

The Effect of Respiratory and Physical Intervention on Selected Parameters of Heart Rate Variability in Hematooncological Patients after Treatment

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Abstract

The aim of this research was determined the effect of respiratory intervention for twelve weeks and physical intervention for twelve weeks on selected parameters of heart rate variability in hematooncological patients after treatment. Spectral analysis of heart rate variability was measured by DiANS PF8 machine with Medical DiANS PC software. Evaluated were complex indices – Total score and Sympathovagal balance (S-V balance). The intervention programme was composed of three months of respiratory training and then three months of physical training. The experimental group, which absolved this combination of respiratory and physical intervention, was assessed at free time points: firstly, before the respiratory intervention, secondly between the respiratory and the physical intervention and thirdly after the physical intervention. The control group (without intervention) was measured twice between six months. 30 hematooncological patients (16 women and 14 men) were participated in this research, ranging in age $53,74 \pm 14,76$ years from Internal Hematology and Oncology Clinic of The University Hospital Brno. Results of selected parameters of heart rate variability showed positive increase in sympatovagal balance after respiratory training, but without statistically significant effect of intervention programme.

Keywords: *Oncological patients, lymphoma, respiration exercise, physical exercise, autonomic nervous system, heart rate variability*

INTRODUCTION

Oncologic diseases are on second place in reasons why people dying in the Czech Republic and in the World too. According to the National Cancer Registry were in year 2016 diagnosed 779 causes of neoplasm of non-Hodgkin lymphoma and 152 causes of neoplasm of Hodgkin lymphoma. In year 2016 died in the Czech Republic 565 patients with non-Hodgkin lymphoma and 46 patients with Hodgkin lymphoma. (1) Physical activity can be very beneficial for patients with oncological disease. Positive effect has on quality of life. (3) With oncological diseases is connect fatigue too. On fatigue can have physical activity positive influence too. (4,5,6) Physical activity should have place in oncologic treatment. (7) Physical activity has influence on heart rate variability. Moderate aerobic endurance activity improves autonomic heart regulation. (9) Connection has fatigue and activity of autonomic nervous system too. (10)

METHODS

Participants

For the research were intentionally chosen patients from Internal Haematology and Oncology Clinic of The University Hospital Brno in remission after oncological treatment of Hodgkin's or Non-Hodgkin's lymphoma. In this research group specifically were 9 patients with Hodgkin's lymphoma diagnosis and 21 patients with Non-Hodgkin's lymphoma diagnosis. Except one case was used chemotherapy treatment, the most was used chemotherapy regiment BEACOPP (bleomycin, etoposide, adriamycin, cyclophosphamide, vincristine, procarbazine, prednisone), secondly regiment R-CHOP (rituximab + cyclophosphamide, doxorubicin vincristine, prednisone). Chemotherapeutic treatment was applied independently or combined with radiotherapeutic or biologic treatment. In two cases was used autologous transplant after chemotherapeutic treatment.

The research group were composed of 16 women and 14 men ranging in age $53,74 \pm 14,76$ years (age at the time of the first measurement). The reconditioning programme completed 17 patients and in the control group was included 13 patients.

The reconditioning programme included only patients in remission (within 2 months after the end of oncological treatment) and without any contraindication regarding the performance test. The randomisation was geographic (patients from vicinity with a possibility to commute regularly for the exercise lessons).

Measures

The participants, who were included in the experimental group were assessed at three times – firstly before the respiratory intervention, secondly between the respiratory and the physical intervention and thirdly after the physical intervention. The participants in the control group were tested at two times within 6 months.

The study instruments included measure of heart rate variability (DiANS PF8), body composition (Inbody230), strength of upper limbs (handgrip), cardio-respiratory fitness (spiroergometric: Lode Excalibur + Cortex Metalyzer®), inspiratory and expiratory mouth pressures (Micro RPM), anamnestic examination, psychologic examination of quality of life (SEIQoL – Schedule for the Evaluation of Individual Quality of Life) and examination of nutritional habits (FFQ – Food Frequency Questionnaire).

In this part of the research was main procedure measure of heart rate variability. Heart rate variability was measured on DiANS PF 8 machine and analysed by Medical DiANS PC software. Test was composed from three 300 R-R intervals and based on orthostatic reaction. Evaluated were complex indices of spectral analysis Sympathovagal balance and Total score.

Interventions Programme

The intervention programme was composed of respiratory intervention for twelve weeks and physical intervention for twelve weeks.

Respiratory intervention

Before the intervention were participants educated by physiotherapeutic for right technique of the exercise. The respiratory intervention was applicated every day for twelve weeks at home with breath machine Threshold® IMT (Inspiratory Muscle Trainer) and Threshold® PEP (Positive Expiratory Pressure). Resistance was individual set on 30% of maximal inspiratory/expiratory pressure. These parameters were measured and set by physiotherapeutic on the first testing of participants before respiratory intervention.

