CHAMBER RESTRICTED ENVIRONMENTAL STIMULATION AND HEART RATE VARIABILITY

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Abstract: The aim of the study is to answer whether environment with restricted environmental stimulation (REST; chamber REST variant) influences the functioning of the autonomic nervous system (ANS). The criterion of the effect on ANS is measuring the heart rate variability (HRV). A pilot research of chamber REST (a variant on the Dark Therapy; DT): in co-operation with dr. Andrew Urbiš from Beskydy Rehabilitation Centre in Čeladná (BRC) we commenced measuring HRV with an emWave2 device in clients prior to and after a week of chamber REST (DT). From the data obtained from the measurements we can tentatively make the preliminary conclusion that HRV tends to increase after a week of DT. Thanks to the findings we are preparing a more elaborated experimental study in 2015.

Keywords: restricted environmental stimulation; REST; chamber REST; dark therapy; heart rate variability; emWave2; pilot study.

1 Introduction

The paper includes a short theoretical introduction in the REST techniques and heart rate variability. In the research section we are describing the pilot experimental study of a small extent. It was based on the measuring of HRV in six individuals undergoing the procedure of flotation REST and consisted in measuring the HRV in thirteen individuals undergoing a week of dark therapy in BRC. The measuring was carried out in the morning before the procedures started and a week later, in the morning, after the end of the procedure. Apart from the experimental group, we created a control group without any intervention.

We research REST, in particular the specific variant called dark therapy, based on continuously increasing supply and demand for the therapy not only in the Czech Republic, but also Slovakia. This increased interest, as well as our own experience, has been the impulse for us to research the effects of the techniques in greater detail. The study is our first attempt at investigating the effects of DT on human physiology, in particular on HRV. We measured HRV with an emWave2 device.

Even though the emWave2 has not been used in research often, we consider publishing the data as meaningful. Mainly for their inspirational information value - the pilot data presented below may provide guidance for further, more specific and more extensive research. We consider that as the main benefit of the paper, i.e. presenting a modest basis as a basis for further research.

2 Theoretical basis

2.1 Restricted environmental stimulation (REST)

The REST techniques are based on previous experiments with sensory deprivation (SD). The experiments investigated the effect of variability and reduction of environmental stimulation to a minimum extent. This includes social stimulation, i.e. social isolation is a part of that. These experiments were terminated because they were connected with touchless torture and interrogation practices (Zubek, 1969). *Technika omezené zevní stimulace* is a term introduced in the Czech environment as the equivalent for the current English term Restricted Environmental Stimulation Technique (REST) instead of the outdated term of sensory deprivation (Kupka, et al. 2012).

Restricted environmental stimulation thus includes the above-mentioned reduction of environmental stimuli to the minimum, in particular any visual and auditory stimuli, the decreased diversity applies to all other sensory modalities as well as social contact - depending on the selected type of restricted environmental stimulation (we will use the acronym REST as the equivalent in its general meaning) and its particular form. There are three basic forms: flotation REST, chamber REST and immersion REST (Lilly, 1977; Suedfeld, 1980; Zubek, 1969).

The research of REST shifted (compared to the predominant focus of previous experiments with SD) to revealing the medical and therapeutic possibilities of the methods, in particular in reducing the level of stress and its negative impacts on human organism (Suedfeld, 1983, 1999). And that is the area of our research focus where we are mapping the specific phenomenon in chamber REST - the DT variant, in our conditions. The reason for that is an increasing interest in these methods both among general and professional public in recent years.

For the purposes of this paper we will discuss only the variant of chamber REST (in the above-mentioned Czech modification called dark therapy; Malůš, et al., 2013).

Dark therapy (chamber REST)

Environment with restricted environmental stimulation - darkness, quiet and solitude - is known to our general public as *dark therapy*. It was PhDr. Andrew Urbiš (2012) who established this term in the Czech Republic. He works in the Beskydy Rehabilitation Centre (BRC) as a therapist.

