

# **Equine Metabolic Diseases and Laminitis**

A photograph of four horses standing in a stable. From left to right: a white horse, a dark brown horse, a light brown horse with a white blaze, and a dark brown horse with a white blaze. The background shows wooden stall dividers and a white wall.

**Elizabeth (Betsy) Lordan, DVM**

# **2 Major Metabolic Diseases Associated with Laminitis**

**Cushings Disease (PPID):**

Tumor of the pituitary gland alters production of regulatory hormones

**Equine Metabolic Syndrome:**

An endocrine disorder associated with obesity and subsequent insulin resistance

**Both diseases can be characterized by Insulin Resistance!**

# Equine Metabolic Syndrome: What is it?

- An endocrine disorder associated with:
  - Obesity/Regional Adiposity (fat pads)
  - Insulin Resistance
  - Hyperinsulinemia



# How do horses get EMS?

- Overfeeding is probably the number one cause of EMS
- Some horses are more prone than others, but owners need to be aware that by allowing a horse to become obese, we are essentially killing them with kindness.

# Equine Metabolic Syndrome: Who is at risk?

- “Easy keepers”
  - require less calories to maintain body weight
- Certain breeds prone to obesity:
  - Ponies, Morgans, Arabians, Saddlebreds, Paso Finos, Quarter Horses and Tennessee Walkers



# Pregnant Mares

- Insulin resistance is a common finding in pregnant mares
- Helps shuttle glucose to the growing foetus
- Can exacerbate pre-existing metabolic conditions and cause problems
- Be conscientious of your mare's condition at conception and throughout the pregnancy
- Better mare management means many foals for years to come

# What does obesity look like in the horse?

**Body Condition Score Chart**

Areas of emphasis for body condition scoring: thickening of the neck, fat covering the withers, fat deposits along backbone, fat deposits on flanks, fat deposits on inner thighs, fat deposits around tailhead, fat deposits behind shoulders, fat covering ribs, shoulder blades into neck.

**1 Poor**  
 Actual carcass structure; spine, ribs, tailhead, points of hip and buttock projecting prominently; bone structure of withers, shoulders, and neck easily ascertainable; no fat cover can be felt.

**2 Very Thin**  
 Actual carcass; slight fat covering over base of spine; ribs, tailhead, points of hip and buttock prominent; withers, shoulders, and neck structure fairly discernible.

**3 Thin**  
 Fat holding about halfway on spine; slight fat cover over ribs; spine and ribs easily discernible; tailhead prominent, but individual vertebrae cannot be identified visually; points of hip appear rounded but easily discernible; points of buttock not distinguishable; withers, shoulders, and neck unobscured.

**4 Moderately Thin**  
 Slight ribs along flank; line of ribs discernible; tailhead prominence depends on conformation; fat can be felt around it; points of hip not discernible; withers, shoulders, and neck not obviously thin.

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**5 Moderate**  
 Back to fat (no cross the edge); ribs not visually distinguishable but easily felt; fat around tailhead beginning to feel spongy; withers appear rounded over spine; shoulders and neck blend smoothly into body.

**6 Moderately Fleishy**  
 May have slight crease down back; fat over ribs fleshy/spongy; fat around tailhead soft; fat beginning to be deposited along sides of withers, behind shoulders, and along sides of neck.

**7 Fleishy**  
 May have crease down back; individual ribs can be felt, but noticeable filling between ribs with fat; fat around tailhead soft; fat deposited along withers, behind shoulders, and along neck.

**8 Fat**  
 Crease down back; difficult to feel ribs; fat around tailhead very soft; area along withers filled with fat; area behind shoulders filled with fat; noticeable thickness of neck; fat deposited along inner thighs.

**9 Extremely Fat**  
 Obvious crease down back; patchy fat appearing.



Kentucky Equine Research, 1070 Embassy Ferry Dr., Amos, KY 40004, 855-475-7888, www.kenr.com

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# Regional Adiposity





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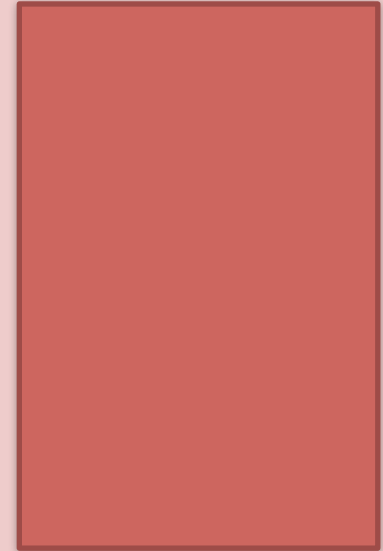
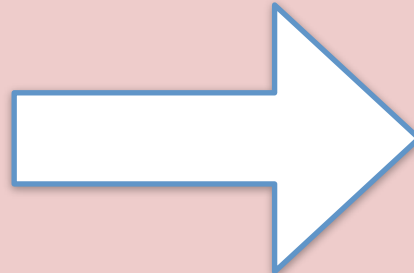


# Insulin Resistance

- When a horse is obese, fat deposits exhaust their normal storage areas and are then directed to other places such as skeletal muscle, liver and pancreatic tissues.
- Fat cells release inflammatory products. These tissues eventually stop responding appropriately to insulin and insulin resistance develops.

