

# Endocrine and metabolic diseases and associated Laminitis



CHUCK MAKER DVM  
ALPINE EQUINE HOSPITAL PC  
17776 HWY 82

CARBONDALE, CO 81623

ALPINEEQUINE.NET

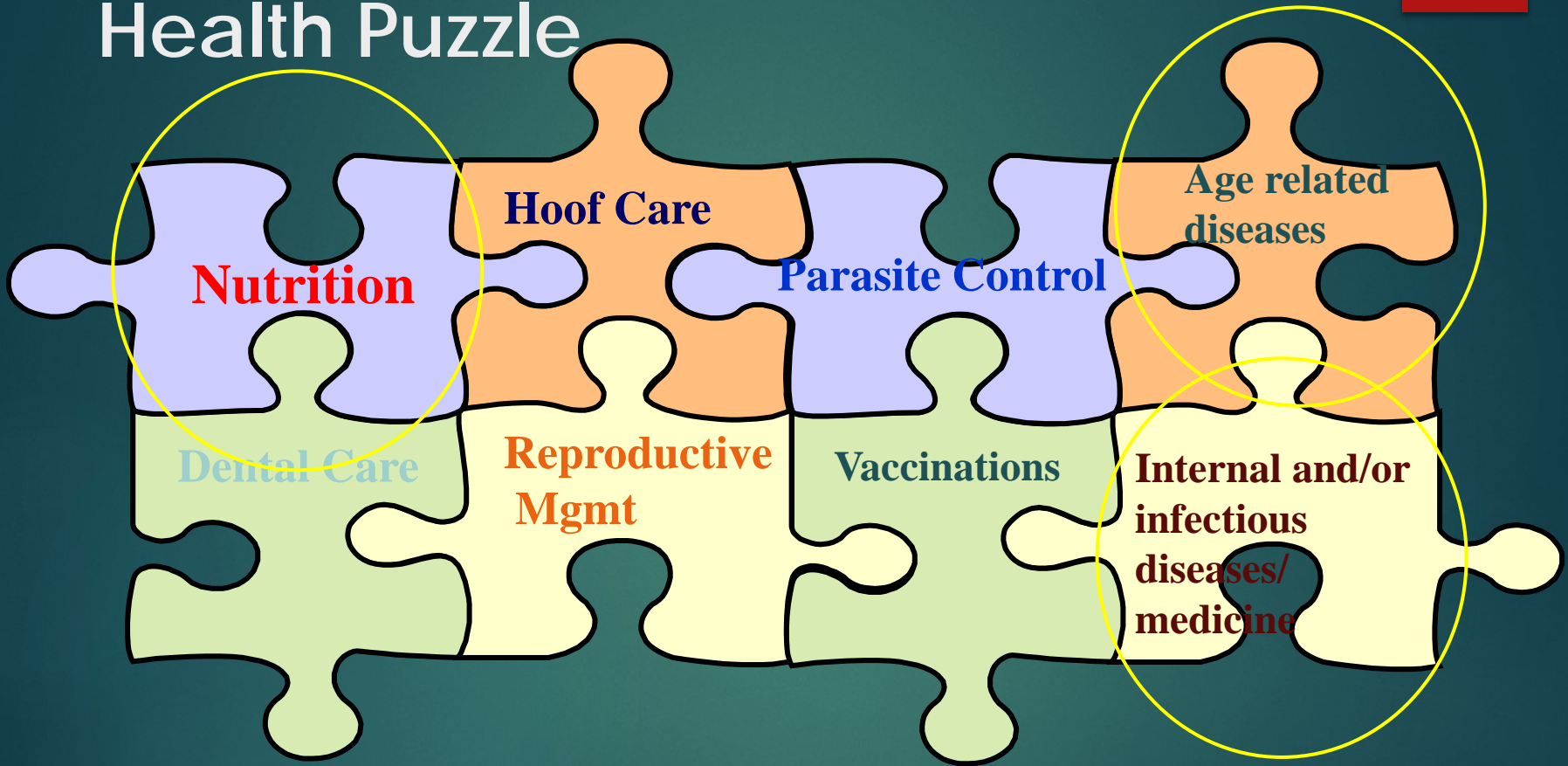
OFFICE DESK-970-379-7100

CELL-970-366-1320

DRMAKER@ALPINEEQUINE.NET



# Horse Herd Health Puzzle



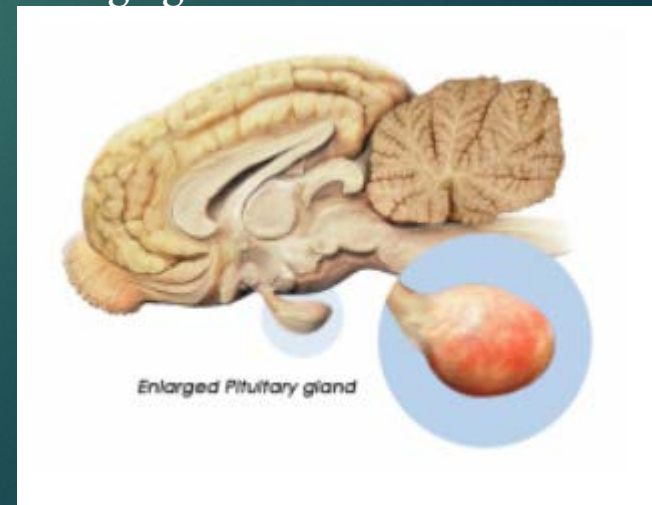
# RFVHC Table topic 3.0

previous discussions on file

- ▶ 1.0-RFVHC First Aid for the trail and barn
- ▶ 2.0 Colic and Osteoarthritis
  
- ▶ This discussion will focus on:
  - ▶ Equine Cushings disease
  - ▶ Equine Metabolic Syndrome
  - ▶ Nutrition and how it relates to EMS and PPID
  - ▶ Endocrinopathic Laminitis

