

IMPLEMENTATION OF THE MOTEK CAREN SYSTEM IN BEHAVIOURAL THERAPY FOR PATIENTS WITH ANXIETY DISORDERS

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SUMMARY

Background: Virtual reality exposure therapy (VRET) is becoming a more and more popular treatment method for patients suffering from anxiety disorders. One of the VRET methods, which could be used for this group of patients is MOTEK CAREN system, however, so far no studies have been published on its implementation in psychiatric disorders.

Subject and methods: Presented here is a case of a 45 year old woman suffering from anxiety disorders, who underwent a series of four subsequent trainings with the use of MOTEK CAREN system repeated once a week. Data from the system were collected on the work of muscles, joints, reactions of the ground, etc. Blood pressure, pulse and salivary cortisol level were measured before and after each training. The level of state and trait anxiety was each time measured with the STAI inventory.

Results: The changes of the values of heart rate, blood pressure and salivary cortisol suggest that all trainings were stressful events for the patients, as they were not observed in the control session. But the gradual decrease in the levels of salivary cortisol and anxiety as state after subsequent trainings may be signs of a gradual adaptation of the patient to the stressful situation. A lower cadence during the trainings compared to the control session was observed, however the speed of the cadence increased with each session.

Conclusions: Trainings with the MOTEK CAREN system can be promising in the treatment of anxiety disorders. Of course in order to draw more evidence based conclusions this observations must be confirmed on a larger sample of patients.

Key words: intellectual disability - vocational rehabilitation - employment

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INTRODUCTION

Anxiety disorders belong to the most common psychiatric disorders, and if they are not successfully treated, they may become disabling (Antai-Otong 2016). Some of them turn out to be treatment-resistant and the researchers look for possible augmentation strategies, which often do not appear to be beneficial (Patterson & Van Ameringen 2016). In the last two decades a new promising method used in mental disorders, especially anxiety disorders has become virtual reality (VR) (Diemer et al. 2015). Virtual reality exposure therapy (VRET) is a more and more popular treatment method for anxiety and specific phobias (Parsons and Rizzo 2008). It can be an alternative to other, more traditional exposure-based therapies, like cognitive-behavioral treatments and in vivo exposure therapy, and it is based on immersion in virtual environment generated by a computer, which decreases the phenomenon of avoidance and creates good possibilities to work with emotional problems (Gerardi et al. 2010). Patients are exposed to virtual environments that resemble feared real-life situations (Morina et al. 2015). The spectrum of anxiety disorders, which can be treated with VRET is very wide and includes: phobias, panic disorder, post-traumatic stress disorder (Meyerbrocker & Emmelkamp 2010), as well as acrophobia, or fear of heights, which is

a widespread and debilitating disorder affecting about 1 in 20 adults (Krijn et al. 2004, Coelho et al. 2009) and agoraphobia (Meyerbrocker et al. 2011). VRET may also be an addition to traditional psychotherapy methods like cognitive behavioural therapy (CBT) (Diemer et al. 2014) and/or medication with such substances like paroxetine or venlafaxine (Pitti et al. 2008). Although VRET may be an effective method of treatment, some authors suggest caution in interpreting the existing literature due to methodological limitations of many studies (McCann et al. 2014). One of the developing methods of VRET is Motek Medical's Computer Aided Rehabilitation Environment (CAREN) system, which has been used in physical rehabilitation and biomechanical research. It consists of a 180 degree projection screen used to display a virtual scene, and motion capture system. It is also equipped with a six degree of freedom actuated platform (Sinitski et al. 2015). So far, this system has been used mostly for the rehabilitations of patients with neurological diseases like stroke (Fung et al. 2004, Lamontagne et al. 2007) or in balance training in people with multiple sclerosis (Kalron et al. 2016).

Results from literature show that CAREN system is a capable tool for both assessment and rehabilitation but still very few studies have been published on the research on patient populations (Collins et al. 2015). Especially there are no possible data regarding patients

suffering from psychiatric disorders, so the the aim of this paper was to present an example of the implementation of MOTEK CAREN system in the treatment of anxiety disorders.