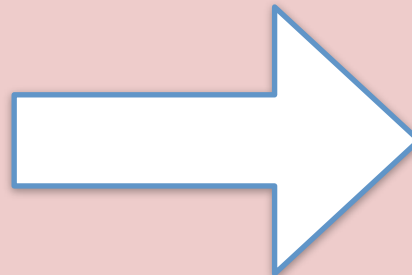
# Reviewing the function of insulin

When a normal animal eats, the body converts food material into glucose and glucose levels in the blood rise.



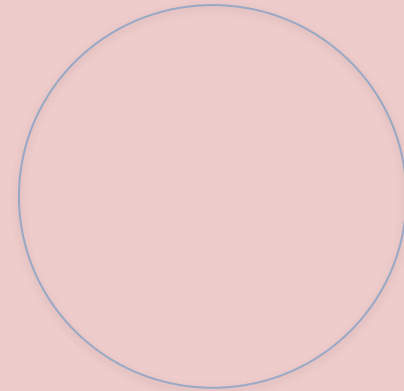
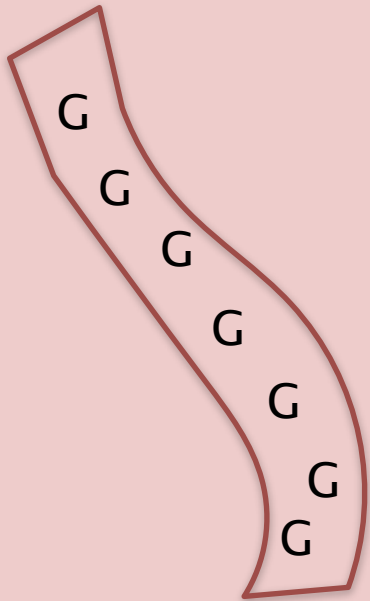
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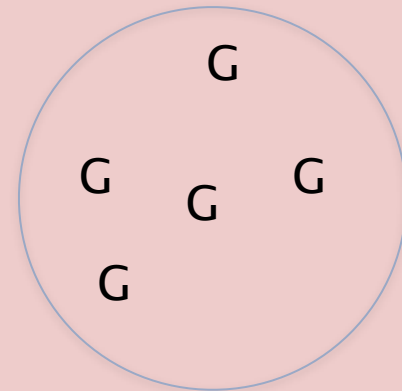
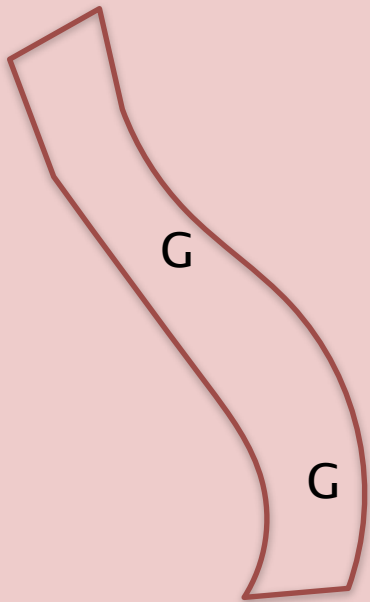
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Insulin is a hormone produced in the pancreas which functions within the body to move glucose from the bloodstream into the cells to provide the body with energy



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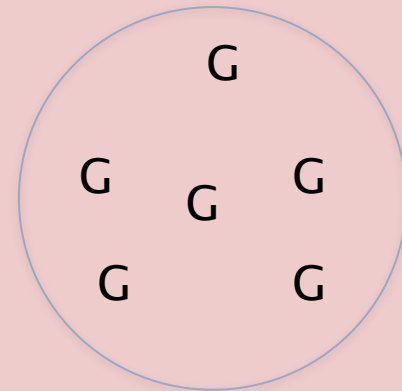
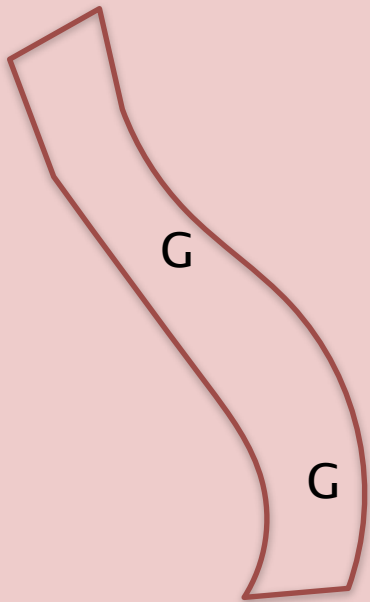
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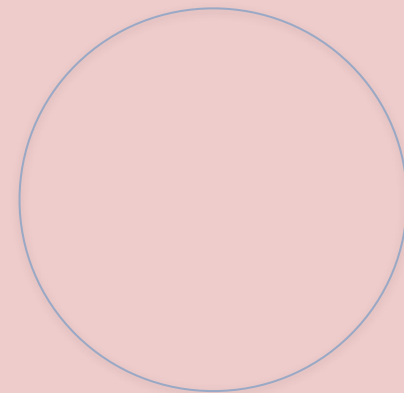
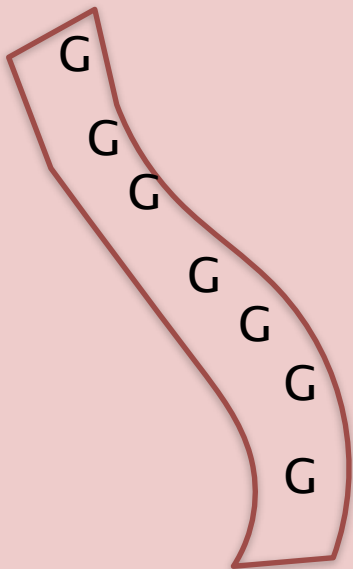