# Equine Cushings disease: Equine pituitary pars intermedia dysfunction (PPID)

- ▶ slowly progressive neurodegenerative disease of older horses
  - ▶ nonmalignant hypertrophy and hyperplasia of middle pituitary gland
  - ▶ Symptoms: hirsutism, laminitis, polyuria, and polydipsia.
  - ▶ Prevalence: 15% to 39% of aged equids (>15-18 years of age)
  - ▶ these estimates likely provide the lower range for prevalence of the disease due to the fact they selected horses with coat abnormalities
    - ▶ The only animal risk factor for the disease is increasing age
    - ▶ no apparent sex or breed predisposition





# Equine Cushings disease and EMS

- ▶ 40% estimate of PPID horses have evidence of abnormal glucose metabolism, including hyperinsulinemia, hyperglycemia, or both
- ▶ although only 20% have evidence based on results of EMS diagnostic tests
  
- ▶ As yet unclear if the abnormal glucose metabolism and hyperinsulinemia are attributable to PPID or concurrent equine metabolic syndrome

# Equine Cushings disease

- ▶ hirsutism, hyperhidrosis, polyuria, polydipsia, polyphagia, muscle atrophy, laminitis, and more docile demeanor/cognitive changes.
- ▶ Hirsutism is a clinical sign in 95% of advanced cases
- ▶ Hirsutism: delayed or absent seasonal shedding resulting in a long, shaggy hair coat with lightening of the coat color.
- ▶ PPID horses have a greater proportion of hair follicles in the anagen phase (especially on the neck) than healthy equids
  - ▶ Anagen-hair growth vs telogen (hair loss)
- ▶ Polyuria and polydipsia are common clinical
  - ▶ Likely due to diabetes insipidus and not to hyperglycemia.



# Equine Cushings disease

- ▶ Topline muscle loss associated with PPID is characterized by atrophy of type 2 (slow-twitch) fibers
- ▶ Lean muscle loss/muscle atrophy mechanisms unknown
- ▶ Common central obesity, characterized by excessive fat deposition in the crest of the neck and in the supraorbital fossae
  - ▶ comorbidity with equine metabolic syndrome vs a characteristic of PPID.
- ▶ Laminitis is common in equids with PPID
- ▶ Unclear if this is a result of PPID or comorbidity with EMS.





# Equine Cushings disease

- ▶ Other effects of PPID
  - ▶ Affected equids are often infertile
  - ▶ Periodontal disease!!!!!!!!!!
  - ▶ Slow wound healing
  - ▶ Internal parasitic infections
  - ▶ heal poorly
  - ▶ Prone to opportunistic infections especially skin infections
  - ▶ Horses may show any combination of these signs with only a single sign being evident or multiple signs being present. Very often the first sign that we see is laminitis or founder.




# Equine Cushings disease- Treatment

- ▶ Treatment is palliative and not curative
  - ▶ clinical signs can be controlled by administration of pergolide
  - ▶ underlying neurodegenerative disease is not cured.
  - ▶ treatment aims to reduce secretion of the products of the melanotropes through the use of dopamine agonists or serotonin antagonists.
  - ▶ Treatment must be continued for the life
- ▶ The **treatment of choice pergolide mesylate**, a dopamine agonist for m90 days
  - ▶ Laboratory (plasma ACTH concentration) signs of the disease should be evaluated.
  - ▶ Pergolide mesylate is rapidly absorbed
  - ▶ compounded Pergolide-in an aqueous vehicle because it is susceptible to degradation if exposed to heat, light, or both.

# Equine Cushings disease

- ▶ A commercial form of pergolide mesylate formulated for use with horses and ponies (Prascend<sup>®</sup>) is available AND MORE DEPENDABLE-avoid compounded products
- ▶ Cyproheptadine, a serotonin antagonist: rarely used in the treatment of PPID.
- ▶ Symptomatic treatments
  - ▶ clipping of the hair coat in spring
  - ▶ treatment of laminitis
  - ▶ prevention of injuries and wound infection
  - ▶ dietary management to reduce hyperglycemia in those animals with this abnormality documented (see “Equine Metabolic Syndrome”)
  - ▶ maintenance of optimal body weight
  - ▶ Some require careful nutritional management due to special needs



# Equine Metabolic Syndrome or IR-Etiology and Epidemiology

Properly termed peripheral insulin dysfunction!

**Etiology** Unknown, but likely involves genetic predisposition for insulin resistance with phenotypic expression permitted or induced by environmental factors that favor obesity.

**Epidemiology** Associated with obesity and particular breeds, especially ponies. Standardbreds appear to be at reduced risk. No sex predilection. Increasing incidence with age.

Patients with pasture-associated (endocrinopathic) laminitis infer risk factors are present for insulin resistance and EMS.



