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Research Article

Biofeedback and Variability of Heart Rate in Acute Myocardial Infarction

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Abstract

Autonomous nervous system, specifically the parasympathetic system, can be trained by means of biofeedback technique, increasing its neuroplasticity to benefit the vagal tone, primarily the heart rate variability. The aim of this investigation was to evaluate the behavior of the heart rate variability in patients recovering from acute myocardial infarction after the use of Biofeedback technique. The study used was a quasi-experimental design type before and after to analyze the presence of changes in the proportion of subjects with heart rate variability before and after the biofeedback technique. Mc Nemar's test was used. As a result of the study, a significant difference was observed ($p = 0.003$) between the proportions of those subjects with modified heart rate variability before and after the Biofeedback. It seems it is possible to modify the vagal tone using the biofeedback technique and therefore would warrant further investigations regarding the therapeutic benefits of the technique as a complementary and alternative mind-body therapy for cardiac patients.

Keywords: *Biofeedback; Heart Rate Variability; Myocardial Infarction; Heart Coherence*

Introduction

Biofeedback is a procedure of moulding, in which the feedback received by the subject is a particular modality of reinforcement. This approach postulates that one can learn to modify the activity of the autonomic nervous system. This learning can be done through operant conditioning, where controls of the autonomous variables occur without intervening medical processes. Biofeedback involves the use of electronic equipment to monitor internal events while teaching the patient to adjust mental processes to control bodily functions and processes, such as body temperature, blood pressure, muscle tension, and especially heart rate variability (HRV), which is no more than the variation of the heartbeat frequency during a defined time interval in an analysis of consecutive circadian periods. In the basal state, the heartbeat is produced with a variable frequency, not equidistant, with respiratory sinus arrhythmia being the most demonstrative example [1-4].

HRV is the result of the interactions between the autonomic nervous system (ANS), its sympathetic-parasympathetic balance and the cardiovascular system. Basically, the heart rate (HR) is modulated by a joint action, but independent, of these two systems, as both stimuli occur at the same time. The value of the HR cannot be fixed and there is a constant oscillation in HR values, where the VFC is increased by the parasympathetic system and diminished by sympathetic action. During inspiration there is a predominance of the sympathetic system and during expiration there is parasympathetic or vagal predominance. It is possible to synchronize the minimum variability of the heart rate, shorter RR intervals, with the inspiration and the maximum variability of the heart rate with expiration, which is called cardiac coherence [5-7].

At the level of the brain bulb are parasympathetic nuclei of the vagus nerve of both the respiratory and cardiovascular systems, a controlled diaphragmatic breathing with inspirations of 4 seconds and long expirations of 6 seconds, the bulbar respiratory nuclei are stimulated, which in turn, these by contiguity, activate the nuclei cardiovascular events by increasing the vagal cardiovascular response. This phenomenon of negative feedback is the basis of Biofeedback training in this experiment. This type of breathing exercise during a specific period of time exercises the autonomic nervous system, in the same way that we exercise a skeletal muscle, increasing the neuroplasticity of the parasympathetic autonomic system, which is trainable through Biofeedback techniques, increasing its protective effect on the cardiovascular system, and other systems that benefit from increased vagal tone. Using computerized equipment and sensors, the patient's information is collected and plotted. The information that is collected and plotted is the VFC beat by beat and its respiratory frequency by means of a dynamic chart which allows the patient to follow a respiratory pattern programmed at the same time on the same screen to achieve adequate cardiac coherence [8,9].

Experimentally induced myocardial ischemia in animal models have shown an important association between decreased heart rate variability and the occurrence of spontaneous ventricular fibrillation, decreased ventricular fibrillation threshold, and mortality. Subsequently, procedures that increase the variability of heart rate, such as beta-blockers and exercise, reduce mortality, increase the threshold for ventricular fibrillation and decrease ventricular fibrillation induced by ischemia, exercise or spontaneous. This is found in both animal studies as well in human studies [10-14]. HRV is a sensitive indicator of the degree of aging of the autonomic nervous system and a predictor of cardiovascular mortality as high as the fraction of execution of the left ventricle [15].

