THERMOGRAPHY IN DIAGNOSIS OF INFLAMMATORY PROCESSES IN HORSES IN RESPONSE TO VARIOUS CHEMICAL AND PHYSICAL FACTORS

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To study the effects of acute and chronic inflammatory responses of the horse's thoracic (front) and pelvic (hind) limbs, several studies were done over a seven year period at the School of Veterinary Medicine, Auburn University, Alabama.

Phase I. Normal Thermographic Pattern of the Horse Over 100 horses were used to establish normal thermographic patterns of both thoracic and pelvic limbs. There is a high degree of right leg to left leg symmetry to the infrared emission of the horse, which has also been shown in humans. But in the horse, there is also a high degree of symmetry between the front and rear legs from the carpus and tarsus distally. After exercise, the temperature patterns of lower legs remained very similar to normals obtained before exercise. Even though there was an overall increase of temperature due to exercise thermal patterns remained the same.

Phase II. Chemically Induced Acute Inflammation of the Thoracic (Front) Limbs and the Use of Anti-inflammatory Compounds in Horses Thirteen ponies were used to inject 1.25 ml of 1.9% iodine solution (hypodermin R) around the distal portion of the lateral left front splint. This was done to create an area of acute inflammation. Twenty-four hours after iodine injection, ponies were divided into four groups. Group 1 was control with no medical treatment. Group 2 was treated with Benzydamine Hydrochloride ointment. Group 3 was

pelvic limbs were also done before and after local nerve blocks of both pelvic and thoracic limbs. Responses varied according to the site of injection. Nerve blocks only persisted for a short duration because carbocane is a short-acting local anesthetic. It was concluded that the thermography can be effectively used to evaluate vasoconstrictive and vasodilatory drugs in horses. Neurectomized areas can also be detected by thermographic techniques.

Phase IX. Thermographic Evaluation of Chemically (Amphotericine B) Induced Arthritis of the Carpus and Tarsus Joints Along With or Without Injection of Steroids in the Joint

The objectives of this study were to chemically induce intercarpal and tibiotarsal arthritis by injection of amphotericine B and to evaluate the effects of corticosteroids in the treatment of induced arthritis. Both thermography and radiography were used to evaluate the above stated objectives. Twelve ponies were used consisting of 48 joints to be evaluated. Eight joints were used as controls, 8 were injected with dextrose for a positive control 8 joints were used for amphotericine B injection only and of the other 16 joints, 8 were injected with methylprednisolone before amphotericine B and the other 8 were injected with methylprednisolone 24 hours after amphotericine B. Ponies were evaluated physically, thermographically and by radiography. Results of this study showed that the corticosteroid treatment of intra-articular injection in the joints was effective in alleviating the pain and clinical signs of lameness when compared to the induced arthritis non-treated joints. Even after the clinical signs of arthritis disappeared thermography still showed the presence of inflammation up to 30 to 40 days after the injection of amphotericine B. Radiographic evidence also provided that arthritis persisted longer than it was evident on physical exam. Present and previous studies from this clinic show that thermography can diagnose subclinical inflammation and it can be used to evaluate the healing processes. (See publication for more details).

Phase X. Use of 8 and 10 Ounce Chains on Scarred Horses

This study consists of two parts. In the first part of the experiment two horses were scarred using chain and mustard oil. Along with these, two scarred horses were bought. The second part of the study consisted of using 8 and 10 ounce chains and 14 ounce rollers on the scarred horses to evaluate their effect on the scar.

Part 1 of Phase X, Scarring Processes: Two horses were used to produce scars using 16 or 14 oz. chains with clinical soring described previously. It took an unpleasant 2 months of detergent, mustard oil and chain use to produce minimal scarring of two horses. Bleeding of pasterns first occurred in about 7 to 8 days, while