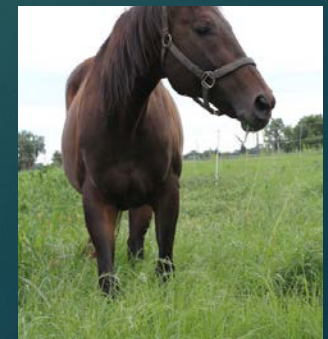
# Equine Metabolic Syndrome-Symptoms

- Obesity
- regional adiposity including a cresty neck
- predisposition to laminitis without underlying factors
- Affected horses/breeds
  - Horses or ponies of different breeds but similar body weight differ in their insulin resistance and some particular **breeds** are at increased risk of EMS
  - Ponies, Morgan Horses, Paso Fino, Andalusian, Arabian, Saddlebred, Quarter Horses, Tennessee Walking Horses, and Warmblood Horses
  - Standardbreds and perhaps Thoroughbreds are at reduced risk.
  - The frequency of the condition increases with age in ponies
  - Geldings and mares affected equally



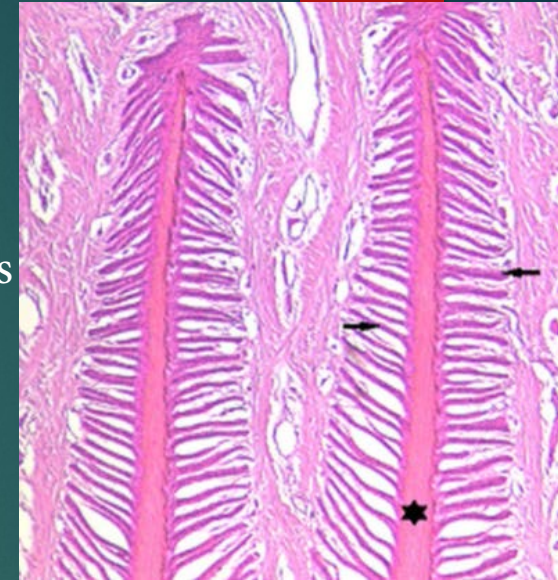
# Equine Metabolic Syndrome-Symptoms

- A **seasonality** to the occurrence of pasture-associated laminitis might represent seasonal changes in energy intake (from pasture) of susceptible animals rather than seasonal variations in severity of insulin resistance.
- insulin resistance in horses vary depending on season
  - Declines in insulin sensitivity of in summer.
  - Insulin sensitivity related to season in healthy, mature horses is not seen
- Obesity is common in domestic horses-approx. 20%
- Chronic intake of DE beyond maintenance needs (overeating) and insufficient exercise are thought to be risk



# Equine Metabolic Syndrome-Symptoms

- EMS is primarily a manifestation of insulin resistance, and IR is associated with obesity.
- EMS likely includes multiple abnormalities
  - energy metabolism
  - adipocyte function
  - hemostasis (thrombosis)
  - inflammation, response to lipopolysaccharide (endotoxin) exposure, and oxidant stress
- The pathogenesis of laminitis associated with EMS involves structural changes to the primary and secondary lamellae due to elevated insulin levels
- human IR is currently thought linked to inflammation induced by macrophage activation in adipose tissue
  - there is increasing evidence of a similar mechanism in equids.





# Equine Metabolic Syndrome-diagnosis of EMS

## CLINICAL PATHOLOGY-

- Hyperinsulinemia-
  - Fasted vs non-fasted
  - Hyperinsulinemia in the absence of conditions that increase insulin secretion (stress, pain, feeding) is strong evidence of the presence of insulin resistance
  - Factors that can increase serum insulin
    - concentration feeding, stress and pain, and sedatives
- Others-Hyperleptinemia, Hypertriglyceridemia
- Yet many older EMS might also have PPID which requires additional diagnostics

# Equine Metabolic Syndrome-

## diagnosis of EMS cont

### CLINICAL PATHOLOGY

- Dynamic testing
  - administration of insulin and monitoring of blood (plasma) glucose-complex testing & cumbersome and has a high risk
- Modified test oral sugar test (OST) provides
  - reliable and safe for detection of IR and elevated insulin
- Give Karo Corn Syrup 0.15 mL/kg to equids after an overnight fast.
- Measure insulin and glucose concentrations are measured
  - immediately before and 30, 60, and 90 minutes after

