

### Question

A rancher in the Rocky Mountains has found that many of the beef calves born this season are deformed with cleft palates, arthrogryposis, and crooked spines. The pregnant cows were grazing on pastures that have had a large amount of several species of the plant pictured. What is the problem that caused these congenital anomalies?



- Lupine
- Oleander
- Tansy ragwort
- Larkspur
- Locoweed

**Explanation** - Some **lupines** contain alkaloids called sparteine and anagyrene. Cows eating lupine **during early gestation** often give birth to calves with cleft palates, crooked legs and distorted/malformed spines. Six of the poisonous species implicated in "**crooked calf disease**" are silky lupine (*L. sericeus*), tailcup lupine (*L. caudatus*), velvet lupine (*L. leucophyllus*), silvery lupine (*L. argenteus*), lunara lupine (*L. formosus*), and yellow lupine (*L. sulphureus*).

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### Question

Which of these treatments is least effective for treating cyanide toxicity?

- Sodium thiosulfate
- Methylene blue
- Supplemental oxygen
- Sodium nitrate

**Explanation** - The answer is **supplemental oxygen**. Cyanide blocks cellular respiration and blocks oxidative transport. As a result, **hemoglobin cannot release oxygen to the tissues** and venous blood stays saturated with oxygen and is bright red. Supplemental oxygen is unlikely to change this. The other three options (sodium thiosulfate - methylene blue - sodium nitrate) are the usual treatments for cyanide toxicity.

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## Question

A 5-year old cow presents with skin lesions confined to the nonpigmented areas (see image). The affected skin is dry and raised at the periphery. The skin of the teats appears dry. Which of the following could result in this presentation?



- Ingestion of moldy feed containing aflatoxins
- Ingestion of Quercus spp.
- Ingestion of Pteridium aquilinum (bracken fern)
- Ingestion of lupine

**Explanation** - This is a case of **photosensitization** based on the skin lesions confined to the nonpigmented areas.

Primary photosensitization can occur when photodynamic agents are absorbed from the G.I. tract such as *Hypericum perforatum* (**St. John's wort**), *Fagopyrum esculentum* (**buckwheat**), *Ammi majus* (**bishop's weed**), and *Cymopterus watsonii* (**spring parsley**).

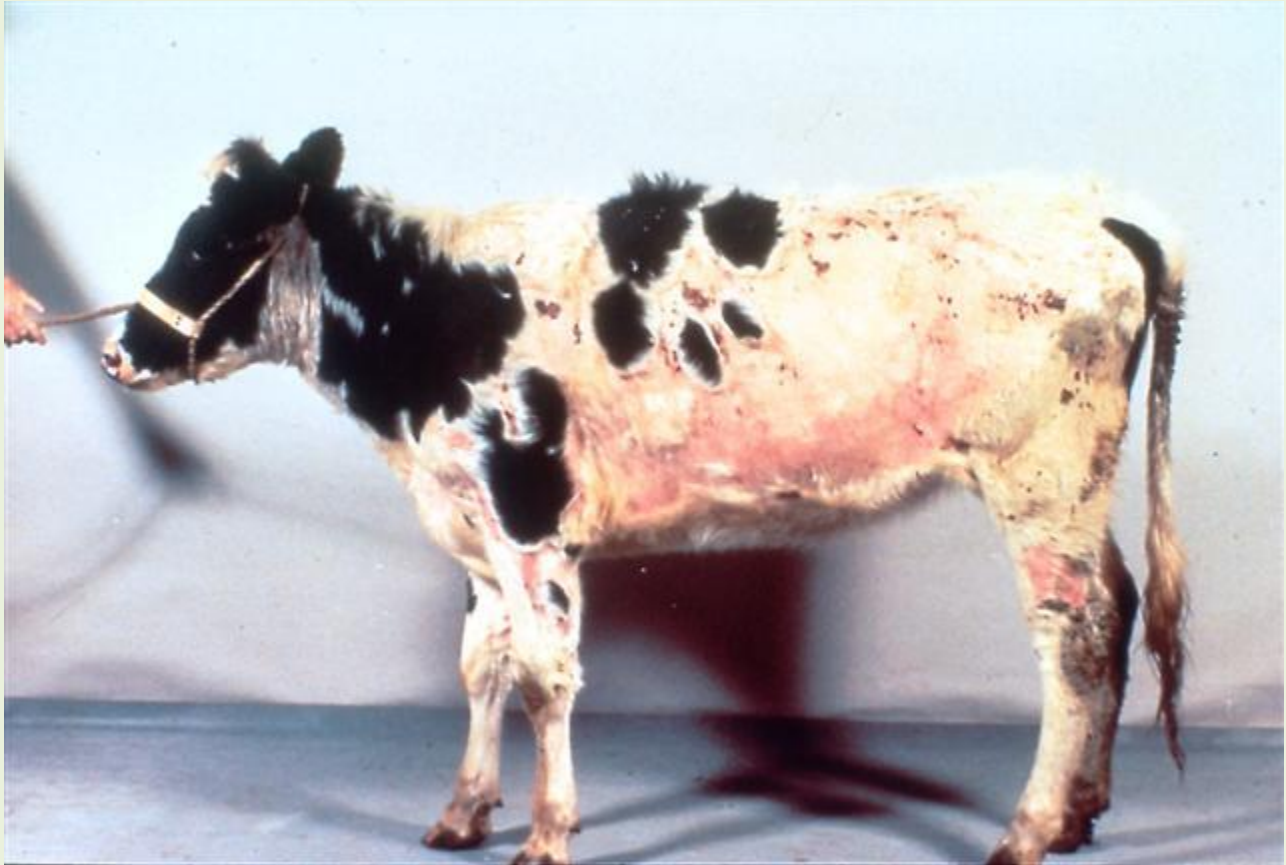
Secondary (hepatogenous) photosensitization occurs when the liver's excretion of phylloerythrin is impaired due to liver damage. Phylloerythrin is derived from the breakdown of chlorophyll by rumen microbes. The best answer in this question is **aflatoxins** because they are known to cause liver damage.

