Research Article

ECG Phenomena in Patients with Post-Infarction Left Ventricular Aneurysm

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Abstract
The objective of the research was to study the ECG phenomena in patients with post-infarction left ventricular aneurysm (PLVA) depending on the treatment approach.

Materials and methods. We analyzed results of 24-hour ECG monitoring of 238 patients with PLVA. The main group was divided into 3 subgroups depending on the treatment approach: patients who were treated with optimal background therapy (OBT), percutaneous coronary interventions (PCI), coronary artery bypass graft (CABG) surgery. All patients underwent 24-hours standard ECG monitoring.

Results. Our research showed that 50.0% of patients of the first group had tachycardia. AV-junction conduction problems often were observed in those persons (PQ interval was 179.7±8.4 ms, which was significantly higher than in the control group, 149.3±5.4 ms, p<0.05). The longest QT interval was also stated for the first group, 532.4±27.3 ms, which was significantly longer than the average values of the control group (438.7±24.6 ms) and the second group (460.2±20.5 ms) respectively, p<0.05. Revascularization procedures (in the second and third groups) allowed achieving heart rate (HR) control in 66.1% and 62.5% of patients respectively. Complete right bundle branch block (CRBBB) was the most frequent phenomenon of patients of the third group (47.9%), which was significantly higher than in the patients of the first and control groups. We also detected a high frequency of supraventricular ectopic complexes in patients of the first and the third groups. A percentage of ventricular ectopic beats was the highest in the third group (17.7%).

Conclusions. Patients with PLVA tended to have tachycardia, but the use of LV revascularization procedures allowed improvement of heart rate control. The patients were also characterized by a high percentage of impulse conduction in the atria, “AV-junction” and His bundle branches and the use of LV revascularization procedures did not improve the mentioned phenomena, and increased the risk of ectopic complexes in some cases (after CABG). Patients with PLVA had significantly prolonged “QT-interval” and therefore (along with the frequent disorders of repolarization) increased risk of sudden death. However, the use of LV revascularization (PCI) reduced it significantly.

Keywords
post-infarction left ventricle aneurysm; ECG phenomena; treatment tactic

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Problem statement and analysis of the recent research

Formation of postinfarction left ventricular aneurysm (PLVA) is one of the death causes from coronary heart disease, a marker of unfavorable prognosis in most cases [8]. Control of ECG changes remains an important factor in assessment of the disease severity. According to some authors, the evolution of the T-wave may reflect the magnitude of the damage in case of myocardial infarctions. In one study, the presence of T-wave along with Q-waves that were present more than one year, were indicative of transmural LV damage, while their positive polarity correlated with non-transmural damage and the presence of living LV myocardium [1]. Postinfarction ECG changes may be observed during the days, weeks and sometimes even longer [2]. Full ECG normalization after Q-myocardial infarction is rarely observed, and can be found exceptionally in cases of mild necrosis with subsequent improvement of contractility and LV ejection fraction. The mentioned dynamics is often associated with spontaneous recanalization of infarct-dependent artery or good collateral blood supply of the affected areas, and points to a favorable prognosis. On the contrary, ECG changes such as Q-waves, “frozen” elevated ST segment observed for several weeks or longer after myocardial infarction correlate with poor LV contractility (akinesia or dyskinesia), although they are not mandatory markers of LV aneurysm. ECG changes of type “rSR” in the “I” standard lead or chest leads V2-V4 could be another signs of LV aneurysm [3].

Along with ECG markers of PLVA clinical predictors of adverse events play important role as well which often depend on the chosen treatment approach. Functional disorders are also believed to often lead to malignant arrhythmias or fatal bradyarrhythmias, nevertheless the role of ECG changes depending of treating tactic are not sufficiently highlighted [5, 7].
The objective of the research was to study patterns of ECG changes in patients with postinfarction left ventricle aneurysms depending on the treatment approach.

1. Materials and methods of the research

We analyzed results of ECG monitoring of 238 patients with post-infarction left ventricular aneurysm (PLVA). The main group was divided into 3 subgroups. The first subgroup included 134 persons with PLVA who received only optimal background therapy (OBT). The second subgroup included 56 patients with PLVA, who underwent percutaneous coronary intervention (PCI) along with OBT. The third subgroup included 48 patients with PLVA after coronary artery bypass graft (CABG) surgery. The study included patients who did not undergo aneurysm suturing. At the time of inclusion in the study all individuals of the research groups were diagnosed with left ventricular aneurysm. The control group consisted of 36 patients after myocardial infarction (MI) without PLVA. All patients of the research and control groups were relevant for the age and gender distribution. All study participants were fully informed about the purpose and course of the research, and written informed consent was obtained for participation.

All patients underwent 24-hours ECG monitoring. The ECG monitoring was performed by the standard method [4, 6, 10] using the Holter-system “Cardiosens K” with the use of three modified chest leads. During ECG ectopic activity was evaluated: the number of extrasystoles, their morphology to assess the origins, parity, conditions of development and relation to neighboring QRS complexes was determined. The variability of intervals RR, the width of QRS complex, ST-segments and QT intervals was assessed. Conduction defects, the presence of organized paroxysmal arrhythmias were separately evaluated.

