Technology for Enforcement:
Pressure Algometry

Kevin K. Haussler, DVM, DC, PhD
Examination for Soring

Visual inspection of pastern region
- Signs of inflammation
- Proliferative granulation tissue
- Open wounds

Digital palpation of the distal forelimbs
- Identify presence of pain
- Abnormal tissue indicative of illegal therapy

Positive Pain Response

- Repeatable to digital palpation
- Ensure that the reaction is not due to anxiety or excitement
Perceived Limitations of Current Exam

Inconsistent application of thumb pressure

- Not quantified
- May vary between examiners

Comments of owners and trainers of “positive” horses

- Too much pressure was applied
- Any normal horse would respond to the applied pressure
Pressure Algometry

Mechanical nociceptive threshold (MNT)

- The minimum pressure which induces pain or a pain response

A high pressure measurement indicates a high pain threshold or a low pain response

_Fischer AA. Pain 1987; 30(1): 115-126._
Pressure Algometry


Objectives

1. Assess how nonsored Tennessee Walking Horses respond to mechanical pressures ≤ 10 kg/cm²
   - Nonsored Tennessee Walking Horses can tolerate mechanical pressures > 10 kg/cm² within the pastern region of both thoracic limbs
     - By experienced Veterinary Medical Officers (VMOs) responsible for enforcement of the Horse Protection Act (HPA)

2. Establish reference mechanical nociceptive thresholds (MNTs) within the pastern region
Materials and Methods

Tennessee Walking Horses (N=26)

- Housed on a single farm
- All actively showing
  - Average duration of 3 years (range 1-10 years)
- Flat shod in the fore feet
- Unshod in the hind feet
- No signs of lameness
- Pass a Horse Protection Act (HPA) inspection for soring
  - 2 experienced APHIS veterinary medical officers (VMOs)
Horses

1 horse excluded
  • Intolerant to pressure algometry procedure

25 horses
  • 11 mares, 11 geldings, 3 stallions
  • Age – 7 years (3-12 years)
  • Body weight – 405 kg (341-490 kg)
  • Height at withers – 153 cm (144-166 cm)

All horses passed examination for soring
Mechanical Nociceptive Thresholds

4 sites commonly found to be painful in sored horses
• Pastern – Dorsal, lateral, medial, and palmar
Mechanical Nociceptive Thresholds

1. Response to applied pressure
   - 5 VMOs - Inexperienced in pressure algometry
   - Pressure algometer – Upper limit of 10 kg/cm²
     - 3 consecutive measurements at each site

2. Reference MNTs
   - 1 person - Experienced in pressure algometry
   - Pressure algometer – Upper limit of 30 kg/cm²
   - Measured last
     - Limit trauma associated with increased applied pressure
MNT Measurements

- 4 pastern sites
- 3 consecutive measurements/site
- 4 or 5 examiners per limb
- 48 to 60 MNTs per limb
- 96 to 120 MNTs per horse
- 25 horses
- Total of 2,628 MNT measurements
MNT Values of 5 VMOs

Hypothesis:
- Nonsored Tennessee Walking Horses tolerate mechanical pressures > 10 kg/cm²

Overall > 10 kg/cm²
- 80% (range 53 to 98%)
MNT Values (≤ 10 kg/cm²) of 5 VMOs

Overall = 9.5 ± 0.3 kg/cm² (range 6.4 to 10.0)
Reference MNT Values of Pastern

Adaptation and Sensitization

- Adaptation: 17 ± 14%
- No Change: 70 ± 15%
- Sensitization: 13 ± 12%

Proportion of Measurements
Skin Lesions

6 (24%) horses
- Unilateral skin lesions or mild scarring

No significant MNT differences
- To opposite limb
- Other horses without skin lesions
No Significant Differences

- Age, sex, body weight, wither height
- Recent exercise
- Order of measurements
- Hand dominance of examiners
Mental Status

Separate nonblinded examiner

Mental status during MNT measurements

Grades (1 to 5)
- 1 – Very calm, stood quietly during all measurements
- 2, 3, 4 - Intermediate gradations of increasing anxiety
- 5 – Extremely anxious and unmanageable

Hypothesis
- Calmer horses (grade 1) have higher MNTs (lower pain)
Mental Status Scores

Average score = 1.3 ± 0.7 (range 1-5)

10 horses had mental status scores > 1 across all 6 examiners

Distribution of scores

- Grade 1 (N=120)
- Grade 2 (N=20)
- Grade 3 (N=6)
- Grade 4 (N=3)
- Grade 5 (N=1)

Horses with high initial mental status scores tended to have lower scores after repeat MNT examinations
Tolerance to Procedure

Overall willingness or tolerance to stand quietly on each thoracic limb by each examiner

Grades (1 to 5)
- 1 – Stood completely quietly and readily tolerated all measurements
- 2, 3, 4 - Intermediate gradations of decreasing tolerance
- 5 – Repeated lifting of the limb and inability to stand on the limb for the majority of measurements

Hypothesis
- Tolerant horses (grade 1) have higher MNTs (lower pain)
Tolerance to Procedure Scores

Average score = 1.3 ± 0.6 (range 1-4)

13 horses had tolerance scores of 1 across both limbs and 6 examiners

Distribution of scores

- Grade 1 (N=162)
- Grade 2 (N=48)
- Grade 3 (N=8)
- Grade 4 (N=1)
- Grade 5 (N=0)
Correlations Between Scores

Mental status scores
- No correlation with MNT values
  - Calm horses did not have higher MNTs
  - Anxious horses did not have lower MNTs

Tolerance to procedure scores
- No significant left-right limb differences
- No correlation with MNT values

Positive correlation between mental status and tolerance to procedure scores
- Calmer horses had higher tolerance scores
- Anxious horses had lower tolerance scores
Hypothesis

