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Applicability of Whole-Body Vibration Exercises as a new tool in Veterinary Medicine

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Abstract

Whole body vibration (WBV) is generated by devices which produce oscillations - vibratory platforms. Several benefits of the use of vibrating platforms have been described, such as increase of muscle strength, improvement of exercise performance and improvement of balance and functional mobility. Although WBVE has been studied and used in many applications in human subjects, there are only a few studies published about whole-body vibration as a therapeutic modality in animals. The present review aimed to summarize the findings of original articles about the effects of WBVE on animals. Veterinary Medicine articles published in international journals were selected, and small animals, large animals, and wild animals were included. Few studies related to WBVE were identified, and fewer publications still about wild animals. The use of wrong vibration parameters, including vibration intensity, exposure time, amplitude, and acceleration also causes adverse effects in animals. More studies are needed to determine an adequate protocol and the efficacy of whole body vibration in each species, as well as to explore other therapeutic applications.

Keywords: Vibrating platform; Mechanic vibrations; Veterinary.

Resumo

Aplicabilidade dos Exercícios de Vibração de Corpo Inteiro como nova ferramenta da Medicina Veterinária

As vibrações de corpo inteiro são geradas por dispositivos capazes de gerar oscilações - plataformas vibratórias. Diversos benefícios do uso de plataformas vibratórias têm sido descritos, como aumento da força muscular, melhora do desempenho físico e melhora do equilíbrio e da mobilidade funcional. A vibração de corpo inteiro tem sido estudada e usada em muitas aplicações em seres humanos, existindo apenas alguns estudos publicados sobre vibração de corpo inteiro como modalidade terapêutica em animais. A presente revisão teve como objetivo resumir os resultados de artigos originais que investigaram os efeitos da vibração de corpo inteiro em animais. Foram utilizados artigos publicados em revistas internacionais em Medicina Veterinária, e foram incluídos pequenos animais, animais de grande porte e animais silvestres. Poucos estudos relacionados ao uso da vibração de corpo inteiro foram identificados e as publicações sobre animais silvestres foram escassas. O uso de parâmetros de vibração errados, incluindo a intensidade de vibração, tempo de exposição, amplitude e aceleração, também causa efeitos adversos em animais. Mais estudos são necessários para determinar um protocolo adequado e a eficácia da vibração de corpo inteiro em cada espécie, como também para explorar outras aplicações terapêuticas.

Descritores: Plataforma vibratória; Vibrações mecânicas; Veterinária.

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Resumen

Aplicabilidad de los Ejercicios de Vibración de Cuerpo Entero como nueva herramienta de la Medicina Veterinaria

La vibración de todo el cuerpo es generada por dispositivos que producen oscilaciones - plataformas vibratorias. Se han descrito varios beneficios del uso de plataformas vibratorias, como el aumento de la fuerza muscular, la mejora del rendimiento del ejercicio y la mejora del equilibrio y la movilidad funcional. La vibración de todo el cuerpo ha sido estudiado y utilizado en muchas aplicaciones en sujetos humanos, solo hay unos pocos estudios publicados con vibración de todo el cuerpo como modalidad terapéutica en animales. La presente revisión tuvo como objetivo resumir los hallazgos de artículos originales que investigan los efectos de la vibración de todo el cuerpo en animales. Se utilizaron artículos publicados por revistas internacionales en un área específica - Medicina Veterinaria, y se incluyeron animales pequeños, animales grandes y animales salvajes. Se identificaron pocos estudios relacionados con el ejercicio de WBVE, y bajas publicaciones en animales salvajes. El uso de parámetros de vibración incorrectos, incluyendo la intensidad de la vibración, el tiempo de exposición, la amplitud y la aceleración, también causa efectos adversos en los animales. Más estudios son necesarios

para determinar un protocolo adecuado y la eficacia de la vibración de todo el cuerpo en cada especie, así como para explorar otras aplicaciones terapéuticas.

