

The HORSEREPORT

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Dedicated to the health, well-being, performance, and veterinary care of horses through research and education.

School of Veterinary Medicine

Transporting Horses: Minimizing the *STRESS*

For horses that breed, show, or compete in athletic events, transport may be a necessary and frequent part of life. Although some horses adapt well to transport, others do not, and being moved from one place to another can be highly stressful for them. Factors in the transport that contribute to stress include *physical factors* such as confinement, withholding of food and/or water, the motion of the trailer, noise, and road conditions; *psychological stressors* such as separation from the herd and exposure to unfamiliar environments or animals; *climatic factors* such as air temperature and humidity; and the *health status* of the horse.

Horses stressed by transport are more susceptible to a variety of diseases, particularly pneumonia, colic, diarrhea, and laminitis (founder, or inflammation of the hoof). They may also suffer minor or acute injuries incurred during transport. Additionally, the stress of transport may alter energy metabolism, which may affect the horse's



Thanks to K.C. Horse Transport, Inc. for providing a photo model.

ability to perform an athletic endeavor soon after transport. For all of these reasons, it is important for the horse's welfare to minimize the stress of transport.

Few studies on the effects of long-distance transportation of horses have been done; yet, there have been numerous research studies reported on post-transit respiratory diseases in horses. To gain more insight into the physical

responses of horses during transport, Dr. Carolyn Stull from the UC Davis Center for Equine Health, and Dr. Anne Rodiek from California State University-Fresno, teamed up to study the physiology of horses both during transport and recovery. The study was conducted using a commercial equine van that traveled the interstate highways of

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DIRECTOR'S MESSAGE

On Transporting Our Equine Companions



Dr. Gregory L. Ferraro

The relationship between humans and horses continues to grow and expand. Horse enthusiasts continue to find new and unique activities and athletic endeavors in which to participate. Each of these new pursuits will, over time, draw participants from an ever-widening geographical area. Combined with an already healthy array of traditional horse-and-rider activities, one can easily understand why the appearance of horse vans, trailers, and other conveyances has become so commonplace on our highways.

Each equestrian demonstration or competition requires the transport of large numbers of horses from outlying areas to a central location and then back home again. Horse lovers spend countless hours practicing and preparing these athletic events, but little time thinking about the effect of transport on the performance of their companions. Thousands of horse trailers, vans, and other conveyances are manufactured and sold every year, yet relatively little effort has gone in to determining the optimal means of conveyance for horses. The design of most horse transport vehicles has been dictated by tradition and economic forces of the marketplace. Many of them emphasize conveniences and amenities designed to please the human counterpart of the team.

The fact of the matter is that we, as owners and team partners of our horses, could be criticized for not spending sufficient time or effort in analyzing the effect of transport on horses. Factors that influence the health and welfare of horses during the often long hours of transport have not been properly studied or understood. The method of transport has been taken by many as a given that has rarely been questioned. Consequently, we have often had to face the unpleasant realities of poor perfor-

scientifically to determine what factors influence health maintenance and potential athletic performance. Moreover, the configuration of traditional equine conveyances has been investigated and compared with an eye toward improving design for the overall health benefit of the horses.

What follows in this issue of our *Horse Report* are some of the initial findings from this research initiative. We hope that it provides you with at least some minimal information with

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Researchers at the UC Davis Center for Equine Health have recently sought to correct this situation by conducting several pioneering studies on the effect of transport on horses. The physiological effects of transport have been measured

which you can improve your horses' well-being. Much more research in this area needs to be done, however, and so our studies will continue. It is our hope that through ongoing public support we can continue to increase our knowledge and provide sound recommendations regarding equine transport in the future.



Transporting Horses

Continued from page 1

central California under typical summer conditions. The study subjects were 15 mature, healthy horses that were experienced travelers. Their physiological responses were documented during 24 hours of road transport, followed by a 24-hour recovery period during which horses rested in their individual stalls. It was important to study the recovery period to obtain information on how quickly the physiological responses return to pretransit or baseline values. Here are some of the findings.

