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Changes in cortisol release and heart rate and heart rate variability during the initial training of 3-year-old sport horses

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ABSTRACT

Based on cortisol release, a variety of situations to which domestic horses are exposed have been classified as stressors but studies on the stress during equestrian training are limited. In the present study, Warmblood stallions ($n = 9$) and mares ($n = 7$) were followed through a 9 respective 12-week initial training program in order to determine potentially stressful training steps. Salivary cortisol concentrations, beat-to-beat (RR) interval and heart rate variability (HRV) were determined. The HRV variables standard deviation of the RR interval (SDRR), RMSSD (root mean square of successive RR differences) and the geometric means standard deviation 1 (SD1) and 2 (SD2) were calculated. Nearly each training unit was associated with an increase in salivary cortisol concentrations ($p<0.01$). Cortisol release varied between training units and occasionally was more pronounced in mares than in stallions ($p<0.05$). The RR interval decreased slightly in response to lunging before mounting of the rider. A pronounced decrease occurred when the rider was mounting, but before the horse showed physical activity ($p<0.001$). The HRV variables SDRR, RMSSD and SD1 decreased in response to training and lowest values were reached during mounting of a rider ($p<0.001$). Thereafter RR interval and HRV variables increased again. In contrast, SD2 increased with the beginning of lunging ($p<0.05$) and no changes in response to mounting were detectable. In conclusion, initial training is a stressor for horses. The most pronounced reaction occurred in response to mounting by a rider, a situation resembling a potentially lethal threat under natural conditions.

Introduction

Domestic animals are exposed to a variety of anthropogenic stressors. Interactions between humans and horses have developed over millennia. They are probably more intricate than with any animal species and go far beyond the animals' natural behavioral repertoire. Until the early 20th century, effective interactions between horse and rider have been considered both an art and a military necessity. Riding has always been also a leisure activity and today equestrian sports are a growing recreational activity in many countries. While research in equine exercise physiology has developed science-based programs to improve the physical fitness of equine athletes (Hinchcliff et al., 2008) with regard to the teaching of horses, the theories of classical equitation (e.g. De la Guérinière, 1733; Podhajsky, 1965) so far have not been supplemented to a larger extent by scientific studies. Modern equestrian sports have been criticized for training methods not acceptable under animal welfare aspects. However, scientific studies on the stress experienced by horses during initial equestrian training are limited.

Based on increases in cortisol release, a variety of situations to which domestic horses are regularly exposed have been classified as potential stressors. This includes physical training (Snow and Rose, 1981; Marc et al., 2000), equestrian competitions (Dybdal et al., 1980; Lange et al., 1997; Cayado et al., 2006), transport (Baucus et al., 1990; Clark et al., 1993; Schmidt et al., 2010a; Schmidt et al., 2010b), veterinary examinations (Berghold et al., 2007) and exposure to a new group (Alexander and Irvine, 1998). During short-term stress, glucocorticoids enhance energy mobilisation (Raynaert et al., 1976) and may change behavior (Korte, 2001). While in most studies, cortisol concentrations were determined in plasma, recently techniques to analyse cortisol in equine saliva have been established, avoiding the need of repeated venipuncture (Schmidt et al., 2010a, Schmidt et al., 2010b).

Additional parameters for stress determination are heart rate and heart rate variability. Heart rate variability (HRV), i.e. short-term fluctuations in beat-to-beat (RR) interval, reflects the balance of sympathetic and parasympathetic tone and provides information on the stress response of the autonomic nervous system. Increases in the values of the HRV variables standard deviation of RR interval (SDRR) and root mean square of successive RR differences (RMSSD) reflect a

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