Palabras clave: Plataforma vibratoria; Vibraciones mecánicas; Veterinaria.

Introduction

Whole body vibration (WBV) has been studied for a few decades. In 1970's the National Institute of Occupational Safety and Health in the USA identified some of the types of WBV and found in several work situations potential health and safety implications of industrial vibration exposure.[1] In the following decades many studies have been done to understand the effects of WBV.[2-6] And it was especially during the 2000's that therapeutic benefits of whole body vibration exercises (WBVE) started to be researched.

Several different benefits of the use of vibrating platforms have been described, such as improvement of exercise performance,[7,8] an increase in muscle strength,[5,9,10] and improvements in balance and functional mobility.[11,12] Review papers and systematic reviews with or without meta-analyses have been used to compare WBVE studies and suggest the best protocols to achieve different benefit to each patient.[13-16] Although WBVE has been studied and used in many applications in human subjects, there are only a few studies published with whole-body vibration as a therapeutic modality in animals. The present review aims to summarize the findings of original articles that investigate effects of WBVE on animals.

There are three main types of oscillating vibrating platforms that allow the transmission of these mechanical vibrations. They differ according to the movement of their base, which may have alternating or vertical displacement (synchronous or triplanar). In addition, in order to establish the intervention protocol through mechanical vibrations, it is necessary to understand all variables, such as physical parameters, exposure time, and position on the oscillating vibrating platform.

Whole-body vibration exercise in animals

A study with seven healthy adult horses conducted by Carstanjen and others analysed the effects of WBVE on clinical parameters and blood values after a single WBVE session (Table 1).[17] Heart and respiratory rate were measured by auscultation and venous blood samples were obtained before and immediately after the WBVE session. A statically significance decrease in serum cortisol and creatine kinase values were observed, which may relate to a low-stress condition and low intensity exercise response, respectively. A 10 minutes WBVE session was well tolerated in adult horses and did not cause any sign of measured discomfort.

Another study evaluated the renal resistivity index

Table 1. Overview of Whole-Body Vibration studies in healthy animals

Study	Subjects	Duration	Parameters	Study design
Carstanjen et al.[17]	7 healthy adult horses, 4 geldings, 3 mares, age range from 8-27 years	Single session (10 minutes)	15 to 21Hz, for 10 minutes	Horses were standingstood on four separate platforms; heart and respiratory rate wereas measured and blood samples were collected before and immediately after a WBVE session.
Freire et al.[18]	10 intact healthy dogs, 6 males and 4 females, age range from 1.7-3.5 years and weight range from 20.5-41 kg; Dog breeds were Pit Bull (n = 5), Labrador retriever (n = 3), Rottweiler (n=1) and one crossbreed	Single session (15 minutes)	30 Hz for 5 min, followed by 50 Hz for 5 min and finishing with 30 Hz for 5 min; velocity from 12-40 ms-2 and amplitude varied 1.7-2.5 mm	Dog were placed at the center of the vibrating platform standing on all four feet; ultrasound exams were performed before and immediately after the WBVE platform session.
Santos et al.[19]	10 healthy intact Beagle dogs, 3 females and 7 males, age range from 2-4 years old and body mass range from 10.1-17.9 kg	5 days (15 minutes/day)	30 Hz for 5 min, followed by 50 Hz for 5 min and finishing with 30 Hz for 5 min; velocity from 12-40 ms-2 and amplitude varied 1.7-2.5 mm	Dog were placed at the center of the vibrating platform standing on all four feet; blood samples were collected before, immediately after, 1 h and 6 h after the end of each session, and 24 h and 48 h after the last WBVE session.

in 10 healthy dogs after a single WBVE session (table 1) was performed by Freire and colleagues.[18] Ultrasound exams were performed to identify and evaluate each kidney and the renal vascular tree before and immediately after the vibration session. No significant differences were observed between the resistivity index values obtained before and immediately after the session, suggesting that WBVE single session does not alter the renal resistivity index.