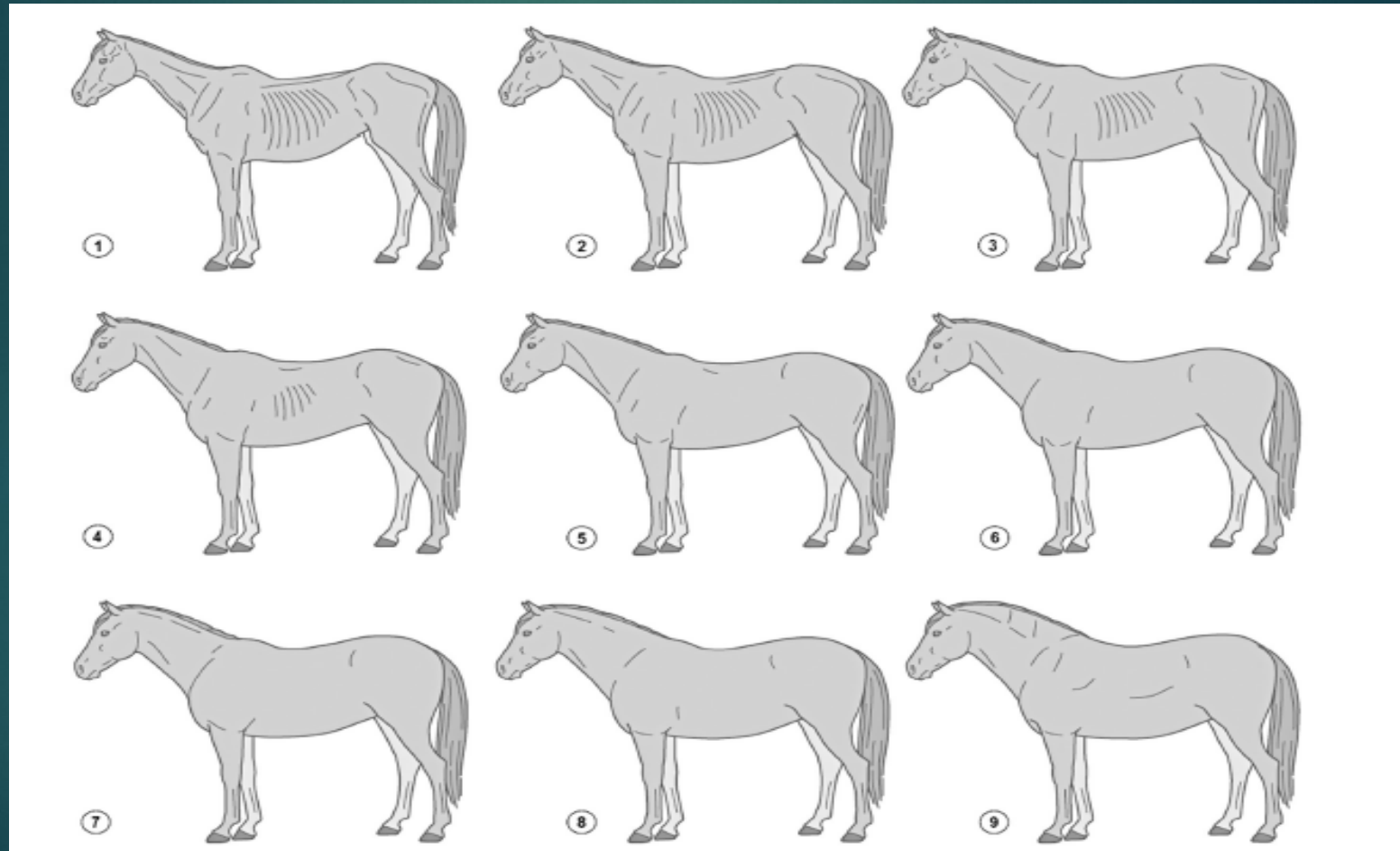
# Equine Metabolic Syndrome- dietary management

- Achieve and maintain an ideal BCS (next slides)
- body weight-(body weight does not indicate body composition).
- Minimize intake of nonstructural carbohydrates (starch)
- NSC induce an insulinemic and hyperglycemic response in EMS horses and those at risk
- Ensure an adequate and balanced intake of essential nutrients.



# Equine Metabolic Syndrome-

## Body Score Categories 1-9



# Body Score Categories: 1-3

- ▶ 1 Poor Animal extremely emaciated; spinous processes (the tops of the vertebrae), ribs, tailhead, tuber coxae (point of the hip), and ischii (point of buttock) projecting prominently; bone structure of withers, shoulders, and neck easily noticeable; no fatty tissue can be felt.
- ▶ 2 Very Thin Animal emaciated; slight fat covering over base of spinous processes; transverse processes (part of the bone projecting sideways from the lumbar vertebrae) of lumbar vertebrae feel rounded; spinous processes, ribs, tailhead, tuber coxae, and ischii prominent; withers, shoulders, and neck structure faintly discernible.
- ▶ 3 Thin Fat buildup about halfway on spinous processes; transverse processes cannot be felt; slight fat cover over ribs; spinous processes and ribs easily discernible; tailhead prominent but individual vertebrae cannot be identified visually; tuber coxae appear rounded but easily discernible; ischii not distinguishable; withers, shoulders, and neck accentuated.



# Body Score Categories:4-6

- ▶ 4 Slight ridge along back; faint outline of ribs discernible; tailhead prominence depends on conformation, fat can be felt around it; tuber coxae not discernible; withers, shoulders, and neck not obviously thin.
- ▶ 5 Back is flat (no crease or ridge); ribs not visually distinguishable but easily felt; fat around tailhead beginning to feel spongy; withers appear rounded over spinous processes; shoulders and neck blend smoothly into body.
- ▶ 6 May have slight crease down back; fat over ribs spongy; fat around tailhead soft; fat beginning to be deposited along the side of withers, behind shoulders, and along sides of neck.





# Body Score Categories: 7-9

- ▶ 7 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 Obese Crease down back; difficult to feel ribs; fat around tailhead very soft; area along withers filled with fat; area behind shoulder filled with fat; noticeable thickening of neck; fat deposited along inner thighs.
- ▶ 9 Very Obese Obvious crease down back; patchy fat appearing over ribs; bulging fat around tailhead, along withers, behind shoulders, and along neck; fat along inner thighs may rub together; flank filled with fat.

Weight reduction will only occur if the horse's energy expenditure is greater than its energy intake. Weight loss can only be accomplished by reducing the number of calories going in and increasing the number of calories expended.



# Equine Metabolic Syndrome- exercise management

- ▶ insulin sensitivity of obese horses is enhanced with increased exercise
- ▶ exercise training does not improve the insulin sensitivity of fit horses
- ▶ Moderate exercise by nonobese ponies previously affected with laminitis reduced biomarkers for stress (serum insulin concentrations)
- ▶ These results suggest a beneficial role for relatively low-intensity exercise (10 minutes enforced walking followed by 5 minutes of trotting) in reducing inflammation in ponies and horses at risk of laminitis.

# Equine Metabolic Syndrome- Take home prevention

- An ideal body condition for a horse would be:
  - one at which it has insulin sensitivity within the reference range (i.e., is not insulin resistant)
  - Where plasma triglyceride concentrations within the reference range
  - and is not at increased risk of laminitis.