SUBJECT AND METHODS

Case report

Described here is a case of a 45 years old woman, who participated in the trainings with the use of MOTEK CAREN system. The patients is divorced, a mother of two children, 24 years old son and 20 years old daughter. Since 1996 she has had agoraphobic syndromes: panic attack, especially when she is outside without attendance. Except of that she also reported: dizziness, fatigue, anxiety, tachycardia, chest pain and slightly decreased mood. Since 2001 she has never gone out of her home alone. The majority of chores were done by her husband and children. Even at home she tried not to stay alone. During this time she has been treated pharmacologically, using only benzodiazepines

(alprazolam, clorazepate, bromazepam) which led to developing drug tolerance and decrease of effectiveness of the treatment. Despite the attempts to withdraw using benzodiazepines and switching to antidepressants (fluoxetine, paroxetine, sertraline, amitriptyline, mianserin) nothing gave any results. From 2004 to 2008 she was attending individual psychotherapy, and sometimes family therapy. After she had ended therapy she decided to leave her husband due to his alcoholism. This change has significantly improved quality of her life and diminished syndromes. However she was still addicted to benzodiazepines, taking 2 mg of alprazolam every day. After long hesitations she agreed to attend psychiatric ward for detoxication. She left it after two weeks not using benzodiazepines, taking 30 mg of paroxetine, but still with agoraphobic syndromes. From 29.01 to 13.03.15 she was at psychotherapeutic ward, she was treated using group therapy, with satisfactory results. Since that time she has been using 30 mg of paroxetine and 30 mg of chlorprotixen a day. She doesn't have agoraphobic syndromes but she reports feeling of dizziness and vertigo.

Table 1. Values of basic parameters and differences between them before and after training

Session No	1		2		3		4		Control
Heart Rate (B/min)									
Before	80		88		77		84		84
After	109		152		108		110		96
Variation	29		64		31		26		12
Pressure (mmHg)									
	Sys	Dias	Sys	Dias	Sys	Dias	Sys	Dias	
Before	105	75	110	75	110	75	110	70	
After	110	70	120	85	130	85	115	80	
Variation	5	-5	10	10	20	10	5	10	
Temperature (°C)									
Before	35.7		36		35.6		35.9		35.9
After	35.4		36		34.7		36.2		35.5
Variation	-0.3		0		-0.9		0.3		-0.4
Cortisol Concentrations (nmol/l)									
Before	9.2		5.68		5.94		6.52		6.45
After	13.8		8.23		7.78		9.45		6.52
Variation	4.6		2.55		1.84		2.93		0.07

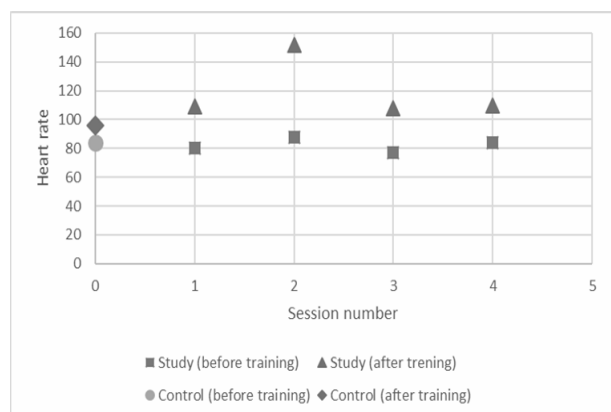


Figure 1. Differences between heart rate before and after training, in comparison to the control walk

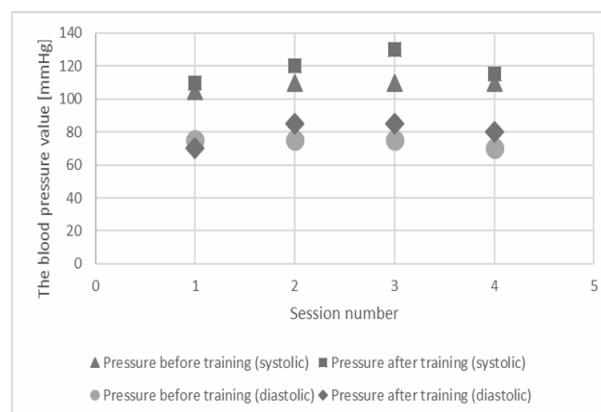


Figure 2. Differences in systolic and diastolic blood pressure before and after training

Methods

The patient participated in four subsequent trainings with the use of MOTEK CAREN system repeated once a week. The trainings were performed on a simulation platform with six degrees of freedom of movement. The platform had a built-in track, with two independent lanes, the whole being a dynamometric plate. During the training the patient located on the platform responded to the image displayed on the screen, mechanical stimulation caused by the movement of the platform and the stimulation of sound generated by surround system. 180-degree semi-circular screen created the illusion an immersion in the displayed scene. These elements gave a possibility of interaction and feedback important in the process of treatment and rehabilitation. The parameters were recorded by the marker acquisition system VICON motion BONITA which allows to collect the data on anthropometric parameters, to determine the angle, velocity, and linear acceleration and angular shapes modeling the patient's body as well as the torque and power of the individual "joints". Management of the above-mentioned streams of information enables the diverse and rich scenarios and generally immersing the patient in a virtual environment freely configured. For the purpose of the research two scenarios were carried out. In the first scenario, the patient walked on a rope bridge suspended over the precipice of changing slope. The bridge was subjected to random side movements of variable amplitude. The audio system generated the sound of the wind that caused the swaying of the bridge. In the second scenario (which was a control training session), the patient was walking along a forest road. The results of all measurements were synchronized in time. Data were collected on the work of muscles, joints, reactions of the ground, etc. The system provides highly accurate and objective figures. At the same time the physician had an access to the video from the study. The system provided a chart from which the information about the movement of the hip, spine or knees were analyzed. Blood pressure, pulse and salivary cortisol level were measured before and after each training. The level of state and trait anxiety was each time measured with the STAI inventory.