Bracken fern toxicity causes acute hemorrhagic syndrome in cattle. Lupine toxicity primarily causes birth defects. Quercus (oak) toxicity causes GI and renal dysfunction.

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## Question

You are presented with a Holstein heifer that is normal in size for her age but has severe skin lesions, resembling sunburn, over much of the body. Only the white areas seem to be affected (see image). You also find that several other heifers from the same pasture have milder skin lesions with the same distribution. You examine the pastures and feed and find that this Washington State pasture is full of Hypericum. What is the correct diagnosis?



- Phylloerythrin photosensitization
- Primary Hypericin photosensitization
- Hereditary porphyria
- Liver failure with hepatogenous photosensitization
- Primary peroline photosensitization

**Explanation** - The plant *Hypericum perforatum* contains the chemical hypericin which, when ingested, localizes in skin and acts as a **primary photosensitizing agent**. Ingestion of other plants such as buckwheat, ryegrass, and whiteheads can also have this effect.

Secondary, or hepatogenous photosensitization, occurs when the liver fails to excrete phylloerythrin, the compound derived from the breakdown of a chlorophyll. Phylloerythrin accumulates in the skin, resulting in photosensitization.

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## Question

Which type of urolith occurs most commonly in western U.S. range cattle grazing mature grasses as shown in the photo? Image courtesy of David Van Metre



- Silicate
- Struvite
- Calcium oxalate
- Calcium carbonate

**Explanation -** **Silicate stones** are the result of high intakes of **silica in mature range grasses**, combined with other factors such as dehydration.

Struvites (ammonium, magnesium, and phosphate) tend to be found in feedlot animals receiving large amounts of grain. Calcium carbonate stones are most common in sheep grazing pastures high in calcium and oxalates.

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## Question

Fluoride toxicity at a young age in cattle may result in permanent damage to which of the following?

- Liver
- Heart
- Teeth
- Eyes

**Explanation -** The correct answer is **teeth**. Fluoride toxicity results in ameloblasts prematurely reducing in size. Eventually, the enamel epithelium forms an irregular matrix which does not calcify normally. Fluoride toxicity will cause **bone lesions**. Interestingly, the first palpable lesions are seen on the medial surface of the proximal third of the metatarsal bones. A key thing to know is that articular surfaces are not affected with osteofluorosis so this may help rule it in or out from other diseases such as osteomyelitis, septic arthritis, and osteoarthritis.

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### Question

Mycotoxins found in feed are important problems in cattle. Which of the following is an important mycotoxin?

