Some Aspects of the Stress Responses to Road Transport in Thoroughbred Horses with Special Reference to Shipping Fever

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We performed two sets of experiments consisting of 36 hr and 41 hr of transportation to elucidate the road transit-induced stress response’s profiles in horses with clinical signs of respiratory disease (“affected” horses) and horses without clinical signs of respiratory disease (“unaffected” horses). In both sets of experiments, “affected” horses showed a significantly greater increase or decrease in levels of the indices of the stress response, i.e., eosinophil count, erythrocyte sedimentation rate, levels of serum glucose, adrenocorticotropic hormone (ACTH) and 11-hydroxycorticosterone (11-OHCS) than “unaffected” horses after road transportation. Compared with “unaffected” horses, “affected” horses had a different pattern of changes in indices of the stress response, suggesting that they failed to adapt to transportation.

Key words: horse, respiratory disease, road transport, stress response

It is well known that an increased incidence of the respiratory disease (so-called “shipping fever”) follows prolonged transport [3]. Four hypotheses on the pathogenesis of this respiratory disease are pertinent here: One is that pre-existing mild airway infections can turn into pneumonia when horses are subjected to transportation [8]. Second, exposure to noxious gases or large amounts of airborne irritant in the vehicle may contribute to development of disease [2, 6]. Third, transport may impair pulmonary defense mechanisms [9]. Finally, restraint of horses with their heads in an elevated position during transport may result in increased entry of pharyngeal secretions into the lower respiratory tract, thus inducing pneumonia [7]. Regardless of these hypotheses, the role and influence of transport stress in the development of this disease and the disease process itself are still not completely understood. In a previous report, we demonstrated by pathomorphological examination that acute pneumonic lesions would be a manifestation of the disease, rather than a cause, and we also revealed some of the clinical features of the disease [5]. The role of the hypothalamic-adrenal cortex axis, as a general adaptive mechanism, responsive to a wide variety of stress, is now well known. Most of the researchers adopted the blood levels of adrenocorticotropic hormone (ACTH), cortisol and glucose, and hematological changes as the indices of stress.

To further clarify the pathology of the disease we here describe some aspects of biological response to transit-stress that were not described in our previous study [5]. Details of the experimental horses used and the methods of transport are described in the above article. The criteria used to define transit-related respiratory disease were a rectal temperature of >38.6°C, coughing, nasal discharge, and lethargy during transport [5]. Only horses with a rectal temperature in excess of 38.6°C were considered to be affected, regardless of whether the other criteria were present or absent. Blood samples were collected before, immediately after, and 24 hr after the end of the transport. Whole blood samples were tested immediately after blood collection, and the remaining samples were frozen at –70°C until assessment at a later time. As the indices of stress, the number of peripheral blood eosinophils and the concentration of serum glucose were determined by Hitachi automatic analyzer (Model 747, Hitachi High-Technologies Co., Minato-ku, Tokyo, Japan). Erythrocyte sedimentation rate was...
measured by the Westergren method (40 min). The concentration of plasma 11-hydroxycorticosteroid (11-OHCS) was determined by a method described previously [1]. Plasma ACTH was measured by radioimmunoassay as described previously [4].

**Experiment 1**

We investigated the effects of a 36-hr road transport journey on the levels of indices of the stress response, i.e., peripheral eosinophil count and erythrocyte sedimentation rate in 29 Thoroughbred horses aged 23 to 27 months [5]. The blood test results in horses with clinical signs of respiratory disease (“affected” horses) or without clinical signs of respiratory disease (“unaffected” horses) were compared before and after transport by using t-tests. The level of significance was set at \( p < 0.05 \).

Affected horses showed a significantly greater increase or decrease in eosinophil count and erythrocyte sedimentation rate than unaffected horses after transportation (Fig. 1). There were significant intergroup differences in these 2 items after transport (Fig. 1).

**Experiment 2**

To obtain more detailed analyses of changes in various indices of stress response during transport, we monitored the 4 parameters (Fig. 2) every 6 hr during a 41-hr road transport journey in 8 Thoroughbred horses aged 27 to 29 months [5]. Levels of ACTH and 11-OHCS in the unaffected horses rapidly increased and peaked at 5 hr after departure; they then gradually declined to reach baseline levels by 41 hr (Fig. 2). In contrast, affected horses tended to have peak levels of ACTH and 11-OHCS upon development of fever and at the end of the transport, but not at 5 hr after departure (Fig. 2). The eosinophil count decreased from the beginning of transport in both groups (Fig. 2). In unaffected horses it tended to return to the baseline level after reaching a minimum value at 17 hr (Fig. 2), but in affected horses it remained constantly low throughout the transportation period (Fig. 2). Blood glucose gradually increased from the early stages of transport in both groups, and this increase was much greater in affected horses (Fig. 2).

In Experiment 1, affected horses showed a significantly greater decrease or increase in eosinophil levels and erythrocyte sedimentation rate than did unaffected horses, suggesting that these horses had been exposed to stronger stress by whatever cause. In other words, greater stress could be a cause of greater susceptibility to transit-related respiratory disease. Experiment 2 demonstrated that levels of ACTH and 11-OHCS-indices of the stress response-peak 5 hr after departure in unaffected horses in Experiment 2, indicating that the horses were under the highest stress...
during the early periods of transport. In other words, these responses during the early periods of transport suggest that the animals were thought to be in a startle reaction with fear and anxiety to the unfamiliar environment, indicating the participation of sensory-neurological pathway. These parameters then began to decrease; therefore we suggest that these horses adapted to their environment as the journey continued. However, affected horses had different patterns of change in ACTH and 11-OHCS, both of
which rose again upon development of fever.

The data presented here from Experiment 2 are based on relatively small group size (n=3 for affected and n=5 for unaffected horses) and it is therefore difficult to determine the significance of intergroup changes. In addition, no account has been taken of potential diurnal variation in ACTH and 11-OHCS concentrations. However, we assumed from the result that possible associations of the development of transit-related respiratory disease with failure to adapt to transportation by undetermined causes. Further studies were required to evaluate the validity of the assumption described above.

References