ORIGINAL RESEARCH

The Effects of Loose Group versus Individual Stall Transport on Glucocorticosteriods and Dehydroepiandrosterone in Yearling Horses

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ABSTRACT

The European Union recently published regulations regarding the welfare of horses during transport, requiring that horses be transported in individual stalls. The objective of this study was to determine whether concentrations of cortisol, corticosterone, or dehydroepiandrosterone (DHEA) differed among horses transported in individual stalls versus in loose groups. A total of 20 yearlings that were regularly handled and accustomed to being tied, but were naïve to transport, were assigned to be transported for 6 hours in either individual stalls or a loose group. The experiment was replicated with a second trial 35 days later following a switchback design. Jugular blood samples were analyzed for plasma cortisol, corticosterone, and DHEA concentrations at pretransport, after 2, 4, and 6 hours of transport, and at 2 and 4 hours after unloading. The data were analyzed using a mixed model repeated measures analysis of variance for treatment effects, whereas differences between sample times within each trial, and pretransport concentrations between trials, were analyzed using paired *T*-tests. No significant differences were found between treatment groups in concentrations of cortisol ($P = .713$), corticosterone ($P = .370$), or DHEA ($P = .416$). Cortisol and corticosterone concentrations increased significantly during transport, and returned to pretransport concentrations by 2 hours post-transport ($P < .01$). Changes in concentrations of cortisol and corticosterone indicated that transportation was a significant stressor; however, being transported in a loose group versus individual stalls was not different for these horses.

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INTRODUCTION

Regulation of the transport of horses for slaughter for human consumption in the United States is detailed in Chapter 88 of 9 Code of Federal Regulations (CFR), and is directed toward the group transport of commercial horses. Specifically, the Code bans the transport of commercial horses in double-deck trailers, which is common in the transport of other livestock species.[1] It also details requirements for supplying adequate quality feed and potable water to horses within a minimum of 6 hours of transport, segregating stallions and other aggressive animals during transport, and ensuring adequate floor space for each animal. A recent set of regulations for horse transport is the European Union's Council Regulation (EC) No. 1/2005, which mandates that all nonregistered horses should be transported in single deck trailers with a minimum of 75 cm of clearance above the withers and must be offered food and water every 8 hours during transport. The maximum transport period is 24 hours, and during long journeys, the horses are to be stalled individually unless they have a foal. Stalls must be constructed of adjustable partitions, and each horse should be provided with a space of 1 to 1.75 m^2, depending on age.[2]

The basis for the European Union requiring that each horse be stalled individually is unclear. Horses are a very social species, and isolating them into individual stalls during a stressful event, such as transport, may have an additive effect on the overall stress of the animals if they are not accustomed to being restrained in stalls. In a 2002 study, researchers reported that horses that were cross-tied in individual stalls during transport showed greater stress, including higher cortisol concentrations, and took longer to return to pretransport conditions than loose horses when transported for 24 hours.[3] However, restricting the space in which a group of horses are contained can cause the social structure of a herd to become unstable, thereby resulting in conflicts.[4] In addition, studies on the optimal density for the transport of loose groups of horses[5-7] and

cattle[8,9] indicate that lower density is preferable. Decreasing the amount of space that horses have in a loose group during transport prevents them from shifting to compensate for changes in speed and direction.[10] Horses transported at a higher density were more likely to fall or be injured, and had a decreased likelihood of rising to their feet after falling.[7] Ability of a horse to balance during transport is central to its behavior while in transit and may contribute to the amount of stress experienced by the animal.

