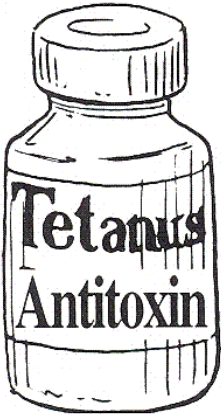
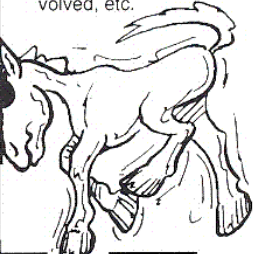
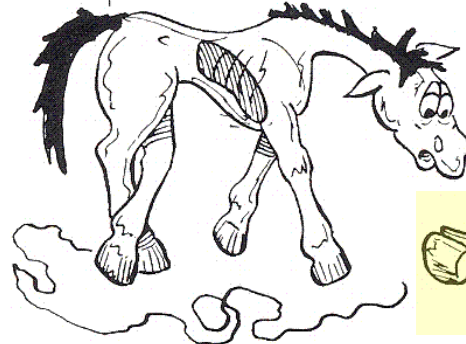


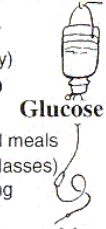
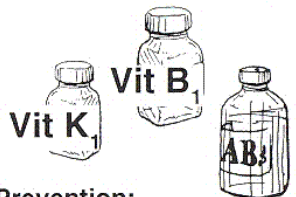


## Liver

## DIGESTIVE SYSTEM

Condition	Facts/Cause	Presentation/CS	Diagnosis	Treatment
<b>Serum hepatitis, Acute hepatitis, Theiler's diz, Idiopathic hepatitis</b> Mk 138; IM 843; I2M 920; EM&S 700; E 640; M 245; Pic 83 	<ul style="list-style-type: none"> <li>• <b>Acute to subacute hepatitis in adult horses</b></li> <li>• <b>Equine origin biologicals</b> <ul style="list-style-type: none"> <li>- <b>Tetanus antitoxin</b>, antiserum of equine origin, pregnant mare serum</li> </ul> </li> <li>• Occurs more commonly on certain farms</li> <li>• Occurs in horses hyperimmunized w/ tetanus antitoxin</li> <li>• Diz occurs 4-10 week after last tetanus antitoxin administration</li> <li>• Other cases w/ no equine biologic show similar type of acute hepatic diz (idiopathic hepatitis)</li> <li>• Occur in late summer &amp; fall                             <ul style="list-style-type: none"> <li>- Suggested infectious or blood borne agent involved</li> <li>- Seasonal occurrence, multiple horses involved, etc.</li> </ul> </li> </ul> 	<ul style="list-style-type: none"> <li>• <b>Malaise &amp; weight loss wk-mo before acute signs</b> (liver has to lose more than half its functional capacity before failure signs)</li> <li>• <b>Acute hepatoencephalopathy</b> (incoordination, walk in circles, oblivious to surroundings)                             <ul style="list-style-type: none"> <li>- Delirious, head pressing, fall, make repeated attempts to rise, unmanageable</li> </ul> </li> <li>• <b>Icterus</b></li> <li>• <b>Photodermatitis</b> (white muzzle &amp; limbs)                             <ul style="list-style-type: none"> <li>- May appear centrally blind</li> </ul> </li> <li>• Intravascular hemolysis</li> <li>• <b>Clin. course rapidly progressive</b></li> <li>• <b>Dying in 2-5 d after initial CS</b> <ul style="list-style-type: none"> <li>- Acute abdominal pain, may get violent &amp; cause damage to themselves</li> </ul> </li> <li>• <b>Comatose, generally die</b></li> </ul> 	<ul style="list-style-type: none"> <li>• Hx, CS</li> <li>• Lab:                             <ul style="list-style-type: none"> <li>- <b>↑ in all liver enzymes</b></li> <li>- <b>↑ Bilirubin</b>, glucose variable, clotting profiles prolonged, BSP prolonged</li> </ul> </li> <li>• <b>PM (postmortem):</b> <ul style="list-style-type: none"> <li>- <b>Small, flaccid liver</b> ("dishrag" liver) (swollen acutely)</li> <li>- Microscopically necrosis &amp; bile duct proliferation</li> </ul> </li> </ul>  Color me Yellow 	<p><b>Treat as for liver failure: Rompun</b></p> <ul style="list-style-type: none"> <li>• <b>Sedate (xylazine)</b> for hepatoencephalopathy</li> <li>• <b>10% glucose IV</b> (if low blood glucose)</li> <li>• <b>↓ Blood ammonia</b> (nasogastric tube &amp; mild laxative (mineral oil) + neomycin (but kills GI flora) or lactulose (acidifies GI to ↑ ammonia to ammonium))</li> <li>• <b>Correct any acidosis slowly</b> (exacerbates hepatoencephalopathy)</li> <li>• <b>Slow 5-10% dextrose drip</b> (↓ hepatic work load)</li> <li>• <b>Dietary management</b> (small meals 4-6 x/d (beet pulp, cracked corn, molasses)                             <ul style="list-style-type: none"> <li>- Force feed mixed paste if not eating</li> <li>- IV feeding, but \$\$</li> </ul> </li> <li>• <b>Vit. B<sub>1</sub>, folic acid &amp; Vit. K<sub>1</sub> weekly</b></li> <li>• <b>Protect from sun when grazing</b></li> </ul>   <p><b>Prevention:</b></p> <ul style="list-style-type: none"> <li>• <b>Avoid using T. antitoxin:</b> use only on horses w/ wounds who are unimmunized or those of questionable immunization &amp; foals from mares not immunized during late gestation (see</li> </ul>

