

Effect of Meal on Retinal Blood Flow in IDDM Patients

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Objective: The effect of postprandial hyperglycemia on retinal blood flow was examined in 11 adults with insulin-dependent diabetes mellitus (IDDM) and 9 nondiabetic subjects. **Research Design and Methods:** Retinal blood flow was measured with bidirectional laser Doppler velocimetry before and 60 and 120 min after a 50-g carbohydrate breakfast. Diabetic subjects were studied twice, being randomized to take their usual insulin (isoglycemic study) or to omit their morning short-acting insulin (hyperglycemic study). Nondiabetic subjects were studied once and received no insulin. **Results:** Plasma glucose rose significantly (from 11.5 ± 5.2 to 22.1 ± 5.5 mM, $P < 0.001$) during the hyperglycemic study but not during the isoglycemic or nondiabetic studies. There were no significant changes in blood pressure or retinal blood flow in any of the groups studied. **Conclusions:** Short-term hyperglycemia does not increase retinal blood flow. *Diabetes Care* 14:756–58, 1991

Changes in retinal blood flow may play a role in the pathogenesis of diabetic retinopathy (1). It is known that insulin-induced normalization of plasma glucose lowers retinal blood flow (2) and that infusion of glucose increases retinal blood flow in experimental animals (3,4). The effect of postprandial hyperglycemia on retinal blood flow has not been studied. The aim of this study was to test the hypothesis that postprandial hyperglycemia increases retinal blood flow in diabetic subjects.

RESEARCH DESIGN AND METHODS

Eleven patients with insulin-dependent diabetes mellitus (IDDM) on an insulin regimen, such as the NovoPen or continuous subcutaneous insulin infusion (allowing omission of morning short-acting insulin), were recruited from the Diabetic Retinopathy Clinic at the Hammersmith Hospital. Exclusion criteria included proliferative retinopathy, >70 yr of age, ischemic heart disease, hypertension, and inability to cooperate with the measurement procedure. The study protocol was approved by the Royal Postgraduate Medical School Ethics Committee.

Patients attended at 0830, having fasted from midnight and omitted their morning short-acting insulin. Patients on continuous subcutaneous insulin infusion maintained their basal rate but did not have their morning bolus.

Nine nondiabetic subjects, recruited from the staff of the Diabetic Retinopathy Unit, were studied on one morning only.

Plasma glucose (normal range 3.5–5.5 mM) was measured with a Beckman Glucose Analyzer II (Fullerton, CA). HbA_{1c} (normal range 2.6–5.8%) was measured by affinity chromatography with a glyco-gel B boronate affinity gel. Brachial artery blood pressure was measured while sitting with an automated digital sphygmomanometer (Takeda, Toyko).

Retinal blood velocity was measured by bidirectional

laser Doppler velocimetry (BLDV), as described by Riva et al. (5), with 12 pairs of spectra from a temporal vein in each subject.

Six retinal vessel diameter measurements were made from four monochromatic photographs taken of the BLDV measurement site with a Context Vision GOP—32 image-analyzing computer (Tecnikrningen 1, Linköping, Sweden) by a technique similar to that used by Brinchmann-Hansen et al. (6).

All observers were masked as to the plasma glucose and whether the patient had received insulin or not.

At each visit, plasma glucose, retinal blood flow, and blood pressure were measured at baseline and 60 and 120 min after a standard breakfast containing 50 g carbohydrate.

Diabetic patients attended the department on two occasions separated by at least 1 wk. During the isoglycemic study, the patient's usual morning dose of short-acting insulin was administered 20–30 min before breakfast. During the hyperglycemic study, no short-acting insulin was administered.

Statistical analysis. The data are means \pm SD unless otherwise indicated. The percentage changes refer to

percentage change of the overall mean compared to its baseline value unless otherwise stated. The results were evaluated with two-way analysis of variance and paired *t* tests. The statistical power of the study was determined from the residual mean square.

RESULTS

The age of the diabetic and nondiabetic subjects was 34.7 ± 5.9 and 30 ± 5.2 yr, respectively. Four diabetic subjects had no retinopathy, and the other seven had background retinopathy. The duration of diabetes was 18 ± 4.7 yr. HbA_{1c} was $8.8 \pm 1.8\%$. No patients were taking any medication other than insulin and oral contraceptives.

The baseline plasma glucose was similar for the isoglycemic group (12.4 ± 5.9 mM) and the hyperglycemic group (11.5 ± 5.2 mM). During the hyperglycemia study, plasma glucose rose significantly to 22.1 ± 5.5 mM after 2 h ($P < 0.001$ compared to baseline). There was no significant change in the isoglycemic or nondiabetic studies.

