

Insight into the exocrine pancreatic function (serum amylase and lipase) in type 2 diabetes mellitus

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Abstract

Introduction: Insulin has its effect on the basal and stimulatory secretion of exocrine pancreatic enzymes. In this context this study has been done to understand the relationship between the exocrine and endocrine entities of pancreas by analyzing two most commonly estimated exocrine enzymes; serum amylase and serum lipase in type 2 DM.

Materials and Methods: The study was conducted at Rajarajeswari Medical College and Hospital, Bengaluru, Karnataka from January 2012 to December 2012. Hundred clinically diagnosed cases of type 2 diabetes mellitus {Fifty well controlled (HbA1c < 7.0%) and Fifty poorly controlled (HbA1c \geq 7.0%)} and twenty five healthy volunteers (controls) in the age group of 30-60 years who have satisfied the inclusion and exclusion criteria were the study subjects. Serum amylase and serum lipase levels were estimated by enzyme kinetic assay and HbA1c was estimated by Ion exchange resin method.

Results: Serum amylase and serum lipase levels were within the reference range in all the three study groups. There was no significant difference in serum amylase among well controlled and poorly controlled type 2 DM. In contrast, significant difference in serum amylase levels was observed between diabetic group and controls ($p < 0.05$). Whereas significant difference in serum lipase levels was observed among the two groups of the diabetics ($p < 0.05$) and also between cases and controls ($p < 0.01$).

Conclusion: The potential underlying connection between exocrine and endocrine function of pancreas in patients with type 2 DM needs further investigation with larger population; to consider the analysis of serum pancreatic enzymes especially serum lipase levels as an additional informative parameter to assess the glycemic control in type 2 DM.

Keywords: Type 2 DM, Serum amylase, Serum lipase.

Introduction

Diabetes mellitus is the most common endocrine disease with prevalence of 8.3% in 2011 and to be 9.9% in 2030.¹ Type 2 DM is most common among the diabetes. Dysfunction of the endocrine pancreas causes DM. Although the role of the islets in the regulation of acinar cell function seemed a mystery to investigators, since last three decades a steadily growing understanding of the interrelationship of the endocrine and the exocrine pancreas has been observed. The islet innervation and vascular anatomy have been more fully characterized and provide an appropriate background for understanding the interrelationship between the endocrine and exocrine pancreas.²

Exocrine function is mediated by islet-derived hormones such as insulin, glucagon and somatostatin, other humoral factors including pancreastatin and ghrelin, and also neurotransmitters (nitric oxide, peptide YY, substance P and galanin) released by the nerves innervating the pancreas.² Insulin is believed to bind to its own receptor on the acinar cell³ leading to stimulation and potentiation of amylase secretion by various mechanisms including regulation of amylase gene transcription;⁴ stimulation of DNA, RNA and acinar protein synthesis⁵ and increase in glucose uptake.⁶ Glucagon has been found to have an inhibitory influence on the exocrine secretions. In summary

endocrine pancreas has a trophic effect on the exocrine pancreas.

Type 2 DM is manifested due to either defective insulin secretion or defective action or both resulting in chronic hyperglycemia which per se causes injury to most of the cells of the body. In addition autonomic neuropathy and micro and macrovascular complications of DM causes progressive damage to the insulin acinar axis. Hence analysis of serum amylase and lipase could be an additional informative parameter for the assessment of chronicity and progress of the illness. In this context we have studied effect of Insulin on the basal and stimulatory secretion of exocrine enzymes via islet-acinar axis by estimating serum amylase and lipase in type 2 DM.

Materials and Methods

Our study included clinically diagnosed cases of type 2 DM patients attending medical OPD of Rajarajeswari Medical College and Hospital, Bengaluru. Fifty well controlled (HbA1c < 7.0%) type 2 diabetes mellitus patients and fifty poor controlled (HbA1c \geq 7.0%) type 2 diabetes mellitus patients and twenty five healthy volunteers in the age group of 30-60 years were included in the study. Patients with history of pancreatitis, salivary gland inflammation, alcoholism, renal failure and other acute medical or surgical illness were excluded from the study.

Institutional ethical committee clearance was obtained. After obtaining informed consent, blood sample from the study group was collected under full aseptic precautions in gray and red capped collection tubes. Glycated Hb (GHb) was estimated by Ion exchange resin method. Whole blood was mixed with lysing reagent to prepare a hemolysate, then mixed with a weakly binding cation-exchange resin. The non-glycated Hemoglobin binds to the resin leaving GHb free in the supernatant. The GHb percentage was determined by measuring the absorbance of the GHb fraction and of the total Hb. Expected range: Non Diabetic: 4.0-6.0%, Good Control: <7%, Poor Control: $\geq 7.0\%$. Serum amylase and lipase levels were estimated by kinetic spectrophotometry method (Kits supplied by Transasia Company).