Physical intervention

The physical intervention was going three times of week for twelve weeks. Physical training had 60 minutes and started with warm-up on cardio machines. Main parts of lessons were composed of cardio training (used were spinning bicycles, cross trainers, steppers, treadmills and rowing machines). All the exercise lessons were closed with stretching and relaxation. During the exercise lesson was controlled individual level of set intensity based on heart rate (it was used chest belt ST Polar RS 100, RS 300X) and subjective level of intensity on the Borg chart (in 5 minutes intervals). The optimal individual level of intensity was set on 60-80% of maximal heart rate, which was measured on the first testing of participants on spiroergometric.

Statistical Analysis

Statistical analysis was performed with software Statistica 12. The normality of distribution was verified with Shapiro-Wilk test, Kolmogorov-Smirnov test and Lilliefors test. Based on the results of these tests was determined that data were nonparametric, and number of participants was small. Therefore, was chosen nonparametric Wilcoxon t-test. A p value of less than 0.05 was considered statistically significant. Results were verified with Cohen d . A Cohen d value 0.2 indicates small effect size, 0.5 represents medium effect size and 0,8 considers large effect size. Values of S-V balance and Total score were compared in experimental group before the respiratory intervention, after the respiratory intervention and after the physical intervention. In the control group were studied differences of these values, which was measured at two times within 6 months.

RESULTS

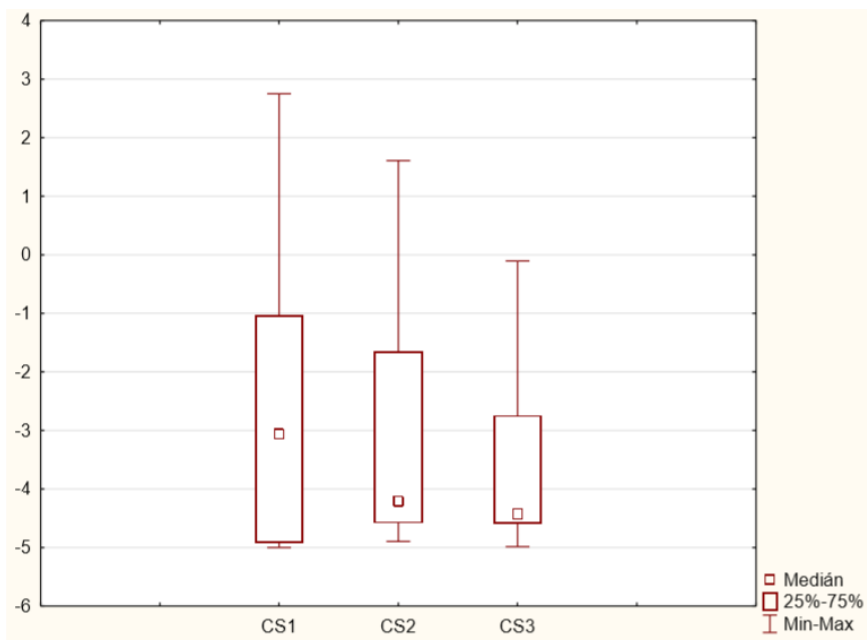
Median of total score value at first testing of experimental group (before respiratory intervention) was -3,0627. Minimal value was -5,0 and maximal 2,75. Median of S-V balance value at first testing of experimental (before respiratory intervention) group was -1,78235. Minimal value was -4,55 and maximal 2,73. Median of total score value at second testing of experimental (between respiratory and physical intervention) was -4,|2076. Minimal value was -4,90 and maximal 1,61. Median of S-V balance value at second testing of experimental (between respiratory and physical intervention) was -0,1088. Minimal value was -4,96 and maximal 2,68. Median of total score value at thirdly testing of experimental group (after physical intervention) was -4,42880. Minimal value was -4,99 and maximal -0,11. Median of S-V balance value at thirdly testing of experimental group (after physical intervention) was -0,0907. Minimal value was -3,82 and maximal was 1,17.

Median of total score value at first testing of control group was -3,2174. Minimal value was -4,99 and maximal 1,69. Median of S-V balance value at first testing of control group was -0,5748. Minimal value was -4,99 and maximal 2,56. Median of total score value at second testing of control group was -3,29305. Minimal value was -4,91 and maximal 1,18. Median of S-V balance value at second testing of control group was -0,06845. Minimal value was -3,88 and maximal was 2,13.