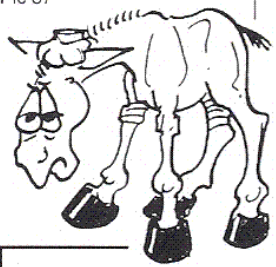
**Ingestion of waste oil** (spread to control dust), tetrachlordibenzodioxin • Tx: Supportive, additionally show acute signs after being exposed fairly recently. Use of intestinal protectants and/or cathartic is indicated

# Theiler's vs. Tyzzer's- Equine Liver diseases

Guide to Equine Clinics, vol. 1 Pasquini, 3<sup>rd</sup> ed.

## Tyzzer's Diz, *Bacillus piliformis* infection, Dead foal diz

Mk 152; IM 848, 378; I2M 925; EM&S 698; E 640; C4T 218; C3T 442; C2T 110, 242; Pic 87

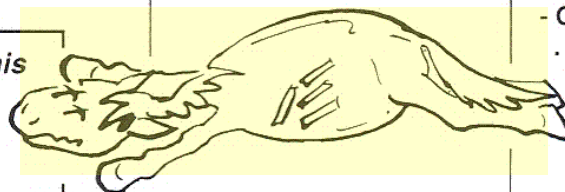


"Dead foal diz", *Bacillus piliformis*  
CS: Jaundice, Dead  
Dx: Difficult, Stain liver  
Tx/Px: nearly 100% fatal

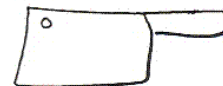
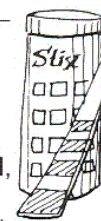
- *Bacillus piliformis* (motile, filamentous, gram (-), spore forming, obligate intracellular bacteria)
- Fatal diz of foals 7-40 days (also fatal in lab animals)
- Focal bacterial hepatitis
- Mares m/b carriers
- Sporadic, generally only one foal affected

- Most found dead or in coma
- Depression
- Anorexia
- Recumbency
- $\pm \uparrow$  Temp. (102 - 106° F)
- Marked jaundice usually
- Convulsions (hypoglycemia)
- Coma terminally