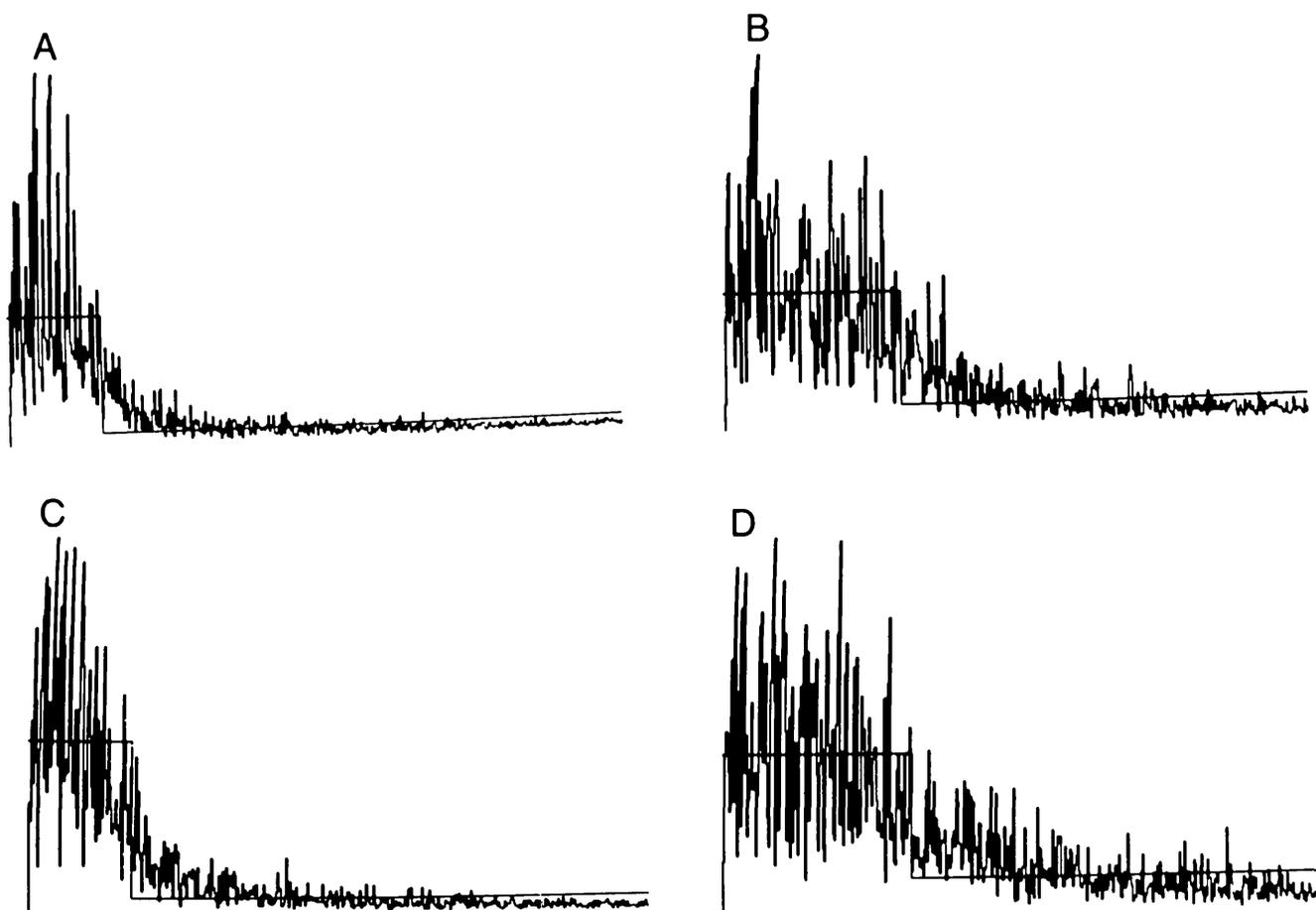


FIG. 1. Typical spectral pairs showing no change in retinal blood flow with hyperglycemia. *A* and *B*, fasting bidirectional Doppler shifts (plasma glucose 2.9 mM; centerline retinal blood velocity 1.7 cm s^{-1}). *C* and *D*, shifts 2 h after breakfast without insulin (plasma glucose 20.1 mM; centerline retinal blood velocity 1.78 cm s^{-1}).

Baseline retinal blood flow was not significantly different between the two patient visits or between diabetic patients and nondiabetic subjects. There were no significant changes in retinal blood flow, blood velocity, vessel diameter, or blood pressure during the hyperglycemic or isoglycemic patient studies or during the nondiabetic volunteer study ($P > 0.05$, 2-way analysis of variance; Fig. 1). The power of the study to detect a change in retinal blood flow was 86% for a 30% change and 98% for a 40% change from baseline.

CONCLUSIONS

We previously demonstrated a 33% increase in mean retinal blood flow in pigs with an 8-mM rise in plasma glucose (4). An increase of such magnitude should have been detectable in this study, although this comparison must be made with some caution because of the dissimilar experimental conditions. The patients in this study had rather longer durations of diabetes than those studied by Grunwald et al. (2). This raises the possibility that the negative result was a consequence of reduced retinal vascular reactivity, as has already been described for O_2 with increased duration of diabetes (7). Such impaired regulation merits further investigation in studies designed to clarify the effect of diabetes and its duration on retinal vascular reactivity.

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In-Hospital Prognosis of Patients With Fasting Hyperglycemia After First Myocardial Infarction

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Objective: To investigate the incidence and prognostic significance of fasting hyperglycemia in a large group of patients with a first myocardial infarction. **Research Design and Methods:** Blood glucose was measured after an 8-h overnight fast in 752 patients with a first myocardial infarction. Three groups of patients were identified: patients with normal fasting blood glucose (92.5%), patients with fasting hyperglycemia but no prior history of glucose intolerance (3%), and patients previously known to have diabetes mellitus (4.5%). **Results:** The fasting hyperglycemic patients were significantly older and had significantly more in-hospital complications than the normal blood glucose group. Previously known diabetic subjects tended to be older and had more mechanical complications postinfarction than the group with normal blood glucose but the difference did not reach statistical significance. There was no significant difference between the diabetic subjects and patients with fasting hyperglycemia in

mean age and in-hospital prognosis. **Conclusions:** Fasting hyperglycemia detected after a first myocardial infarction is associated with a poor in-hospital prognosis that was not due to larger infarct size, as reflected in peak levels of cardiac enzymes. The measurement of a fasting blood glucose level provides additional information in identifying high-risk groups of patients postinfarction. *Diabetes Care* 14:758–60, 1991

The prevalence of high random blood glucose measurements on admission to the coronary care unit is reported to be nearly 50%. The purpose of this study was to investigate the incidence and prognostic significance of fasting hyperglycemia in a large group of patients with a first myocardial infarction.