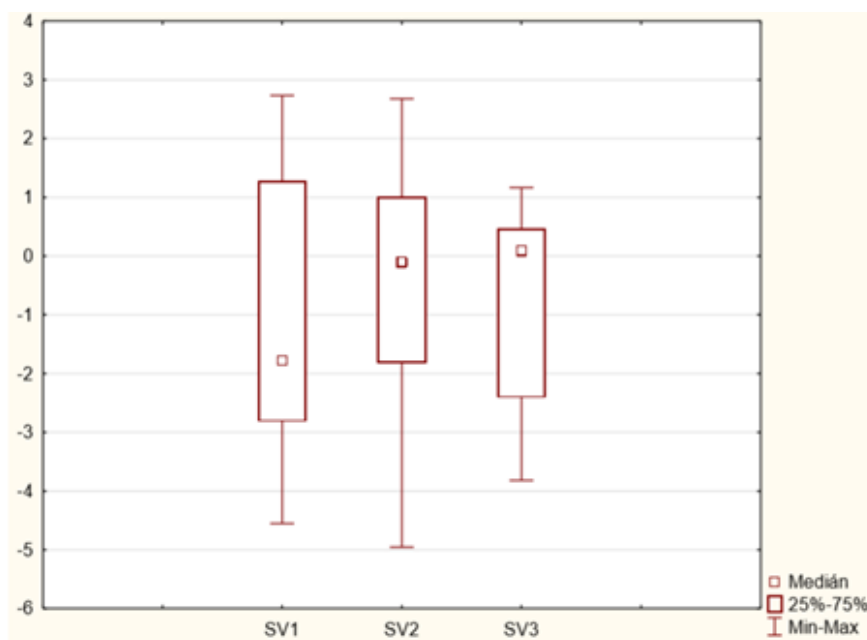
A statistically significant p value was set $p < 0.05$. P value of Total scores between measurements before (CS1) and after respiratory intervention (CS2) was 0,64 (Cohen d 0.11). P value of Total scores between measurements before respiratory (CS1) and after physical intervention (CS3) was 0,64 (Cohen d 0.03). P value of Total scores between measurements after respiratory (CS2) and after physical intervention (CS3) was 0,55 (Cohen d 0.15). P value of S-V balance between measurements before (SV1) and after respiratory intervention (SV2) was 0,13 (Cohen d 0.03). P value of Total scores before respiratory (SV1) and after physical intervention (SV3) was 0,24 (Cohen d 0.01). P value of Total scores between measurement after respiratory (SV2) and after physical intervention (SV3) was 0,55 (Cohen d 0.03).

P value of Total scores between measurement of control group (CS1 and CS3) was 0,48 (Cohen *d* 0.01). *P* value of S-V balance between measurement of control group (SV1 and SV3) was 0,89 (Cohen *d* 0.02).

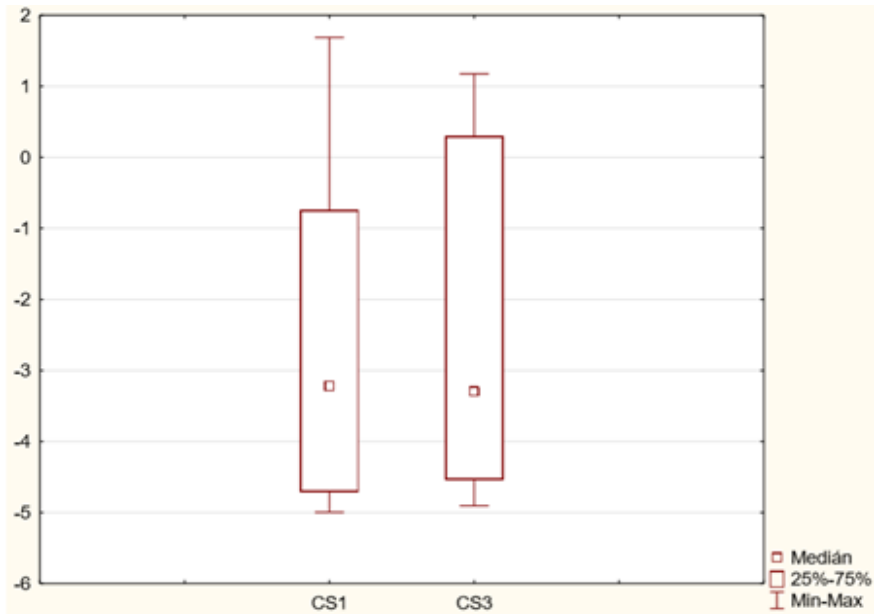
We didn't reject null hypotheses of equality of mean values – effect is not statistically significant.



