic compounds of high molecular weight transported by saliva or excreted through excretion. [38]. Nakajima et al. discovered that insulin-dependent diabetics have reduced blood lipase. and amylase levels. These findings might be explained by the reduced activity of adenoblast cells in the proximity of insulin-depleted islets. In another study. Other pancreatic enzymes, including elastase, trypsin, and chymotrypsin, were lowered. Analyzing pure pancreatic secretions embedded in the pancreatic duct lumen in diabetic individuals with uncontrolled hyperglycemia revealed considerably lower amylase concentrations and somewhat higher bicarbonate and lipase levels. Diabetes is one of the most common chronic illnesses, threatening the lives of millions of people globally [39]. Dyslipidemia, which is characterized by hyperglycemia and low blood insulin, is a significant risk factor for diabetes complications and has been extensively researched [40, 41].

CONCLUSION AND RECOMMENDATIONS

HbA1c, FBS Amylase, and lipase are key prognostic markers in diabetic foot patients. Levels greater than eight were linked to worse prognoses, complications, longer hospital stays, and more severe and costly therapy and surgical interventions. This

raises the strain on the health-care budget. Controlling diabetes is a critical aspect in preventing diabetic complications. If it happens, appropriate control may lessen the impact.

Authors contributions:

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Conflict of interest:

The authors declare no conflict of interest.

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