The principle of DT, as implemented in the Czech Republic, is a stay of an individual in absolute darkness, quiet and solitude for a period of at least a week (or multiples thereof). Most often it is performed in simply, however functionally furnished room. There is a bed, a comfortable armchair, a shelf or a side table. There is also a toilet, a washbasin and a shower in the room. Sufficient quantity of food and drink is provided once a day. The person stays in this space continuously usually for seven days. Shorter stays are possible, however, it is recommended to stay for seven days which is a certain basic cycle in which we normally live. In BRC Čeladná this facility includes also an Orbitrek elliptical trainer, a sophisticated recuperation unit for continuous and silent ventilation and a one-way communication device. By this telephone the client may reach three places 24/7 - his guide (caretaker, therapist), the nurses and doctors at the rehabilitation centre. If needed, the client can end his stay at any time - he can unlock the door and leave the room.

The difference compared to the original research of REST techniques consists in several factors. The most important one is the context, because in our place the individuals-clients seek and undergo the DT service voluntarily, for a payment, as they consider it meaningful. Another factor is the length of time mentioned above, basically one week and more. In the original experiments the research context was such that the individuals underwent one to three-day stays, they were hired as volunteers and were paid for the stay (Suedfeld, 1999). We must not neglect the person and personality of the guide - a therapist who helps the clients process whatever is important and topical for them that emerges during the stay. We also need to mention the spiritual dimension spread by Holger Kalweit (2004) in Europe (introducing DT in the 1990s in Germany under the name of die Dunkeltherapie) which influenced many people interested in DT.

2.2 Heart rate variability (HRV)

Even though the heart function may be influenced by a number of physiological factors, the most important one is the autonomic nervous system (ANS), especially the sympathetic and the parasympathetic part (Čihák, 1997).

Heart is an organ abundantly innervated with sympathetic and parasympathetic fibres. ANS is responsible for fast regulation of rhythm and the transmission system during the day when the organism is exposed to a great number of exogenous stimuli - e.g. physical and mental stress or during the changes of body posture.

Heart rate (HR) oscillates in the course of time. These physiological oscillations are influenced by many factors (psyche, thermoregulation, acid-base balance, blood gases, blood pressure, hormone concentration, breathing, immune system dysfunction etc.) (Čihák, 1997).

The value of average HR applied traditionally only reflects the final effect of a number of regulatory influences on the cardiovascular system and is characteristic of certain feature of a completed homeostatic chain (Baevsky et al., 2004). The simplest way of demonstrating the effect of autonomous modulation is monitoring the HRV. Thus it may be stated that HRV is used as an autonomous tonus marker (Stejskal & Salinger, 1996).

The diagnostics of heart rate variability is one of the methods of analysing ANS. Heart rate variability shows the changes in the beat to beat interval. Autonomic nervous system consists of two branches - sympathetic and parasympathetic, that usually work in an opposing way. While the sympathetic system is present in processes requiring fast reaction (keeping the organism alert), the parasympathetic system is present in processes taking place in resting state. On the whole, the parasympathetic system participates in the protection and restoration of homeostasis, the protection and replenishing of energy reserves (Placheta, 2001).

The difference between high and low HRV

Heart rate variability thus shows the condition of our organism. From the results recorded by the device, individual components of HRV may be analysed. The components are obtained by translating the RR intervals between subsequent contractions of the heart, numerically expressed in milliseconds into a spectral image of 0 to 0.5 Hz rate range (Placheta, 2001, Stejskal & Salinger, 1996).

