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Hypothalamic-pituitary-adrenal axis responses of horses to therapeutic riding program: Effects of different riders

Esterina Fazio *, Pietro Medica, Cristina Cravana, Adriana Ferlazzo

Department of Veterinary Sciences, Unit of Veterinary Physiology, University of Messina, Polo Universitario Annunziata, 98168 Messina, Italy

HIGHLIGHTS

- HPA axis response was evaluated in therapeutic and recreational riding.
- HPA axis response was less responsive to disabled riders than to healthy ones.
- Cortisol was one of the indicators of HPA axis stress response.
- On riders affected by psycho-motor disabilities levels of cortisol decrease.

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ABSTRACT

In order to determine whether therapeutic riding could result in higher levels of stress than recreational riding, hypothalamic-pituitary-adrenal (HPA) axis response was evaluated in six horses by monitoring circulating β-endorphin, ACTH and cortisol concentrations. Horses were already accustomed to be trained both for therapy and riding school activity since 2004. Intervention consisted of 60-minute therapeutic sessions, two times per week for 6 weeks with different riders: disabled and recreational riders (session A and B respectively). The therapeutic riders' group (A) consisted of six children with psychomotor disabilities; the recreational riders' group (B) consisted of six healthy children without any previous horse riding experience. Horses were asked to perform the same gaits and exercises at all sessions, both with disabled and healthy users.
The statistical analysis showed that during both sessions the mean basal β-endorphin and ACTH levels of horses did not show any significant changes, while the one way RM-ANOVA showed significant effects of sessions A on the cortisol ($F = 11.50$; $P < 0.01$) levels. Horses submitted to sessions A showed lower cortisol levels both at 5 min ($P < 0.001$) and at 30 min ($P < 0.005$) after therapeutic sessions than those after session B. Results suggest that in tested horses and for the variables settled, HPA axis was less responsive to disabled than healthy, recreational riders. Among the endocrine responses, cortisol was one of the indicators of HPA axis stress response.

1. Introduction

Hippotherapy (HPOT) and therapeutic riding (TR) are two different practical approaches of Equine Assisted Activities and Therapy (EAAT). EAA use the horses in recreational and visitation programs. Therefore, specific treatment goals are not planned and the visit content is spontaneous. EAT is a goal-directed intervention in which the horses that meets specific criteria is an integral part of the treatment process. EAT is directed and/or delivered by a health/human service professional with specialised expertise [1–3]. HPOT is frequently used to achieve physical goals, but it also affects psychological, cognitive, social, behavioural and communicative outcomes [4,5]. Evidence has begun to accumulate, as illustrated by two systematic reviews [6,7] which demonstrated clinically the beneficial effects of hippotherapy on children suffering from cerebral palsy, and concluded that hippotherapy is a promising intervention.

TR is a special training program in which persons with disabilities (physical, mental and psychological impairments) learn horsemanship skill, in order to pursue a therapy, education, sport, recreation and leisure experience [8]. This is a type of equine-assisted therapy that requires riders to learn the basics to lead a horse in hand and control her/his mount, with the long term goal of independent riding if it is possible [9,10]. Additional benefits are: motivation, bonding and communication between horse and rider [11]. Therapeutic riding incorporates grooming and caring of horse, recreation on horseback and riding and social interaction to promote a broad range of skill development.

The discriminating sensitivity of HPA axis to emotional values of the adverse environmental stimuli justifies the use of HPA hormone

* Corresponding author. Tel.: +39 90 3503583; fax: +39 90 3503975.
E-mail addresses: fazio@unime.it (E. Fazio), pmedica@unime.it (P. Medica), ccravana@unime.it (C. Cravana), ferlazzo@unime.it (A. Ferlazzo).

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analysis in the monitoring of animal welfare [12,13]. Selye [14] was the first to introduce the concept of stress and activation of the HPA axis in response to an aversive situation. Moreover, physical exercise is a physiological challenge that induces threshold- and intensity-dependent HPA axis response. In athletic horses, the secretion of β-endorphin, ACTH and cortisol is exclusively or partially dependent on type, intensity and duration of exercise [15] as well as on individual fitness [16].

Despite remarkable amount of papers about the therapeutic horseback riding wishing to analyse the therapeutic effects on human health, still very few studies focused on the impact of these activities on horses and their welfare. In the past, health, conformation, quality of gait and temperament have been the main psychophysical conditions analysed in order to choose animals suitable for therapeutic riding program (TR program) [17]. Thus, relatively little research has been done on how objectively to define standard criteria and suitability useful to select, train and maintain horses specifically for EAT [18], although behavioural, neuroendocrine and functional assessment of horses in TR programs have been partially done [17,19].

On this basis, the aim of this research was to investigate HPA axis response in horses by monitoring the circulating β-endorphin, ACTH and cortisol and check if any different kind of rider, namely psychomotor patients or healthy children.

2. Material and methods

This study was performed according to the guideline of the Italian Ministry of Health, and was formally approved by Ethological Committee of the Faculty. Informed consent was obtained from the subjects and/or their parents.