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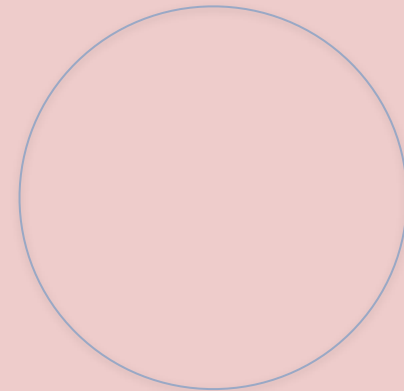
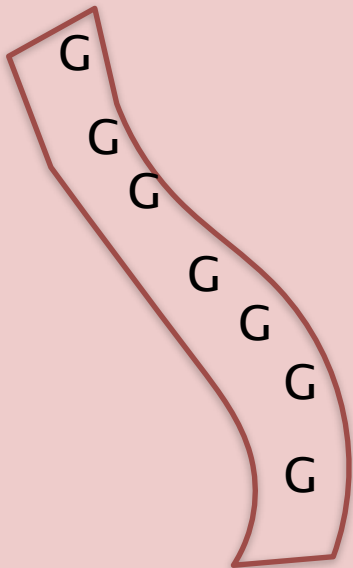


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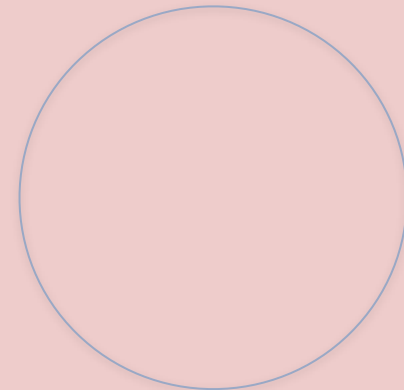
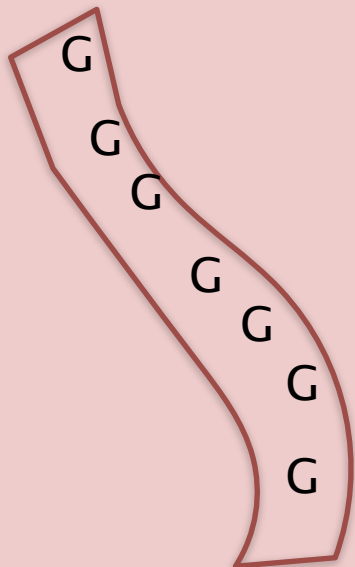
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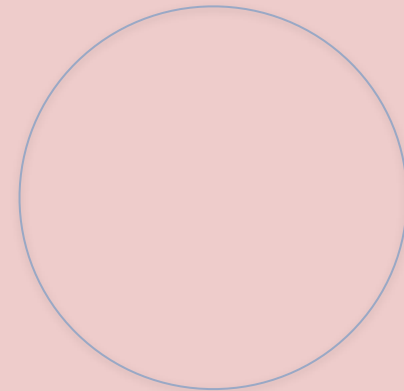
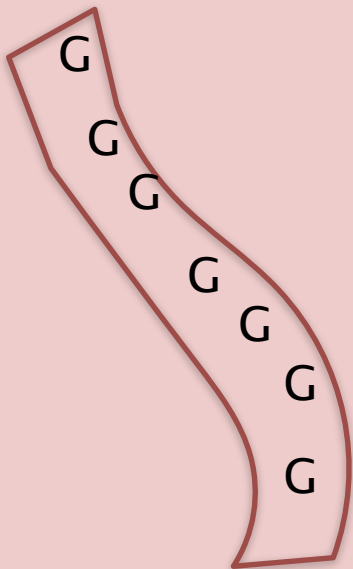
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More insulin is produced and both the insulin and glucose levels in the blood are high