Ischemic heart disease continues to be one of the first three causes of mortality in the developed world, as well as in Cuba. The ventricular arrhythmias is one of the direct cause of death in many cases, and the sympathetic activity plays an important role in its' development. In addition, the increase in sympathetic activity influences ventricular remodelling causing heart failure in the immediate future of the ischemic patient [16-18].

The main objective of this investigation was to evaluate the behavior of HRV in patients recovering from a myocardial infarction, using respiratory techniques based on the principles of Biofeedback. The experiment consisted of subjecting the patients in a controlled environment to a session of diaphragmatic breathing exercises guiding their inspiratory and expiratory times by means of a computerized program. The heart rate was monitored during 10 minutes before and after the experiment. The standard deviation of the averages of the RR intervals measured in milliseconds was considered as the variability of the heart rate (SDNN), and calculated digitally. To make the analysis easier, we transformed the dependent variable VFC into a nominal dichotomous variable, considering that HRV existed when the SDNN was greater than 50 milliseconds, a value considered as adequate variability in normal subjects. Our question was to ask ourselves what would happen to VFC after submitting the patient to a breathing session with Biofeedback techniques.

Materials and Methods

Independent Variable: Biofeedback. Dependent variable: Variability of the heart rate. Indicator of the dependent variable: standard deviation of the basic interval RR (SDNN).

Study Design

Patients recovered from an acute myocardial infarction, treated at the General Dr. Gustavo Aldereguia Lima Hospital of Cienfuegos, were randomly selected during the months of July and August of this year. The HRV of each patient was measured digitally before and after the action of the independent variable.

For the statistical analysis the SPSS .21 analysis was used. Affirming that the independent variable positively modifies the dependent variable in response to our question (X^2 Mc Nemar > X^2 2/2.1) indicating that there are differences between the proportions before and after the experiment (P1 ≠ P2). Hypothesis 0 (H_o) would be rejected under these conditions. The probability that the differences of the before and after were a product of chance would be doubled by the value of p. If found significant the difference would be found with a value of p less than 0.05. The McNemar test was used for these analyzes. The data was shown in graphs and output tables with values in absolute numbers and percent.

Results and Discussion

This sample may have a high level of uncontrollable contamination in the research, twenty patients were randomly selected with a diagnosis of acute myocardial infarction in the Cardiology ward during the study period. Those chosen where chosen based on their clinical stability and voluntariness. In favour of the study, each subject became their own control minimizing bias of the sample. A brief characterization of subjects is shown in table 1. The variables age, sex, location of the IMA and treatment create a strong influence on HRV, depending on aging, autonomic nervous system damage and vagal or sympathetic predominance during the coronary event [19,20].

General Characteristics	No = 20	%
Male	12	60 %
Female	8	40 %
Average Age	65 ± 10.5	
IMA anterior	7	35%
IMA posterior	13	65%
IMA Thrombolized	14	70%
IMA Not Thrombolized	6	30%

Table 1: *General characteristics.*

In this small study when analyzing HRV, a significant difference (p = 0.003) was observed between the proportions of the subjects before and after Biofeedback (Table 2). Before the Biofeedback training session, 80% of the subjects showed that the HRV SDNN did not exceed 50 milliseconds, but after the session only 35% remained with a lower HRV of 50 milliseconds (Figure 1). The average SDNN before the intervention was 48 ms and after the intervention it was 86 ms.