Tennessee Walking Horses are “more sensitive”

- Lower mechanical nociceptive thresholds

Compare similar sites within the digit to a population of mixed breed horses (N=24)
Forelimb MNTs (N=24 horses)

Tennessee Walking Horses (N=25)

Mechanical Nociceptive Thresholds (kg/cm²)

- Neck
- Shoulder
- Elbow
- Carpus
- Cannon
- Digit
Digital Palpation

Apply thumb pressure with enough force to

- Flatten the flesh of the thumb
- Partially blanch the thumbnail
  - Approximately 2.3 kg (1 pound) of force
  - Thumb surface area = 4 to 6 cm²
  - Equals 0.4 to 0.6 kg/cm² of pressure
Comparison of Applied Pressures

Methods of Pressure Application

- Blanch Thumbnail: 0.5 kg/cm²
- VMOs using 10-kg PA: 11-16 X
- Reference MNT: 33-49 X

80% - > 10 kg/cm²

47-70 X
Limitations of Study

Flat shod
- Long toes, pads, weighted shoes, action devices

Non-sored horses
- Sored horses are expected to have lower MNTs

Upper limit of 10-kg algometer
- Repetitive measurements and potential tissue injury

No formal inter- and intra-examiner repeatability

No correlation between skin lesions or scarring and MNTs
- Areas of pain could have been present, but were not measured

Home environment
- Not at a novel or show environment
- Effect on mental status and tolerance to procedure scores
Conclusions

- Reference MNTs of the pastern region of non-sored Tennessee Walking horses provide an objective standard for the evaluation of potentially sored horses.

- Pressure algometry, in lieu of digital pressure, can quantify mechanical pressure applied during soring inspections and provide consistency between examiners.
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Source for Pressure Algometer

Wagner Instruments
- Force gauge, Model FPK 60
- 0 to 30 kg/cm²
- 1 cm² rubber plunger
- www.wagnerinstruments.com
The End
MNT Measurements
MNT Measurements
Feet
Questions

- Description of technology
- How it might detect soring
- Costs to train and equip an inspector
- Equine research and testing already been completed
- Legally supportable in ticketing soring
- How quickly and efficiently could an inspection for soring be done before entering show ring
- Successful in court cases
- Detect soring even if covered up by stewarding or local anesthetics
- Applied to horses after a show class that appear sore
- Does a sore horse have a better chance of testing sore after a class
Soring

The practice of inflicting pain on the limbs of a horse with the purpose of accentuating gait

United States Department of Agriculture, Animal and Plant Health Inspection Service (2001)
The Horse Protection Act. Understanding the scar rule. Program Aid No. 1685.
Soring Examination

- Lameness examination
- Observation of any pain behavior
- Physical examination of the forelimbs from the carpus distally
- Inspection of the shoes, pads and action devices

Thermography

- Significant thermographic differences within the distal forelimb have been reported for treated and nontreated limbs within the same horse

  
Effect of Hand Dominance

• All 6 examiners were right-handed
  • Compared MNTs at medial and lateral pastern sites
Pressure Algometry

- Able to quantify applied pressure
- Determine normal mechanical nociceptive thresholds
  - Axial skeleton
    
  - Thoracic limb
    
Materials and Methods

2 (of 5) VMOs – Selected at random

- Lameness – Figure 8 pattern
- Digitally palpated unweighted thoracic limbs from carpus to hoof
  - Pain or inflammation in pastern region
    - Light digital pressure
  - Visual examination of pastern region
    - Skin lesions or scarring – Graded: Mild, moderate or severe
MNT Measurements

Pressure applied perpendicular to 4 pastern sites
  • Rate - 5-10 kg/cm²/second
  • Duration – 2-3 seconds
  • Avoidance reaction
    • Lift thoracic limb or pull limb away
  • Maximal recordable pressure of instrument

3 consecutive measurements
  • Within-site repeatability

Wait 2 minutes between the each MNT measurement session by 4 or 5 different examiners per horse
  • 20 minutes per horse
MNT Values of 5 VMOs

Hypothesis:

- Nonsored Tennessee Walking Horses tolerate mechanical pressures > 10 kg/cm²

Overall > 10 kg/cm²
  - 80% (range 53 to 98%)

Overall ≤ 10 kg/cm²
  - 20% (range 2 to 47%)

Examiners
VMOs ≤ 10 kg/cm²

• Left-right differences - 0.1 ± 0.2 kg/cm²
30-kg Algometer

Reference MNTs
• 3 consecutive MNTs across sites and horses

Compare left-right MNTs
• Pool MNT values

Signalment effects
• Age - < 7 years; ≥ 7 years
• Sex – Female; Male
• Body weight - < 410 kg; ≥ 410 kg
• Wither height - < 154 cm; ≥ 154 cm
• Exercise status – Recently exercised; Unexercised
Statistical Tests

- Left-right paired MNTs
- Left-right tolerance scores
- Order of MNTs
- Effect of hand dominance on MNTs
- Pastern site differences in MNTs
- Presence or absence of skin lesions on MNTs
- Signalment – Age, sex, weight, height, exercise
- Correlations – MNTs, mental status, tolerance to procedure
Adaptation and Sensitization

Assess 3 consecutive measurements at each site

- Sequential increases > Adaptation
- Sequential decreases > Sensitization
- No change or consistent pattern

Proportions of above patterns

Median of 3 consecutive measurements

- Site-specific baseline MNT within horse
Reference MNTs

Proportion of patterns of 3 consecutive measurements
• No significant left-right differences

Mean range of 3 consecutive measurements
• $2.1 \pm 1.6 \text{ kg/cm}^2$

Left-right paired differences
• $0.7 \pm 2.8 \text{ kg/cm}^2$
The End