



Cortisol release, heart rate, and heart rate variability in transport-naive horses during repeated road transport

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Abstract

Domestic animals are often repeatedly exposed to the same anthropogenic stressors. Based on cortisol secretion and heart rate, it has been demonstrated that transport is stressful for horses, but so far, changes in this stress response with repeated road transport have not been reported. We determined salivary cortisol concentrations, fecal cortisol metabolites, cardiac beat-to-beat (RR) interval, and heart rate variability (HRV) in transport-naive horses (N = 8) transported 4 times over a standardized course of 200 km. Immunoreactive salivary cortisol concentrations always increased in response to transport ($P < 0.001$), but cortisol release decreased stepwise with each transport ($P < 0.05$). Concentrations of fecal cortisol metabolites increased from 55.1 ± 4.6 ng/g before the first transport to 161 ± 17 ng/g the morning after ($P < 0.001$). Subsequent transport did not cause further increases in fecal cortisol metabolites. In response to the first transport, mean RR interval decreased with loading of the horses and further with the onset of transport (1551 ± 23 , 1304 ± 166 , and 1101 ± 123 msec 1 d before, immediately preceding, and after 60–90 min of transport, respectively; $P < 0.05$). Decreases in RR interval during subsequent transports became less pronounced ($P < 0.001$). Transport was associated with a short rise in the HRV variable standard deviation 2 ($P < 0.001$ except transport 1), indicating sympathetic activation. No consistent changes were found for other HRV variables. In conclusion, a transport-induced stress response in horses decreased with repeated transport, indicating that animals habituated to the situation, but an increased cortisol secretion remained detectable.

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1. Introduction

Companion animals are increasingly exposed to anthropogenic stressors that are unlikely to occur in the natural surroundings of a species. The animals often have to adapt to situations or tasks they would naturally avoid. Transport is a potential stressor in most large domestic animals. The horse is a species that has been transported for centuries, first by ship and by train, and

today mainly by road, but also by air. Based on increased cortisol secretion and changes in heart rate and heart rate variability (HRV), it has been clearly demonstrated that transport is stressful for horses [1–13]. Cortisol may improve the animals' stress response by energy mobilization and behavioral changes [14,15]. HRV, that is, short-term fluctuations in heart rate, reflects the balance of sympathetic and parasympathetic tone and is used as an indicator for the stress response of the autonomic nervous system. In general, increases in the values of the HRV variables standard deviation of beat-to-beat (RR) interval (SDRR) and root mean square of successive RR differences (RMSSD) reflect a shift

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