Manufacture and Clinical Application of XZY-1 Model Computer Assisted ECG Automatic Diagnosis System

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Summary: The manufacture and clinical application of XZY-1 model computer assisted ECG automatic diagnosis system and its hardware and software frames are described briefly in this paper. The results of 234 ECGs analysed by this system were as follows: (1) For the analysis of normal ECGs, the sensitivity, specificity and accuracy of this system were all over 95%. (2) For ventricular hypertrophy, bundle branch block and myocardial infarction, the sensitivity, specificity and accuracy were all over 90%. (3) For the diagnosis of sinus arrhythmia, sinus bradycardia, sinus tachycardia, low voltage and clockwise and counterclockwise rotation, the sensitivity was over 80%, while the specificity and accuracy were over 90%

The results of the preliminary study showed that this system is of help in analyzing ECGs without complicated arrhythmia. It might be useful for health survey in a large population because of its capacity for storing a large amount of information and high speed of processing.

Key words: computer, electrocardiography

Computer assisted ECG automatic diagnosis system is an important application of computer in the field of biomedical engineering. This paper is a report on XZY-1 model computerized ECG system, its manufacture and clinical application.

MATERIALS AND METHODS

1. An outline of XZY-1 model computer aided ECG system

In this system, ECG data of patients were collected using Nihon Kohden 4203 model electrocardiograph modified by electronic time-division auto-multiplexing. ECGs of 12 leads were divided into 4 sets (I, II, III, aVR, aVL, aVF, V1, V2, V3, V4, V5, V6). Each set ran on for 5 s. With 171—12A model A/D converter ECG analogic signals were converted into digital forms at sampling rate 250 Hz, which then were fed into DJS-132 computer. Data processing and measurement as well as autodiagnosis were performed in central processing unit (CPU). The hardware frame of this system is shown in fig.1.

Fig. 1. Hardware frame of XZY-1 model computer aided ECG automatic diagnosis system. CRT: Cathode-ray tube,
2. Software of data analysis and diagnosis

After input of ECG digital signals into computer, the first step was data processing including digital filtering and fitting straight line in order to eliminate artifacts and to correct baseline drift. Then, some characteristic values were obtained by measuring the durations and amplitudes of QRS complex, P wave, T wave and ST segment as well. Finally, decision analysis and automatic diagnosis were made by diagnostic program. Software frame of data analysis and diagnosis is shown in fig.2.

3. Patients

234 consecutive ECGs were collected from 90 normal individuals and 144 patients without arrhythmia, including 127 males and 107 females, aged from 5 to 75 years. The clinical diagnosis was as follows: coronary artery disease in 35 cases, congenital heart disease in 22 cases, rheumatic heart disease in 13 cases, hypertension in 15 cases, cardiomyopathy in 7 cases, cor pulmonale in 6 cases, palpitation in 10 cases, and other disorders in 36 cases.

4. Data statistics

To estimate the accuracy of this computerized ECG system and its clinical value, two electrocardiographers read and measured each ECG carefully and made their own diagnosis independently. If there was any disagreement with the ECG diagnosis, the serial ECGs were reviewed to obtain identical diagnosis. Then, the parameters and diagnosis presented by the electrocardiographers were compared with those by computer program.

The sensitivity, specificity and accuracy of the computer program were calculated using the following equations:

(1) Sensitivity = TP/(TP+FN)
(2) Specificity = TN/(TN+FP)
(3) Accuracy = (TP+TN)/(TP+TN+FP+FN)

TP: true positive; TN: true negative;
FP: false positive; FN: false negative.

RESULTS

1. Measurement of general ECG parameters

The data including heart rate (HR), P-R interval, Q-T interval and mean axis obtained from one electrocardiographer were compared with those from the other. Average values of parameters measured by the two electrocardiographers were compared with those of computer program (table 1, 2).

The results shown in table 1 sug-