Statistical Analysis

This is a descriptive study. The data obtained was analyzed statistically using one way anova calculator for independent measures. Pearson's correlation coefficient was used to find out the correlation.

Results

This study included fifty well controlled and fifty poorly controlled type 2 diabetes mellitus and twenty five healthy volunteers (controls) in the age group of 30-60 years. There were 25 males and 25 females in each study group. Majority of them were in 45-55 years of age with average age of 53 years in well controlled group and 50 years in poorly controlled group. In

control group there were 10 males and 15 females with average age of 50 years.

Mean FBS levels in well controlled and poorly controlled type 2 DM were 129 ± 48 mg/dl and 208 ± 73 mg/dl respectively. Mean PPBS levels in well controlled and poorly controlled type II DM were 208 ± 87 mg/dl and 315 ± 81 mg/dl respectively. Mean HbA1c level in well controlled diabetes and poorly controlled type 2 DM was 6.1 ± 0.65 and 8.3 ± 0.96 respectively.

Mean serum amylase activity was 51 ± 17 U/L in well controlled DM (HbA1c <7) study group and 56 ± 16 U/L in poorly controlled (HbA1c >7) study group and 42 ± 14 U/L in controls (Fig. 1). There was no significant difference in serum amylase activity among the three study groups. But we observed significant difference between the two diabetic groups and controls at $p < 0.05$. Weak negative correlation between amylase and HbA1c was observed in both good ($r = -0.0903$) and poorly ($r = -0.1156$) controlled type II DM.

Mean serum lipase activity was 45 ± 12 U/L in well controlled, 54 ± 14 U/L in poorly controlled type 2 DM study group and 32 ± 14 U/L in control group was observed (Fig. 2).

In contrast to serum amylase levels, we observed significant difference in serum lipase levels among the study two groups at $p < 0.05$ and significant difference between study groups and controls at $p < 0.01$. Weak positive correlation between Lipase and HbA1c was observed in both good ($r = 0.1365$) and poorly ($r = 0.2178$) controlled type 2 DM.

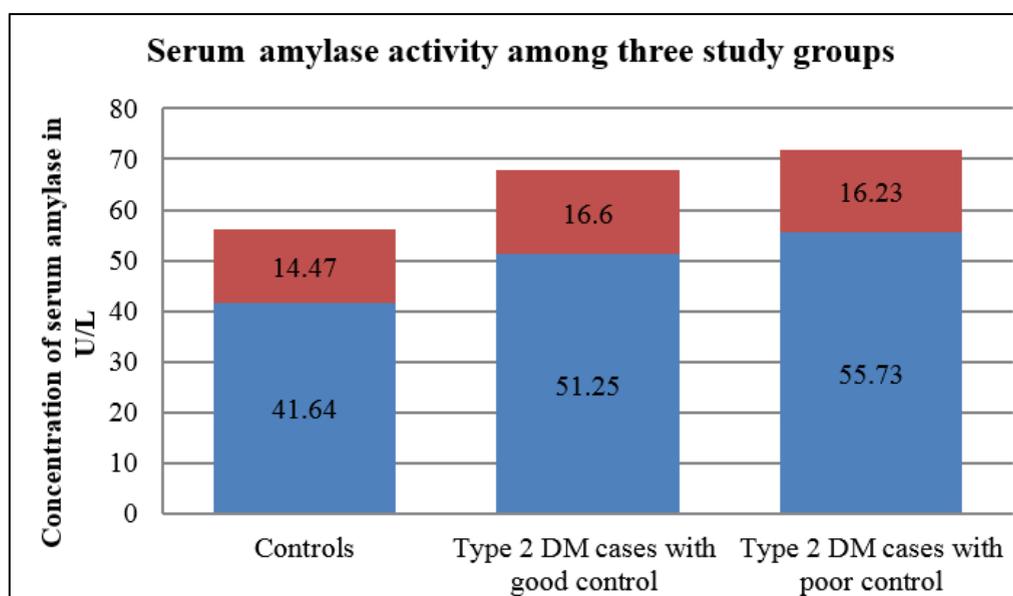


Fig. 1: Serum amylase activity among the three study groups. (Reference range of serum amylase up to 130 U/L)