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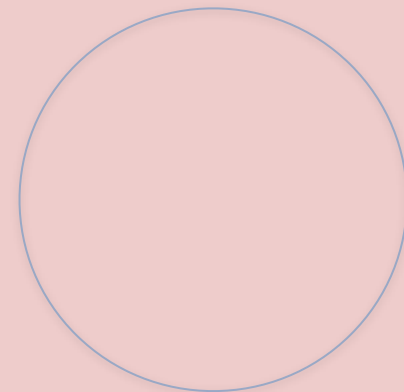
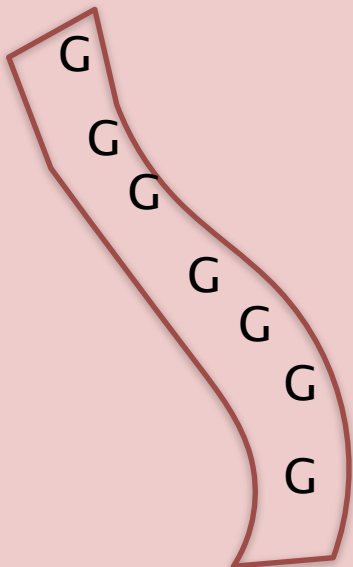
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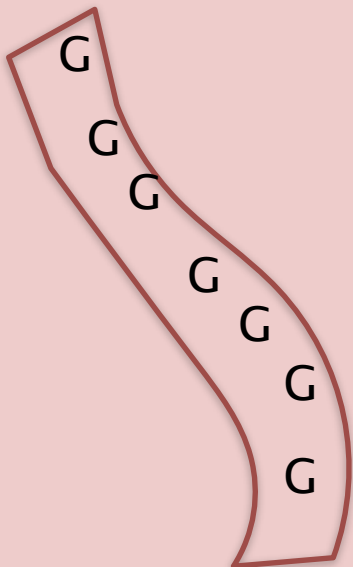
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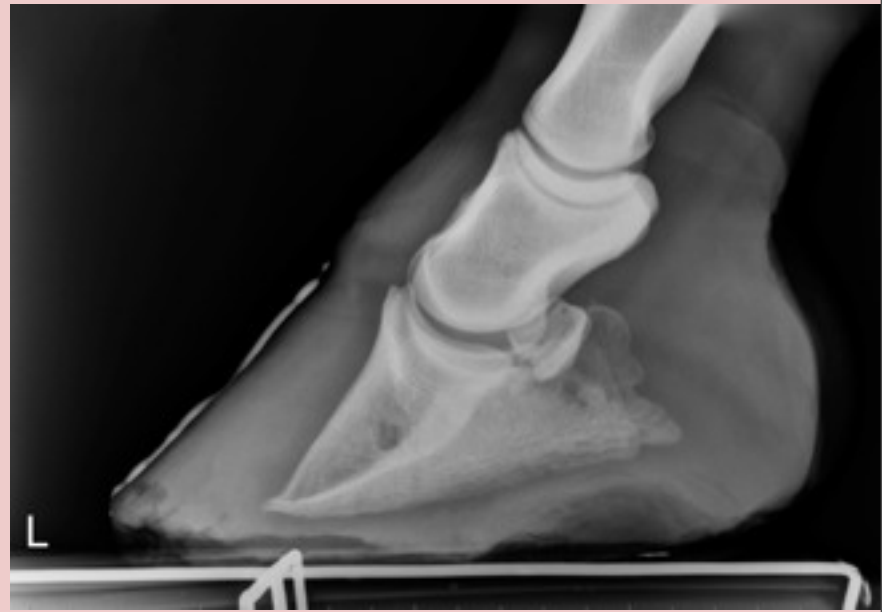
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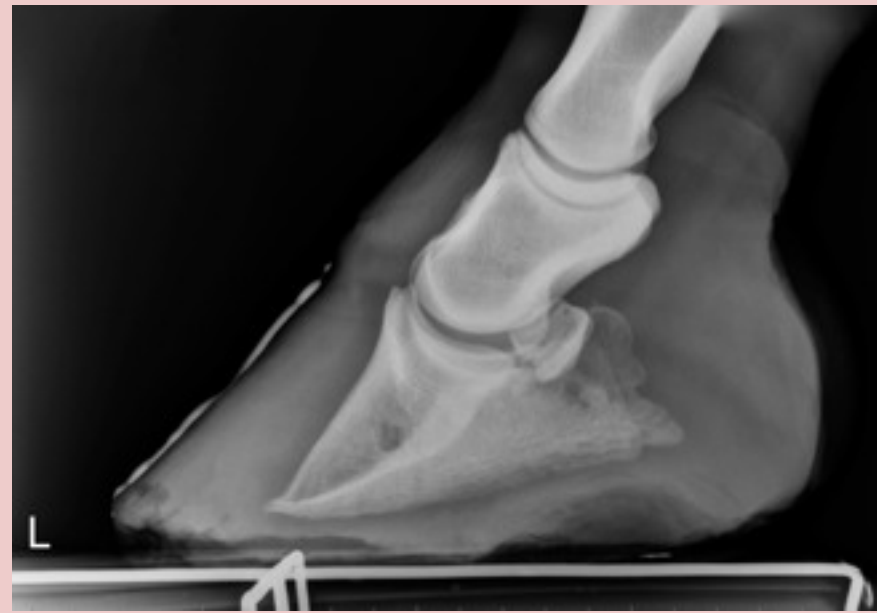
# Why does IR lead to Laminitis?