General health. Body weight, rectal temperature, and white blood cell count (WBC) were measured as general indicators of health and the ability of the horses to handle the heat of the summer during transport. The horses generally lost about 6% of body weight, possibly due to heat dissipation, sweat loss, and decreased gut fill during transit, but they recovered half of their weight loss 24 hours after transit. This may support the notion that horses respond to heat stress during transit through respiration and sweating mechanisms.

Dehydration. Hematocrit and total protein concentration are often used as indicators of dehydration in horses. These measurements also showed differences (increases) during transit, with a return to baseline values during the post-transit period, indicating some dehydration had occurred. Interestingly, during the last 12 hours of transport when the hematocrit levels peaked, the horses had consumed 91% of the water offered.

Muscle fatigue. Minimal muscular fatigue was found in the horses during the transit period, as indicated by the measurement of lactate. However, two serum enzymes with high activity in skeletal muscle and evaluated clinically in horses with muscular diseases are CPK and AST. In this study, CPK was slightly elevated after transport, and AST rose in response to transport and returned to baseline within 24 hours



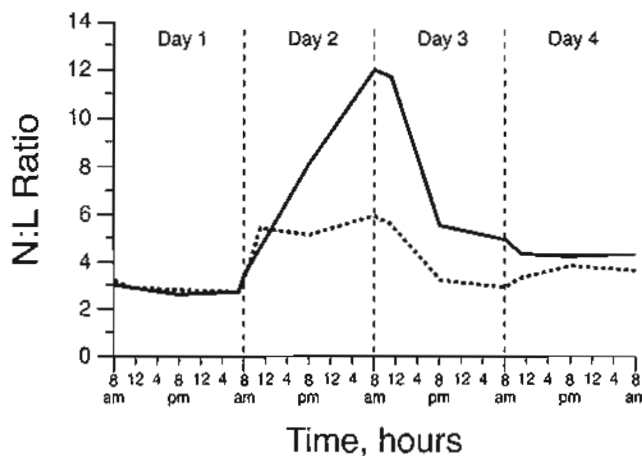
When providing feed for horses during transport, make sure it is quality hay with minimal dust and mold.

after transport.

Stress. During stressful situations such as exercise or transport, activation of the hypothalamic-pituitary-adrenal axis results in an increased concentration of the hormone cortisol in blood circulation. The concentration of cortisol in these horses increased during loading and continued to rise throughout the 24-hour transit period, peaking at the termination of transit. After unloading, the stress of transportation ceased and cortisol concentration dramatically decreased. This large increase of cortisol during transport influences the immune system, and its influence can be measured by the ratio of two

types of white blood cells, namely the neutrophil:lymphocyte (N:L) ratio. This ratio also increased during transit and did not return to baseline within the 24-hour recovery period. This continued elevation in the N:L ratio may contribute to disease susceptibility following long-term transport.

Horses in this study that underwent 24 hours of transport in hot, summer conditions clearly showed physical responses that included changes in stress measures, serum metabolites, dehydration and immune indicators, body weight, and rectal temperatures. To minimize the stress of transport on horses, see the recommended guidelines (p. 5).



Graph showing the neutrophil:lymphocyte (N:L) ratio. This ratio increased during transit and did not return to baseline within the 24-hour recovery period. Continued elevation in the N:L ratio may contribute to disease susceptibility following long-term transport.

How Cross-Tying During Transport Affects Horses

Transportation stress has long been thought to predispose horses to respiratory disease. The stress response during transport causes changes in serum cortisol concentrations, heart rate, immune parameters, and serum muscle enzyme activities. Another variable in the transport of horses—cross-tying—has been the subject of concern to UC Davis Center for Equine Health researchers. While cross-tying horses individually in stalls is common practice for transporting show and race horses, horses also travel in small groups or individually without being restricted by tying.