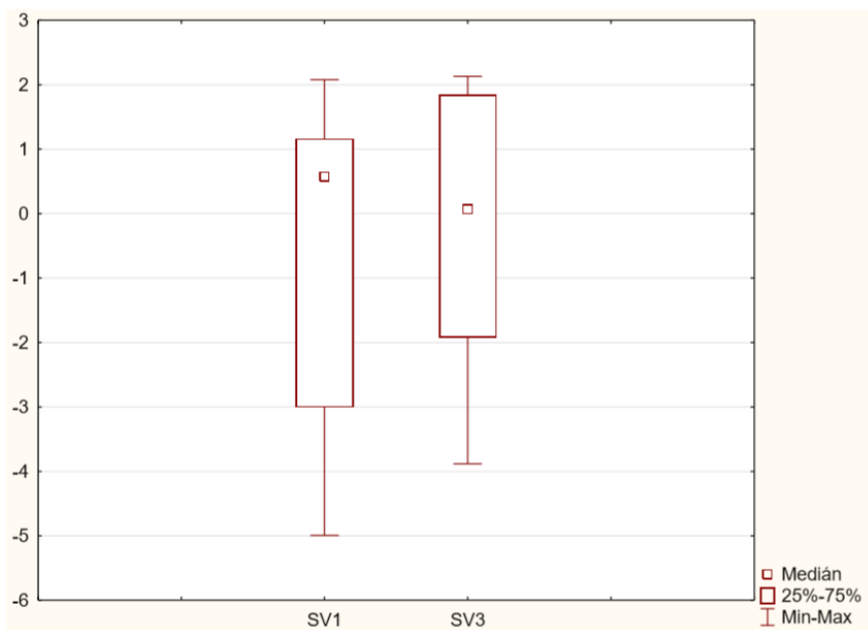
Box-plot n. 1 – Total score EG (author)



Box-plot n. 2 – S-V balance EG (author)



Box-plot n. 3 - Total score CG (author)



Box-plot n. 4 - S-V balance CG (author)

Box-plot n.1 – Total score EG: Values of Total score in the experimental group. CS1 – Total score before the respiratory intervention, CS2 – Total score between the respiratory and the physical intervention, CS3 – Total score after the physical intervention

Box-plot n.2 – S-V balance EG: Values of S-V balance in the experimental group. SV1 – S-V balance before the respiratory intervention, SV2 – S-V balance between the respiratory and the physical intervention, SV3 – S-V balance after the physical intervention

Box-plot n.3 – Total score CG: Values of Total score in the control group. CS1 – Total score at the first testing, CS3 – Total score at the second testing

Box-plot n.2 – S-V balance CG: Values of S-V balance in the control group. SV1 – S-V balance at the first testing, SV3 – S-V balance at the second testing

DISCUSSION

In years 2017 and 2018 were connected 30 participants (16 women and 14 men) ranging in age $53,74 \pm 14,76$ years from Internal Hematology and Oncology Clinic of The University Hospital Brno. From all participants were 21 with non-Hodgkin lymphoma and 9 with Hodgkin lymphoma. In experimental group were included 17 participants and 13 were included in control group. Respiration programme finished 17 participants, but whole interventional programme completed only 13 participants. 3 participants did not finish physical programme because of time or health complications, 1 participant weren't measured after interventional programme because he was on holiday in this time. In control group were measured 13 participants at the first time, but second testing absolved only 8 participants. Reasons were for example relapse of disease, move out of Brno or lose interest in research.

Results did not show statistically significant effect of intervention in experimental group and no statistically significant difference between measurements in control group. For verification will be preferable larger file of participants. The biggest problem in physical training was in attendance, which was influence by in two cases by long-term illness, in one case by departure to a health resort or complexly by irregular participation of physical training. These gaps between trainings could cause why didn't be statistically significant effect of intervention. Reason would be big age variance of group or very difference values of selected parameters before interventional programme too. Another reason could be fact, that physical intervention was only 12 weeks, for better answer of training would be preferable longer time. At the end I think that better would be measurement of heart rate variability more often, for example continual every day at home too. Single measurement can be influence by actual condition of organism and stress.

However, in absolute result was improvement in S-V balance parameter in the experimental group.

Compared with other authors we can see that physical activity can have positive influence on heart rate variability in cancer patients. For example, the study from Niederer et al (2013) which showed significantly difference between non-intervention and intervention post treatment in heart rate variability parameter Total Power follow-up score (2.0 ± 0.5 vs. 2.6 ± 0.5 logms²) (9)

CONCLUSION

The aim of this research was determined the effect of respiratory intervention for twelve weeks and physical intervention for twelve weeks on selected parameters of heart rate variability in hematooncological patients after treatment. Respiration training and physical activity can be very beneficial for patients with oncological disease and physical activity should have place in oncologic treatment. In this research was showed improvement in complex indices of heart rate variability S-V balance parameter, but it wasn't statistically significant effect of intervention.

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