3 Suspected Mechanisms





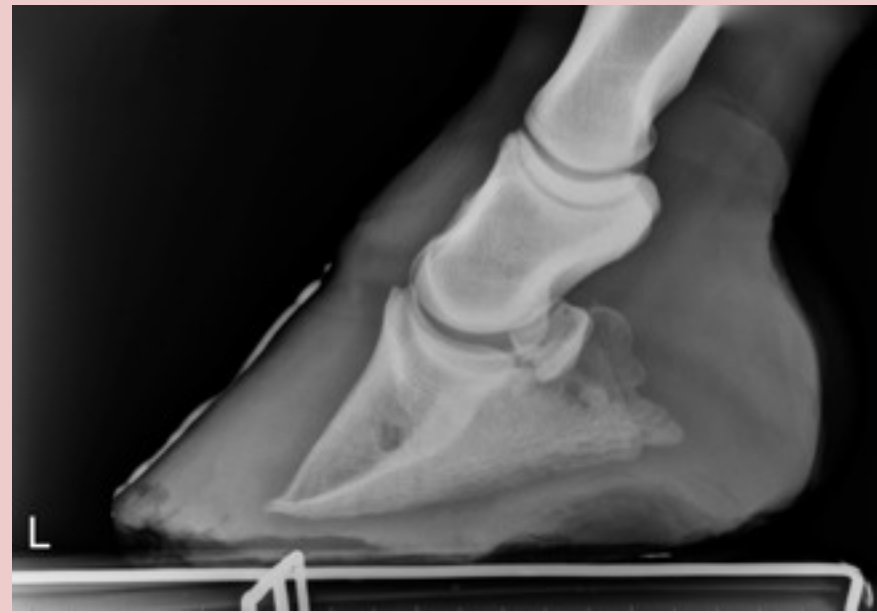
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## 3 Suspected Mechanisms

- 1.) Altered blood flow or cellular dysfunction in the blood vessels of the foot
- 2.) Impaired nutrient delivery to hoof tissues
- 3.) Proinflammatory or prooxidative state caused by obesity and insulin resistance

# Metabolic Syndrome

Not all fat horses have insulin resistance and not all insulin resistant horses are fat!

Obesity is considered a major risk factor but is not definitive.

Some horses continue to be laminitic even after losing weight because metabolic derangements are still present.

# Other complications of equine obesity

- Added stress on:
  - Cardiovascular system
  - Bones and joints
    - Growing horses
      - Increased incidence of developmental orthopaedic disease
    - Older horses
      - Worsening of arthritis symptoms
      - More stress on bones and joints

# How do we test for Insulin Resistance?

- Our goal is to determine if the body can respond appropriately to an elevated glucose level
- Artificially elevate blood glucose levels
  - How much does insulin rise?
  - Does blood glucose decrease in response to insulin?

# Equine Metabolic Syndrome: Diagnosis

- **Oral Sugar Testing**
  - **Horses are fasted after evening meal**
  - **Blood drawn 8 hours later for baseline glucose & insulin levels**



# Equine Metabolic Syndrome: Diagnosis

- **Oral Sugar Testing**
  - **Horses are fed glucose powder**
  - **Blood drawn again in 2 hrs to measure glucose & insulin levels**





# Interpreting the test

- Initial blood test:
  - Fasting insulin concentration should be less than 20 uU/ml
  - Glucose 4.5-5.5 mmol/L
- Post Glucose Blood Test:
  - Insulin
    - <45uU/ml Normal
    - 45-60uU/ml repeat test
    - >60uU/ml suspect EMS
  - Glucose >125mg/ml suspect EMS

# Things that can affect the test

- Stress
- Pain
- Acute laminitic episode should be stabilised prior to any testing



# Equine Metabolic Syndrome: Treatment

- 1.) Treatment for acute laminitis
- 2.) Dietary management
- 3.) Exercise
- 4.) +/- Medications



# Exercise and Diet!

- Proper weight management can help reverse the effects of Equine Metabolic Syndrome and Insulin Resistance in many cases



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We encourage you to take it seriously for the long term health of your horse