Dr. Carolyn Stull and Dr. Anne Rodiek recently conducted a study to examine the specific physiological responses of horses during transport to either cross-tying or traveling loose. They found that the cross-tied horses had larger increases of selected stress parameters 24 hours following transport than did horses traveling without being tied. In particular, they found that levels of serum cortisol, which is secreted during stressful situations, were greater in the cross-tied horses, although the levels returned to normal following transport. Cortisol also affects other physiological responses, such as the neutrophil:lymphocyte (N:L) ratio, which may be a more reliable indicator of chronic stress than cortisol. A substantial increase in N:L ratio was seen in the cross-tied horses compared with the loose horses. Neutrophilia, indicated by an increased N:L ratio, has been associated with respiratory disease in horses following long-term road transport.

Other studies have found that elevation of the horse's head, which

restricts the range of neck movements, compromises the immune system and increases the number of bacteria in transtracheal aspirates. The increase in bacteria is thought to be the result of a decrease in clearance rate of the bacteria from the tracheobronchial secretions in horses that are confined and unable to lower their heads. This information suggests that the practice of cross-tying may, along with other

factors, predispose horses to respiratory disorders following transport. It also leads to further questions on the athletic potential and disease susceptibility of the horse during the recovery period and post-transit complications from other stressors such as social stress, thermal stress, and housing or pathogen challenges.

In view of these findings, Dr. Stull and Dr. Rodiek recommend that a small box stall is preferable to cross-tying during long-distance road transport. "If you have to use cross ties or a trailer design that keeps horses' heads elevated,



If cross-ties must be used in the transport of horses, unload the horses every 6 to 8 hours to let them move around, graze and rest.

unload every six to eight hours to let them move around, graze and rest," advises Dr. Stull. And if you use a commercial carrier to ship a horse across the country, "pay the extra amount to get a box stall. It will be worth it when your horse arrives less stressed and ready to compete."



HELPFUL TIPS

Recommendations for Minimizing the Stress of Transport

- ☉ Start with a healthy horse! Horses with subclinical or clinical respiratory disease should avoid transport except in emergency situations. Consult a veterinarian with these cases prior to shipping.
- ☉ During long-term transport (greater than 6 to 8 hours), do not elevate or restrict the movement of the head and neck by cross-tying. A small box stall that allows the horse to drop its head is preferred for minimizing stress and susceptibility to disease after transport.
- ☉ Dietary adjustments are not necessary in horses shipped short distances. Horses intended to endure long transportation schedules should be provided with feed and water on a regular schedule. Laxatives such as bran mashes may not be necessary. Some nervous horses may develop loose manure or diarrhea and become dehydrated from the loss of fluids.
- ☉ If you provide hay to your horse during transport, make sure it is quality hay with minimal dust and mold.
- ☉ Water should be offered every 6 to 8 hours if possible. However, many horses may not drink during transit.
- ☉ Relative humidity and environmental temperature rise quickly in stationary closed vehicles. Horses should be unloaded upon arrival or during stops to minimize thermal stress, especially during summer.
- ☉ Respiratory ailments such as shipping fever and pneumonia may not show symptoms for 2 to 3 days following transport. However, depression in the attitude of the horse, lack of appetite, and the development of coughing or nasal discharge may be signs of shipping fever. Death within 30 days following transport due to pneumonia has been reported in horses transported over durations of 8 to 43 hours. Daily recording of rectal temperature is advisable. A veterinarian should be consulted for horses exhibiting any of these signs.



Development of a Method to Detect Stress in Horses During Road Transport

One of the most common problems associated with transporting horses by road in a trailer or van is the development of respiratory disease ("shipping fever") during or shortly after the trip. The disease ranges from mild subclinical forms to severe pneumonia that is fatal. One of the primary factors thought to be associated with the development of this disease is suppression of the horse's immune system due to stress experienced during the trip. The immune system normally plays a major role in fighting off infection; however, some of the hormones released during periods of stress can suppress the immune response and make it easier for an infection to overwhelm the horse.