Several physiological indicators of stress have been used to identify and study transport stress in horses, with heart rates[11-14] and cortisol concentrations[3,6,11,14-17] having been most commonly used in recent studies. Plasma cortisol and corticosterone are known to increase in animals at the onset of a stressor, and stimulate gluconeogenesis to release energy stores that the animal can use to resist the stressor. However, long-term exposure to stressors, causing an extended elevation of the glucocorticoid response, can have a detrimental immunologic effect and cause the animal to become more susceptible to disease.[18]

In addition to glucocorticoids, dehydroepiandrosterone (DHEA), a neurosteroid, has recently been studied in the field of stress research and psychological disorders. Differences in DHEA and cortisol concentrations have been found between psychologically healthy patients and those diagnosed with chronic fatigue syndrome (CFS),[19] post-traumatic stress disorder (PTSD),[20] schizophrenia,[21] attention-deficit hyperactivity disorder,[22] and major depression.[23] Similar to cortisol, DHEA secretion is initiated by adrenocorticotropic hormone (ACTH); however, several studies suggest that differences exist in the amount of time that DHEA and cortisol take to return to normal concentrations after the onset of an acute stressor or ACTH challenge, depending on the overall stress of the individual. A significant difference in DHEA: cortisol ratio over time was found between patients diagnosed with CFS and healthy control patients, where the ratio for CFS patients was significantly higher over time than control patients when administered the same dosage of ACTH.[19] Conversely, schizophrenic patients were found to have higher cortisol:DHEA ratios than healthy patients under normal day-to-day conditions.[21] Also, veterans with PTSD were found to have significantly higher DHEA concentrations than veteran patients without PTSD.[20] However, patients with major depression showed significantly lower DHEA concentrations than healthy patients during normal activity over a 4-day period.[23] These studies indicate that although DHEA may be lower during nonstressful activity in afflicted patients versus healthy patients, there may be a link between long-term stress disorders and elevated concentrations of DHEA or DHEA:cortisol ratios during a stressful event.

The objectives of this study were to determine whether young horses that underwent extensive handling but had not been transported show differences in glucocorticoids and DHEA when transported for 6 hours in individual stalls versus being transported in loose groups.

MATERIALS AND METHODS

A total of 20 yearling Quarter Horse mares (n = 9) and geldings (n = 11) that had regular handling and training experience, but no previous transport experience, were used. All the horses simultaneously participated in a nutrition study on the influence of dietary supplements on the incidence of gastric ulcers. All horses received 1.25% of body weight of grain and 1% of body weight of hay, with seven horses receiving a sulfated form of a trace mineral, six receiving a proteinated form of the same trace mineral, and the remaining seven receiving no supplement to their daily grain and hay diet. During feeding periods, horses were placed in assigned feeding stalls, and between feeding periods, the horses were housed in outside group paddocks adjacent to the feeding barn. Group paddocks were assigned by feed treatments, such that all horses within a feed treatment shared an assigned paddock throughout the study. Horses were exercised 3 days per week for 20 minutes per day and were accustomed to being individually tied. Each of the horses were assigned with a temperament score on a 1-5 scale, with 1 being least excitable and 5 being most excitable, about daily activities and exposure to new experiences. The scores were based on the experiences and interactions of a primary caretaker with each animal over the past year, and were relative to the scores of the other horses in the study.

The horses were assigned to be transported in either individual stalls or loose groups for 6 hours. Gender was balanced, and temperament scores and dietary supplementation were equally represented in both treatments. Using a switchback design, the treatments were reversed during a second trial. To make sure the horses would safely walk up the loading ramp into the trailer and accept being stalled, each horse was individually walked into the trailer, held for <1 minute in a stall, and then exited the trailer 2 days before the start of trial 1. Each trial was completed over a 2-day period. The first trial was conducted in July and the second in August, with 35-day interval between trials. Five horses from each treatment group (stalled vs. loose group) were transported on the first day and the remaining five horses in each treatment group were transported on the second day. The horses were transported in a custom-built $16.2 \times 2.4 \times 2.62$ m^3 (length, width, height, respectively), single-deck, slat-sided trailer (Barrett Trailers, Purcell, Oklahoma) pulled by a semi-tractor. The trailer was divided into three sections as follows: individual stalls, a loose group compartment, and a small staging area for sample collection in the center (Fig. 1). Five individual stalls were constructed by diagonal placement of