>>Monitoring known measures of insulin resistance would provide guidance in achieving the animal's ideal weight and medications <<



# Equine Metabolic Syndrome-challenges and reality

- Affected horses are genetically and metabolically equipped to maintain such a body condition
- reducing body weight is not simple as just reducing feed intake
- reduction in feed intake-1.25% of body weight daily as hay is adequate to achieve a gradual reduction in body weight.
- Remember to provide essential nutrients and provide for the digestive and psychological health while reducing daily calories

# Equine Metabolic Syndrome-

## feeding strategies continued

- eliminate or severely reduce access to pasture
  - Horses can consume 2% to 5% of their bw in pasture/day.
- Green pasture, has a high content of nonstructural carbohydrates (glucose, starch)
  - induces a glycemic and hyperinsulinemia response in susceptible horses.
- dry lot or by fitting a grazing muzzle.
- Measure the nonstructural carbohydrate content of the hay
- To soak or steam?
- cold water for 12 to 16 hours before feeding.
- The water used to soak the hay should not be provided
- Feeding such a diet will reduce body weight and improvement in indices of insulin sensitivity.
- reduction in daily dry matter intake to 1% of body weight can be considered
- Be mindful of behavioral changes

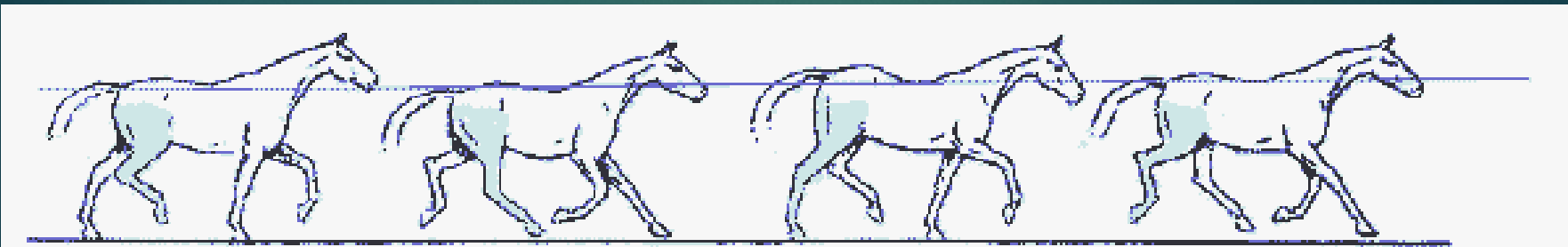
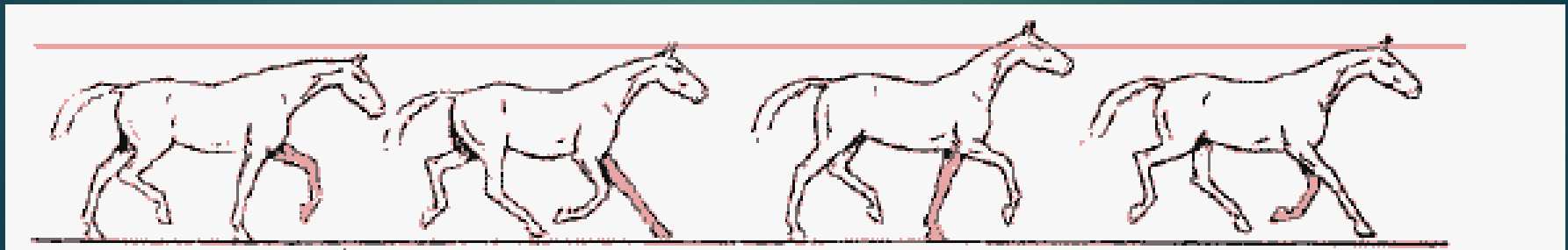
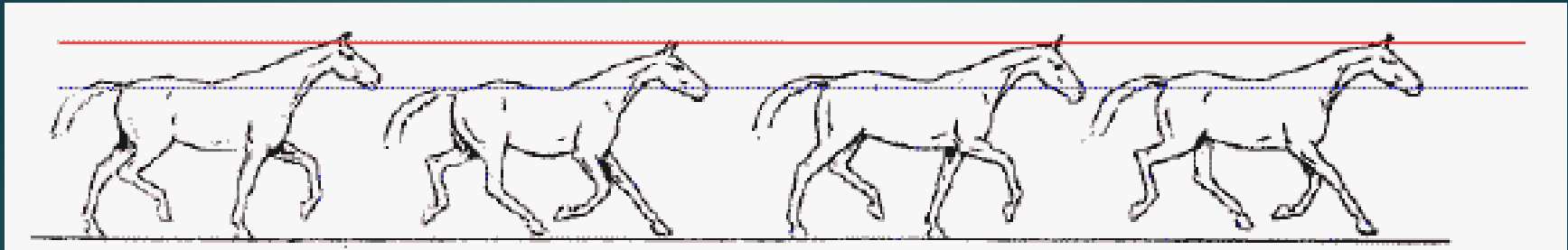
# Equine Metabolic Syndrome- levothyroxine and /r metformin

- Thyroid powder- (12, 24, 36 mg/day) causes weight loss and improves insulin sensitivity in obese horses and is recommended as an adjunct to dietary management
- Metformin: Rx of type 2 diabetes in people to improve insulin sensitivity.
  - pharmacologic investigation has not demonstrated its efficacy at lower doses in improving insulin sensitivity.
    - metformin at 30 mg/kg q12h reduced glycemic and insulinemic responses of healthy horses and horses with dexamethasone-induced insulin resistance to administration of dextrose.
- Pioglitazone variable doses and success- 1-2.2 mg/kg q24h



# Lameness-Laminitis

- ▶ General Signs: Head bobbing, dropping hip, pointing, strong digital pulse, pain on cornering