Color me Yellow



- Definitive Dx difficult, CS nonspecific
- Jaundice if live long enough
- Lab - nonspecific:
  - Marked  $\uparrow$  of liver enzymes SDH, LDH, ALP, AST, GGT
  - Marked  $\uparrow$  bilirubin (mostly indirect)
  - Profound hypoglycemia (< 20 mg/dl terminally)
- PM (postmortem)
  - Marked jaundice
  - Huge liver (hepatomegaly)
  - Pale, diffuse foci of necrosis (1-2 mm)
  - Colitis, lymphoid necrosis & focal myocardial necrosis
  - Histo.: multifocal areas of necrosis, bile duct proliferation
- Definitive Dx:
  - Giemsa or silver stained liver sections
  - Long, slender bacillus, alone, in stacks &/or bundles in hepatocytes



- Nearly 100% fatal
- 50% dextrose IV
- Fluid therapy
- IV antibiotics (tetracyclines, penicillins, erythromycin, streptomycin)



### Prognosis

- Grave: nearly 100% death

### Prevention:

- Sporadic, so not indicated
- If confirmed case, monitor all foals for first 40 d of life
- Subsequent foals of a mare that have had a Tyzzer's foal monitored carefully

## Fetal liver damage

IM 867; I2M 945

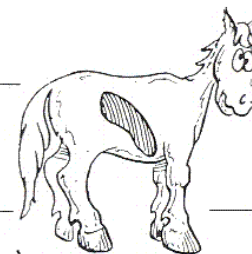
- Infection or toxic damage to foal's liver; EHV (equine herpes virus) - hepatocyte necrosis
- CS: Usually aborted or weak w/ CS or other system
- Dx: Liver lesions (Hepatocyte necrosis, Intranuclear inclusion bodies in hepatocytes)

## Hepatic neoplasia

IM 867; I2M 945; Pic 88

- Uncommon in large animals; 1° Hepatic carcinoma (most common); 1° in yearlings & 2-yr-olds; Lymphosarcoma (2°)
- CS: Weight loss, Icterus,  $\uparrow$  hepatic enzymes
- Tx: None

Color me Yellow



## Liver abscesses

IM 858; I2M 935

- More common in cattle; common incidental finding in horses on necropsy
- CS: Similar to other abdominal abscesses (intermittent colic, intermittent fever, weight loss)
- Dx: CS; Can't be palpated per rectum
- Tx: Rarely drained to outside or removed; Long term ABs (penicillin or ampicillin - m/b in combined w/ rifampin or metronidazole)





## Pyrrolizidine alkaloid toxicity

Mk 1698; IM 850; I2M 928, 1878, 1884, 1443; C4T 222; EM&S 699; E 641; M 245; PP/US/C 425; Pic 80, 85



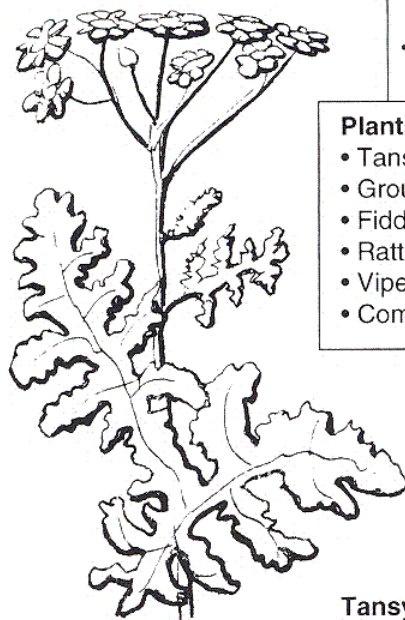
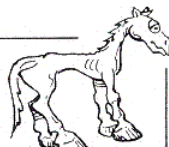
Fiddleneck  
(Stinking Willy)

**Poisonous plants in hay**  
**CS:** Liver failure, CNS, icterus  
**Dx:** Hx, CS, PM (fibrosis)  
**Tx:** Euthanasia, Tx HF; Px: poor to grave