Statistical analysis of the results was performed using a standard software package [9]. Probability of differences between the dependent and independent variants was assessed using Student t-test; difference was considered reliable at p≤0.05.

2. Results of the research and their discussion

The analysis of the results of 24-hour ECG monitoring revealed the following patterns (Table 1). First, it should be noted that patients with PLVA had tendency to tachycardia. For example, patients of the first research group had averagely 173.7±34.8 tachycardic episodes. The persons of the second and the third groups had 112.9±26.4 and 144.6±20.9 episodes of tachycardia, respectively. In comparison, patients of the control group (with postinfarction cardiosclerosis without PLVA) had 55.1±6.2 episodes of tachycardia only, p<0.05. Interestingly, the frequency of bradycardia episodes was significantly different comparing with the control group, only for the second group (the person with PLVA after the PCI) and the third one (persons with PLVA after CABG). Thus, the patients of control group had averagely 12.5±3.4 bradycardia episodes, the persons of the second and the third ones – 36.3±8.5 and 32.7±7.2 respectively, p<0.05. According to these parameters, the duration of bradycardia and tachycardia episodes changed as well. For example, the longest total daily tachycardia duration was characteristic of the first group. They lasted averagely 328.4±36.2 min/day, and that was almost three times longer compared to control group, 117.7±21.1 min/day, p<0.05.

It is worth noting that duration of tachycardia was the lowest in patients of the second group and compared with the first group, the difference was statistically significant, p<0.05. It should also be noted that the duration of daily bradycardia episodes was almost the same as in patients with PLVA (research groups) and without aneurysm (control group).

The reduction of sinus rhythm time was also stated in patients with PLVA, and it was the lowest in patients of the first research group constituting 78%. In comparison, 93% of heart beats in patients of control group had sinus origin and only 7% were complexes of non-sinus origin. Daily sinus rhythm was stated in 84% and 83% of patients of the second and the third research groups. Analysis of non-sinus beats detected a high frequency of ectopic complexes in patients of the first and third groups. For example, the frequency of supraventricular beats (SVB) averaged 4592±329 per day in control group, 22.385±2.674 per day in the third group, and 18.123±1.726 per day in the first group, p<0.05. Even greater incidence of ectopic ventricular complexes (VE) was stated. Their occurrence in the third group was 17.7%. For comparison, in patients of the control group VE were stated only in 4.3% of cases. Individuals of the second group had the lowest incidence of mentioned rhythm disorders constituting 10.9%. The high incidence of aberrant QRS in patients of the first and the third groups should also be noted.

3. Conclusions and prospects for further research

Thus, we may conclude that patients with PLVA tend to have tachycardia, but revascularization procedures improve HR control. Such patients are also characterized by a higher percentage of “AV-junction” and bundle branch conduction disorders and the use of revascularization procedures do not allow optimizing these phenomena, and even increase the risk of ectopic complexes in some cases (after CABG). Patients with PLVA have significantly prolonged “QT-interval” and therefore (along with the frequent disorders of repolarization) increased risk of sudden death. However, the use of LV revascularization (PCI) reduces it significantly.

Interpretation of the research results is limited by various treatment regimens in different groups and different terms of LV revascularization. A perspective further direction of the research is the study of rhythm dispersion and ECG-parameters in patients with PLVA and different treatment approach.
Table 1. Results of 24-hours ECG monitoring in patients of control and research groups (M±m).

| ECG phenomena                     | Control group (n=36) | I (n=134) | II (n=36) | III (n=48) |
|-----------------------------------|----------------------|-----------|-----------|------------|
| Average heart rate, b/min.        | 68.6±5.4             | 92.7±6.3  | 82.3±4.7  | 73.9±5.1   |
| Episodes of bradycardia, per day  | 12.5±3.4             | 23.7±5.5  | 36.3±8.5* | 32.7±7.2*  |
| Episodes of tachycardia, per day  | 55.1±6.2             | 173.7±34.8* | 112.9±26.4* | 144.6±20.9* |
| Bradycardia, minutes/day          | 78.2±9.3             | 63.7±7.9  | 77.6±13.2 | 89.1±11.1  |
| Tachycardia, minutes/day          | 117.7±21.1           | 328.4±36.2* | 187.3±28.2¶ | 212.3±22.1* |
| Sinus rhythm time, %              | 93%                  | 78%       | 84%       | 83%        |
| Non-sinus rhythm time, %          | 7%                   | 22%       | 16%       | 17%        |
| Heart beats per day               | 123 284±2496         | 212 348±4592* | 178 367±4395* | 165 823±4623*¶ |
| SEB, number per day (%)           | 4592±329 (3.7%)      | 18123±1726* | 11328±947*¶ | 22385±2674*¶ |
| VEB, number per day (%)           | 5298±628 (4.3%)      | 27236±4263* | 19347±3852* | 29368±5347* |
| Aberrant QRS (%)                  | 6752±358 (5.5%)      | 34012±6235* | 21745±4368* | 33375±3298* |

Notes.
* - significant difference between control and research groups, p<0.05;
¶ - significant difference between the first and other research groups, p<0.05;
SVE - supraventricular ectopic beats;
VE - ventricular ectopic beats.

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Received: 7 September 2016
Revised: 12 October 2016
Accepted: 12 October 2016