Muscle Dysfunction

Barbara Harrison, DVM

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Ocean State Equine Associates

MUSCLE DYSFUNCTION
Exercise Intolerance

- Lameness
- Cardiac disease
- Respiratory disease
- Conditioning
- Subclinical illness

... MUSCLE DISEASE?
A Whirlwind Tour...

- How Muscles Work
- Diagnostic Approach
- Common Muscle Diseases
  - Tying Up: SER, RER
  - PSSM
  - HYPP
  - EMND
- Strength and Conditioning
- Traumatic Injury
- Take Home Points
HOW MUSCLES WORK
Myofibers: The Muscular Unit

- Muscle cells are WEIRD!
- Many cells merge into single continuous muscle FIBER
- Many fibers together make up muscle
- Different muscle fiber types have different jobs

Postural, dexterity (fingers, eyes), sprinting, endurance
Different diseases may target a specific fiber type because of the way they use energy
Muscle Function

• Nerves signal muscles to contract by changing electrolyte balances inside the cell

• Both contraction and relaxation of muscle takes energy
  – Why muscles in energy crisis spasm instead of becoming flaccid
Energy Use in Exercise

- **Carbohydrate Metabolism**
  - Early Aerobic Energy
  - Glucose
  - Glycogen

- **Fat Metabolism**
  - Most Energy Available

**Anaerobic** = without oxygen  **Aerobic** = with oxygen
WHEN MUSCLES DON’T WORK
Diagnostic Approach

• Thorough physical exam + lameness exam
• HISTORY
• Blood Chemistry
  – Exercise Tolerance Test
• Blood Vitamin E level
• Genetic Testing
• Muscle biopsy
Diagnostic Approach: Blood

Exercise Tolerance Test
- Baseline CK/AST/Electrolytes
- 20 minutes of trot work
- Redraw blood 4-6h later
- >3x baseline CK

Vitamin E
- High daily variability in blood
Diagnostic Approach: Genetic Testing

**HYPP**
- Reported as H/H, H/N, N/N
- Dominant inheritance

**PSSM**
- GYS 1 gene, Dominant
- Sensitivity
  - 90% in draft breeds
  - 72% in QH
  - 18% in Warmbloods
- Positive results can be trusted
- Negative results may be false
  - Biopsy is next step
Diagnostic Approach: Muscle Biopsy

- Not as scary as it sounds!
- Hamstring muscles, tailhead, or both
Muscle Biopsy Process

- Standing sedation
- Local numbing (like a nerve block)
- 3” vertical incision
- 1” cube of muscle
- 14 day lay-up until sutures removed
- No long term performance deficits due to procedure
Muscle Biopsy Analysis

- Fiber types
- Fiber size
- Glycogen build up
- Fat build up
- Mitochondrial Damage
- Tissue Vit. E level

Only way of definitively diagnosing some muscle diseases
What is “Tying Up”? 

- Stiffness or soreness, unwillingness to move forward
- Firm muscles
- Sweating
- Visible trembling
  - “Muscle fasciculation”
- Brown Urine
  - “Pigmenturia” “myoglobinuria”

=> Destruction of muscle cells “myocytes”
Sporadic Exertional Rhabdomyolysis

- Intense episode of “tying up”
- High intensity work without appropriate conditioning
- Polo ponies, hunt horses, event horses early in season
SER Treatment

- DO NOT TRY TO WALK THEM OUT
  - Cold hose
- Intravenous fluids
  - Myoglobin is toxic to kidneys!
- Banamine
- +/- tranquilizer
- Strict stall rest
  - as little as 5 minutes of walking may initiate further tying up
  - Usually ~2 weeks, then gradual return to work
  - Avoid extreme exertion after rest in future

Recurrence of SER is rare, as there is no underlying disease
Recurrent Exertional Rhabdomyolysis

- Thoroughbreds, Standardbreds, other light breeds
- Submaximal exercise
- Mares > geldings or stallions
- Often related to anxiety/stress
  - High cortisol levels

Calcium Imbalance?
RER Treatment

• Depends on severity
  – May benefit from light walking
  – May be identical to SER

• Shorter period of stall rest

• Electrolyte Replacement

• Medications:
  – Sedatives, Dantrolene, Phenytoin
  – Prevents ER while returning to work
  – Prohibited in competition
RER Management

- Avoidance of stressors
  - Quiet barn environment
  - Predictable daily routine
  - Reintroduction to stressors

- Minimize time in stall
  - In and out + turnout ideal

- Exercise program:
  - Daily work
  - Interval Training Program

- Diet:
  - Low sugar, avoid alfalfa hay
  - Provide salt block at all times
Monday Morning Disease

- Draft horses
  - European Breeds
  - Low prevalence in British breeds
- High concentrate diet
- “Tie up” when resuming work after Sunday off
- Pigmenturia (brown urine)
- Potentially fatal

Now known to be due to Polysaccharide Storage Myopathy
Type I PSSM:

