

ORIGINAL ARTICLE

Diagnostic values of different ECG durations in paroxysmal AF diagnosis

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Abstract

Objective: To evaluate the application value of different-duration electrocardiograms (ECGs) in paroxysmal atrial fibrillation (AF) diagnosis.

Methods: A total of 220 patients with paroxysmal atrial fibrillation diagnosed by 24-h dynamic electrocardiogram in our hospital from January 2019 to December 2020 were selected as the study subjects. The patients were monitored for 10 s, 5 min, and 24 hr, respectively. The results of the three different-duration ECGs were compared and analyzed in order to evaluate their paroxysmal AF diagnosis value.

Results: Paroxysmal AF was detected in 18 patients (8.2%) with the 10-s ECG; in 89 patients (40.5%) with the 5-min ECG; and in 199 patients (90.5%) with the 24-h dynamic ECG.

Conclusion: In patients with paroxysmal AF, ECGs with longer detection times had higher detection rates.

KEYWORDS

detection rate, diagnosis, dynamic electrocardiogram (ECG), paroxysmal atrial fibrillation

1 | INTRODUCTION

Atrial fibrillation (AF) is a form (Van Steenkiste et al., 2021) of atrial arrhythmia that frequently occurs in clinical practice. AF types include paroxysmal AF, persistent AF, and permanent AF. Paroxysmal AF caused by atrial premature beats (APBs) is the most clinically common of the three, and its incidence is increasing (Wyffels et al., 2021) year by year. Some studies show that, among these three types of AF, paroxysmal AF accounts for 35% (Costa et al., 2021) of AF incidence. Furthermore, partial recurrent paroxysmal AF can transform into persistent AF, resulting in complications, such as heart failure or thrombosis and seriously threatening the patient's life. As a result, effectively preventing and controlling paroxysmal AF in time has become both a priority and a challenge. (Ikeda, 2021) In recent years, people's living standards have improved; however, the incidence of cardiovascular disease has increased. The number of patients with AF is growing, which poses a major threat (Bonizzi et al., 2020) to people's health and safety. At present, the main persistent AF examination method at home and abroad is ECG. However, paroxysmal

AF with a short onset time cannot currently be diagnosed (Lan et al., 2020) with a general ECG. Nonetheless, longer duration (e.g., 5 min) ECG examinations are carried out clinically in addition to the routine ECG in order to screen patients with different symptoms and conditions, thus, diagnosing them without delay.

The application effects of 10-s, 5-min, and 24-h ECGs in patients with paroxysmal AF were compared and analyzed as follows.

2 | STUDY METHODS

2.1 | Basic clinical patient information

A total of 220 patients (120 men and 100 women) diagnosed with paroxysmal AF in the Harrison International Peace Hospital between January 2019 and December 2020 were selected as the study subjects. The patients were aged 35–82, with a mean age of 65.1 ± 5.2 years. Among the patients, 82 had coronary heart disease, 52 had hypertension, 31 had diabetes, 22 had rheumatic heart

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disease, 9 had chronic bronchitis, and 24 had no organic diseases. All patients volunteered and agreed to participate in the study. The general data of the patients were not statistically different; however, they were comparable.

The study was conducted in accordance with the Declaration of Helsinki (as was revised in 2013). The study was approved by Ethics Committee of the Harrison International Peace Hospital and informed consent was taken from all the patients.

2.2 | Instruments and methods

All 220 patients were examined with a 10-s, 5-min, and 24-h ECG.

Diagnostic criteria for paroxysmal AF (Toman et al., 2020): ① a sinus rhythm was present before and after the onset of persistent AF; ② no abnormal Quantronic Resonance System was found; ③ the RR interval in the ECG was irregular; ④ the heart rate was abnormal; and ⑤ p waves were replaced by fibrillary waves of different intervals, sizes, and shapes. The above-listed conditions are all consistent with paroxysmal AF.

Examination preparation: room temperature was kept at a constant 25°C, supine, relaxed, 12-lead electrocardiogram was recorded continuously for 10 s, 5 min, paper speed of 25 mm/s, gain of 10 mm/mV, baseline stable, image clear without interference. ECG was performed for 10 s and 5 min, followed by 24-h dynamic ECG.

