Correlation between Plasma Amylase Activity and Concentration of Non-esterified Fatty Acids (NEFA)* (23264)

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Administration of insulin, glucose or glucagon lowers plasma amylase(1-3) and causes a sharp drop in plasma non-esterified fatty acids (NEFA)(4-6). These apparently unrelated blood components have not been studied jointly, however, nor has amylase level been examined in relation to other agents known to affect NEFA concentration. In the present investigation glucagon, glucose, fructose, epinephrine, and orinase were administered to normal and diabetic patients. They were found to produce strikingly parallel variations of amylase and NEFA.

Methods. Normal and diabetic patients were studied at Mt. Sinai or Rockefeller Institute Hospital. After an overnight fast, blood samples for determination of amylase (7), glucose(8), and NEFA concentrations (4) were taken in duplicate prior to administration of a test agent and at 20-minute intervals for 2 to 4 hours thereafter.

Results. Fig. 1 shows the average percentage changes of blood sugar, amylase and NEFA in 19 non-diabetic and 9 subjects with stable diabetes following administration of glucagon. Amylase and NEFA varied in parallel ($p<.001$) ($r = 0.65 \pm 0.09$). The reductions in concentration of both components were of greater magnitude in normal subjects than in diabetics ($p<.001$ at 40 min.) and, as with the blood sugar, the returns toward control value in normals were more rapid. Glucose tolerance tests (5 normal subjects) and a fructose tolerance test (one normal subject) (Fig. 2), caused decreases of both amylase activity and NEFA concentration with reciprocal rises of blood sugar. Insulin, known to produce a fall in plasma NEFA associated with a decrease of blood sugar(4), also caused a significant reduction in amylase in 14 patients ($p<.001$). Orinase (1-butyl-3-p-tolylsulfonylurea), 2.0 g administered intravenously to 4 stable diabetics and 4 normal subjects (Fig. 3), caused hypoglycemia with associated decreases of amylase and NEFA concentrations ($p<.001$) Epinephrine (1.0 mg) given subcutaneously (Fig. 4), produced parallel increases of both amylase and NEFA in 2 normal subjects.

Discussion. The sources and functions of blood amylase are unknown. Enzymes with amylase activity can be extracted from pancreas, salivary glands, and liver. In clinical practice elevation in blood amylase usually is attributed to regurgitation of the external pancreatic secretion as a result of duct obstruction(9). However, the fact that blood amylase is maintained following removal of the pancreas in the dog(1) and man(10), suggests that non-pancreatic sources are more important than pancreas for maintenance of normal blood levels. Both pancreas and salivary glands have been totally removed from rats without causing a decrease in blood amylase(11). By exclusion, it appears that the liver might be the main source of blood amylase(12).

At any rate, changes in blood amylase are distinct from changes in amylase content of pancreatic juice: (a) insulin hypoglycemia, which is a stimulus to exocrine secretion of pancreatic amylase(13), caused a fall in blood amylase; (b) epinephrine, which diminishes exocrine secretion of amylase by the pancreas(14), elevated blood amylase; (c) secretin and pancreozymin, which stimulate pancreatic flow and enzyme secretion in patients with a normal unobstructed pancreatic duct system, have no effect on blood amylase (9); (d) amylase and NEFA responses to glucagon in one patient following subtotal pancreatectomy were similar to the results obtained in diabetic subjects with no known defect of external pancreatic secretion.

The consistently parallel variations of blood

* The Glucagon was furnished by the Eli Lilly Co., Indianapolis, and the Orinase by Upjohn Co.

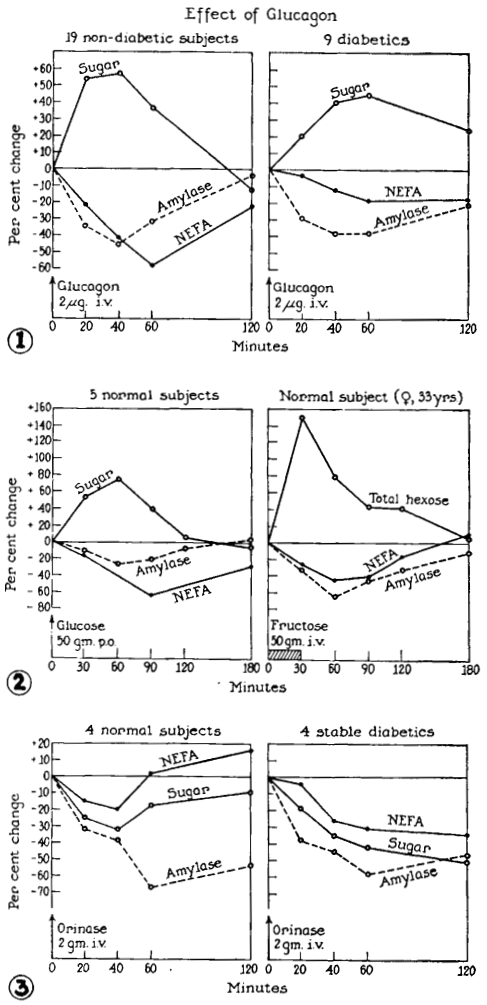

FIG. 1-3.

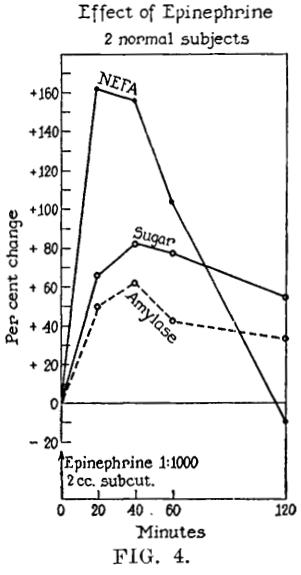

FIG. 4.

amylase and NEFA suggest these two components might be involved in some common process. The decrease in plasma NEFA following administration of insulin appears to be due to reduction in delivery of fatty acids from tissue stores to blood(15). Possibly the associated decrease in amylase is related to this reduced flow of fatty acids to cells. It is also interesting to note that insulin and glucose, which increase carbohydrate utilization, produced a decrease in plasma NEFA and amylase, while epinephrine, which promotes fat catabolism, caused an increase in both NEFA and amylase.

Summary. Blood amylase and plasma nonesterified fatty acid concentrations responded in a correlated way to glucagon, glucose, fructose, epinephrine and orinase. Apparently these two components are associated in some common metabolic process, extrapancreatic in location.

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