Studies have been carried out at the Centre for Research and Development of Polish-Japanese Academy of Information Technology www.bytom.pja.edu.pl in accordance with the methodology of clinical trials.

RESULTS

All basic parameters, such as heart rate or body temperature, as well as the salivary cortisol concentrations, were measured twice, before and after each training (Table 1).

Values of heart rate, blood pressure and salivary cortisol were significantly increasing during each of sessions, what may suggest that the training successfully elicited a psychological stress in the participant (Figures 1, 2, 3).

What is more, lack of significant alteration of cortisol concentrations before and after the control session, as well as considerably lower increase of heart rate in comparison to normal training, indicate that variations in values of those parameters during training, are not induced by the sole physical effort (Figures 1, 3).

There was also a visible downward trend in variations of cortisol concentrations between sessions, visible on a figure 4, which may imply that the participant gradually adapted to the stressful situation. Further confirmation of such hypothesis may be found in the analysis of distance parameters obtained during each session. With each training, our patient's steps were faster and therefore her amount of strides per minute increased (Figures 5, 6).

Significantly lower cadence during the training, combined with a significantly higher heart rate, in comparison to a control walk (Figure 7), may be the further evidence for an effective induction of stress by a simulated situation. It is interesting however that in spite of the increase of the speed of the cadence, it was never as fast as in the control training session.

The level of anxiety as state measured with the STAI inventory decreased with each training, and the level of anxiety a trait remained the same through all trainings.

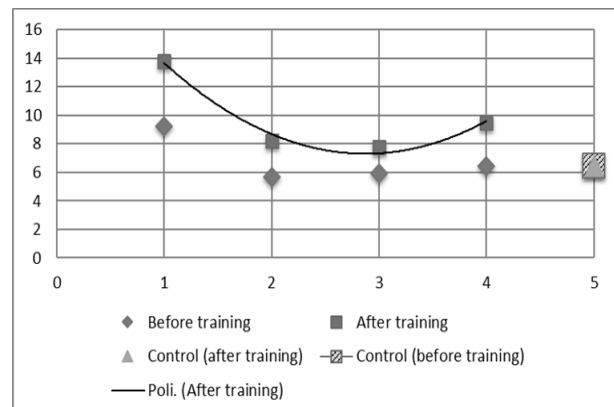


Figure 3. Differences between cortisol concentrations before and after training, in comparison to the control walk

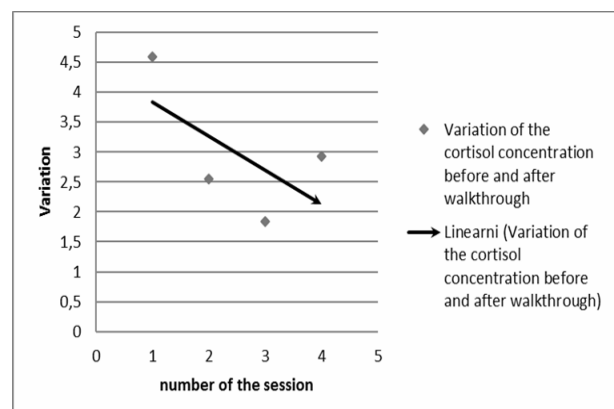


Figure 4. Comparison of variations of cortisol concentrations between sessions

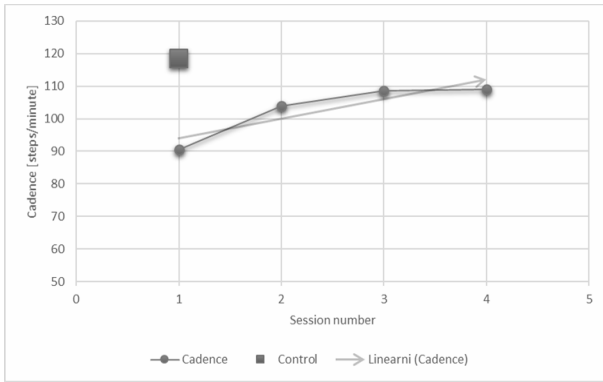


Figure 5. Average cadence on each of sessions in comparison with the control walk