# Lameness-Laminitis

- ▶ Increased heat/Cold feet
- ▶ Changes digital pulses
- ▶ Discolored spots on sole
- ▶ Chronic sole bruising
- ▶ Abnormal findings
  - Soft swelling or sunken coronet
  - Dropped solar arch
  - Seedy toe



# Lameness-Acute Laminitis

- ▶ Resists lifting feet
- ▶ Elevated heart rate
- ▶ Sweaty
- ▶ Distressed
- ▶ Strong digital pulse



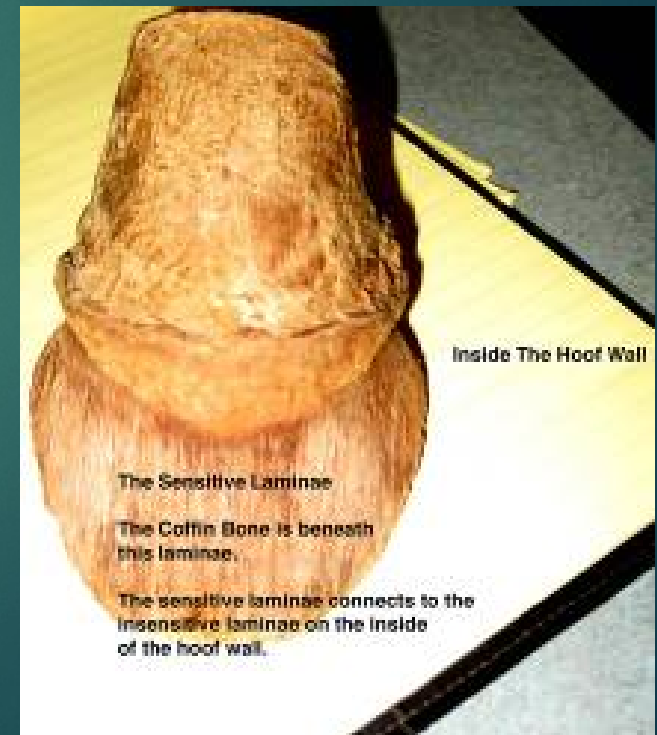
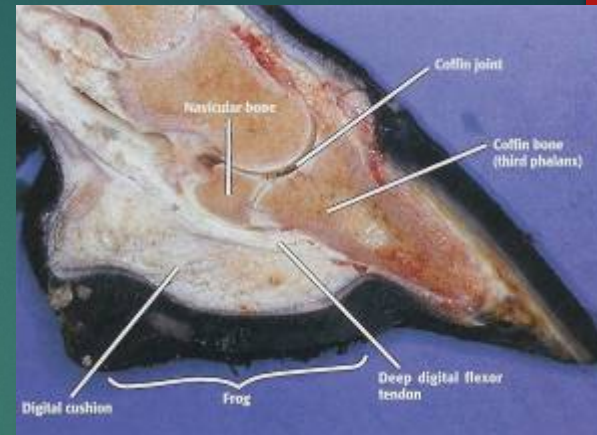


# Internal anatomy of the foot



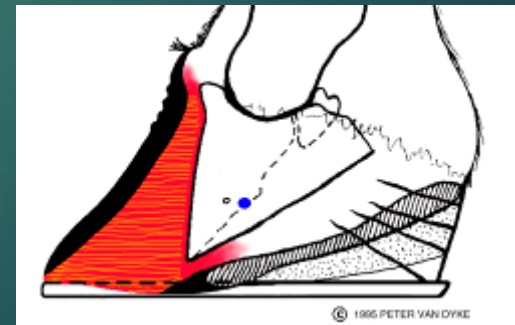
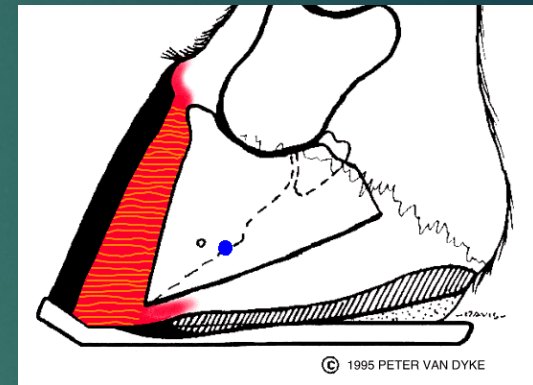
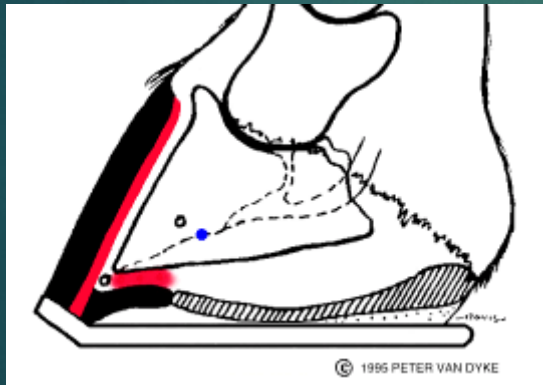
# Internal anatomy of the foot

- ▶ Prognosis
  - ▶ 30% return to soundness
  - ▶ 10% intermittently lame
  - ▶ 10% permanent severe lameness
  - ▶ 50% death
- ▶ Quantify outlook with digital venogram