2.1. Therapeutic riding horses

Six Italian Saddle female horses, with a mean age of 18 years (range 17–19), mean weight of 475 kg (range 452–498) were recruited from riding school "Conca d'Oro" with owners consent and on the basis of their same level of therapeutic and riding school experience. The horses were trained and used for therapeutic riding, twice a week, and for riding school activities, three times a week.

Horses were subjected to the same type of management, were kept in individual boxes (4 m × 4 m) with natural lighting, at an outdoor temperature of 18–20 °C and a relative humidity of 55%, allowing reciprocal visual contact and with access to a sand outdoor paddock 2 to 3 h per day.

A diet consisting of grass hay (~10–12 kg/horse) and a commercially pelleted grain mix (~4 kg/horse) was fed and split into two feedings given at 7.30 and 18.00 h. A mineralised salt block and fresh water were available *ad libitum*.

Horses had no history of medical problems in the preceding six months, had not received any pharmacological treatment for two weeks prior to the study and were considered to be clinically healthy by the referring veterinarian.

The arena surface was flat and covered with grass. Conditions were dry and sunny and the mean ambient temperature was 20 °C (range 18 °C–22 °C).

2.2. Riders

A group of 12 children composed of five males and seven females, aged between 10 and12 years took part in this study. Group A riders, (mean age 11 years and 8 months, mean body weight 48.35 kg, mean height 1.48 m), were six paediatric patients with psychomotor disabilities as well as general diseases of growth, childhood autism, Rett's and Asperger's syndromes. Group *B* riders, (mean age 11 years and 3 months, mean body weight 46.76 kg, mean height 1.46 m), were six healthy able bodied children without any previous experience of horses. In order to evaluate the individual response, each horse was challenged two times a week with alternately two group-A-riders and two group-B-riders, for six consecutive weeks.

2.3. Intervention

The intervention team for each session consisted of a professional horseman and two licensed therapists. Each rider regardless the group, rode the assigned horse by taking three different positions (face forward, side-sitting, face backward) and perform activities on the moving horse. These exercises were performed as the horse was led in a slow, steady walk with the rider responding to the three dimensional movements of the horse. Each session lasted approximately 60 min, during which children rode the horse for about 30 min, while, for the remaining time after session, they lead their horse to the tacking area and learned skills of grooming and un-tacking.

Each horse followed the same routine both for group A and group B. The horse was led with a rope around the enclosed arena at walking pace until the rider decides to take the reins. Each horse was alternatively submitted to session A and B, on a total of two sessions per week. Exercise consisted of walking, with short starting and stopping periods. Every session was carried out inside an enclosed arena (30 m wide × 70 m long) and all doors leading into the arena were closed.

2.4. Hormone analysis

Blood samples were collected from jugular vein by indwelling catheter, prior the session, at 09.00 a.m., and at 5 and 30 min after each session. For the cortisol measurement blood was collected into vacuum Na-heparinate containing tubes. Within 30 min samples were centrifuged at 1600 rpm for 15 min, and plasma was transferred to plastic vials and kept stored at −20 °C until analysis, which was normally done within a month.

For the lactate determination 20 μl of blood was transferred as soon as possible after collection into vials with 200 μl ice-cold 0.6 n perchloric acid. Samples were centrifuged for 5 min by 12,000 rpm and the supernatant transferred to empty vials and stored at 4 °C until analysis, normally within one day.

The blood lactate analysis was done using an enzymatic test kit (Behring, OSUA 40). The coefficient of variation for this enzymatic method was 7.5% at a lactate concentration of 2.15 mmol/L (Precipath® Boehringer Mannheim) and 3.7% at 4.4 mmol/L (SIGMA lactate).

Plasma β-endorphin concentrations were measured in duplicate, using a commercial radioimmunoassay (RIA) kit (Peninsula Lab., Inc., Belmont, CA, USA) for human β-endorphin, which has a 100% cross-reactivity with equine β-endorphin [20]. The hormone assay used has a range for the amount of β-endorphin detected of 1 to 128 μL (3–371 pmol/L). The intra- and interassay coefficients of variation (CVs) were 7% and 15%, respectively.

After centrifugation, serum ACTH concentrations were analysed in duplicate using a commercially available radioimmunoassay kit (ELSA-ACTH, CIS-BioInternational, Gif-sur-Yvette, France) suitable for equine use [21]. The hormone assay used has a range for the amount of ACTH detected of 0 to 440 pmol/L. The intra- and interassay CVs were 6% and 15%, respectively.

Plasma total cortisol concentrations were analysed in duplicate through a competitive enzyme assay (EIA, RADIM). The assay sensitivity was 5 ng/ml. The intra- and inter-assay coefficients of variation (CVs) were 5.5% and 6.8%, respectively.

2.5. HR and lactate measurement

Heart rate and blood lactate measurement were constantly monitored in order to set the appropriate conditions for the exercise performed. HR was measured by Polar Equine Heart Rate Monitor S-610 (Polar Electro Europe BV), and it was always less than 70 beats per minute. Blood