A recent study that subjected 10 healthy Beagle dogs to a WBVE protocol of 15 minutes session per day during 5 consecutive days (table 1) was conducted by Santos and others.[19] Blood samples were collected from each dog once before and 3 times after each session, and also 24 and 48 hours after the last WBVE session. Hemogram and serum biochemistry were analyzed for each blood sample and results showed all haematological and serum biochemical values within the reference range. Results from this study suggest that daily sessions of 30 Hz followed by 50 Hz and finishing with 30 Hz for 5 minutes each during 5 consecutive days of WBVE do not cause adverse effects on haematology and serum biochemistry.

Whole-body vibration exercise as therapeutic modality for animals

Whole-body vibration was described as an adjuvant in the postoperative physiotherapy protocol in a calf.[20] A six-week-old female calf was diagnosed with deformation of the right forelimb associated with supernumerary digits (Table 2). The calf was submitted to surgical removal of both supplementary distal digits and rehabilitation starting 21 days after surgery with WBVE using a vibrating platform daily at 15 to 21 Hz, for 10 minutes.

Prior to surgery the right forelimb showed a hyperflexion of the fetlock and carpal joints and weight bearing on the dorsal aspect of the fetlock joint. The removal of both additional digits allowed full weight-bearing and full extension of the affected limb, and the carpus valgus formation, which was improved during the rehabilitation phase.

Long-term and immediate effects of WBVE were assessed in eight horses with chronic lameness (table 2).[21] Horses were submitted to a WBVE session of 30 minutes twice a day, five days per week, during 60 days. Lameness was evaluated subjectively by a veterinarian and objectively by using a lameness locator (computer system). Long-term evaluations were made at days 0, 30 and 60 of WBVE sessions and immediate evaluations at day 30, 35, 55 and 60 immediate before and within 30 min after the WBVE sessions. Horses with primary forelimb lameness show a significant improvement in long-term evaluations after the first 30 days and a significant worsening after the second 30 days. The immediate effect of WBVE showed a significant worsening in forelimbs lameness and no statistically significant difference in lameness in hindlimbs.

A study performed by Santos and colleagues with 12 penguins evaluated the effects of WBVE training in healthy penguins and penguins with bumblefoot (table 2).[22] Penguins were submitted to a single 15 minutes session of WBVE, which was divided in three moments of five minutes. The temperature of penguins' feet was measured with an infrared thermography camera before and after each moment of the session. An increase in temperature in the plantar surface of the feet was observed, and penguins with bumblefoot did not presented a significant increase in temperature.

Effects of WBVE sessions were shown on the multifidus muscle in nine horses with clinical signs of back pain associated with lameness.[23] WBVE protocol was 30 minutes, twice a day, five days a week for 60 days. Lameness was subjectively evaluated by a veterinarian and ultrasound images were used to measure the cross-section area of the multifidus muscle, captured at days 0, 30 and 60 of treatment. A significant increase of the total (left and right) cross-section area and an improvement in symmetry of the multifidus muscle were observed after WBVE sessions.

WBVE as described as an adjuvant therapy in a case of metritis in a dog (Table 2).[24] A two-years-old female American Pitt Bull terrier was diagnosed with metritis.Physical and complementary examination detected a slight vulvar edema, an enlarged uterus with hypoechoic luminal content on ultrasound exam, and no significant alterations at blood exams. A single session of WBVE exercise was performed, and after 6 minutes a purulent vulvar discharge was observed and remained throughout the session. Ultrasound and blood exams after 7 days showed no sign of abnormalities.