# Lameness-Acute Laminitis

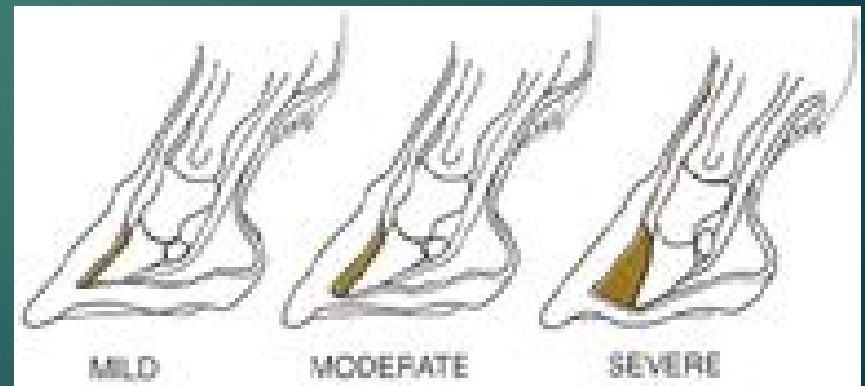
- Sudden
- Shifting weight
- Stilted, shuffling gait
- Fore feet extended – hind feet under the center of the body
- Reluctant to move





# Lameness-Chronic Laminitis

- ▶ Pressure on the sole from a rotated or sunken pedal bone
- ▶ Breakdown of the hoof wall-pedal bone bond
- ▶ Permanent changes in blood supply to the hoof wall



# Lameness-Chronic Laminitis

More susceptible to:

Sole bruises

Abscesses

Flaring & separation of the wall at the toe

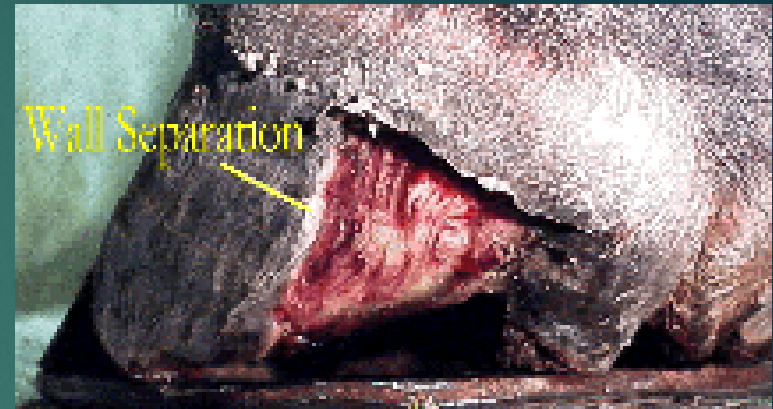
Infection beneath the separated wall

Hoof wall cracks

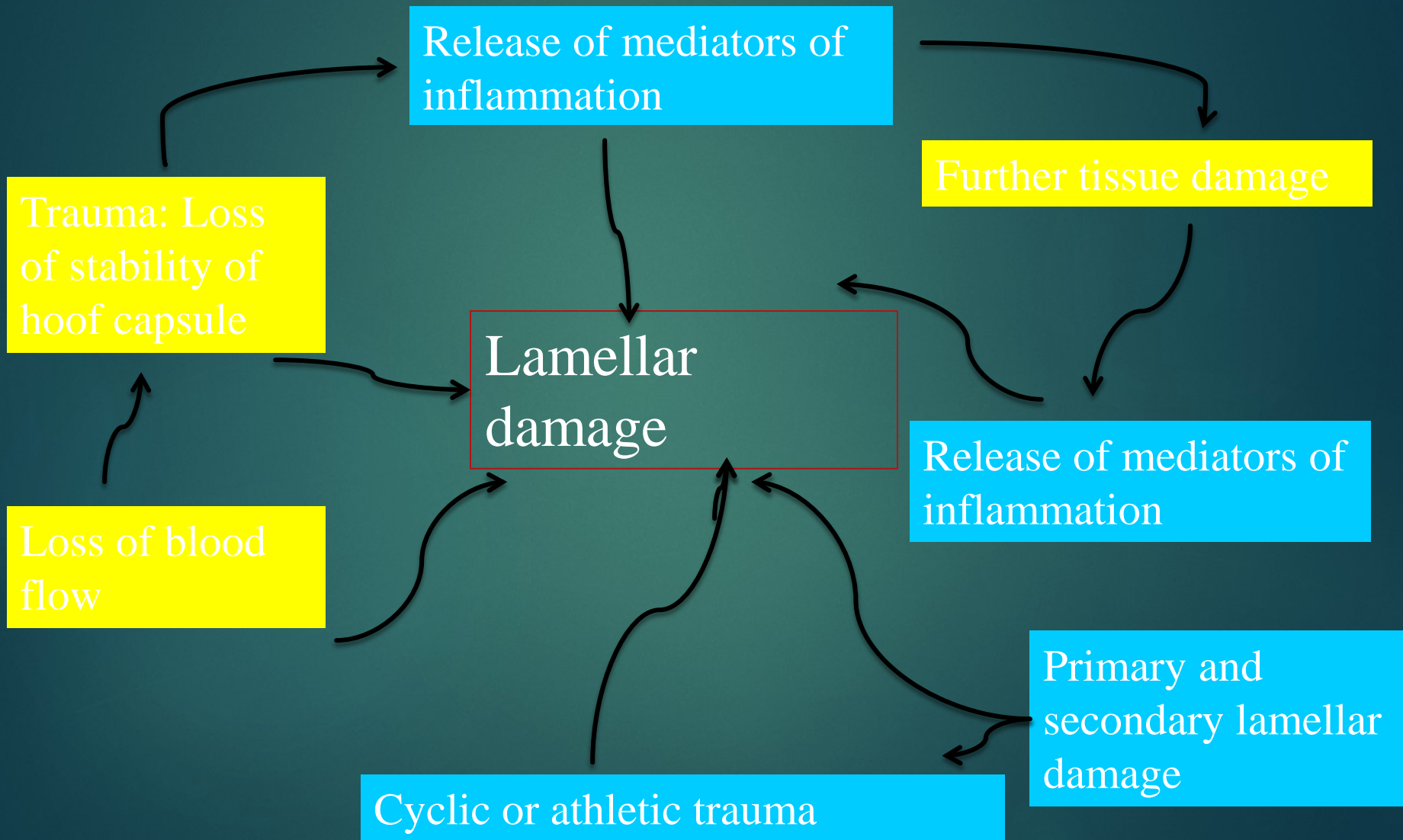
Degeneration of the tip of the pedal bone