- Pyrrolizidine alkaloids
- Cantharidin
- Gossypol
- Aflatoxin
- Hypericin

**Explanation - Aflatoxin** B1 is a potent carcinogen, and can also result in acute or chronic toxicosis. It may cause **severe liver damage** when large doses are ingested. **Levels over 1 ppm** can lead to death. None of the other four listed are mycotoxins.

**Aflatoxins** are toxic compounds that are produced by certain molds found in food, and can cause liver damage and cancer.

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### Question

You go to a dairy which is having trouble with sudden death in calves and decreased reproductive efficiency in cows. Which plant toxin should you have on your differential list?

- Tansy ragwort
- Moldy sweet clover
- Gossypol
- St. John's-wort

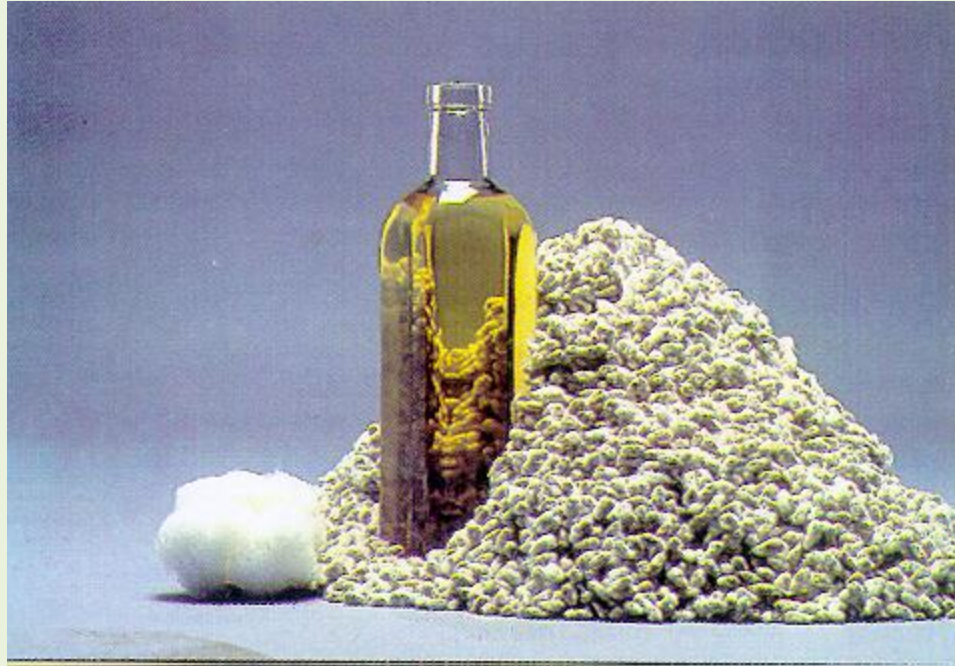
**Explanation -** The correct answer is **gossypol** (found in **cotton seed** in varying amounts) toxicity. Gossypol is a **cardiotoxin** and can **kill calves less than 4 months of age**. In adults, if fed at high levels, it usually causes **sterility in bulls** and **decreased conception in cows**.

Moldy sweet clover inhibits vitamin K and causes a coagulopathy. St. John's-wort contains hypericin and results in photosensitivity. Tansy ragwort is a pyrrolizidine alkaloid and causes liver disease.

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### Question

A group of dairy calves were fed a home-made grain mix that had a high percentage of cottonseed (photo shows seed and oil). Cottonseed is a good source of protein. A few days after being started on this new grain mix, the calves began having problems including dyspnea, and weakness, followed by death in several calves. What is the toxic principle acting here?



- Nicotine
- Gossypol
- Cardiac glycosides
- Tannins
- Cyanide

**Explanation - Gossypol** - Toxic component of cottonseed meal. Causes severe **myocardial necrosis and lung damage**. **Pigs are most sensitive**. Also reproductive effects including ↓ spermatogenesis, irregular cycling, disruption of pregnancy.

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### Question

A veterinarian wishes to know which plants are photosensitizing. He provides you with samples from the hay to pick from, and you tell him that \_\_\_\_\_ can cause secondary photosensitization.

- Erodium
- Amsinckia intermedia
- Hypericum perforatum
- Amni majus

**Explanation -** The correct answer is Amsinckia intermedia. This plant (aka fiddleneck, fireweed, and tarweed) contains **pyrrolizidine alkaloids**. PZAs are hepatotoxic and cause three classical liver lesions. Do you recall them?