Discussion

Use of WBVE as a therapeutic modality has been studied for the past 20 years in human patients. Therefore why not apply this modality also to animals? A few studies have shown that WBVE between 10 to 15 minutes/session and frequencies from 15 to 50 Hz have no deleterious effects in renal resistive index in dogs

and haematological and biochemistry parameters in dogs and horses.[17-19] More studies are necessary to assure safety parameters for the use of WBVE in animals; nevertheless these results are important to guide future studies. Therapeutic effects of WBVE in animals have been shown in a few papers. Some positive effects have been reported, such as improvement in the conditions of lame horses and of a calf treated up to 30 days with WBVE.[20,21] Additionally, a significant outcome in muscle symmetry and hypertrophy was observed in horses with back pain.[23] Positive outcomes of WBVE as a therapeutic adjuvant or modality in animals have been promising, warranting further study. On the other hand, WBVE may provide no benefits or negative effects, as observed in two studies on immediate effects of WBVE sessions which presented no significance difference in hindlimb of lame horses and in temperature of the feet of penguins with bumblefoot.[21,22] In addition, a significant worsening was observed in forelimb lameness in horses immediately after sessions and after 60 days of WBVE.[19] Therefore, caution is essential, for the wrong WBVE protocol may cause adverse effects.

Final considerations

WBVE provides benefits to animals as well as to human patients. However, the use of wrong vibration parameters also causes adverse effects in animals. Therefore, more studies are required to determine the effectiveness and safety of WBVE protocols in each species and to explore other therapeutic applications.

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Table 2. Overview of Whole-Body Vibration studies as a therapeutic modality in domestic animals.

Study	Subjects	Duration	Parameters	Study design
Carstanjen et al.[20]	A 6-week-old female German Holstein-Friesian calf, weighting 67 kg, with deformation of the right forelimb associated with two supernumerary digits	–	15 to 21Hz, for 10 minutes	Calf had the supernumerary digits surgically removed; rehabilitation started 21 days after surgery, including passive manipulation of the limb, the application of dorsal claw extensions, walking exercise and WBVE sessions.- training
Halsberghe[21]	8 adult horses, age range from 6.7-15.4 years; horses breeds were Warmblood geldings (n=4), Irish sport horse geldings (n=2),Thoroughbred gelding (n=1), and Thoroughbred mare (n=1)	60 days (30 minutes/2x per day) 5 days per week	40 Hz for 30 minutes; amplitude of 0.8 millimeter, and an acceleration of 4.9 m/s2 (0.5 g)	A hay net was provide to keep horses occupied; lameness was evaluated subjectively by a veterinarian using a lameness scale and objectively lameness by using a real-time handheld computer system using body-mounted inertial sensors (lameness locator)
Santos et al.[22]	12 captive adult magellanic penguins (Spheniscus magellanicus), weighting from 2.52-3.88 kg	Single session (15 minutes)	20 Hz for 3 moments of 5 minutes; velocity and amplitude varied from 12-40 m secG2 and 1.7-2.5 mm, respectively	Pinguins were kept inside a plastic box placed over the platform; infrared thermography was performed before and after each moment of WBVE training (0, 5, 10 and 15 minutes of session)
Halsberghe et al.[23]	9 adult horses, age range from 6.0-14.4 years; horses breeds were Warmblood geldings (n=5), Irish sport horse geldings (n=2),Thoroughbred (one gelding and one mare)	60 days (30 minutes/2x per day) 5 days per week	40 Hz for 30 minutes; amplitude of 0.8 millimeter, and an acceleration of 4.9 m/s2 (0.5 g)	Lameness was evaluated subjectively by a veterinarian using a lameness scale and ultrasound images of the m. multifidus were captured and used to measure the cross-section area.
Santos et al.[24]	A 2-year-old, intact female American Pit Bull Terrier dog, weighting 32 kg, with slight vulvar edema	Single session (15 minutes)	30 Hz for 5 min, followed by 50 Hz for 5 min and finishing with 30 Hz for 5 min; velocity from 12-40 ms-2 and amplitude varied 1.7-2.5 mm	A purulent vulvar discharge was observed 6 min following the exposure to WBVE and remained continuous throughout the session; antibiotic therapy was prescribed for 15 days.

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