- **See TOX pg 323**
- **Poisonous plants:** Crotalaria, Senecio, Amsinckia, Heliotropium, Echium
  - **Not very palatable** (eaten when thick or other forage sparse [drought])
  - 1st cut **hay**, alfalfa or hay cubes
- **Cumulative & progressive**
  - Acute when ingest tremendous amts.
  - Chronic disorder (more common)
  - Problem 1-5 months later
  - Material often no longer on farm to identify
- **Western US** (also in pastures through out US)
- **Pathology:**
  - Alkaloids, liver metabolized into pyrroles
  - **Pyrroles inhibit mitotic division** so get megalocytes & death of hepatocytes
  - **Fibrosis** replaces cell & liver fails
  - Marked portal hypertension



- **Liver failure**
- Onset of CS acute
- **Weight loss**
- **Hepatoencephalopathy** (abnormal behavior, ataxia, wandering)
- **Icterus** (slight to moderate)
- **Photosensitization** (white areas)
- Rarely diarrhea
- Abortions



### Plants

- Tansy ragwort (*S. jacobea*)
- Groundsel (*S. redellii*, *S. longilobus*)
- Fiddleneck (*Amsinckia intermedia*)
- Rattlebox (*Crotalaria*)
- Viper's bugloss (*E. plantagineum*)
- Common heliotrope (*H. europeum*)

Color me  
Yellow

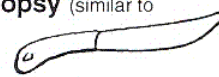
### DDx

- Other plants
- Fungal hepatotoxins

### Tansy ragwort (*S. jacobea*)

- Description
  - 1-4' tall
  - Leaves: deeply irregular
  - Flowers" composite, showy, yellow

- **Geographic area** or where hay grows, usually not a definitive Dx, but suggested
- Feed analysis, time consuming & expensive
- Lab: nonspecific
  - Clotting abnormalities
  - Liver enzymes normal or elevated
  - BSP is prolonged
- **Liver biopsy** (similar to aflatoxins)
  - Triad:
    - . Megalocytosis
    - . Fibrosis
    - . Bile duct proliferation
- None of above specific for this toxicity so Dx difficult if no longer consuming



- **Euthanasia:** if severe fibrosis liver can't regenerate so Tx no good
- Remove plant source

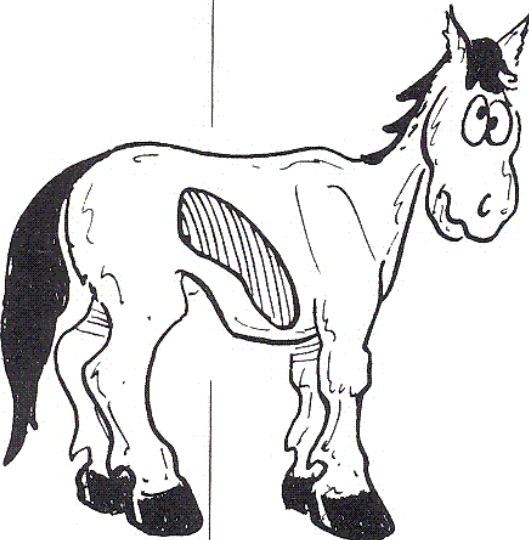
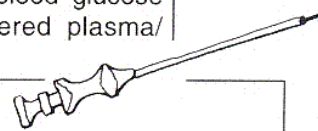
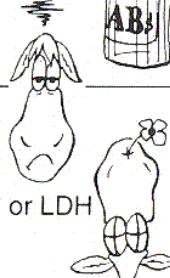
### If appetite & little fibrosis

- **Treat for liver failure**
  - **1st sedate (xylazine)** for CNS CS
  - **10% glucose IV** + methionine
  - **↓ blood ammonia:** nasogastric tube (mineral oil) + neomycin (but kills GI flora) or lactulose (acid GI ammonia to ammonium)
  - Correct any acidosis slowly
  - **Slow 5-10% dextrose drip**
  - **Dietary management**
    - . Small meals 4-6 x/d
    - .. Beet pulp, cracked corn, molasses
  - . Force feed mixed paste if not eating
  - . IV feeding \$\$
  - . **Vit. B<sub>1</sub>, folic acid & Vit. K<sub>1</sub> weekly**
  - . Protect from sun when grazing