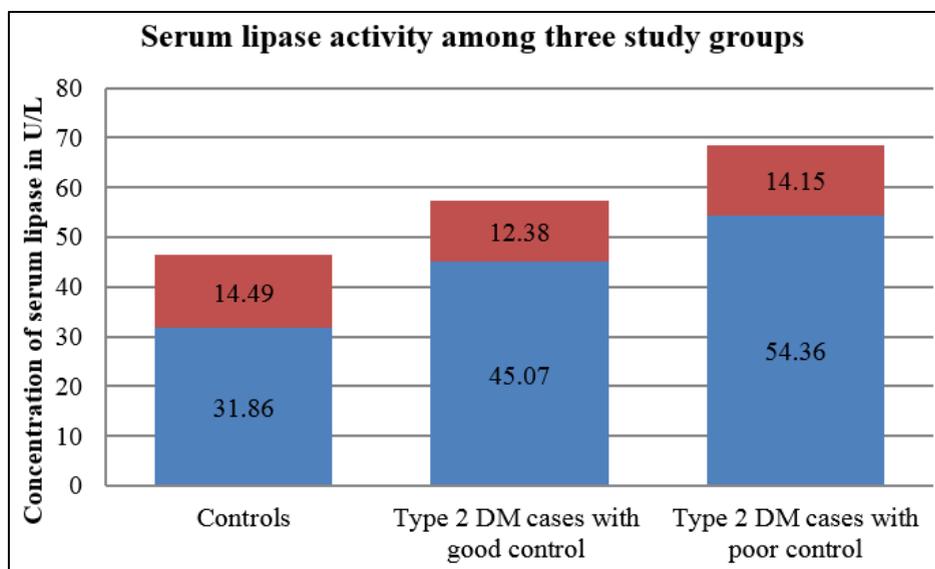


Fig. 2: Serum lipase activity among the three study groups (Reference range of serum lipase: up to 60 U/L. $P < 0.05$ = significant)

Discussion

In clinical practice, serum amylase and lipase activities are measured commonly to diagnose acute pancreatitis. Hyperglycemia seen in type 2 diabetes mellitus affects most of the organs in the body and in addition endocrine pancreas has a trophic effect on the exocrine pancreas. Hence we have studied the activities of serum amylase and lipase to understand the effect of glycemic control on the exocrine pancreas.

In our study, serum amylase activities were within the reference range in all the three study groups. Though within the reference range, compared to healthy volunteers (control) serum amylase levels were high in well controlled type 2 DM (mean HbA1c=6.0) and were higher in poorly controlled type 2 DM (mean HbA1c=8.0). A plausible explanation for this observation may be that insulin resistance was almost compensated with hyperinsulinemia which increases pancreatic exocrine function due to stimulation of islet-acinar axis. We also observed that there was no significant difference in serum amylase among well controlled and poorly controlled type 2 DM and also weak negative correlation among the study subjects. Serum amylase levels may not be related to HbA1c, the reason may be that HbA1c reflects glucose metabolism over preceding one to two months whereas serum amylase may change rapidly in response to changes in plasma glucose concentration and it is rapidly excreted from the kidney.

In our study, serum lipase activities were also within the reference range in all the three study groups. Similar to serum amylase levels, serum lipase levels were high in well controlled type 2 DM and were higher in poorly controlled type 2 DM compared to healthy volunteers (control). In contrast to serum amylase levels, significant difference ($p < 0.05$) in serum

lipase levels among the two diabetic study groups and between diabetic groups and controls ($p < 0.01$) were observed. Possible explanation for this may be in contrast to serum amylase, serum lipase activity remains increased for longer days (up to 8 to 14 days). Hence compared to amylase, serum lipase activities can be used to assess the glycemic control in type 2 diabetes.

Similar to our study findings, few authors have observed increase in serum amylase⁷⁻⁹ and lipase^{7,8,10-12} levels in type 2 DM patients as compared to healthy volunteers but the increase was significant as the study subjects were type 2 DM with complications. This observation may be due to the fact that uncontrolled hyperglycemia with complications leads to acinar cell injury and release of pancreatic enzymes resulting in their rise in serum. In addition associated renal dysfunction in type 2 DM leads to decreased excretion of pancreatic enzymes resulting high levels of serum pancreatic enzymes.

On the other hand several authors¹³⁻²¹ have observed decreased serum amylase and lipase levels in type 2 DM. This observation may be due to differences in study subjects, persistent hyperglycemia in long standing diabetes with poor control might cause acinar cell damage resulting in pancreatic fibrosis and atrophy leading to insufficiency of exocrine acinar cells.

The exocrine pancreatic function depends upon the stage of natural course type 2 DM; varying from mild rise of pancreatic enzymes (compared to controls) in insulin resistance stage to significant rise in some complications associated with type 2 DM to decreased pancreatic enzymes in very chronic uncontrolled type 2 DM. Compared to serum amylase, serum lipase can be considered to assess the glycemic control in type 2 DM.

In addition the results of this study also throw a light on interpreting the data of pancreatic enzymes in type II DM presenting with abdominal symptoms.

Conclusion

However the potential underlying connection between exocrine and endocrine function of pancreas in patients with type 2 DM needs further investigation with larger population; to consider the analysis of serum pancreatic enzymes especially serum lipase levels as an additional informative parameter to assess the glycemic control in type 2 DM.

Limitations of the study: It is a cross sectional study with small sample size and serum insulin level and insulin resistance was not measured to comment on insulin acinar axis.

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