Karakteristike dijastoličke funkcije zdravih ispitanika dobivene analizom mikrovoltazne promjenljivosti izoelektričnih segmenata snimljenih triaksijalnim elektrokardiografom visoke rezolucije – odstupanja u ovisnosti o dobi i spolu

Characteristics of diastolic function of healthy subjects analyzed by microvoltage variability of isoelectric segments, recorded by three-axial high resolution electrocardiograph device – deviations depending on age and gender

Vedrana Baraban¹,
Srđan Čalošević²,
Sven Kurbel¹,
Svjetlana Marić³

¹Medicinski fakultet Sveučilišta u Osijeku, Klinički bolnički centar Osijek, Osijek, Hrvatska

¹University of Osijek School of Medicine, University Hospital Center Osijek, Osijek, Croatia

²Zavod za hitnu medicinu Osijek, Osijek, Hrvatska

²Department of Emergency medicine Osijek, Osijek, Croatia

³Medicinski fakultet Sveučilišta u Osijeku, Osijek, Hrvatska

³University of Osijek School of Medicine, Osijek, Croatia

KLJUČNE RIJEČI: EKG visoke rezolucije, izoelektrična linija, dijastolička funkcija, mikrovoltazna promjenljivost.

KEYWORDS: high resolution ECG, isoelectric line, diastolic function, microvoltage variability.

CITATION: Cardiol Croat. 2014;9(9-10):389.

***ADDRESS FOR CORRESPONDENCE:** Klinički bolnički centar Osijek, Josipa Huttlera 4, 31000 Osijek, Croatia. / Phone: +385-91-2002-171 / E-mail: vbaraban@gmail.com

CILJ: Ovo istraživanje je temeljeno na teoretskom modelu srčane električne aktivnosti¹. Cilj je bio utvrditi je li varijabilnost izoelektričnih segmenata (P-R, S-T i T-P) snimljenih pomoću triaksijalnog elektrokardiografa (EKG) visoke rezolucije u uzastopnim srčanim ciklusima pokazuje neke dobne i spolne različitosti. U ovom je radu poseban naglasak stavljan na analizu dijastoličke faze srčanog ciklusa, odnosno na T-P segment.

PACIJENTI I METODE: Ispitivanje je učinjeno kod ukupno 54 ispitanika (21 žena i 33 muškaraca); 27 mladih ispitanika (prosječna godina 21) i 27 starijih volontera (prosječna godina 53). Svakom ispitaniku snimljen je triaksijalni EKG visoke rezolucije (veličine uzorka 1 kHz) u trajanju od 200 sec, putem Biopac Student Lab. uređaja. Iz T-P intervala izdvojeno je 5 izoelektričnih segmenata, svaki trajanja 50 ms, odabranih za analizu dijastoličke funkcije. Položaj svakog od tih segmenata je preciziran prema poziciji R vala. Za analizu izdvojenih segmenata korištena je Fourierova transformacija: A) u analizi promjenljivosti udaljenosti od svake XYZ točke – medijana oblaka segmenta (u mV); B) u analizi promjenljivosti brzine prostornog pomaka između sukcesivnih milisekundi (u mV/ms).

REZULTATI: Metodom A potvrđene su razlike specifične za dob i spol tijekom dijastoličke faze srčanog ciklusa. Kod žena su izražene manje snage harmonika tijekom protodijastole, dok su viši harmonici bili jači tijekom teledijastole. Stariji ispitanici iskazali su više harmonike tijekom teledijastole. Metodom B potvrđene su dobne razlike u svih pet dijastoličkih izoelektričnih segmenata. Kako se nisu potvrdile razlike u ovisnosti o spolu, rezultati dobiveni ovom metodom sugeriraju da je mikrovoltazna promjenljivost bila isključivo ovisna o dobi.

ZAKLJUČAK: Dobiveni rezultati se uklapaju u bazični teoretski model kojim se srčana aktivnost može opisati dinamičnim prijelazima između pojedinih stabilnih formi srčanog električnog polja tijekom cijelog srčanog ciklusa, kao i tijekom u ovom radu posebno analiziranih dijastoličkih segmenata.

AIM: This study was based on a theoretic model of heart electric activity. The aim was to determine whether variability of the high resolution three axially recorded isoelectric segments (P-R, S-T and T-P) in successive cardiac cycles show some age or gender specific features. In this paper a special emphasis was placed on the diastolic charging analysis i.e. separated T-P segments.

PATIENTS AND METHODS: A total of 54 volunteers were included in the study (21 female and 33 men); 27 younger (mean age 21 years) and 27 older volunteers (mean age 53 years). Three-axial high-resolution ECG (1 kHz sampling rate) of healthy subjects during 200 seconds, recorded by Biopac Students Lab. During T-P interval, five isoelectric segments (duration of each one: 50 ms) were chosen for analysis of diastolic function and were then extracted due to their position from the R wave peak. Fourier analysis was done: A) Fourier of distances in mV between each XYZ point and the center of that segment; B) Fourier of distances in millivolts between successive milliseconds, in mV/ms.

RESULTS: Method A: Gender and age specific differences were found during the diastolic phase of the cycle. Women showed smaller harmonic powers during protodistole, while higher harmonics were stronger in teledistole. Older persons showed higher harmonics during teledistole. Method B: Age dependent differences were found in all five diastolic isoelectric segments which represent the phase of diastolic charging. No gender specific differences suggest that this variability was purely age dependent.

CONCLUSIONS: These results fit well the initial theoretic model, the heart electric activity can be described as unbalanced transitions between stable configurations of the heart electric field during diastolic isoelectric segments.

LITERATURE

1. Kurbel S. A vector-free EKG interpretation with P, QRS & T waves as unbalanced transitions between stable configurations of the heart electric field during P-R, S-T & T-P segments. Theor Biol Med Model. 2014 Feb 10;11:10.
2. Narayanaswamy S. High resolution electrocardiography. Indian Pacing Electrophysiol J. 2002;2(2):50-6.
3. Jesus S, Rix H. High resolution EKG analysis by an approved signal averaging method and comparison with a beat-to-beat approach. J Biomed Eng. 1988;10(19):25-32.

RECEIVED:
September 30, 2014