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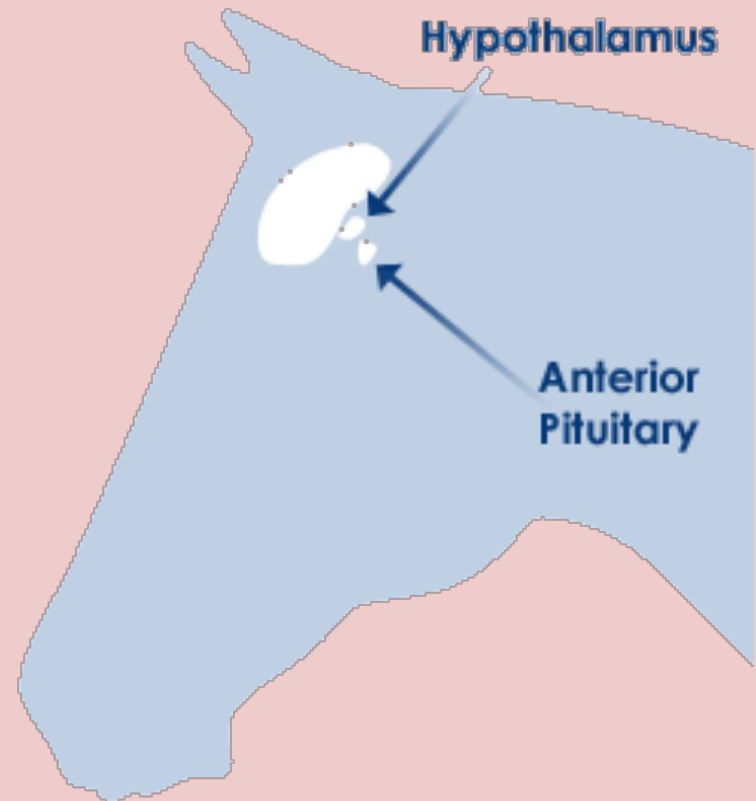
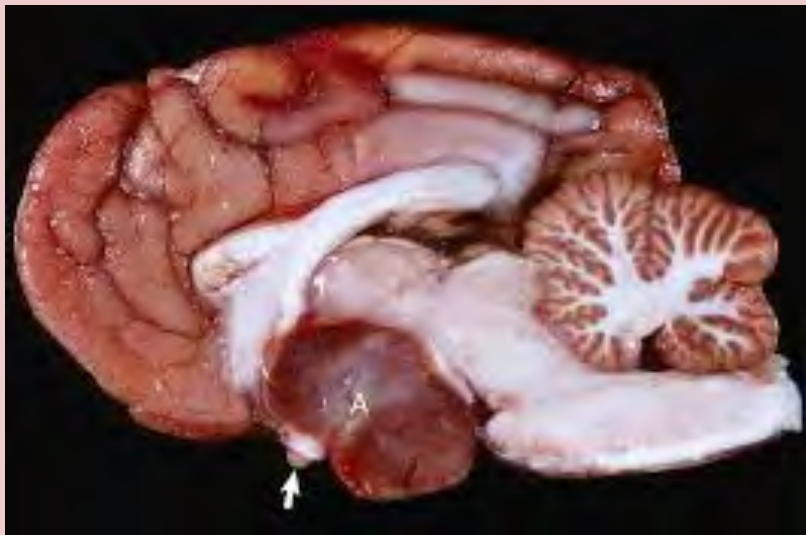
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**Metformin hydrochloride:** Used in humans to control hyperglycaemia and increase insulin sensitivity

These treatments have variable results in studies so we currently do not recommend them

# Cushing's Disease (PPID): What is it?

**Pituitary Pars  
Intermedia Dysfunction**  
Benign adenoma (tumor)  
of the  
pituitary gland



4 lobes of the pituitary gland:

Intermediate lobe affected in horses,  
whereas the anterior lobe is more commonly  
affected in dogs and humans

Pituitary gland produces a large number of proteins  
involved in signaling pathways

DOPAMINE regulates the production of these  
hormones

# Cushing's Disease

- One of the proteins produced by the pituitary is adrenocorticotrophic hormone also known as ACTH
- ACTH only produced in very small amounts in the normal horse and is only makes up about 2% of the proteins produced by the intermediate lobe
- Easier to measure than other proteins so it is used for testing