exercising in chains. Evidence of inflammation of the pasterns was noted on thermovision the day after pre-soring and chain use, particularly after exercise. The thermal pattern became more diffuse and abnormal as the study proceeded. Drop in pressure readings occurred with continued use of chemicals and chains. The animals displayed many signs of discomfort and distress during the use of chemicals and chains. Some were stiffness, trotting instead of gaiting, lying down in the stall, reluctance to move, vagueness as to surroundings, bearing more weight on hind feet, stumbling, falling, hanging the head, wobbling, altered facial expression, and a peculiar stance when standing. Although the horses were seldom exercised in chains more than 15 minutes per day and were not exercised each day because of rain, thrown shoes and weekends, it was apparent that 14 and 16 oz. chains inflict more trauma than 10 oz, chains. Scars can be produced on pasterns with chemicals and chains but despite 2 months of efforts to do so they were small scars and barely discernible in one horse. Thermograms and pressure readings readily distinguish a normal unsore horse from one being treated with chemicals on the pastern and exercised in chains.

Part 2 of Phase X, Effects of Actions Devices on Scars: The objective of the 2nd part of the study was to determine if legal action devices are injurious to the feet and legs of horses bearing scars in that area. Three Tennessee Walking Horses (#11, 13, and 14) with bilateral scars about the pasterns were subjected to studies in which legal action devices were affixed to their pasterns. Fourteen ounce aluminum rollers were used on # 11, 10 oz. chains on # 13 and 8 oz chains on # 14. Horse # 11 had less scar tissue than the other two. He was scarred on the premises with 14 oz. chains prior to this study. The other two horses were purposefully acquired with the scars. Horse # 11, a gelding, was exercised 7/28/80 -8/1/80 without action devices for the purpose of monitoring his physical condition under normal circumstances. From 8/4 -8/15 he was exercised 9 times for 20-22 minutes each time in 14 oz. rollers with vaseline as lubricant. From 8/18 -9/15 he was exercised and monitored seven times to record data on his recovery. Horse # 13, a gelding, was exercised 6/26/80 -7/11/80 without action devices for monitoring normal conditions. From 7/14 -7/25 he was exercised and monitored for 15-30 minutes each time in 10 oz. chains. Vaseline was used as a lubricant. From 7/28 -9/15 he was exercised and monitored 10 times during the recovery period. Horse # 14, a stallion, was exercised and monitored S times 9/15/80 -9/19/80 without action devices to establish normal physical conditions. He was exercised and monitored nine times 9/22 -10/3 in 8 oz. chains for 15 minutes each exercise period. Vaseline was used as a lubricant. From 10/6 -10/22 he was exercised and monitored 12 times during the recovery period. Results of this study showed that all three horses developed raw lesions on the scarred pasterns when exercised in action devices and lubricant. The lesions bled on horses #13 and 14 that exercised in chains. Abnormal thermal patterns developed on the pasterns of the three horses during the

period of exercise in action devices and the drop in pressure readings occurred. Thermal patterns became more regular in appearance and pressure readings increased during the recovery period when the horses were exercised without action devices. Fourteen ounce rollers and 8 and 10 ounce chains will cause raw lesions on scarred pasterns of horses when the horses are exercised 15-30 minutes per day in the devices. Lesions occur in less than 2 weeks, even when the horses are not exercised on weekends. The action devices cause irregular thermal patterns detectable by thermovision, increased sensitivity to pressure on the pasterns, and discomfort and altered gaits visible to observers.

Phase XI. Use of 2, 4 and 6 Ounce Chains

The objectives of this study were to evaluate the use of 2, 4 and 6 ounce chains in Tennessee Walking Horses, without using any other chemical or mechanical technique to induce inflammation. Use of 2, 4 and 6 oz. chains did not cause any detectable pain, tissue damage. Thermographic and pressure evaluation did not change significantly. Thus, it was concluded that the use of 2, 4 and 6 oz. chains for a duration of 2 to 3 weeks did not produce any harmful effects to the horses' legs, with exception to some loss of hair from 6 oz. chains in the pastern areas.