### Prognosis:

- **Poor to grave:** due to tremendous amount of fibrosis
- Mildly affected cases: use serial liver biopsy & enzyme activity to help w/ prognosis

Liver Disease		84			DIGESTIVE SYSTEM
Condition	Facts/Cause	Presentation/CS	Diagnosis	Treatment	
<b>Liver disease</b> M8k 220, 130; Mk 138; IM 837; I2M 913; EM&S 692; E 634; C4T 214; C3T 353; M 245; Pic 79	<ul style="list-style-type: none"> <li>• Liver m/b diseased long before it fails to function</li> <li>• CS not seen in early stages of liver diz</li> <li>• <b>Loss of 80%</b> of liver before regeneration &amp; recovery impossible</li> <li>• <b>Remarkable ability to regenerate</b></li> </ul>	<ul style="list-style-type: none"> <li>• <b>No pathognomonic CS for liver diz</b></li> <li>• <b>No CS of liver diz consistently present</b></li> <li>• <b>Most signs related to failure of liver function</b> (except pain)</li> <li>• <b>Icterus</b> (common in acute, not always in chronic) <ul style="list-style-type: none"> <li>- Also seen in anorexic or fasting horses</li> <li>- Hemolysis can also cause ↑ bilirubin</li> <li>- Failure of uptake, conjugation or excretion of bilirubin</li> </ul> </li> <li>• <b>Wt. loss</b> common, but not specific for chronic diz</li> <li>• <b>Diarrhea</b> possible in chronic liver diz</li> <li>• <b>Dermatitis</b> (hepatic photosensitization) due to phyloerythrin (normally excreted in bile) accumulating in skin</li> <li>• <b>Pruritus</b> sometimes (mechanism unknown)</li> <li>• <b>Hemorrhage terminally</b> (clotting factors made in liver)</li> <li>• Pharyngeal or laryngeal collapse w/ loud stertorous inspiratory noises &amp; dyspnea in some (especially ponies) (mechanism unknown)</li> <li>• <b>Hepatoencephalopathy</b> <ul style="list-style-type: none"> <li>- <b>Behavioral changes:</b> docile animal becomes aggressive, aggressive becomes docile</li> <li>- <b>Depression, incoordination, aimless walking, head pressing, yawning</b></li> <li>- Multiple causes: low blood glucose levels, ↑ ammonia, altered plasma/ amino acid ratio</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• <b>History (Hx), CS</b></li> <li>• <b>Lab</b> <ul style="list-style-type: none"> <li>- Slightly ↓ blood glucose</li> <li>- <b>Ammonia</b> (4x)</li> <li>- ↓ <b>BUN</b> (urease needed)</li> <li>- <b>Terminally ↓ serum albumin</b></li> <li>- <b>Enzymes:</b> <ul style="list-style-type: none"> <li>• ↑ <b>GGT</b> fairly specific for liver diz</li> <li>• ↑ <b>ALP</b> in chronic, also in bone, intestine, placenta &amp; macrophages</li> <li>• <b>SDH, LDH &amp; GDH</b> <ul style="list-style-type: none"> <li>.. ↑ In acute diz, normal or ↓ in chronic</li> </ul> </li> <li>• <b>SDH:</b> active hepatocellular necrosis</li> </ul> </li> <li>- <b>Excretion tests</b> <ul style="list-style-type: none"> <li>• <b>Bilirubin:</b> ↑ indicates liver diz, bile blockage, hemolysis, or fasting horse</li> <li>• <b>Bile acids:</b> &gt; 15 µm/l indicates hepatic diz, cholestasis or portal systemic shunting</li> <li>• <b>BSP</b>, normal &lt; 3.5 min</li> </ul> </li> <li>• <b>Liver biopsy:</b> safe &amp; simple, but avoid if liver abscesses suspected</li> </ul> </li></ul>	<b>Tx for liver failure</b> <ul style="list-style-type: none"> <li>• 1st sedate (xylazine)</li> <li>• 10% glucose IV</li> <li>• ↓ <b>Blood ammonia</b> (↓ # of bacteria producing ammonia) <ul style="list-style-type: none"> <li>- Nasogastric tube</li> <li>• Mild laxative</li> <li>• Lactulose®</li> <li>- Limit CHO</li> </ul> </li> <li>• Correct any acidosis slowly</li> <li>• <b>Slow 5-10% dextrose drip</b></li> <li>• <b>Dietary management</b> <ul style="list-style-type: none"> <li>- Small meals 4-6 x/d</li> <li>- <b>Vit. B<sub>1</sub></b>, folic acid &amp; <b>Vit. K<sub>1</sub></b> weekly</li> </ul> </li> <li>• Fresh plasma transfusions</li> <li>• Steroids: if not infectious</li> <li>• Protect from sun when grazing</li> <li>• Colchicine</li> <li>• <b>Antibiotics:</b> avoid those metabolized by liver such as tetracycline &amp; chloramphenicol</li> </ul>	
				<b>Poor prognostic indicators:</b> <ul style="list-style-type: none"> <li>• Albumin &lt; 2.5 g/dl &amp;/or ↑ globulin level</li> <li>• Prothrombin time &gt; 30% of normal</li> <li>• Greatly ↓ GGT &amp; ALP w/ normal or ↓ SDH or LDH</li> <li>• BSP half life &gt; 8 min.</li> <li>• Marked fibrosis</li> </ul> <b>Grave w/ pyrrolizidine alkaloid toxicosis, mitotic inhibition</b>	
<b>No pathognomonic CS of liver diz</b> <b>CS: Icterus, Weight loss, CNS</b> <b>Dx: GGT, ALP, SDH, BA</b> <b>Sedate</b>		<b>Liver biopsy site</b> <ul style="list-style-type: none"> <li>• Right 14th ICS (intercostal space) intersection w/ line from tuber coxae to point of shoulder</li> </ul>			



