A fasting plasma glucose level ≥ 7.8 mmol/L was sensitive but not specific for identifying poor glycemic control

Bouma M, Dekker JH, de Sonnaville JJ, et al. **How valid is fasting plasma glucose as a parameter of glycemic control in non-insulin-using patients with type 2 diabetes?** Diabetes Care. 1999 Jun;22:904-7.

QUESTION

In patients with type 2 diabetes mellitus who are not using insulin, how do fasting plasma glucose (FPG) measurements compare with those of glycosylated hemoglobin (HbA_{1c}) in determining glycemic control?

DESIGN

Comparison of 2 laboratory tests.

SETTING

A family practice in Amsterdam, the Netherlands.

PATIENTS

1020 patients who were > 40 years of age (mean age 64 y, 67% women), had type 2 diabetes (median duration 2.4 y), were not pregnant, and were not taking insulin.

DESCRIPTION OF TEST AND DIAGNOSTIC STANDARD

FPG levels were measured in venous plasma by the glucose-oxidase method (Boehringer-Mannheim, Mannheim, Germany) and by the glucose-dehydrogenase method (Merck, Darmstadt, Germany). HbA_{1c} was measured using high-perfor-mance liquid chromatography. The sensitivity and specificity of an FPG level of 7.8 mmol/L was calculated with reference to the HbA_{1c} diagnostic standard cut points of 6.5% and 7.0%. These cut points were chosen in accordance with guidelines of the European NIDDM Policy Group and the American Diabetes Association.

MAIN OUTCOME MEASURES

The predictive value of different levels of FPG as an indicator of HbA_{1c} level was analyzed using receiver-operating characteristic curves. Change in FPG level at 3 months was also assessed as an indicator of change in HbA_{1c} level.

MAIN RESULTS

For the 2 HbA_{1c} cut points that separated good from poor levels (6.5% and 7.0%), the areas under the curve did not differ (0.87 and 0.88, respectively; P = 0.35). An FPG level ≥ 7.8 mmol/L detected 90% of patients with an HbA_{1c} level ≥ 7.0%. An FPG level < 7.8 mmol/L detected 66% of patients with an HbA_{1c} level < 7.0%. A change in FPG levels at 3 months of ≤ 0 (i.e., no change or worsening) had a sensitivity of 57% and a specificity of 88% for detecting a deterioration in HbA_{1c} of > 0.5%.

CONCLUSIONS

In patients with type 2 diabetes mellitus who were not receiving insulin, fasting plasma glucose level was highly correlated with glycosylated hemoglobin level. Except at extreme values (< 7 and > 12 mmol/L), fasting plasma glucose level was too imprecise to substitute for glycosylated hemoglobin level as a measure of glycemic control.

COMMENTARY

Clinicians have always considered the blood glucose and HbA_{1c} tests as different—each valuable for complementary purposes. Therefore, the finding that a single FPG level does not accurately predict the HbA_{1c} level is not surprising and will not change clinical practice.

Nevertheless, some details in the article by Bouma and colleagues offer clinical utility. Because clinicians naturally distinguish between glucose levels as disparate as 8 mmol/L and 12 mmol/L (144 mg/dL and 216 mg/dL), it is clinically inappropriate to consider all values > 7.8 mmol/L as equivalent. Likelihood ratios (LRs) allow for more useful clinical distinctions. When the data are recast as likelihood ratios, it appears that an FPG level > 12 mmol/L effectively rules in poor glycemic control (HbA_{1c} level > 7%), with an +LR > 40. Similarly, an FPG level < 7.8 mmol/L lowers the odds of poor glycemic control by a factor of 0.15.

Although the correlation found by Bouma and colleagues (r = 0.77) is remarkably high (meaning that an FPG level can "explain" > 50% of the variability in HbA_{1c} level), perhaps a more clinically relevant question could be posed: Can one accurately predict HbA_{1c} levels from the average value of several glucose levels over an extended period? Older studies have suggested that averaging at least 3 FPG values can improve the correlation with HbA_{1c} level almost to r = 0.9 (1).

Other studies have noted that nonfasting glucose levels may more accurately predict poor glycemic control than do fasting levels. For example, HbA_{1c} levels were more highly correlated with post-lunch glucose levels (r = 0.81) than with fasting levels (r = 0.62), and post-lunch glucose values of > 11.1 mmol/L (> 200 mg/dL) ruled in poor glycemic control (HbA_{1c} level > 7%) (2).

Clinicians must also be mindful that HbA_{1c} values are not a perfect measure of glycemic control. There are substantial interindividual variations in the affinity of hemoglobin and glucose, and rapid erythrocyte turnover can give a false sense of good glycemic control.

Arthur T. Evans, MD, MPH
Cook County Hospital
Chicago, Illinois, USA

References
1. **Paisey RB, Bradshaw P, Hartog M.** Home blood glucose concentrations in maturity-onset diabetes. Br Med J. 1980;280:596-8.
2. **Avignon A, Radauceanu A, Monnier L.** Nonfasting plasma glucose is a better marker of diabetic control than fasting plasma glucose in type 2 diabetes. Diabetes Care. 1997;20:1822-6.