High HRV indicates high adaptive capacity and is a sign that the individual is healthy, having well-functioning autonomic control mechanisms. It is related with a rather good state of health and recuperation after an illness. On the contrary, low HRV is often an indicator of an abnormal or insufficient adaptability of the ANS. It is an indicator of low parasympathetic activation (Pumprla et al., 2002).

emWave2

The device measures HRV expressed by the term of coherence (low, medium and high). It is a term used to describe internal psycho-physiological coherence (Murata et al., 2004). It describes the level of harmony or disharmony both in our psychological (mental and emotional) and physiological (bodily) processes. The higher the value of coherence, the higher the level of psycho-physiological coherence, therefore the optimum functioning of ANS. The research shows that when we reach such a state, our physiological systems function in a more effective way, there is greater emotional stability and the cognitive functions improve (Tiler et al., 1996; Bradley, et al., 2007).

The term of psycho-physiological coherence is closely related to ANS balance and the device translates it in three levels: Low, Medium and High. The proportion of the three levels of coherence is shown in percentages. The more high coherence and the less low coherence, the higher the HRV is and vice versa. Low coherence is characterized by lower ANS balance, as opposed to high coherence which corresponds with a more balanced and optimal functioning of the heart as well as ANS (McCraty, 2001).

3 Description of the experimental and control group

3.1 Experimental group

The basic group consists of individuals who underwent the intervention by dark therapy at BRC Čeladná from September, 2013 to the end of April, 2014. The individuals were the clients of a service called dark therapy which they decided and paid for on their own.

The selective group consists of individuals from the basic group described above who underwent a week's stay and gave their consent to HRV measuring with the help of an emWawe2 device. The basic group consisted of 13 individuals of the average age of 46 years, 7 men and 6 women.

3.2 Control group

Apart from the selective group undergoing the intervention with DT, we created a control group without any intervention of the same number of 13 individuals (the average age was 49 years, 6 men and 7 women). The group consisted of academic workers of Palacký University and other individuals gathered by the snowball method who volunteered and gave their consent to HRV measuring with an emWave2 device.

4 Methodology

4.1 Experimental group

In the experimental group we share data obtained by PhDr. Andrew Urbiš on his own initiative. He started to implement test-retest measuring of the clients with an emWave2 device during the admission interview prior to commencing the week's DT and during the final interview after the stay. The measuring was always done in resting state, in sitting position, for five minutes. Even though it is not a standardized ortoclinostatic test lying - standing - lying, we decided to use the data as they showed significant shifts. We carried out a statistical analysis of the data.

4.2 Control group

As we could not influence the process of obtaining the data from the experimental group, we created a control group (without any intervention) where we measured HRV with the help of an emWave2 device with the same lapse of time and in the same manner (i.e. a five-minute measuring in resting state in sitting position with a week’s time lapse) in individuals in the group of the same number and the closest composition possible (from the point of view of average age and sex). The control group was created in order to establish whether there is, even without intervention, any statistically significant shift between the first and the second measurement.

Even though the emWave2 device is primarily a training and therapeutic tool, we used it in a diagnostic way. We neither instructed the subjects concerning the modification of breathing nor showed to them the values achieved during the measurement (i.e. we did not use the biofeedback features of the device). The individuals received feedback concerning the values measured only after the second measurement in order to reduce the possibility of the second measurement being influenced by their inner expectations.

5 Results

5.1 Results for the differences in "low coherence"

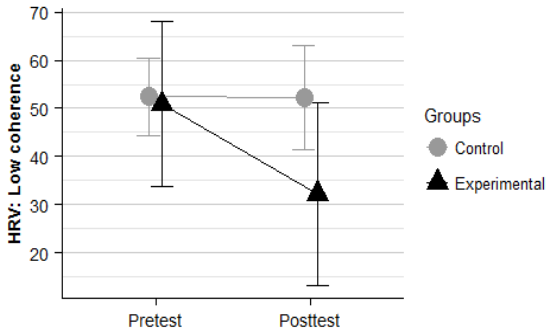

Figure 1: Confidence intervals for low coherence, comparison of the experimental and the control group; Difference in the level of improvement is not significant: t(24) = -1.65; p = 0.31; d = -0.65.

