MUSCLE ATROPHY
WHERE DID IT GO AND WILL IT COME BACK?

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DIAGNOSTIC WORK UP

A careful physical examination of the horse, combined with history and appropriate diagnostic
tests, should initially determine;
1. Is this a systemic disease or a myopathic or neuropathic cause of atrophy?
2. Is this symmetrical or asymmetrical atrophy?
3. Is this focal or generalized atrophy?

History
   o Rapid vs. slow onset of atrophy?
   o Happened previously?
   o Start with a specific muscle group?
   o History of tying-up?
   o Appetite and Diet
     ▪ Amount available and consumed
     ▪ Pasture access
     ▪ Vitamin mineral supplements
   o Change in mentation or attitude?
   o Lying down more, trembling?

Physical examination
Particular focus should be on:
   ▪ Body condition score
     ▪ presence of body fat vs loss of muscle and normal body fat
   ▪ Oral examination – teeth/masseter/temporal muscles
   ▪ Skin, coronary band for evidence of any systemic disease
   ▪ Muscle pain, abnormal tone, fasciculations
   ▪ Neurologic examination
     ▪ Ataxia
     ▪ Weakness
   • Inspection From All Sides
     ▪ Animal must be standing square
     ▪ Comparison of left and right sides
     ▪ Comparison with normal breed musculature
   • Palpation
     o Subtle abnormalities may be felt better than seen
Diagnostic Tests

- **Neuropathies**
  - Serum Vitamin E
  - Electromyography (EMG)
  - Muscle biopsy of sacrocaudalis dorsalis muscle

- **Myopathies**
  - Genetic testing for PSSM
  - Semimembranosus muscle biopsy
  - ACTH or Dexamethasone suppression test for Cushings

- **Systemic Disorders**
  - CBC, serum chemistry profile
    - Albumin, Total protein, muscle enzymes
  - Glucose/xylose absorption tests
  - Abdominal ultrasound
  - Rectal biopsy

Rule Outs

- **Neuropathies**
  - Equine motor neuron disease (EMND)
  - Vitamin E deficient mitochondrial myopathy

- **Myopathies**
  - Severe rhabdomyolysis
  - Polysaccharide storage myopathy (PSSM)
  - Immune mediated myositis (IMM)
  - Inclusion body myositis
  - Cushings disease

- **Systemic Disease**
  - Chronic infections
  - Chronic granulomatous disease (sarcoidosis)
  - Malabsorptive disorders
  - Eosinophilic disorders
  - Lymphosarcoma or other tumors

**NEUROPATHIES ASSOCIATED WITH GENERALIZED MUSCLE ATROPHY**

**Equine Motor Neuron Disease**
**Pathophysiology:** Equine Motor Neuron Disease (EMND) is a neurodegenerative disorder of the somatic lower motor neurons within the spinal cord affecting horses from 2 to 25 years of age. It was first reported in 1990 by Dr. Tom Divers at Cornell University. EMND is very similar to human motor neuron disease (amyotrophic lateral sclerosis, otherwise known as ALS or Lou Gehrig’s disease). However, the human disease is more complex. EMND preferentially affects motor neurons in the spinal cord that have a high oxidative activity. Neuronal cell death results in preferential denervation atrophy of type 1 muscle fibers. Horses that are deprived of pasture or green, high-quality hay, and that are not supplemented with vitamin E for more than a year, are at greatest risk for EMND.

**Clinical Signs:** Subacute and chronic forms of EMND are reported. Subacute signs include acute onset of trembling, fasciculations, lying down, shifting of weight on the rear legs due to inability to lock the stifles abnormal sweating, low head carriage, frequent recumbency, and loss of muscle mass symmetrically throughout the body. Atrophy is often present for one month prior to signs of trembling. Appetite and gait usually are not affected at this stage. Horses do not become uncoordinated, but walking is easier than standing. In chronic cases, the trembling and fasciculations decrease. The horse might stabilize with varying degrees of muscle atrophy, and might look emaciated. The tail usually is elevated.