Researchers in Dr. James H. Jones' laboratory at UC Davis have conducted a number of studies in the past to assess how changing different components in horse trailers, e.g., how the horse is oriented or the design of the suspension or ventilation systems, affects the quality of the transport environment and the amount of stress experienced by a horse. A major problem in such studies is the fact that the main hormone released in response to stress, cortisol, is somewhat variable between individual animals and can be slow to respond to a specific stressful incident. This can decrease the sensitivity in detecting and quantifying the amount of stress experienced by a horse during a period of road transport using changes in the concentration of cortisol in the blood.

Dr. Jones has been working with a group of research veterinar-

ian collaborators in the Japan Racing Association (JRA) and the University of Tokyo to develop a new technique that might be sensitive and relatively simple to use as a means of quantifying relative amounts of stress that a horse experiences while riding in a trailer. The method they have been investigating measures changes in heart rate variability (HRV) over periods of time. Heart rate variability refers to small but regular changes in an animal's heart rate that take place over periods of a few seconds to minutes at a time. These changes occur in all animals, but whether the variation in rate tends to occur faster or slower depends in large part on how active certain unconscious parts of the animal's nervous system (sympathetic vs. parasympathetic) are at any given time. Because stress tends to increase the amount of sympathetic nervous activity,

measures of HRV associated with increased sympathetic nervous response might be expected to increase in conjunction with road transport and could be useful indicators of stress.

To test this hypothesis, the researchers measured changes in HRV patterns when horses were at rest in their stalls vs. when they were transported in a small horse van from the northern Japanese island of Hokkaido to the JRA's Equine Research Institute near Tokyo on the island of Honshu, a trip of 21 hours that covered 800 miles plus a 4-hour ferry ride. The horses wore portable recorders that measured their electrocardiograms (ECG) continuously, and the recordings were then analyzed by computer to determine how the HRV changed over time. The results showed dramatic differences in HRV patterns between rest and transport.



Preparing the horse with ECG electrodes.

Although the HR was overall higher in the horses when they were transported than when they were in their stalls, as would be expected, there were periods of time in which HR was the same or even slightly higher in the stalls. Based on HR alone, it is possible to conclude—erroneously—that the horses were less stressed during transport. However, when the measurements of HRV were evaluated, they showed a completely different pattern *at all times* during transport, clearly demonstrating that the horses were more stressed than when they were in their stalls, even when HR values were the same.

The results of this study suggest that HRV may be a dramatically more sensitive indicator of stress in horses than HR alone, and that this method might be refined as a means for researchers to evaluate whether experimental changes made in the transport environment lower the level of stress experienced by a horse. This technique may also be adapted in the future to enable horse owners to monitor the degree of stress their horse experiences at a given time without the need for collecting blood samples and waiting for laboratory analyses.



Connecting the Holter monitor that records the ECG for up to 24 hours.



The special blanket covering the electrodes, with a pocket to hold the monitor.



In the stall wearing the monitor and blanket.



Japan Racing Association van in which the horses were transported for 21 hours.

Dollars for Davis Benefit Ride a Giant Success

On Sunday, August 10, a group of about 50 people gathered together in the Moraga hills near Lafayette to hit the trails with their four-legged friends. This equestrian event has been held every year since 1992 and has raised over \$34,000 in proceeds benefiting the UC Davis Center for Equine Health. After a 6-mile trail ride over moderate to steep terrain, the group sat down to enjoy lunch and a presentation by CEH's Dr. Gary Magdesian, who described the different research studies currently being conducted at UC Davis and answered questions about West Nile virus and about horses in general. There was also an optional competition and an opportunity to win ribbons! Not only has the



CEH staff enjoyed participating in the benefit ride.

annual Dollars for Davis event been great fun for horse lovers, it has made a significant contribution to the welfare of horses through

research funding and dissemination of information. We hope next year's event will draw an even bigger crowd.