5.2 Results for the differences in "high coherence"

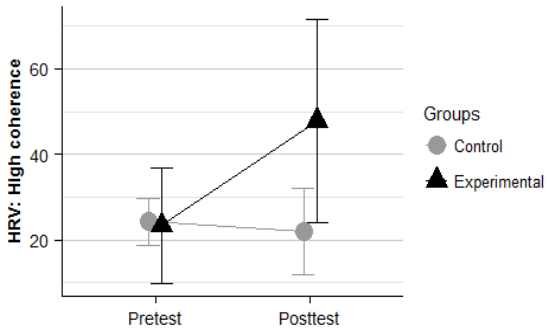

Figure 2: Confidence intervals for high coherence, comparison of the experimental and the control group; Experimental group improved significantly more than control group: t(24)= 3.20; p < 0.01; d = 1.26.

5.3 Results for the differences in "high coherence - low coherence"

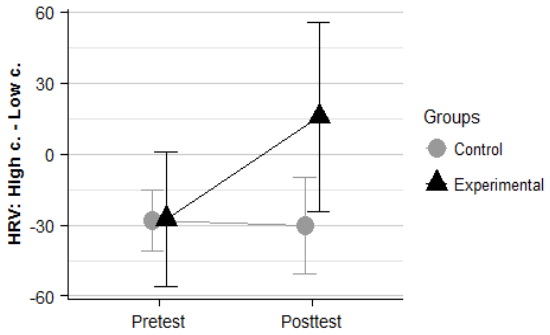

Figure 3: Confidence intervals of the percentage difference between high-low coherence, comparison of the experimental and the control group; The experimental group improved significantly more than the control group: t(24) = 2.70; p < 0.05; d = 1.06.

5.4 Results for the differences in heart rate

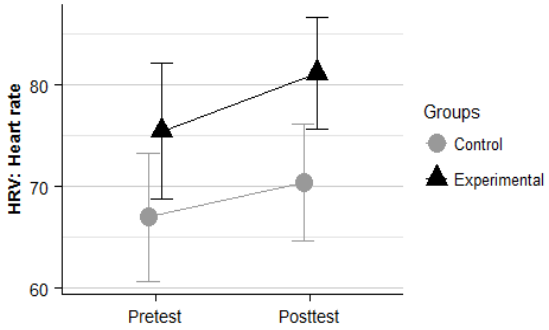

Figure 4: Confidence intervals of HR, comparison of the experimental and the control group; Average HRs of both groups showed significant differences during the second measurement, however, the difference in the change of the HRs between the groups is not statistically significant.

5.5 Results - summary table with statistically calculated values measured with the emWave2 device

Table 1: Summary table for all tested values

Scale	Mean		S. deviation		t-test			Effect size
	Exp.	Con.	Exp.	Con.	t	df	p	
Low	-18.69	-.15	35.64	19.23	-1.65	24	0.11	-0.65
Med	-5.77	2.46	35.41	12.91	-0.79	24	0.44	-0.31
High	**24.46**	**-2.31**	**24.44**	**17.61**	**3.20**	**24**	**< 0.01**	**1.26**
High-Low	**43.15**	**-2.15**	**49.81**	**34.54**	**2.70**	**24**	**< 0.05**	**1.06**
HR	5.69	3.38	11.61	5.71	0.64	24	0.53	0.25

Note to Table 1: Exp. = experimental group; Con. = control group; Significant values are in bold type. Significant differences are the group differences in the scales "coherence high" and "coherence high-low.

6 Conclusion and discussion

The results of our study proved that in individuals subjected to the conditions of the chamber REST (dark therapy variant), compared to the control group, there was a significant increase in “high coherence” and a decrease in “low coherence” in their heart action.