Routine 10-s and 5-min 12-lead ECGs were recorded with an SE-18 electrocardiograph (EDAN products, Shenzhen), and dynamic ECG changes were recorded with the dynamic electrocardiograph (JincoMed, Beijing, JYJX (Zhun) Zi 2014, No. 2211036). The ECG data were comprehensively analyzed (Stamoulis et al., 2019) using the JincoMed MIC 12 LEADS HOLTER (2010) analysis system.

2.3 | Statistical methods

The Statistical Package for Social Sciences 22.0 software was used for statistical analysis. The measurement data, which were expressed as the mean \pm standard deviation, were obtained using the *t*-test, and the enumeration data, which were expressed as a percentage (%), were gathered using the Chi-square test. A *p*-value of < 0.05 was considered statistically significant.

3 | RESULTS

3.1 | Comparison of the 10-s, 5-min, and 24-h ECG AF-detection rates

Eighteen patients with paroxysmal atrial fibrillation were detected by 10-s ECG, accounting for 8.2% of the total. Eighty-nine patients with paroxysmal AF were detected by 5-min ECG, accounting for 40.5% of the total. A total of 199 patients with paroxysmal AF were detected by 24-h dynamic electrocardiogram, accounting for 90.5%

TABLE 1 Comparison of the 10-s, 5-min, and 24-h ECG AF-detection rates(%)

Category	Negative	Positive	Total (cases)
10-s ECG	202 (91.8%)	18 (8.2%)	220
5-min ECG	131 (59.5%)	89 (40.5%)	220
24-h ECG	21 (9.5%)	199 (90.5%)	220

of the total. It can be seen that the longer the ECG monitoring time, the higher the positive rate of paroxysmal atrial fibrillation (Table 1).

3.2 | Arrhythmia diagnosis comparison in positive cases

Ten-second ECG detected two patients with paroxysmal AF caused by premature atrial beat, three patients with paroxysmal AF with premature ventricular beat, and zero patients with paroxysmal AF with long RR interval. A total of five patients with paroxysmal AF accompanied by other arrhythmias were detected by 10-s ECG, accounting for 27.8% of the total number of patients with paroxysmal AF. The 5-min ECG detected 31 cases of paroxysmal AF caused by premature atrial beat, 20 cases of paroxysmal AF accompanied by premature ventricular beat, and 15 cases of paroxysmal AF accompanied by long RR interval. Sixty-six patients with paroxysmal AF with other arrhythmias were detected by 5-min ECG, accounting for 74.2% of the total number of patients with paroxysmal AF. Twenty-four-hour dynamic electrocardiogram detected 103 patients with paroxysmal atrial fibrillation caused by premature atrial beat, 45 patients with premature ventricular beat, 37 patients with long RR interval. A total of 185 patients with paroxysmal atrial fibrillation accompanied by other arrhythmias were detected by 24-h dynamic electrocardiogram, accounting for 93.0% of the total number of patients detected. It can be seen that the longer the ECG detection time, the higher the positive rate of patients with other arrhythmias in paroxysmal AF (Table 2).

4 | DISCUSSION

Electrocardiograms examination is the main means of clinically diagnosing APB-induced paroxysmal AF. In the present study, 2, 31, and 103 cases of patients with APB-induced paroxysmal AF were detected with the 10-s, 5-min, and 24-h ECGs, respectively. It is evident from the numbers of patients included in this study that the number of positive cases increases with detection time. Some studies show (Katsuki and Katsuki, 2019; Ramirez et al., 2019; Yanagisawa et al., 2020) that paroxysmal AF incidence is higher at night than in the daytime. Furthermore, the duration of the disease is longer. Vagal nerve-mediated paroxysmal AF is the most common paroxysmal AF type. The increase in vagal nerve tension and the rule of human day and night living may cause paroxysmal AF occurrence

TABLE 2 Arrhythmia diagnosis comparison in positive cases(%)

Category	Atrial premature beats	Ventricular premature beats	Long RR interval	Total (cases)
10-s ECG	2	3	0	5 (27.8%)
5-min ECG	31	20	15	66 (74.2%)
24-h ECG	103	45	37	185 (93.0%)

and greatly affect the duration of the disease. The 24-h dynamic ECG can monitor ECG activity both during the day and night without the influence of the vagal nerve. It can also accurately record and reflect the patient's cardiac electrical activity, while the 10-s and 5-min short-time ECGs are affected by the length of monitoring time, limiting the monitoring effect.

