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Heart Rate Variability during two Relaxation Techniques in Post-MI Men

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Introduction

Ischemic heart disease (IHD) is rapidly becoming the leading cause of death in developing countries around the world. Psychosocial factors are now recognized as playing a significant and independent role in the development of IHD and its complications. Mental stress has been implicated as a trigger of myocardial infarction (MI) and sudden death in patients with coronary artery disease [1]. Therefore it is important to research the psychosocial risk factors reducing methods, particularly in the setting of cardiac rehabilitation.

Chronic imbalance of the autonomic nervous system is a prevalent and potent risk factor for adverse cardiovascular events, including mortality. Transient variations in HRV have recently been validated as a measure of short-term changes in autonomic tone [2, 3].

There are many exercises and techniques for achieving relaxation. Progressive muscle relaxation (PMR) is a primary method that is easily learned. Previous studies have shown that PMR has beneficial physiologic and psychological effects for various populations. Research has demonstrated that PMR significantly lowers patients' perception of stress, and it enhances their perception of health. PMR is beneficial for patients with essential hypertension [4]. Resent research findings also show that progressive muscular relaxation training may be an effective therapy for improving psychological health and quality of life in anxious heart patients [5].

The studies of meditations therapeutic effects show the benefits ranging from reduced cardiovascular risk factors to improved psychological status [6]. The Mindfulness-Based Stress Reduction (MBSR) program is a meditation training course developed by Dr. Kabat-Zinn and colleagues at the University of Massachusetts Medical School [7]. “Mindfulness” is defined as moment- to-moment nonjudgmental attention and awareness actively cultivated and developed through meditation. In America the use of mindfulness training in treating specific pain conditions, hypertension, myocardial ischemia, weight control, irritable bowel syndrome, insomnia, human immunodeficiency virus (HIV), and substance abuse is presently under investigation in research supported by the National Institutes of Health [7].

While long-term relaxation therapies improve psychological well-being in heart diseases, there is little information regarding the short-term effects of relaxation techniques on beat-to-beat heart rate dynamics. The focus of our work was on whether PMR and MBSM produce any reliable changes of HRV and whether these changes are any different from those produced by a period of just lying quietly. So the main purpose of our work was to reveal the peculiarities of heart rate variability during two relaxation techniques.

Methods

25 hospitalized men (mean age 59 ± 8,06 years) 2–3 days after post-MI stenting participated in two laboratory sessions in which they practiced MBSM and PMR. PMR is a classic relaxation technique which involves tensing and relaxing of different muscle groups. MBSM is the first portion of the first audiotape in the series used by patients in the Mindfulness-Based Stress Reduction Clinic at the Center for Mindfulness, University of Massachusetts. The tape is a guided body scan. Listeners are asked to attend to various parts of their body and their breathing, gently observing these areas and allowing other thoughts to recede.

The study was approved by the Institutional Review Boards of the study sites, and patients gave written informed consent.

ECG monitoring. A computerized ECG analysis system “Kaunas-Load”, developed by the Institute of Cardiology of Kaunas Medical University, was applied for 12-lead ECG recording and analysis [8, 9, 10]. A structure of ECG recording equipment “Kaunas-Load” is shown in Fig. 1.

12 synchronically recorded ECG leads were monitored during test performance for 30 minutes. Signal discretization rate was 500 Hz.

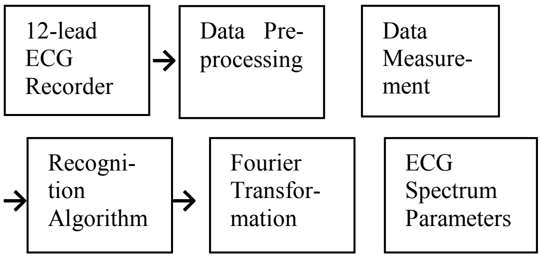

Fig. 1. Structure of ECG recording equipment "Kaunas-Load"

HRV analysis. Heart rate variability was valuated 5 min before each relaxation technique, every 5 min during and 5 min after each relaxation technique.

Spectral analysis, Fourier Transformation [9], was used to determine high (0.15 to 0.4 Hz), low (0.04 to 0.15 Hz) and very low (below 0.04 Hz) frequency bands. The power of each frequency band was logarithmically transformed in ms^2.