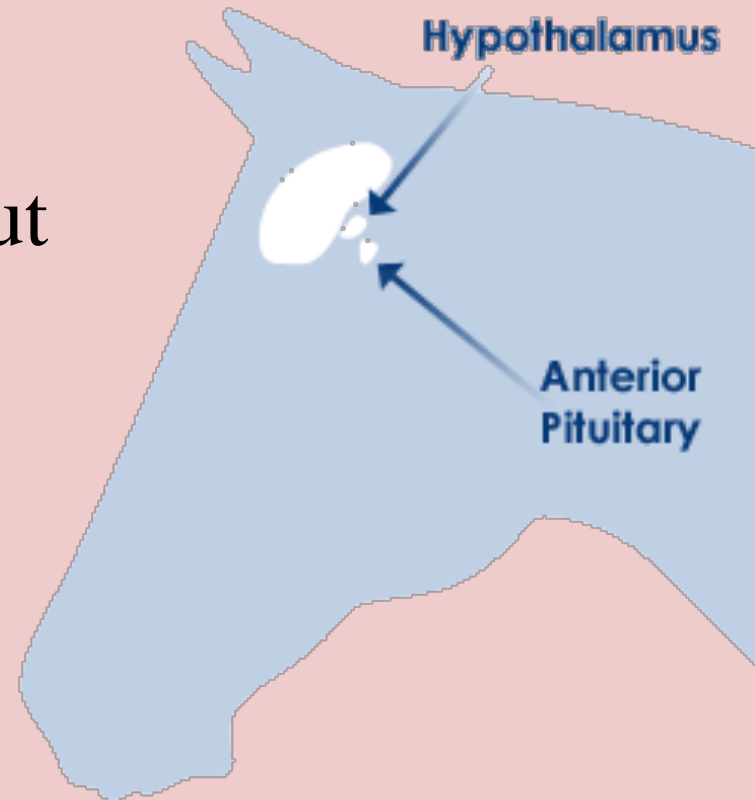
# Cushing's Disease

Age is a primary risk factor for these horses

Loss of dopaminergic input to the gland

The pars intermedia is enlarged in horses with PPID

Hormone production is unregulated



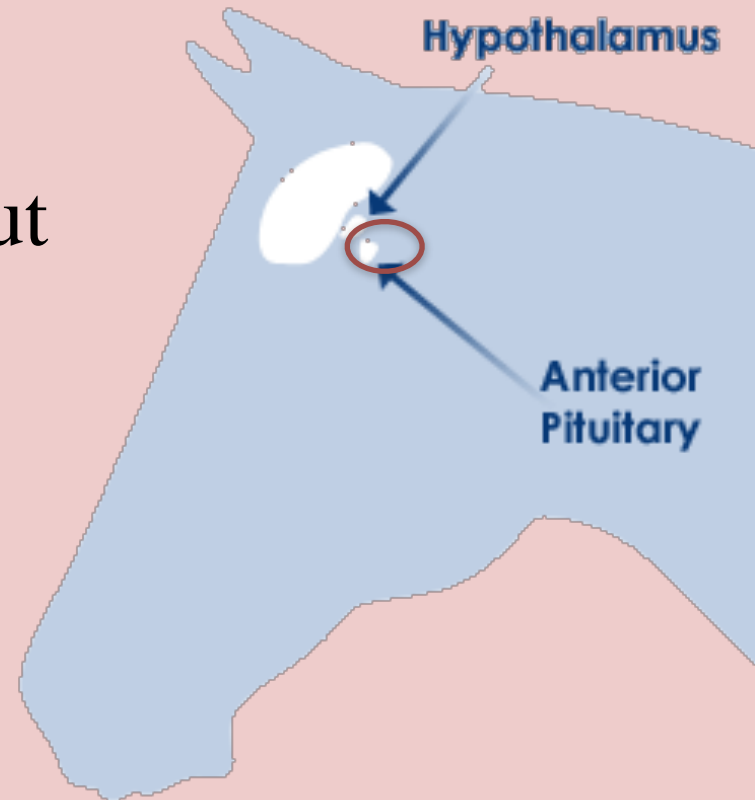
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# Cushing's Disease Clinical Signs

- Hirsutism (shaggy haircoat)
- Excessive drinking/urination
- Weight loss
- Regional adiposity
- Lethargy
- Recurrent infections
- Laminitis



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Clinical signs are suspected to be related to pars intermedia products, but remember ACTH on makes up about 2% of those proteins!



# How is PPID related to Laminitis?



Studies have reported that anywhere from 25-75% of horses with PPID are also insulin resistant

These horses are at greater risk for laminitis

# Cushing's Disease: Diagnosis

- There are many different tests, I'm just going to mention a couple
- Dexamethasone Suppression Testing
  - Fallen out of favor
- ACTH levels (baseline)
  - Time of year important



# Cushing's Disease: Treatment

- Management of acute disease symptoms
- Reduce excess sugar in diet
- Dopamine pathway!
  - Dopamine like substances such as pergolide/prascend can regulate the pathway



# Treatment

**What you should expect to see:**

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**First 30 days:**

Improved:

- \* Attitude
- \* Excessive urination and water consumption
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Remember it can take up to a month to see results, baseline testing should be repeated after 30 days of treatment