VFC Before	VFC After	
	Yes	No
Yes	4	0
No	9	7

Table 2: *Variability of the heart rate before and after the experiment.*
Summary of the Mc Nemar statistic (b + c).
X2 Mc Nemar = 9; gl. 1; p = 0.003

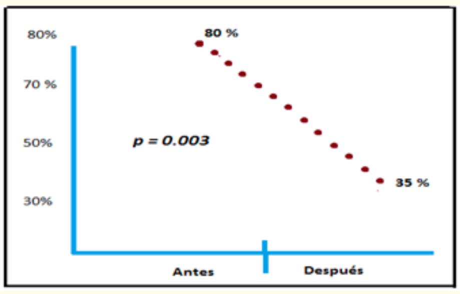

Figure 1: *Proportion of subjects without HRV before and after Biofeedback.*

The reduction of HRV in patients suffering an AMI is well studied and proven, as well as its predictive value of mortality as high as the left ventricular ejection fraction or the oxygen consumption VO_2. For this reason one of the main objectives of physical training during cardiovascular rehabilitation is precisely to increase the HRV and the vagal response in the recovery stage of a determined physical effort. The value of the decrease in HR in the first minute of the recovery stage during an exercise test is a great predictive value of mortality due to cardiac arrhythmias after an AMI indicating the beneficial functioning and neuroplasticity of the parasympathetic system having a cardio-protective effect [21,22].

Until now, physical exercise has usually been thought of as the cornerstone of cardiac rehabilitation to increase the aerobic capacity of VO_2 patients; however, every day alternative medicine gains adherence and is more accepted according to the evidence, taking into account its simplicity, innocuousness and harmonization and body mind coherence. This is evident in that since 1975 the General Hospital of Massachusetts introduced a systematic practice with many of these procedures as an alternative complement to treating their patients and used techniques such as meditation and Biofeedback [23-26].

In this study, taking into account all its limitations and biases recognized by researchers, the difference between HRV before and after Biofeedback ($P1 \neq P2$) was demonstrated at least mathematically. It may be possible to modify the vagal tone in a positive way by means of breathing exercises with Biofeedback techniques. However, a single Biofeedback session can only temporarily modify the vagal tone and it would be beneficial to observe long-term benefits that have been noted in literature with studies that have at least one month of training. It would be interesting to acquire more evidence to use such techniques in cardiovascular rehabilitation programs.

Conclusion

This study proves that it is possible to modify important biological variables using biofeedback technique and benefits the wellbeing of the patient. This technique could be used in conjunction with treatment in cardiovascular rehabilitation. Furthermore, whatever situation able to modify the sympatic activity benefits a patient with ischemic cardio vascular disease. In addition, this technique doesn't have any adverse effects and is easy to perform, as well as useful. Humans are bio-psycho-social beings, mind-body harmony and cardiac coherence, as well as have a perfect sympathetic-parasympathetic balance. It can be as angular as the physical exercise itself in cardiovascular rehabilitation.

Bibliography

1. Hernán A Marín Agudero and Stefano Vinaccia Alpi. "Biofeedback: de las técnicas de modificación de conducta, aplicada a los problemas mentales, a las técnicas de intervención de los problemas físicos". *Informes Psicológicos* 7 (2005): 109-121.

2. Lehrer Paul., *et al*. "Heart Rate Variability Biofeedback Increases Baroreflex Gain and Peak Expiratory Flow". *Psychosomatic Medicine* 65.5 (2003): 796-805.

3. Baer RA. "Mindfulness as a clinical intervention: A conceptual and empirical review". *Clinical Psychology: Science and Practice* 10.2 (2003): 125-143.

4. Del Pozo J and Gevritz RN. "Complementary and alternative care for heart disease". *Biofeedback* 31.3 (2003): 16-17.

5. Rodas G., *et al*. "Variabilidad de la frecuencia cardíaca: concepto, medidas y relación con aspectos clínicos". *Archivos de Medicina del Deporte* 123 (2008): 41-48.

6. Arrado Romero., *et al*. "Variabilidad de la frecuencia cardíaca como indicador de salud en el deporte: validación con un cuestionario de calidad de vida (SF-12)". *Apunts. Medicina De L'esport* 158 (2008): 62-69.

7. C Wilkie Delgado Correa. "Primeros estudios sobre la variabilidad de la frecuencia cardiaca con métodos cibernéticos en Cuba". *Medisan* 21.3 (2017): 346.

