Introduction

The importance of diabetes mellitus, both type 1 and type 2, in the epidemiology of cardiovascular diseases cannot be overemphasized. About one third of acute myocardial infarction patients have diabetes mellitus, the prevalence of which is steadily increasing. In the 1960s, there were 2 million Americans with diabetes mellitus; in the year 2000, their number was 15 million. Statistics have shown that the decrease in cardiac mortality in persons with diabetes mellitus is lagging behind that of the general population. Early diagnosis of diabetes mellitus is crucial.

ECG Measures of Cardiac Autonomic Neuropathy

Baroreflex dysfunction and disturbed heart rate variability are the most commonly used methods to assess CAN. Pop-Busui et al also showed the protective effect of intensive therapy on reducing cardiac complications in pa-
tients with type 1 diabetes mellitus. On 24-hour ECG, on both time and frequency domain analyses, day and night recordings were similar, apparently because of the reduced nighttime vagal modulation of the heart rate in these patients. In a general population prospective study, persons with high resting heart rate and low heart rate variability had increased risk for future development of diabetes mellitus.

Ong et al found the QTc to be shorter if patients had signs of neuropathy, although these patients’ heart rate was higher and their circadian patterns seemed to be preserved. Valensi et al found an unchanged QTc in mild neuropathy, although the circadian day/night QTc pattern was reversed. Pappachan et al expressed the view that the QTc interval can be used to diagnose CAN with reasonable sensitivity, specificity, and positive predictive value. Grossmann et al observed a prolonged QTc only in diabetic patients with CAN; late potentials were not recorded in any of these patients with CAN. CAN patients with prolonged variability in QTc, QT, or both had high incidence of sudden death.

**Detection of Silent Ischemia in Diabetic Patients**

Myocardial ischemia is more often painless in patients with diabetes mellitus. Resting ECG abnormalities as well as cardiac autonomic dysfunction were found to be predictors of silent ischemia in asymptomatic persons with T1D.

In otherwise healthy diabetic men during an average follow-up of 16 years, an abnormal and even an equivocal exercise ECG response was associated with a statistically significant high risk for all-cause and cardiac mortality and morbidity, independently of physical fitness and other traditional risk factors; fit men had a higher survival rate than did unfit men.

In asymptomatic type 2 diabetes patients with a normal resting ECG, exercise testing was the first choice for screening for silent ischemia, whereas thallium scintigraphy with dipyridamole was performed if exercise testing was not possible or was inconclusive; the accuracy of stress ECG was 79%, coronary arteriography being used as gold standard. By combining stress ECG with myocardial scintigraphy, Cosson et al could effectively detect coronary artery lesions in individuals with asymptomatic diabetes mellitus. The use of screening before an exercise training program for patients with asymptomatic type 2 diabetes mellitus “might be justifiable...but remains unproven,” as stated in a recent scientific statement by the American Heart Association.

**Fetal and Childhood ECG Signs in Diabetes Mellitus**

On fetal ECG, ST depression was significantly more prevalent in fetuses of diabetic mothers, as demonstrated by Yli et al. In children with a mean hemoglobin A1c >10%, a reduction in heart rate variability was predictive for onset of symptomatic neuropathy. Shiono et al studied children and adolescents aged 7 to 20 years with poor glycemic control (hemoglobin A1c >10%) with signal-averaged ECG; the authors found a prolonged filtered QRS duration and a significantly low root mean square voltage, demonstrating subclinical cardiac impairment.

**Diabetic Cardiomyopathy**

The preclinical phase of diabetic cardiomyopathy may be diagnosed by

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**Figure 1.** ECG of a 64-year-old woman with type 2 diabetes mellitus without other risk factors. Note the deep S-wave (arrow) in LIII (19 mm) and the high R-wave in aVL (15 mm); ECG indicates basal left ventricular hypertrophy.

**Figure 2.** ECG of a 55-year-old woman with longstanding type 2 diabetes mellitus without overt signs of cardiovascular disease. Note the inverted T-waves in LI and aVL and T taller in LIII than in LI, with horizontal heart position (arrows); this pattern indicates fibrosis in the midventricular area.
Table. Cardiovascular Examinations for Diabetic Patients

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Conclusions

Even early in the course of diabetes mellitus, ECG alterations such as sinus tachycardia, long QTc, QT dispersion, changes in heart rate variability, ST-T changes, and left ventricular hypertrophy may be observed. ECG alterations help evaluate cardiac autonomic neuropathy and detect signs of myocardial ischemia even in asymptomatic patients. Prolonged myocardial fibrosis leads to diabetic cardiomyopathy, with peculiar ECG presentation. Electrocardiographic changes are already present in fetuses, children, and adolescents. The resting ECG, frequently complemented by exercise ECG, assists in cardiac screening of diabetic individuals and helps detect silent ischemia, assess prognosis, and predict mortality (see Table).

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Disclosures

None.

References


The ECG in Diabetes Mellitus
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