# Long Term Response and Monitoring

## 6-12 months

Improvement in haircoat abnormalities

Less pronounced rounding of abdomen

Infections are less likely to develop

Increased skeletal muscle mass

Fewer/milder episodes of laminitis

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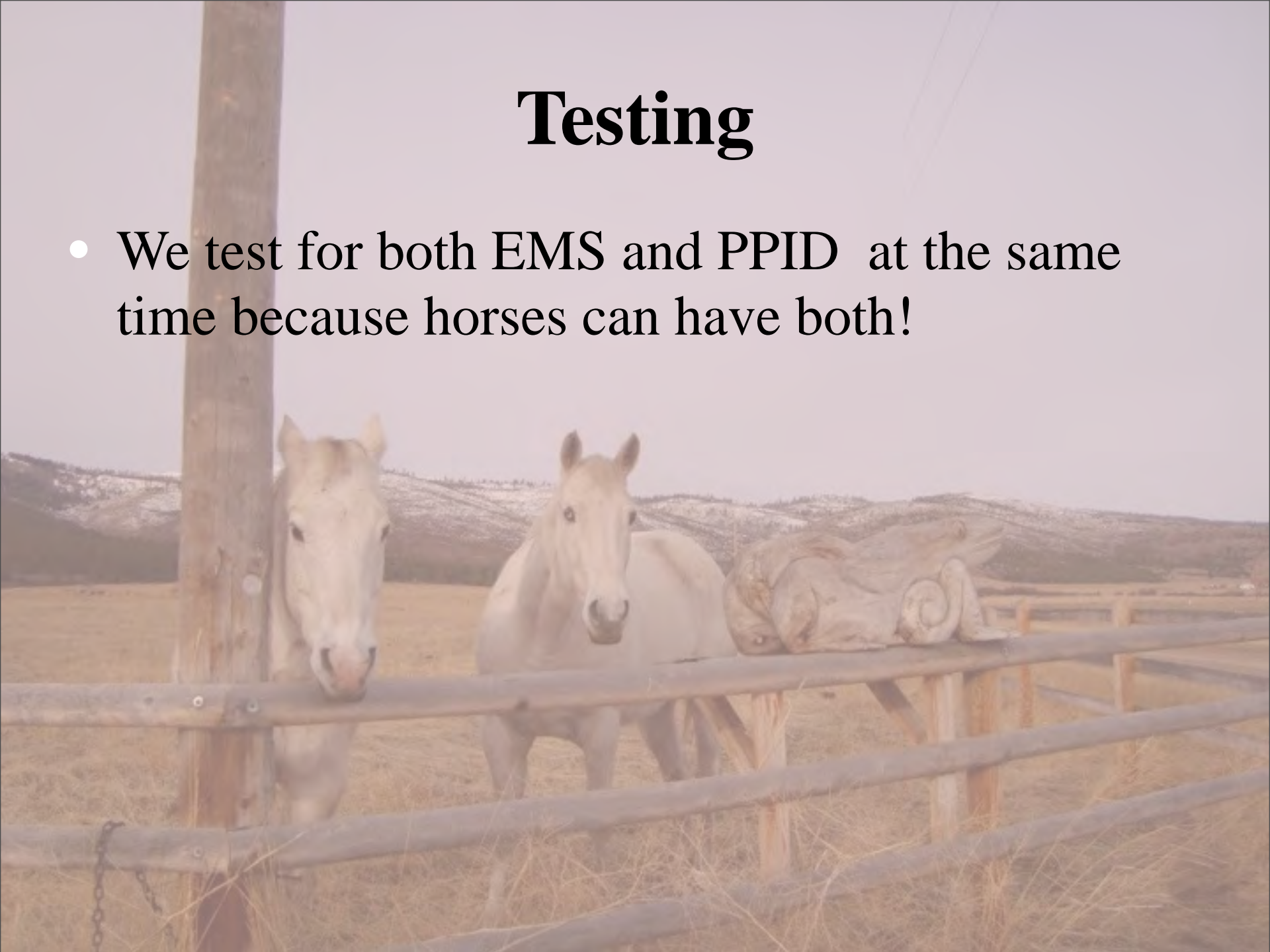
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**Plan to recheck blood tests every 6-12 months and readjust dosage as necessary**



# Testing

- We test for both EMS and PPID at the same time because horses can have both!



# So Remember:

- We want you to be able to enjoy your horses for a long time to come
- Be proactive and cognisant of these risk factors



# References

- McFarlane, Dianne (2008) Diagnosing Equine Pituitary Pars Intermedia Dysfunction in Ambulatory Practice. In: *Proceedings Am. Ass Equine Pract.* 54: 204-206.
- McFarlane, Dianne (2013) Review of Current Understanding of Pituitary Pars Intermedia Dysfunction. In: *Proceedings Am. Ass Equine Pract.* 59: 294-296.
- Geor, RJ, McCue, M and Schultz, N. (2013) Current Understanding of Equine Metabolic Syndrome. In: *Proceedings Am. Ass Equine Pract.* 59: 297-303.
- Morresey, PR (2012) Metabolic Syndrome in the Pregnant Mare. In: *Proceedings Am. Ass Equine Pract.* 58: 339-344.
- <http://sites.tufts.edu/equineendogroup/files/2013/11/EEG-recommendations>

A landscape photograph showing a wide, flat field in the foreground. In the middle ground, a single light-colored horse stands facing left. The background features rolling hills and mountains under a sky filled with large, grey, overcast clouds. The sun is visible as a bright, hazy area behind the clouds on the left side of the frame.

# Questions??