# Theiler's vs. Tyzzer's- Equine Liver diseases

Guide to Equine Clinics, vol. 1 Pasquini, 3<sup>rd</sup> ed.

## Diagnosis of liver diz:

### • History

### • Lab:

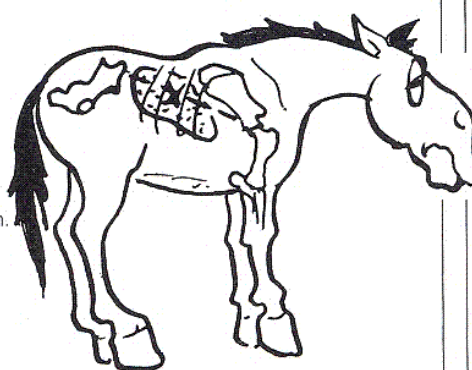
- **Slightly ↓ blood glucose** (gluconeogenesis)
- **Ammonia (4x)** (urease of liver needed to convert)
  - ↑ of ammonia doesn't correlate to level of CNS signs
- **↓ BUN** (urease needed)
- **Terminally ↓ serum albumin** (liver makes albumin, long half life)
- **Enzymes:**
  - **↑ GGT in chronic diz** fairly specific (gamma glutamyl transferase)
    - .. Found in biliary tract (cholestatic instead of hepatocellular)
    - .. Also in pancreas, lungs & kidney (renal diz, not ↑ because excreted in kidney)
  - **↑ ALP in chronic** (alkaline phosphatase)
    - .. Also in bone, intestine, placenta & macrophages
  - **SDH, LDH & GDH** (sorbitol dehydrogenase, lactate dehydrogenase & glutamate dehydrogenase)
    - .. **↑ In acute diz; normal or ↓ in chronic**
    - .. **SDH, liver specific, good indicator of active hepatocellular necrosis**
- **Excretion tests** (checks liver's excretory function)
  - **Bilirubin:** from heme, mainly from RBCs, unconjugated bilirubin is converted by liver to conjugated which is secreted by bile system into intestine where it is converted into urobilinogen
    - **Elevation indicates liver diz, bile blockage, hemolysis, or fasting horse**
      - Liver diz - mostly unconjugated (indirect reacting)
        - .. Direct to total ratio usually < 0.3
      - Bile blockage or intrahepatic cholestasis
        - .. **↑ Conjugated (direct reacting) & unconjugated**
        - .. Direct to total ratio > 0.3
  - **Bile acids** - synthesized by liver from cholesterol & excreted in bile
    - Bile acids > 15 um/l indicates hepatic diz, cholestasis or portal systemic shunting
  - **BSP** (sulfabromophthalein) dye, clearance (halftime) used in lg. animals more than retention test. Inject IV & blood samples taken 5 times in 12 min.
    - Normal < 3.5 min
- **Liver biopsy** - safe & simple
  - Do not do if liver abscesses suspected
  - Diffuse or zonal lesions seen in most toxic, infections & metabolic liver diz - usually Dx by biopsy
  - Easily miss focal lesions - abscesses, granulomas, neoplasia & liver flukes

