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Short communication

Short-term whole body vibration exercise in adult healthy horses

B. Carstanjen[1,2], M. Balali[3], Z. Gajewski[1], K. Furmanczyk[4], A. Bondzio[5], B. Remy[6], H. Hartmann[3]

[1] Department of Large Animal Diseases, Warsaw University of Life Sciences, Poland
[2] Equine Clinic, Freie Universitat Berlin, Germany
[3] Department of Physiology, Freie Universität Berlin, Germany
[4] Department of Applied Mathematics, Warsaw University of Life Sciences, Poland
[5] Department of Biochemistry, Freie Universität Berlin, Germany
[6] GIGA, University of Liège, Belgium

Abstract

The purpose of this study was to analyze the acute effect of whole body vibration exercise (WBVE) on clinical parameters and blood values in horses. Seven horses were exposed to a 10 min WBVE at a frequency of 15-21 Hz. Clinical parameters and venous blood samples were taken before and directly after WBVE. Acute short-term WBVE produced a decrease in serum cortisol ($p=0.02$) and creatine-kinase ($p=0.02$) values. Clinical parameters, hematology, fibrinogen, lactate, IGF-I, GGT, creatinine, myeloperoxidase activity and bone marker values were not significantly changed by WBVE. In adult sound horses WBVE was well tolerated and did not cause any sign of measured discomfort.

Key words: horse, vibration exercise, cortisol, creatine kinase, bone

Introduction

Mechanical vibration applied as an alternative to exercise is of increasing interest. The effect of whole body vibration exercise (WBVE) on vital parameters, muscle and bone has been investigated and it has been widely suggested that WBVE might be an alternative to resistance training for stimulation of the musculoskeletal system. Furthermore, non-pharmacological therapies are interesting alternatives for the treatment of various diseases, e.g. osteoporosis. Aim of this preliminary study was to analyze the acute effect of WBVE on clinical parameters and blood values in horses.

Materials and Methods

Seven sound adult horses (four geldings, three mares), aged 8 to 27 years (14 ± 5.9 yr) were box-rested 18 h before starting WBVE with a Marquis® VMS device (Marquis® Tiermedizin GmbH, Germany). For WBVE the horses were standing on four separate platforms, which independently

Correspondence to: to B. Carstanjen: e-mail: bcarstanjen@web.de

performed horizontal and vertical vibrations at a frequency of 15 to 21 Hz. Horses were subjected to a defined vibration-profile of 10min duration. Heart- and respiratory rate was measured by auscultation. All parameters were assessed and recorded directly before (T_0) and immediately after WBVE (T_{10min}). Venous blood samples were obtained by aseptic puncture of the jugular vein at T_0 and T_{10min}, between 9:00am and 11:30am to avoid possible circadian variations. Blood samples were taken into serum, EDTA-K, natrium-fluorid and lithium heparin tubes. Serum samples were centrifuged within 5 min at 4000 U/min for 10 min at 4°C. The serum to be used for myeloperoxidase activity (MPOa), insulin-like--growth-factor-I (IGF-I), osteocalcin (OC) and carboxyterminal crosslinking telopeptid of type-I-collagen (CTX-I) determination was stored in aliquots of 0.5 mL at -21°C until assayed. Plasma was analyzed for hematology, lactate and fibrinogen values. Blood gas analysis was performed directly after blood sampling to obtain values of pH, pCO_2, BE and HCO_3. Serum samples were analyzed for total protein, electrolytes (P, Na^+, Cl^-, K^+), cortisol, creatinin, γ-glutamyl-transferase (GGT) and creatine kinase (CK). Serum IGF-I quantification was performed using an ELISA (IGF-I, Techomedical, Germany). Serum MPOa was measured according to Fietz (2008). Serum OC was measured with an equine specific in house osteocalcin radioimmunoassay (Carstanjen et al. 2003) and serum CTX-I with an automated electrochemiluminescent-sandwich--antibody-assay (Elecsysβ-CrossLaps/ serum assay, Roche Diagnostics GmbH, Germany). Statistical analysis was performed using R-language (R Development Core Team 2007, http://www.r-project.org). Before the paired t-test was applied, variables were tested for normal distribution with the Shapiro-Wilk test and for homogeneity of variances with the F test. Whenever a normal distribution was evaluated and the homogeneity of variances (p-values >0.05), differences were tested with the paired t-test. In all other cases, the Wilcoxon test for paired samples was used. Significance level was set at $p<0.05$.

Results and Discussion

Acute short-term WBVE produced a decrease in serum cortisol ($p=0.02$) and CK ($p=0.02$) values. Mean serum cortisol values were at T_0 37 ± 7 nmol/L and at T_1 33 ± 8 nmol/L. Mean serum CK values were at T_0 3.08 ± 0.55 U/L and at T_1 2.94 ± 0.47 U/L. Parameters such as plasma lactate and fibrinogen remained unchanged ($p>0.05$). Furthermore, short-term WBVE did not influence clinical parameters, hematology, further biochemical parameters, MPOa or IGF-I values. WBVE had no influence on serum OC and CTX-I concentrations ($p>0.05$).

The endocrine system plays a major role in determining a response to exercise. Parameters such as cortisol, testosterone and growth hormone (GH) have a high attention due to their effects on muscle and bone (Kanter et al. 1988, Dovio et al. 2010). These hormones are furthermore used to determine the physiological stress (eustress) imposed during exercise sessions. Moderate to high intensity WBVE caused an increase in serum cortisol values; in contrast, low intensity WBVE was associated with a decrease in blood cortisol levels (Davies and Few 1973, Elmantaser et al. 2012), as shown in this study. The corticosteroid hormone action in peripheral tissue is partially determined through the activation of two iso-enzymes, which inter-convert hormonally active cortisol and inactive cortisone (Stewart et al. 2001). During intense exercise there is an increased conversion of cortisone to cortisol through 11β-hydroxysteroid dehydrogenases (11β-HSD) activity (Dovio et al. 2010) whereas low intensity exercise produces a reduction in blood cortisol levels (Davies and Few 1973). Factors, such as an exercise intensity dependent increase in GH concentrations might explain decreased cortisol values through a GH dependent inhibition of the isoenzyme 11β-HSD-1 (Elmantaser et al. 2012). Furthermore, in this study a circadian pattern associated decrease in serum cortisol values can be excluded because of the standardized blood-sampling protocol and the short period of 10min between both blood samples. Exercise and moderate to high intensity WBVE are associated with an increase of CK and lactate values (Kanter et al. 1988). In this study, short term WBVE did not influence plasma lactate values and showed a reduction in serum CK values. A study comparing pre-exercise warm-up procedures with and without WBVE revealed lower post-exercise serum CK values in athletes using WBVE for warm-up (Aminian-Far et al. 2011). In this study, clinical parameters, blood gas, hematology and proteins were unchanged by WBVE. In addition, serum MPOa, a marker for neutrophil activation and degranulation, which is increased by strenuous exercise, was unaffected by WBVE. It can be concluded that in this study WBVE did not cause any measurable discomfort. WBVE has been reported to be osteogenic. In this study no effect of WBVE on osteoblast or osteoclast activity was measured, possibly due to the low intensity exercise and the short blood sampling interval. In summary, a 10 min WBVE at 15-21 Hz was well tolerated in adult sound horses and did not cause any sign of measured

discomfort. Because of the small size of the sample and the short duration of this study, further investigations are needed with larger study populations, different WBVE profiles and specific indications.

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