Patients with paroxysmal AF usually suffer from organic diseases, characterized by symptoms, such as panic, palpitation, and chest tightness. (Qiu et al., 2019) The dynamic ECG is used more frequently in order to record the ECG activity accurately and in time. As can be seen in Table 2, paroxysmal AF is accompanied by a long RR interval, meaning that the ventricle does not work for a long time (usually over 2 s). Therefore, timely detection is the basis of accurate and effective clinical treatment. In the present study, paroxysmal AF was detected in 0, 15, and 37 patients using the 10-s, 5-min, and 24-h ECGs, respectively. We can see from the statistical results that patients with a long RR interval were most often detected by the dynamic ECG. Therefore, the 24-h dynamic ECG is used for the detection of paroxysmal AF with long RR intervals, providing an effective basis (Li and Wang, 2016) for clinical diagnosis and treatment. The distinction between PVCs and Ashman's phenomenon can be seen by the characteristics of Ashman's phenomenon: 1. coupling interval: not fixed, consistent with long-short cycle: PVCS coupling interval is usually fixed; 2. There is no compensatory interval for Ashman's phenomenon, and compensatory interval is common for premature ventricular contractions; 3. Ashman's phenomenon appeared when the mean ventricular rate increased, and premature ventricular beats appeared when the ventricular rate slowed down; 4. Most of the QRS patterns of Ashman's phenomenon are right bundle branch block type, and the initial vector is consistent with the basic rhythm. Both right and left bundle branch block types of VENTRICULAR premature beats can occur, and the initial vector is inconsistent with the basic rhythm; 5. Ashman's phenomenon often QRS group deformation, ventricular premature beats do not have this situation, except for multi-source ventricular premature beats; 6. The larger the ratio of long period to short period of Ashman's phenomenon, the more obvious the deformity degree of QRS wave group is, and premature ventricular beats are not affected; 7. Ashman's phenomenon no double law, triple law, often ventricular premature beats; 8. Ashman's phenomenon often occurs in pairs with abnormal QRS wave groups, and premature ventricular beats are often absent.

In recent years, people's living standards have improved; however, the incidence of cardiovascular diseases has also increased, causing serious health and safety risks in a higher number of patients

with AF. (Wang et al., 2017) At present, the general ECG is unable to accurately diagnose paroxysmal AF with a short onset time. (Xu, 2018) Nevertheless, ECG examination items with a longer duration, such as 5 min, are carried out clinically in addition to the routine ECG in order to screen patients with different symptoms and conditions, thus, diagnosing them without delay. Hence, we recommend performing 5-min ECGs, which have a high paroxysmal AF diagnostic rate, for patients with poor clinical tolerance. If the patient's tolerance is high, we recommend performing the 24 h, or even longer, dynamic ECG in order to more accurately record ECG activity and provide a basis for clinical diagnosis and treatment.

5 | CONCLUSION

As a non-invasive, economical, and easy-to-operate examination method, ECG is accepted by the public. (Gan and Xiang, 2019) The 24-h dynamic ECG, especially, is highly precise in paroxysmal AF diagnosis and has an important clinical application value.

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CONFLICT OF INTEREST

The authors declare that they have no competing interests.

AUTHOR CONTRIBUTIONS

Conception and design of the research: Qian Li; Acquisition of data: Juan Liu; Analysis and interpretation of the data: Juan Liu; Statistical analysis: Bing Su; Obtaining financing: None; Writing of the manuscript: Qian Li; Critical revision of the manuscript for intellectual content: Qian Li, Bing Su, Juan Liu. All authors read and approved the final draft.

ETHICAL APPROVAL

The study was conducted in accordance with the Declaration of Helsinki (as was revised in 2013). The study was approved by Ethics Committee of the Harrison International Peace Hospital. Written informed consent was obtained from all participants.

DATA AVAILABILITY STATEMENT

The transcripts from which this manuscript was developed are available on request from the corresponding author.

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