We evaluated *heart rhythm coherence* (HRC) —a stable, sine-wave-like pattern in the heart rate variability waveform. This term was introduced by The Institute of HeartMath [12], where the scientists have found that it is the *pattern* of the heart's rhythm that is primarily reflective of the emotional state. HRC is a highly ordered, smooth, sine-wave-like heart rhythm pattern which is associated with sustained, modulated positive emotions, such as appreciation or love. A method of quantifying heart rhythm coherence is shown in Fig. 2. This method provides an accurate measure of coherence that allows for the nonlinear nature of the HRV waveform over time [12].

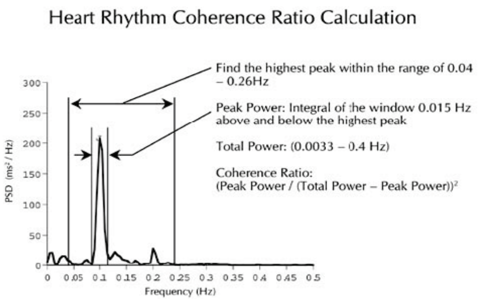

Fig. 2. Heart rhythm coherence ratio calculation [12]

The scientists found that it is the rhythm, rather than the rate, that is most directly related to emotional dynamics and physiological synchronization [12].

All the data have been presented as M ± SD**.** Hypothesis concerning the difference between means was verified using Student's t test for independent and dependent samples. Difference in means was regarded as statistically significant when error probability with respect to criteria was $p<0.05$.

Procedure

ECG was recorded two days for 30 min: lying quietly 5 min before each performed technique, 20 min during each relaxation activity and 5 min after each performed technique. Participants listened via headphone to audio recorded relaxation instructions: (1) first day they practiced mindfulness body scan meditation, (2) during the second session participants practiced progressive muscular relaxation. The changes in heart rate variability were analyzed.

Results

As its is shown in Fig. 3, very low frequency band (VLF) significantly ($p<0.05$) decreased from the starting period of 5 min just lying quietly before performing a technique (19.2 ± 4.15 ms^2 during MBSM and 15.45 ± 6.22 ms^2 during PMR) to the mid- time (10 min) of both performed techniques (12.65 ± 5.1 ms^2 during MBSM and 13.65 ± 5.82 ms^2 during PMR). From the mid-time in both relaxation techniques VLF started to increase and reached a peak in the 13th minute: 21.05 ± 7.2 ms^2 during MBSM and 23.4 ± 9.14 ms^2 during PMR ($p<0.05$). Then the VLF wave significantly ($p<0.05$) went down during both relaxation techniques until 15-20 min period of performing (14.95 ± 4.92 ms^2 during MBSM and 17.6 ± 7.42 ms^2 during PMR). During the last evaluating period for 5 min of lying quietly after performed techniques VLF was significantly ($p<0.05$) lower (15.75 ± 3.41 ms^2 after MBSM and 12.9 ± 4.82 ms^2 after PMR) compared with the starting period just lying quietly for 5 min before performing a technique.

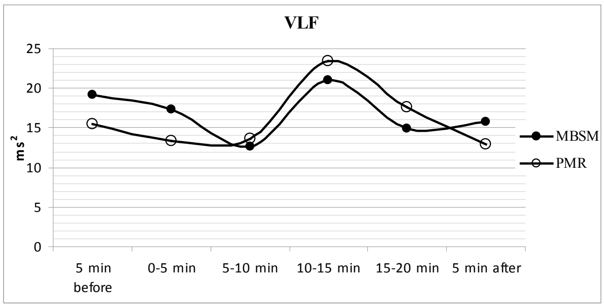

Fig. 3. Very low-frequency heart rate variability (VLF) during two relaxation techniques: solid circle – VLF during Mindfulness Body Scan Meditation (MBSM); open circle – VLF during Progressive Muscular Relaxation (PMR)

There is a similar tendency in the low frequency band (LF): it decreased ($p<0.05$) from the starting period just lying quietly for 5 min before performing a technique (4.85 ± 1.12 ms^2 during MBSM and 8.65 ± 3.22 ms^2 during PMR) to the end (15-20 min) of both performed techniques (4.15 ± 1.02 ms^2 during MBSM and 5 ± 2.14 ms^2 during PMR) (Fig. 4). The differences in LF appeared only during the last evaluating period of lying quietly for 5 min after performed techniques: LF increased ($p<0.05$) after MBSM (6.45 ± 3.22 ms^2) but decreased ($p<0.05$) after PMR (3.75 ± 0.92 ms^2) compared with the starting period of just lying quietly for 5 min before performing the techniques.