Chronic lameness

Slowed hoof wall and sole growth



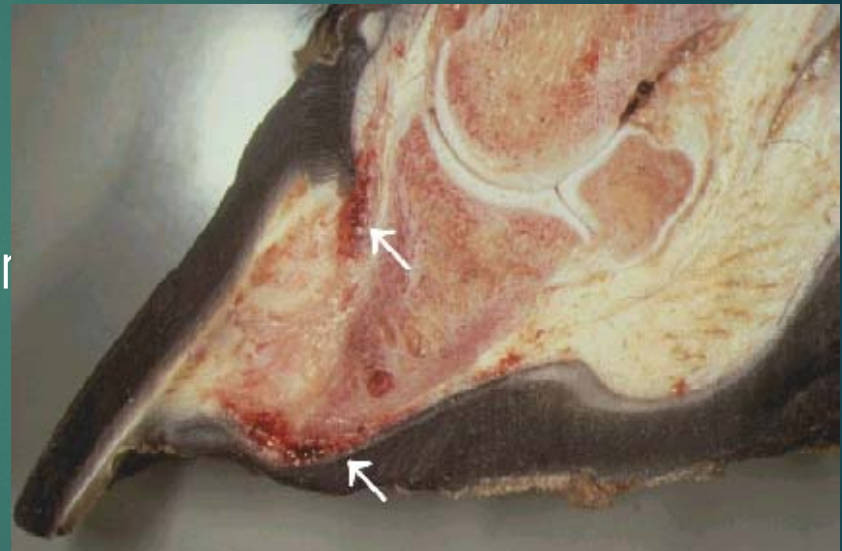
# Inflammatory Cascade





# Lameness- Laminitis Other contributing factors

- ▶ Bacterial Toxins and systemic inflammation
  - ▶ Colic
  - ▶ Colitis
  - ▶ Potomac Horse Fever
  - ▶ Pleuropneumonia
  - ▶ Endometritis
  - ▶ Postoperative colic
  - ▶ Black walnut wood shavings

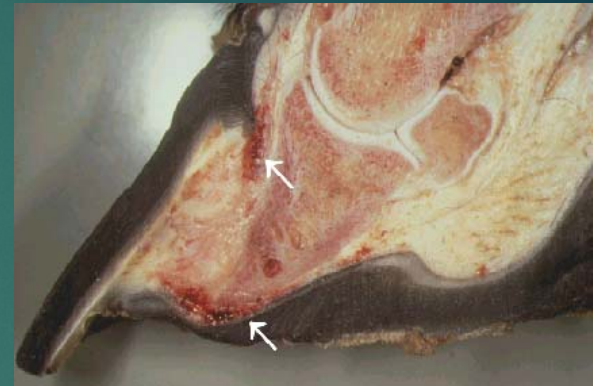


# Lameness- Laminitis Other contributing factors

- ▶ Carbohydrate overload
- ▶ Severe dehydration or shock
- ▶ Corticosteroids-Dex testing?
- ▶ Pituitary gland dysfunction in older horses
- ▶ Extreme weight loading
- ▶ Repeated concussion ("road founder")
- ▶ Stress related

# Lameness- Laminitis treatment

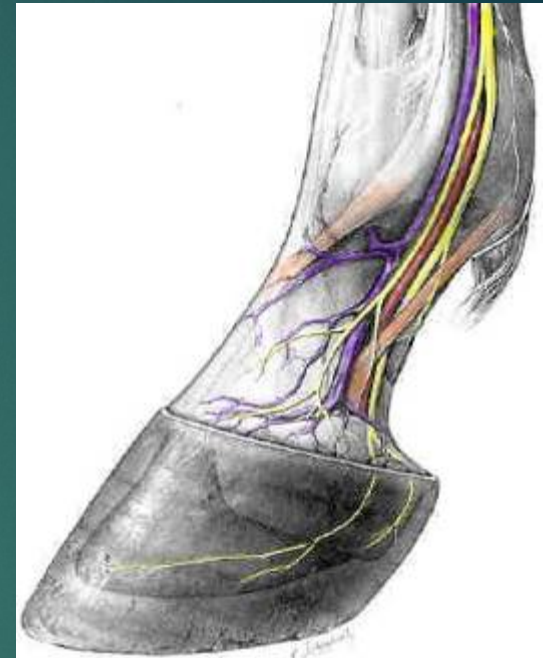
- ▶ Prevent or limit coffin bone rotation
  - ▶ Frog support
  - ▶ Wedges & trimming
  - ▶ Reverse shoes
  - ▶ Deep bedding
  - ▶ Restricted exercise
  - ▶ Surgery





# Lameness- Laminitis treatment

- ▶ Relieve the pain
  - ▶ Medications
  - ▶ Poultices
  - ▶ Nerve blocks
- ▶ Improve blood flow in feet
  - ▶ Medications
  - ▶ Podiatry
  - ▶ Mechanics of different shoeing applications



Questions?