We consider the results of the study as inspiring and worthy of further investigation, however, we are also aware of the limits of the study, which were several. Firstly, from the point of view of the methodology of measurement, standardized ortoclinostatic test was not applied; it will be a part of the follow-up study. Secondly, the emWave2 device is designated primarily for training, therapeutic practice or personal use. It is not originally intended for diagnostics, therefore it may not be easy to use the terms it operates with and translate them to the usual medical terms. Despite these drawbacks, the statistical analysis (despite the small size of the group) suggests that even the emWave2 device may provide meaningful data.

The emWave2 device measures hear action and its variability (which is influenced by ANS) which statistically significantly increases after a week's stay in dark therapy, compared to the control group (which shows no change). Even though the device works primarily with the specific terms of low, medium and high coherence, we know that low coherence corresponds with low variability and high coherence corresponds with high variability. It remains the task of further studies to provide a more precise terminological clarification. Thus we plan, as a part of a follow-up study, to compare the data from emWave2 with tested devices for monitoring HRV.

Literature:

1. BRADLEY, R. T., et al. Reducing test anxiety and improving test performance in America's schools: Results from the TestEdge national demonstration study. Boulder Creek (CA): HeartMath Research Center, 2007.
2. ČIHÁK, R. *Anatomie 3*. Praha: Grada Publishing, 1997. 672 p. ISBN 80-7169140-2.
3. KALWEIT, H. *Dunkeltherapie. Die Vision des inneren Lichts.* Bercker: Koha, 2004. 330 p. ISBN 978-3936862379.
4. KUPKA, M., et al. Limited outer stimulation technique. *Československá psychologie*, 2012, 56, 5, pp. 488-499. ISSN 0009-06.
5. LILLY, J. C. *The Deep Self*. New York: Simon & Schuster, 1977. ISBN 0-671-22552-9.
6. MALŮŠ, M., KUPKA, M., KAVKOVÁ, V. Technika omezené zevní stimulace (REST): výpovědi ze tmy. In *Kvalitativní přístup a metody ve vědách o člověku XII: Hranice normality*. Olomouc: Univerzita Palckého, A. Neusar (Ed.), 2013. pp. 322-330. ISBN 978-80-244-3917.
7. MCCRATY, R. Science of the heart. Boulder Creek (CA): HeartMath Research Center, Institute of HeartMath, Publication, 2001, 01-001.
8. MURATA, Tetsuhito, et al. Individual trait anxiety levels characterizing the properties of Zen meditation. *Neuropsychobiology*, 2004, 50, 2, pp. 189-194. 0302-282X.
9. PLACHETA, Z., et al. *Zátěžové vyšetření a pohybová léčba ve vnitřním lékařství*. Brno: Vydavatelství MU, 2001. 179 p. ISBN 80-210-2614-6.
10. PUMPRLA, Jiri, et al. Functional assessment of heart rate variability: physiological basis and practical applications. *International journal of cardiology*, 2002, 84, 1, 1-14. ISSN 0167-5273.
11. STEJSKAL, P., SALINGER, J. Spektrální analýza variability srdeční frekvence. *Med Sport Bohem & Slovaca, 1996*, 2, 33-42.
12. SUEDFELD, Peter. *Restricted Environmental Stimulation: Research and Clinical Applications.* New York: John Wiley and Sons, 1980.
13. SUEDFELD, P., BALLARD, E. J., MURPHY, M. Water immersion and flotation: From stress experiment to stress treatment. *Journal of Environmental Psychology*, 1983, 3, 2, pp. 147-155.
14. SUEDFELD, P. Health and therapeutic applications of chamber and flotation restricted environmental stimulation therapy (REST). *The International Journal of the Addictions*, 1999, 14, pp. 861–888.
15. URBIŠ, A., *Terapie tmou: návrat k harmonii a ke zdraví*. Frýdek-Místek: Alpress, 2012. 222 p. ISBN 978-80-7466-053-5.
16. ZUBEK, J., P. *Sensory Deprivation: Fifteen Years of Research*. New York: Appleton-Century-Crofts, 1969.

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