**Diagnosis:** There is no definitive antemortem diagnosis for EMND. EMND is usually identified based on history, clinical signs, measurement of serum vitamin E, muscle enzymes, and muscle biopsy. The index of suspicion is increased if previous cases of EMND have been reported on the farm or if the horse has been without green forage for an extended period of time. A dark reticulated bar may be seen on the retina between the tapetum and optic disc in some cases. Mild elevations in CK and AST (1000 IU/L) and CSF protein concentration (>100 mg/dl) are often present as is serum vitamin E below 2 ug/ml. Vitamin E concentrations are also low in the liver, fat, spinal cord and muscles. *Muscle biopsy* of the sacrocaudalis muscle is preferred because it has a high proportion of oxidative type 1 muscle fibers that are preferentially atrophied with this disease. The area to biopsy is about one inch above the tail hairs and one half inch off of midline. Fat deposits may occur in this area so a deep sample that provides pink muscle tissue rather than white fat is necessary. The pathognomonic diagnostic feature required to diagnose EMND is neurogenic angular atrophy of type 1 and type 2 fibers.

**Treatment:** Oral vitamin E at 5,000-7,000 units per day for a 1000 lb horse is recommended. A new natural form of vitamin E called Elevate ([www.kppusa.com](http://www.kppusa.com)) or Nano-E ([ker.com](http://ker.com)) provides superior blood levels of vitamin E for affected horses.

**Outcome:** Stabilization of clinical signs and gradual improvement may occur if horses are not too debilitated prior to treatment. Prognosis is considered guarded. Owners of horses on the same
premises or owners of horses without pasture access should supplement horses with vitamin E at 2,000 units per day.

**Other Peripheral Neuropathies**

**Pathophysiology:** There are other peripheral neuropathies in horses that are rarely reported and of unknown etiology. **Clinical signs:** Progressive muscle weakness and atrophy which is often symmetrical but may be multifocal rather than generalized. **Diagnosis:** Rule out EMND by history, clinical signs and serum vitamin E. Rule out chronic lead exposure. Biopsy of atrophied muscles will show neurogenic atrophy of type 1 and type 2 fibers. **Treatment and Outcome.** No known treatments and often progressive

**MYOPATHIES ASSOCIATED WITH GENERALIZED MUSCLE ATROPHY**

**Mitochondrial Myopathy Associated with Low Vitamin E**

**Pathophysiology:** Some horses with clinical signs identical to subacute or chronic EMND do not have the hallmark feature of neurogenic atrophy in their muscle biopsies. Rather, these horses have a previously unrecognized syndrome characterized by abnormal moth-eaten staining pattern in mitochondria and low muscle but not consistently serum vitamin E. This disorder is either an early manifestation of EMND prior to neuronal damage or a specific myopathic form of oxidant damage to muscle mitochondria. **Clinical Signs:** Horses with this mitochondrial myopathy present with slow onset of muscle atrophy and weakness, with more severely affected horses having muscle fasciculation, increased recumbency, and lowered head and neck carriage. **Diagnosis:** Serum vitamin E concentrations below the standard reference range (< 2 – 4 µg/ml) may be present, but in some cases, serum vitamin E concentration were within or above this range. In all horses identified to date, muscle vitamin E has been abnormally low. **Muscle biopsy** of the sacrocaudalis muscle shows predominantly myogenic atrophy [anguloid myofiber atrophy of type 1 and 2 fibers] with significantly abnormal mitochondrial staining (moth-eaten fibers) suggestive of oxidative damage. A diagnosis of this mitochondrial myopathy requires that fresh frozen rather than formalin fixed samples be evaluated in order to perform mitochondrial staining. **Treatment:** As per EMND **Outcome:** All horses, identified to date, have responded completely to supplemental vitamin E and returned to previous body conditions and performance levels. Early recognition and treatment of a vitamin E deficiency may improve the previously reported poor clinical outcome of EMND.

**Severe Rhabdomyolysis**

**Pathophysiology:** Cases of severe nonexertional rhabdomyolysis may progress from swelling to marked generalized atrophy. These cases may be due to polysaccharide storage myopathy type 1
or 2, lipid storage myopathies, severe immune mediated myopathies, or other infectious agents such as *streptococcus equi* or *anaplasma phagocytophila*.

**Clinical Signs:** Horses show severe evidence of muscle pain, stiffness and often recumbency. Initially musculature is enlarged and swollen and often show a deep valley along spine between swollen epaxial muscles. Within days this may progress to marked muscle atrophy.

**Diagnosis:** Serum CK activities > 150,000 U/L. Genetic testing for PSSM type 1. Muscle biopsy of semimembranosus muscle may reveal PSSM, a lipid storage myopathy or immune-mediated myopathy.

**Treatment:** Anti-inflammatories, analgesics, dantrolene, IV fluids, 2.5% dextrose, monitor electrolytes and creatinine. Use IV calcium sparingly if low serum calcium to avoid excessive calcification of skeletal muscle.