The curve of the high frequency band (HF) during these two different relaxation techniques is also similar (Fig. 5). Although HF during the starting period of just lying quietly for 5 min before performing the techniques was different (2.35 ± 0.92 ms^2 before MBSM and 6.3 ± 2.42 ms^2 before PMR), at the end it decreased after both activities (2.25 ± 1.7 ms^2 ($p>0.05$) after MBSM and 1.95 ± 0.3 ms^2 ($p<0.05$) after PMR.

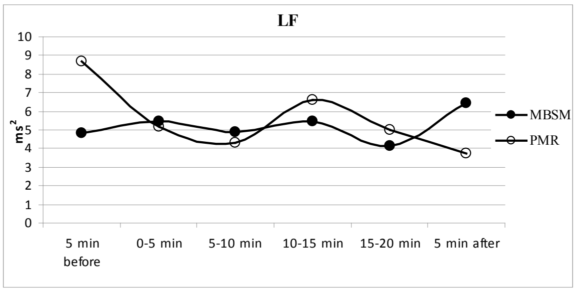

Fig. 4. Low-frequency heart rate variability (LF) during two relaxation techniques

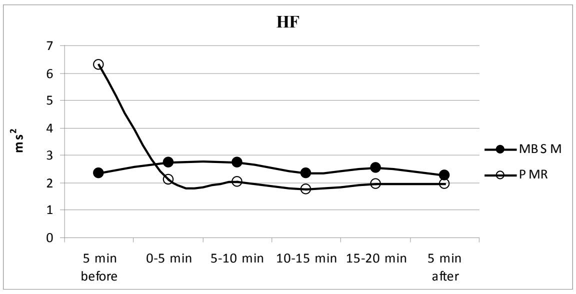

Fig. 5. High-frequency heart rate variability (HF) during two relaxation techniques

The curves of total HRV during both relaxation techniques are similar as well (Fig. 6). The highest point was at the same time during MBSM and PMR and after the techniques total HRV significantly ($p<0.05$) decreased (24.45 ± 7.27 ms^2 after MBSM and 18.6 ± 4.14 ms^2 after PMR.) compared with the starting total HRV (26.4 ± 7.02 ms^2 before MBSM and 30.4 ± 9.71 ms^2 before PMR).

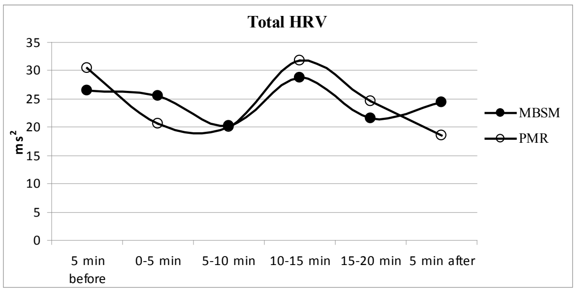

Fig. 6. Total heart rate variability (HRV) during two relaxation techniques

The curves of HRC are identical (Fig.7)..

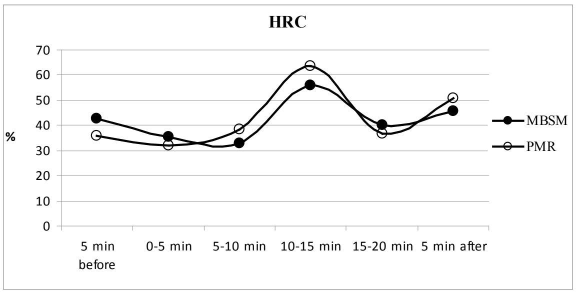

Fig. 7. Heart rhythm coherence (HRC) during two relaxation techniques

During both relaxation techniques HRC was growing until the same time of performance and reached its peak during the 13th minute (55.81 ± 5.8 Hz during MBSM and 63.62 ± 12.7 Hz during PMR). HRC was significantly ($p<0.05$) bigger after relaxation techniques than before performing them

Collectively, these findings indicate that both relaxation techniques decreased ($p<0.05$) the total HRV and HRV in all the spectra, except there was a difference in LF during the last evaluating period of lying quietly for 5 min after the performed techniques. The results show that both relaxation techniques significantly ($p<0.05$) increased the HRC.