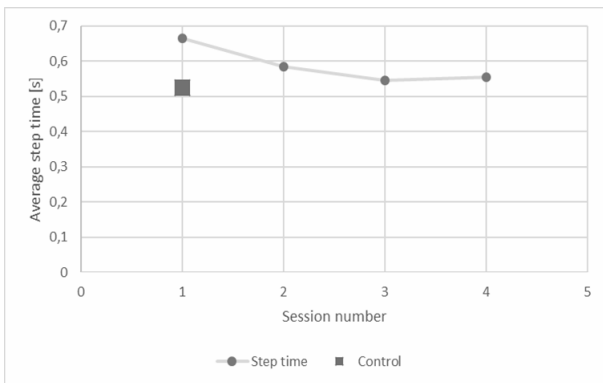


Figure 6. Average step time on each of session in comparison with the control walk

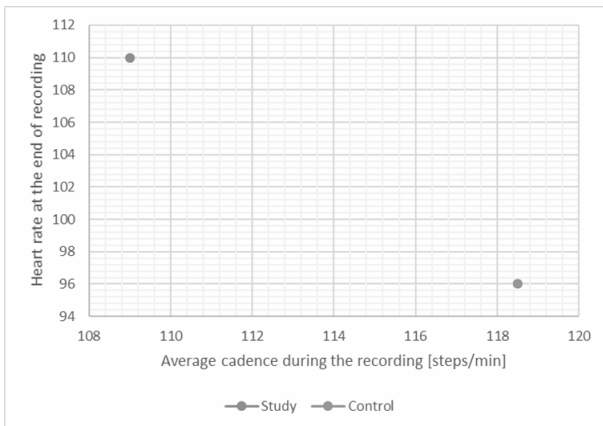


Figure 7. Comparison of an average cadence to heart rate ratio, between training sessions and the control walk

DISCUSSION

The results obtained by our patient during the trainings show some changes in the parameters like blood pressure and heart rate, as well as in the salivary cortisol levels. The changes of the values of heart rate, blood pressure and salivary cortisol suggest that all trainings we stressful events for the patients, as they were not observed in the control session. But the gradual decrease in the levels of salivary cortisol and anxiety as state after subsequent trainings may be signs of a gradual adaptation of the patient to the stressful

situation. In the literature the analysis of salivary cortisol during VR exposure compared to physiological reactions like heart rate gives inconsistent results, for example in the study by Diemer et al. (2016) in patients exposed to virtual height challenge an increase of heart rate and skin conductance level was observed, but there was no increase in salivary cortisol levels (Diemer et al. 2016). This observation is interesting as the increase of salivary cortisol level was observed during in vivo exposure therapy in agoraphobic patients (Schumacher et al. 2014). Another important parameter observed during VR trainings of anxiety patients is locomotion and gait. Persons with visual height intolerance or acrophobia exhibit typical restrictions of visual exploration and imbalance during stance and locomotion when exposed to heights. Eye and head movements are reduced, and gaze freezes to the horizon. Body posture is characterized by a stiffening of the musculoskeletal system with increased open-loop diffusion activity of body sway, a lowered sensory feedback threshold for closed-loop balance control, and increased co-contraction of antigravity leg and neck muscles. Walking is slow and cautious, broad-based, consisting of small, flat-footed steps with less dynamic vertical oscillation of the body and head (Brandt et al. 2015). In case of our patient we observed a lower cadence during the trainings compared to the control session. However the speed of the cadence increased with each training, which may be another evidence for her adaptation to stress. There is another group of publications found in the literature discussing the alteration of gait in the anxiety patients. For example patients with functional dizziness are concerned about falling but did not fall more often than healthy controls (Schlick et al. 2016). Patients with phobic postural vertigo show gait changes which correlate with their fear of falling and balance confidence. Absent visual feedback leads to more pronounced gait deteriorations in phobic postural vertigo patients than in healthy subjects, indicating a higher reliance of patients on visual information during walking. These findings support the view that the gait characteristics of phobic postural vertigo can be attributed to an inadequate, cautious gait control (Schniepp et al. 2014). The effective treatment of different forms of anxiety disorders is very important for the improvement of their quality of life, like for example in the visual height intolerance, which can have a considerable impact on patients' daily life and interpersonal interactions (Schaffler et al. 2014). It is also important to search for new methods of treatment of the phobic postural vertigo, as it is more difficult to treat than panic disorder with agoraphobia (Holmberg et al. 2007). The above observations support the hypothesis that trainings with the MOTEK CAREN system can be promising in the treatment of anxiety disorders. Of course in order to draw more evidence based conclusions this observations must be confirmed on a larger sample of patients.

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Studies have been carried out at the Centre for Research and Development of Polish-Japanese Academy of Information Technology www.bytom.pja.edu.pl

Conflict of interest: None to declare.

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