**Outcome:** Muscle mass will return within months if horse survives the episode of rhabdomyolysis.

### Type 1 PSSM

**Pathophysiology:** Some Percheron and Belgian draft horses heterozygous for PSSM are prone to progressive muscle atrophy and weakness. This is most severe in drafts and quarter horse related breeds that are homozygous for type 1 PSSM. Muscle is gradually replaced by fat and connective tissue.

**Clinical Signs:** Gradual onset of muscle wasting, particularly affecting gluteal and epaxial muscles symmetrically. This may progress to marked muscle atrophy and weakness with difficulty rising.

**Diagnosis:** Serum CK activities mildly elevated. Genetic testing for the *GYS1* mutation for PSSM type 1 is often homozygous affected (P/P). Muscle biopsy of affected muscles shows amylase resistant polysaccharide, myofiber atrophy, increased connective tissue and adipose cells.

**Treatment:** Low starch high fat diet, regular exercise

**Outcome:** Guarded for return of muscle strength and mass if biopsy is severe.

### Immune-Mediated Myositis

**Pathophysiology:** Immune-mediated myositis (IMM) primarily affects Quarter horse-related breeds. A bimodal age distribution seems to occur in affected horses with all horses identified to date either ≤ 8 yrs of age or ≥ 16 yrs of age. In approximately 1/3 of horses with IMM a triggering factor appears to have been exposure to *S. equi* or a respiratory disease. Specific muscle groups develop an acute lymphocytic infiltrate which results on dissolution of muscle fibers.

**Clinical Signs:** The most prominent clinical sign is rapid onset of muscle atrophy, particularly affecting the back and croup muscles, accompanied by stiffness and malaise. Atrophy may progress to involve 50% of the horses' muscle mass within days and may lead to generalized weakness. Focal symmetrical atrophy of cervical muscles has been reported in a pony with IMM.

**Diagnosis:** Hematologic abnormalities are relatively minor in affected horses and are usually restricted to mild to moderate elevations in serum CK and AST activity. However, in some cases, serum muscle enzyme activities are normal.
Muscle biopsy of the epaxial and gluteal muscles taken within the first two weeks shows lymphocytic vasculitis, anguloid atrophy, lymphocytic myofiber infiltration, fiber necrosis with macrophage infiltration and regeneration. Biopsies of semitendinosus or membranosus muscles may show some evidence of atrophy and vasculitis, but significant inflammatory infiltrates may be absent in these tissues. The extent of the inflammatory infiltrates in epaxial muscles is such that a diagnosis can often be established from several formalin fixed Trucut samples.

**Treatment:** Horses with concurrent evidence of streptococcal infection should be treated with antibiotics. It is likely prudent to avoid intramuscular injections. Administration of corticosteroids appears to immediately improve signs of malaise and inappetence and prevented further progression of muscle atrophy. Recommended dosages are: dexamethasone (0.05 mg/kg) for three days, followed by prednisolone (1 mg/kg for 7 to 10 days) tapered by 100 mg/week over one month. Serum CK activity often normalizes after 7 – 10 days. Muscle mass will usually gradually recover over two-to-three months.

**Outcome:** Horses that are not treated with corticosteroids may develop extensive muscle atrophy, but in many cases, muscle mass will gradually recover. Recurrence of atrophy in susceptible horses is common and may require reintroduction of corticosteroid therapy. Some horses develop focal residual muscle atrophy.

**FOCAL MUSCLE ATROPHY**

**Causes:** Neurogenic Atrophy or Myogenic

1. **Neurogenic Atrophy**
   - Trauma
     - Physical or Post-anesthetic
   - Compression
     - Boney compression, scar tissue or tumor
   - Disease
     - EPM or Polyneuritis equi

2. **Myogenic Atrophy**
   - Disuse
   - Trauma so severe that it disrupts the architecture need for complete repair
   - Immune-mediated myopathy

**Diagnostics**
- History
  - Progression, duration, trauma, anesthesia
- Physical and neurologic examination
  - Ataxia, tail tone, anal tone
- EPM IFAT testing of serum
- Serum AST and CK
- Radiology where bony impingement possible
- Ultrasonography
- Muscle biopsy
Treatment

- Remove underlying condition
  - EPM- Ponazuril
  - Relieve compression
    - Necks - articular facet injections
  - Rehabilitation Therapy
    - Electrical stimulation
    - Therapeutic ultrasound
    - Resistance training
      - Aquatreadmill
      - Sloped treadmill

Weights

REFERENCES