8. Fernando Marquínez-Báscones. "Cerebro y coherencia cardiac". *Gaceta Medica de Bilbao* 103.4 (2006): 157-161.

9. Javier O., *et al*. "Diagnóstico de la dinámica cardiaca durante 16 horas desde los sistemas dinámicos aplicable en UCI". *Revista de la Universidad Industrial de Santander. Salud* 49.1 (2017): 75-84.

10. Enrique Galve., *et al*. "Novedades en cardiología riesgo vascular y rehabilitación cardiac". *Revista Española de Cardiología* 68.2 (2015): 136-143.

11. Galve E., *et al*. "Temas de actualidad en cardiología: riesgo vascular y rehabilitación cardiac". *Revista Española de Cardiología* 67.3 (2014): 203-210.

12. Ridker PM and Cook NR. "Statins: new American guidelines for prevention of cardiovascular disease". *Lancet* 382.9907 (2013): 1762-1765.

13. Beatty AL., *et al*. "Trends in referral to cardiac rehabilitation after myocardial infarction: data from the National Cardiovascular Data Registry 2007 to 2012". *Journal of the American College of Cardiology* 63.23 (2014): 2582-2583.

14. Gielen S and Landmesser U. "The Year in Cardiology 2013: cardiovascular disease prevention". *European Heart Journal* 35 (2014): 307-312.

15. Bauer A., *et al*. "Improved Stratification of Autonomic Regulation for risk prediction in post-infarction patients with preserved left ventricular function (ISAR-Risk)". *European Heart Journal* 30.5 (2009): 576-583.

16. Gabriel Steg., *et al*. "Carina Blomstrom LundqvistGuía de práctica clínica de la ESC para el manejo del infarto agudo miocardio en pacientes con elevación del segmento ST". *Revista Española de Cardiología* 66.1 (2013): 5-11.

17. Yanier Coll Muñoz, *et al*. "Infarto agudo de miocardio. Actualización de la Guía de Práctica Clínica". *Revista Finlay* 6.2 (2016).

18. Amsterdam EA., *et al*. "2014 AHA/ACC Guideline for the Management of Patients With Non–ST-Elevation Acute Coronary Syndromes". *Journal of the American College of Cardiology* 130.25 (2014): e344-e426.

19. Roffi M., *et al*. "2015 ESC guidelines for the management of acute coronary syndromes in patients presenting without persistent ST-segment elevation". *European Heart Journal* 37.3 (2015): 267-315.

20. Tatiana Chantal Castro-de la Torre., *et al*. "Correlación de la variabilidad de la frecuencia cardiaca con SYNTAX II en angina crónica". *Revista Médica del Instituto Mexicano del Seguro Social* 55.1 (2017): S107-S111.

21. Jeria C., *et al*. "Alteración de la variabilidad del ritmo cardíaco en pacientes con síndrome coronario agudo sin supradesnivel del segmento ST. Experiencia preliminar". *Revista Chilena de Cardiología* 31.2 (2011): 104-112.

22. Antonio González Sánchez., *et al*. "Efecto de la localización del infarto de miocardio sobre la variabilidad de la frecuencia cardíaca: estudio en la fase aguda". *Revista Española de Cardiología* 51.8 (1998): 642-647.

23. Oswaldo Gutiérrez Sotelo., *et al*. "Variabilidad de la frecuencia cardíaca en pacientes con angina inestable: Correlación con otros marcadores pronósticos". *Revista Costarricense de Cardiología* 6.1 (2004).

24. Zamir Merali and Jason D Woofine. "Arrhythmias at Toronto Notes". 32nd Edition Toronto (2016): C17-C25.

25. Zamir Merali and Jason D Woofine. "Ischemic Heart Disease at Toronto Notes". 32nd Edition Toronto (2016): C26-C35.

26. Deirdre Fay. Attachment-Based Yoga and Meditation for Trauma Recovery, Simple, safe and Effective practices for Therapy. ED Norton and Company New York (2017): 2-319.

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