The Dollars for Davis benefit ride provided a day of enjoyment for all those who attended, while benefiting the Center for Equine Health.

SUCCESS STORY

Mule Rescue Led by Dr. John Madigan

Amidst the more routine life-saving activities of veterinarians at the UC Davis School of Veterinary Medicine, an occasional extraordinary situation arises that calls for extreme team effort, as well as the use of a helicopter. On August 8, a mule from the Pine Creek Pack Station fell about 100 feet off a trail near Bishop, California, injuring her leg and pelvis. The mule was treated while emergency rescue from the UC Davis School of Veterinary Medicine was awaited. The rescue involved five members from the UC Davis Veterinary Emergency Rescue Team led by Dr. John Madigan and including Dr. Larry Galuppo, Allen Page, Richard Morgan, and veterinary student James McKasson. The team flew to Bishop on an airplane chartered from Woodland Aviation and paid for by the pack station, carrying with them a specialized frame and sling with which to carry out the mule's rescue. Also joining the effort was Bishop-area veterinarian Dr. David Doonan. As the photo illustrates, this tremendous effort was quite successful and the



Rescue of the mule that had fallen about 100 feet off a trail near Bishop, California.

mule is now recovering from its injuries.

To support these kinds of activities, the Center for Equine Health has established an Animal Rescue and Disaster Medicine Endowment. This endowment will enable veterinarians to develop improved techniques for the rescue of animals during natural disasters. The

fund also supports research into various medical conditions of these afflicted animals and the development of improved treatment regimens. Contributions to support this endeavor are always needed and may be forwarded to the Center for Equine Health, earmarked for the Animal Rescue and Disaster Medicine Endowment.



Certificate of Recognition Presented to Linda Starkman Burke



The UC Davis Center for Equine Health and School of Veterinary Medicine presented a Certificate of Recognition to Linda Starkman Burke for her outstanding dedication to the welfare of the sport horse. Ms. Burke has been an ambassador for the Center for Equine Health since 1995, providing significant leadership, guidance, and service in support of its research and educational mission. She has also been a tireless advocate on behalf of the School of Veterinary Medicine.

In addition to the Certificate of Recognition, the Center will present an annual research grant award in her name to a faculty member.

Ms. Burke has been involved with her own hunters and jumpers for many years. In addition to being a model citizen of California's equine industry, she is a registered nurse and mother of three and rides every day on a paint horse called "Joey, the Devil." Our deepest appreciation to Linda Burke.

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Dr. Julie Baumber Wins the 2003 Wilson Award



This year's James M. Wilson Award was presented to Dr. Julie Baumber for her work on the effects of reactive oxygen species on equine sperm.

The Wilson Award is given each year to the most outstanding equine research publication authored by a graduate academic student or resident in the UC Davis School of Veterinary Medicine. Dr. Baumber's publication, "Reactive Oxygen Species and Cryopreservation Promote Deoxyribonucleic Acid (DNA) Damage in Equine Spermatozoa," was honored with the Wilson Award.

The use of frozen semen in the equine industry has increased in recent years. However, the fertility of frozen semen is not as good as natural service, and there is a significant variation among stallions in the "freezability" of their semen. Reactive oxygen species (ROS) are highly reactive metabolites of oxygen that are generated during cell metabolism. These metabolites are toxic to cell

function, although they are usually counteracted by cellular antioxidants. If ROS generation exceeds the antioxidant capacity, oxidative stress ensues. Previous research has shown that equine sperm can generate ROS independently from cell metabolism, and that ROS generation is increased by abnormal cells and those damaged by freeze-thawing. Furthermore, semen preparation for freezing involves the removal of seminal plasma, the predominant source of antioxidant protection. As a result, freezing may subject equine sperm to oxidative stress.