Phase XII. Use of Non-Steroid Anti-inflammatory Compounds (Phenylbutazone Flunixin-Meglumine) to Enhance Healing after Soring with Mustard Oil and Chains

In this study horses were sored using mustard oil and 10 oz. chains described previously. Following soring one group of horses were treated with phenylbutazone twice a day and the other group was treated with Flunixin-Meglumine for 5 days. Steroid ointment was also applied locally in the area of inflammation for 5 days. Then treatments were discontinued. Normally it took about 3 to 6 weeks for complete healing after initial induction of inflammation without any treatment with anti-inflammatory compounds. But the use of phenylbutazone (IV) and local application of steroid ointment enhanced healing. Horses on phenylbutazone healed in about 10 days, whereas use of Flunixin-Meglumine use took about 15 days for complete recovery. Enhanced healing effects could actually be seen within 48 to 72 hours after initiation of treatment with anti-inflammatory drugs.

Phase XIII. Evaluation of Dimethyl Sulfoxide (DMSO) Alone and In Combination with Gibson's Liniment, Applied to Limbs of Horses

To determine if DMSO alone or mixed with liniment would mask soring or otherwise interfere with thermography so that thermal patterns associated with sored feet and legs would not be detected.

Two horses were used in this study. Gibson's liniment, 90% strength DMSO, and oil of mustard were applied to determine the effects on the forelegs of horses. Thermovision, a Micron, a Carillon pressure device, a rectal thermometer were used to evaluate the effect of above stated compounds. DMSO and Gibson's liniment were applied alone and in combination of 1:1 and 1:2 liniment-DMSO. Amounts painted onto the legs and feet ranged from 10 to 20 cc. Rear legs and feet were used to increase the number of tests. Ten drops of oil of mustard were applied to the right leg of one horse. Fifteen cc of a 1-2 mixture of liniment-DMSO was applied the next day after thermovision confirmed an elevated temperature pattern. Horses were exercised for 4 days and physical condition monitored in a routine manner. The horses were monitored and exercised 7 more times during an 18 day recovery period. Preliminary studies conducted revealed that DMSO, Gibson's liniment, and mixtures of the two caused inflammation that was detectable by thermography and that caused a decline in pressure measurements. A study on one horse with DMSO—liniment mixture yielded basically the same results. The heat pattern caused by oil of mustard did not subside when DMSO, liniment or mixtures were applied. There were no detectable distortions of patterns that might confuse thermographic findings in sore horses.

Phase XIV. Use of Seven Commercial Compounds to Determine if they Can Mask Soring

Studies were done to determine if preparations containing silicone can alter or cover up thermal patterns obtained by thermography. Several Large Animal Clinic horses were used over a period of 5 days to determine the effects of various dilutions of silver nitrate and 5 hair sprays and a boat water-proofing liquid containing silicone. Normal thermal patterns were obtained before the preparations were applied as a spray or with a dauber to the legs and feet. The limbs were observed at different time intervals during the day with a thermovision camera and the next day before the material was washed off. Mustard oil was used on several feet to cause an abnormal thermal pattern. None of the compounds used masked or altered normal or mustard-oil-induced abnormal thermal patterns. Thus it was concluded that silicone containing substances and silver nitrate used in this study did not mask or alter thermal patterns in horses.

Phase XV. Preliminary Studies to Evaluate the Effects of Change in the Heel to Toe Ratio

The objectives of this study were to determine if deviation of hoof angle will alter the gait of Tennessee Walking Horses and to determine if tendonitis or other inflammation were caused by deviation of hoof angle. Two horses, # 22 and # 23 were placed under observation on 4/9/81 and monitored before and after 15-20 minutes of exercise with thermography, pressure device, Micron,