Color me  
Yellow

### DDx:

- **Icterus - fasted 48 hours** (must be acutely off feed; therefore icterus & ↑ unconjugated bilirubin doesn't mean liver diz)

↑ GGT - Chronic  
↑ SDH - Acute

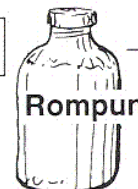


85

## Treatment for Liver Failure

- **1st Sedate (xylazine)** for hepatoencephalopathy
  - Diazepam, chloralhydrate or barbiturates
- **10% glucose IV** (if low blood glucose)
- **↓ Blood ammonia** (↓ # of bact. producing ammonia)
  - Nasogastric tube
    - Mild laxative (mineral oil) + neomycin or lactulose
    - Neomycin (may induce diarrhea, so not commonly used)
    - Lactulose® (↑ acidity in GI to incr. amount of ammonia converted to ammonium, therefore not absorbable)
  - Limit CHO, low protein diet to minimize ammonia
- Correct any acidosis slowly (exacerbates hepatoencephalopathy)
- **Slow 5-10% dextrose drip** (decr. hepatic work load)
- **Dietary management**
  - Small meals 4-6 x/d, beet pulp, cracked corn, molasses
  - Force feed mixed paste if not eating (by rehydrating pellets & nasogastric tube)
  - Dextrose to water (ready source of energy)
  - IV feeding expensive. Amino acid supplementation
  - **Vit. B1 folic acid & Vit. K1 weekly**
- **Fresh plasm transfusions** for clotting abnormalities & m/b Vit. K
- **Corticosteroids:** if suspect acute hepatitis not due to infectious agent, & in chronic w/ unknown cause (prednisolone doesn't require hepatic transformation)
- **Grazing, protect from sun**
- **Colchicine** used empirically in chronic liver cirrhosis to ↓ fibrosis, but may cause laminitis
- **Antibiotics:** w/ liver biopsy & positive results of bacteria
  - Culture & sensitivity should be done
  - Avoids those metabolized by the liver, such as erythromycin, tetracycline, chloramphenicol

K1 & B1



Rompun



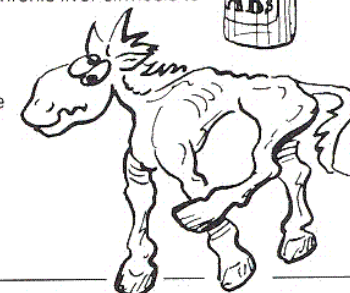
Vit B<sub>1</sub>



Vit K<sub>1</sub>



AB



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