By studying the physiological changes occurring in equine sperm during the freeze-thaw process, Dr. Baumber's research objectives are to (1) minimize the adverse effects currently observed in frozen equine sperm, and (2) improve the fertility of frozen-thawed equine sperm. Future research will be directed at gaining a better understanding of how reactive oxygen species are involved in freeze-thaw damage and to determine if antioxidant addition to the freezing extender can improve semen quality after thawing.

Dr. Baumber received a BSc in physiology (1997) from the University of Sheffield, UK, an MSc in equine science (1999) from the University of Wales in Aberystwyth, and a PhD in comparative pathology (June 2003) from UC Davis. She is currently working as a post-doctoral fellow in the UC Davis School of Veterinary Medicine.

Sara Thomasy Wins the Rowan Fellowship

Sara Thomasy, a second-year veterinary student, has been selected to receive the Louis R. Rowan Fellowship this year. The fellowship provides a \$5,000 cash award for a veterinarian pursuing a PhD in an equine-related medical science at the UC Davis School of Veterinary Medicine.

The Center for Equine Health's Director nominates candidates to the California Thoroughbred Foundation (CTF) Board of Trustees, who then selects the award recipient. This fellowship was established by the CTF in honor of its cofounder, Louis R. Rowan. A well-known California breeder who raced Thoroughbred horses throughout the United States, Louis Rowan was one of the founding directors for the Oak Tree Racing Association and a well-respected and progressive horseman.

Ms. Thomasy is a graduate student in the UC Davis School of Veterinary Medicine, concurrently pursuing both a DVM and a PhD in pharmacology and toxicology. She expects to receive her veterinary degree in the spring of 2005. She is currently studying the pharmacodynamics and metabolism of transdermal fentanyl in Dr. Scott Stanley's laboratory. Upon completion of her degrees, she plans to continue with equine pharmacology research.

Her current research focuses on the study of opioids in the horse. Currently, there is a limited selection of pain medications for the horse, especially for use in chronic or postoperative pain. One of the most effective analgesic classes, the opioids, has not been used exten-



sively in the horse, as it has been for the relief of pain in humans, because of the traditional belief that they produce unacceptable levels of central nervous system stimulation and gastrointestinal tract inhibition at high doses. Because of this belief, veterinarians have been hindered in their ability to provide adequate analgesia to horses in severe, chronic pain. Recently, clinicians have begun to re-evaluate the use of fentanyl in horses using a transdermal therapeutic system. Ms. Thomasy's research objective is to investigate how opioids cause CNS excitation in the horse and to study the analgesic efficacy of transdermal fentanyl.

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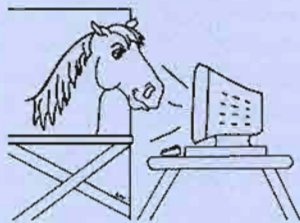
COMING EVENTS

Horse Day**October 11-12, 2003**

The UC Davis Department of Animal Science will hold its Eighteenth Annual Horse Day Symposium on Saturday and Sunday, October 11-12. Saturday's program will feature speakers on such topics as vaccinations, nutritional supplements, getting your horse out of a jam, shoeing for crooked legs, genetics, and veterinary medicine in the wilderness. A farrier workshop will be held on Sunday.

Registration for October 11 includes all course materials and refreshments. Pre-registration (before October 1) is \$25. A box

lunch is available for \$6.75. For the Sunday farrier workshop, registration fee is \$50 for lectures in the morning, or \$150 for lectures and afternoon lab. Registration for Horse Day at the door is \$40; however, lunch will not be available for purchase. Following the lecture program on Saturday, a demonstration on training the weanling will be presented at the Animal Science Horse Barn Arena. Alternatively, a tour is available of the Veterinary Medicine Teaching Hospital. For more information, contact the Animal Science Department at (530)752-1250.

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THE HORSEREPORT

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