During MBSM and PRM the tendencies repeat themselves, so these two techniques in terms of HRV are very similar. The results show that the mind-influenced changes in HRV are not less expressed than those which are formed physically.

Conclusions

1. MBSM and PRM produce reliable short-term changes of HRV and these changes are similar during both relaxation techniques.

2. These changes are significantly different from those produced by a period of time just lying quietly before performing the techniques.

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This study examines the short-term effect of two relaxation techniques on heart rate variability (HRV) in patients with ischemic heart disease. The focus of our work was on whether progressive muscular relaxation and body scan meditation produce any reliable changes of HRV and whether these changes are any different from those produced by a comparable period of just lying quietly. A computerized ECG analysis system “Kaunas-load”, developed by the Institute of Cardiology of Kaunas Medical University, was applied for 12-lead ECG recording and analysis. ECG was recorded with the patient lying quietly for 5 min before each performed technique, for 20 min during each relaxation activity and for 5 min after each performed technique. Participants listened via headphone to audio-recorded relaxation instructions. The changes in HRV were analyzed. The results indicate both similarities and differences in the HRV responses to different relaxing activities. Ill. 7, bibl. 12 (in English; abstracts in English, Russian and Lithuanian).

А Ляонайте, А. Ваинорас. Вариабильность сердечного ритма во время двух техник расслабления у мужчин после инфаркта миокарда // Электроника и электротехника. – Каунас: Технология, 2010. – № 5(101). – С. 107–110.

Исследован коротковременный эффект двух техник расслабления на вариабильность сердечного ритма (ВСР) у пациентов с ишемической болезнью сердца. Цель нашей работы было исследовать вызывает ли прогрессивное расслабление мышц и медитация сканирования тела достоверные изменения в ВСР и отличаются ли эти изменения от вызванних спокойным лежанием. Компьютеризированная система ЭКГ анализа “Kaunas-load”, созданная Институтом кардиологии Каунасского медицинского университета, была использована для 12 отведений ЭКГ записи и анализа. ЭКГ записывалась 5 мин в спокойствии лежа по 20 мин во время каждой техники расслабления и 5 мин после каждой техники расслабления. Участники через наушники слушали аудиозапись по инструкции расслабления. Были анализированы изменения в ВСР. Результаты показали сходство и разноличие ВСР ответа на разные техники расслабления. Ил. 7, библ. 12 (на английском языке; рефераты на английском, русском и литовском яз.).

A. Leonaitė, A.Vainoras. Miokardo infarkto ištiktų vyrų širdies ritmo variabilumas taikant dvi atsipalaidavimo technikas // Elektronika ir elektrotechnika. – Kaunas: Technologija, 2010. – Nr. 5(101). – P. 107–110.

Tirtas trumpalaikis dviejų atsipalaidavimo technikų poveikis išemine širdies liga sergančių vyrų širdies ritmo variabilumui (ŠRV). Mūsų darbo tikslas buvo ištirti, ar progresyvusis raumenų atpalaidavimas ir kūno apžiūros meditacijos sukelti ŠRV pokyčiai yra patikimi ir ar jie skiriasi nuo ramaus gulėjimo sukeltų ŠRV pokyčių. 12 derivacijų EKG įrašui ir analizei buvo naudota kompiuterizuota EKG analizės sistema „Kaunas-krūvis“, sukurta Kauno medicinos universiteto Kardiologijos instituto. EKG buvo rašoma pacientui 5 min ramiai gulint prieš atsipalaidavimą, po 20 min kiekvieno atsipalaidavimo metu ir 5 min po kiekvienos atsipalaidavimo. Dalyviai per ausinuką klausėsi relaksacijos audioįrašo. Buvo analizuoti ŠRV pokyčiai. Rezultatai parodo ŠRV atsako į skirtingas atsipalaidavimo technikas panašumus ir skirtumus. Il. 7, bibl. 12 (anglų kalba; santraukos anglų, rusų ir lietuvių k.).

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