rectal thermometer and visually by rider, technician and veterinarian. Horse # 22 was shod from 'barefoot status to wedges, pads and shoes on 4/13. Horse # 23 had been shod similarly before 4/9/81. On 4/29 the heels of both horses were raised 8 degrees, before exercise and monitoring. On 5/11 the heels were dropped 12 degrees by removing wedges and the horses exercised and monitored. Horses were then exercised and monitored on 10 separate days during the period of 5/12 .6/1. No action devices or chemicals were applied to the feet or legs during the study.
Thermography study suggests that shoeing of the forefeet in pads and wedges from a barefoot status (horse # 20) causes a 1–2 degree rise in temperature in the superficial and deep flexor tendon area. Similarly, inflammation in this area was observed on thermography when the angle of the hoof was raised or lowered (both horses). When the heels were lowered on 5/11 and observed until 6/1 there was a gradual decrease of inflammation in the flexor tendon area.
Pressure readings taken at the usual 6 points on the foot fluctuated to a minor degree, reaching their lowest levels 2 days after the heels were elevated 8 degrees in both horses. Raising the heels 8 degrees caused both horses to stumble and tire easily. They did not regain a sound gait for about 7 days. When the heels were dropped 12 degrees the horses gaited more soundly although there was swelling in the flexor tendons for about 7 days. Raising or lowering the heels of Tennessee Walking Horses and shoeing one with wedges and pads from barefoot status causes thermal patterns in the flexor tendon area that can be distinguished on thermography. These changes cause less fluctuation in pressure readings than the use of action devices or chemicals. Inflammation subsides about one week after the heels are raised or lowered 8 and 12 degrees respectively. Raising the heel causes a more observable change in the horses' gait than lowering the heel after it has been raised.

Phase XVI. Pressure Shoeing

Two horses were used for pressure shoeing technique. Horses' gaits can be altered by pressure shoeing. The degree of soreness from pressure shoeing depended on the techniques used. Soreness from pressure shoeing was not detectable in the pastern areas by physical examination or by thermographic technique in all cases, because pads obscure the solar surface of the foot. But obtaining thermographs of the sole after removal of pads, soreness was obvious due to inflicted inflammation to the solar surface of the foot.

Phase XVII. Comparison of Pressure Data Between Pelvic and Thoracic Limbs Before and After Exercise for 5 Continuous Days

The studies were done to evaluate the six point pressure data of the coronary band and pastern areas of both pelvic (hind) and thoracic (front) limbs in 6 horses to determine the variation in the front

and back legs. there were no significant differences in pressure data from the front to the back legs of these horses. Pressure values averaged between 30 to 40 psi, before and after exercise in all normal horses. Whereas in horses where acute inflammation was induced by chemical or physical means significant decrease in pressure values were recorded.

Phase XVIII. A Field Trial with 8 Horses in Murfreesboro, Tennessee, to Evaluate the Pressure Device, Micron Temperature along with Thermography

This study was done using 8 Walking Horses brought during the month of June, 9-11, 1981. Horses were brought in by owners and/or trainers for this study. A 3 day trial was performed in which all horses were examined before and after exercise by 3 veterinarians and 1 DQP. In some cases as many as 4 to 5 veterinarians may have examined these horses. Each individual was requested to submit his own report without consultation with others, to Dr. Purohit for final compiling of the data. After examination by the DQP and veterinarians, thermographic evaluation was done before and after exercise. The pressure data on the pastern area were collected, and a hand-held infrared gun was used to determine the temperature of the legs. Owners were allowed to use 10 oz. legal chains, but they were asked not to notify us if they used any chemical or other technique to sore the horse. During the 3 days of this study, 3 horses at one time or another did show sensitivity to the physical examination and the same horses were classified as having inflammatory reaction on thermography and pressure device. Whereas 4 horses were not considered sore by all criteria used in' this study. Thermography technique was able to detect inflammation, on 2 horses even before they were exercised on day 1. Of the 3 sored horses 2 showed only selected areas of inflammation. One horse by day 3 showed acute inflammation on thermography. This horse was used with 10 oz. chains. Of the 8 horses, 1 horse in this study was very difficult to handle and several veterinarians and 1 DQP had considerable difficulty in examining this animal. The difficulty extended even to the point of the horse not allowing the use of the infrared Mikron thermometer. This horse had normal pressures on day 1 before exercise, with exception to the pocket and bulb of the heels, which were sore both on pressure and thermography technique. There was an excessive drop in pressure after exercise on day 1. Thereafter, the only sensitive areas noted were the backs of both front legs, especially in the pocket and the bulb of the heels. It was concluded that 3 of the 8 horses were sore, 1 was questionable, and 4 were considered not sore. There were some discrepancies among veterinarians, but after overall evaluations, only 1 horse which was questionable created the controversy, due more to the behavior of the horse.

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