- Gene mutation (GYS 1) results in abnormal sugar storage
  - Prevalent in European Draft breeds
  - 9% of all QH
    - Halter/pleasure lines > working lines
  - Dominant inheritance

- Prevents the signal to switch to using fat for energy

[Image of a person riding a white horse]
Type II PSSM:

- Gene has not been identified
- Milder clinical signs
  - Low energy
  - May take longer to identify problem
  - 75% prevalence in some warmblood breeds
- Often identified 8-12yo
  - Cumulative
  - Management change
  - Body loses ability to access abnormal glycogen
PSSM treatment

• Low starch, High fat diet
  – May require decreasing portion of diet from hay
  – Corn oil, Omegatin
  – Re-Leve, Ultium, (rice bran), alfalfa

• Regular exercise

• May look like horse is “wasting away” as glycogen build-up is reduced

• PATIENCE! May take 6 months to build muscle
**Hyperkalemic Periodic Paralysis**

- A CHEMICAL instead of STRUCTURAL cause of Muscle Dysfunction
- Body releases a flood of potassium ions (K+) into blood, causing muscles to become weak
- Occurs at rest, at times of stress
- No stiffness following episode
HYPP Treatment

Emergency Protocol:

• Administer 120ml Karo Syrup orally at first sign of weakness
• Contact veterinarian immediately

Management:

• Avoid grains with high sugar content
• Avoid feeding alfalfa hay
• Low stress environment
• Engage barn community with monitoring
Equine Motor Neuron Disease

- Vitamin E Deficiency
- Muscle weakness
- Vitamin E is a powerful antioxidant which is particularly important to the function of the neuromuscular unit
- Horses without grass turn-out or selenium deficient diets are predisposed to EMND
EMND Treatment

• Vitamin E *without* selenium
  – Allows administration of high doses of vitamin E without causing selenium toxicity
  – 5-10x labeled dose

• Goal is to stop progression of disease

• Significant improvement rare in adult horses
Supplements?

- Often flavored with sugar
- No regulation or quality control
- Often no true research behind development
- May adversely effect natural electrolyte balances

QUALITY FEED SALT BLOCK
+/- VITAMIN E
And the List Goes On...
STRENGTH & CONDITIONING
It Makes Sense

• Allow young horses time to develop

• Start slow and build in time and intensity

• Don’t jump the gun
  – Train to a level above what you show

PATIENCE
**Delayed Onset Muscle Soreness**

- DOMS induced by using untrained muscles
- Exact cause unknown:
  - lactic acidosis, muscle spasm, connective tissue damage, muscle damage, inflammation, enzyme efflux

**Treatment:**

- TRAINING
  - Stretching, warm-up
  - Temporary pain relief in work
  - Decrease intensity and length of work for 1-2 days following intense DOMS episode
- (Massage, Therapeutic Ultrasound, Acupuncture)
- More frequent smaller meals?
Recovery

- Marathoners don’t run 26.2 mi a day... and often don’t resume training for as much as a month following a marathon

- A period of rest following competition allows the body to restore chemical balance, rebuild energy stores, and heal subclinical injuries

- Recovery ≠ Stall rest
  - Turn out, light work (lunge or long line), stretching
Cross Training

**Strengthening**
- Multi-modal strength training
- Decreases the repetitive stress injuries common in single-discipline horses

**Tissue Education**
- Bone, muscle, and fibrous tissues are constantly being turned over and replaced to better suit athletic demands

**Proprioception**
- The body’s intuitive knowledge of where it is in space
- Allows snap-second corrections to prevent strains, sprains, and ruptures
Compensation Injury

• Due to unloading of pain at a primary site
• May resolve on its own when primary problem is corrected, may need secondary intervention

• Muscle is the most commonly effected tissue
  – Tightness and splinting
  – **GOOD**: easy to correct abnormalities
    • Stretching - Mesotherapy
    • Acupuncture - Steroid Injections
    • Massage - Shock wave therapy
  – **BAD**: most often overlooked because rarely causes true lameness
    • DOES cause performance failure
OTHER MUSCLE PATHOLOGY

TRAUMATIC MUSCLE INJURY
Muscle Tears

- Slipping, sliding, and scooting
- May occur during work but more often occurs in turnout
- Swelling occurs immediately and may have fluid wave from developing hematoma
- Initially require stall rest but within 2 weeks mobilization is essential to preventing FIBROTIC MYOPATHY
Muscle Tears
Therapeutic Modalities

• Manual Therapy
  – Stretching, ROM
• Therapeutic Ultrasound
• Massage
• Electro-stimulation
  – (PENS, TENS)
TAKE HOME POINTS

• Muscle dysfunction can cause performance failure
• Clinical signs of different disease processes overlap, history and appropriate diagnostics are essential to diagnosis
• In general consistent controlled exercise and a low starch, high fat diet are indicated for horses with muscle disease