**Megalocytosis, biliary duct hyperplasia, and fibrosis.**

As a result of liver damage, the liver will be unable to clear normal chlorophyll breakdown products such as phylloerythrin, which causes photosensitization secondary to liver damage. The other answer choices are primary photosensitizing agents.

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### Question

A dairy farmer in California calls you in distress. He has just found 16 dead yearling Holstein heifers in a pasture near his home. There are no survivors. All 16 were observed yesterday and appeared normal. You perform a postmortem on two animals and find the plant pictured in the rumen. You walk out to look at his pasture and note that this plant is growing in the cemetery adjacent to his pasture, and you find a pile of clippings containing grass and the plant near the fence. What is the plant?



- Yew
- Locoweed
- Lupine
- Oleander
- Skunk cabbage

**Explanation** - Both **Japanese yew** (*Taxus cuspidata*) and **English yew** (*T. baccata*) contain alkaloids called taxines that are highly toxic and depress myocardial conduction by blocking sodium movement through membranes. Collapse and sudden death are commonly seen when this plant is ingested, often when clippings are consumed by livestock. **Oleander** causes similar clinical scenarios.

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### Question

It is summer in the hills of coastal California. During spring and early summer, cattle in the area were eating the plant shown in the photo, before other forage was available. Which of the following disorders might occur in cattle which ate a large amount of the plant shown?



- Cardiac arrhythmia
- CNS signs
- Cyanide toxicosis
- Liver failure
- Bone marrow suppression

**Explanation** - The plant is **bracken fern** and it contains a toxic glycoside (ptaquiloside) plus thiaminase. In cattle, chronic bracken fern ingestion (consumption of the animal's body weight over several months) can result in **bone marrow suppression**, as well as alkylation of DNA leading to **tumors**. The problem will manifest as **hemorrhages**, **hematuria**, and/or **cancers in the bladder** or other organs. The bone marrow suppression leads to **anemia and neutropenia**. The thiaminase seems to affect horses more than cattle. Horses develop thiamine deficiency manifested as weight loss, ataxia, lethargy, tremors, recumbency, and death.

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### Question

A rancher in California has found several 8-month old steers dead in a corral holding 40 animals. Others in the group appear depressed and have diarrhea. The animals are being fed oat grass hay harvested from the neighboring field. As you examine two of the ill animals you note cardiac arrhythmias, rumen stasis, and generalized muscle weakness. You find some leaves in the rumen of one animal you necropsy. Nearby you notice some bushes surrounding the hay field, dropping leaves into the field (see photo) that appear to be the same ones found in the rumen. What is the plant responsible for these problems?





- Lupinus sp
- Senecio jacobea
- Astragalus sp
- Prunus sp
- Nerium oleander

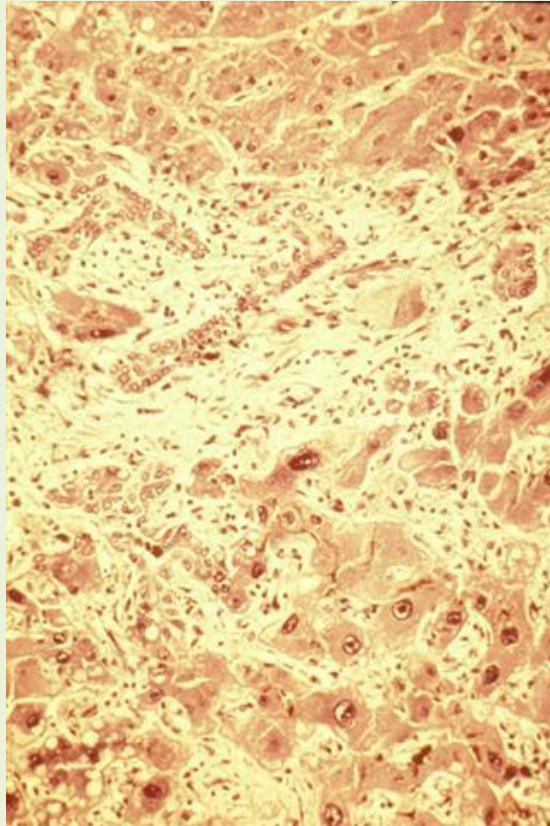
**Explanation** - **Oleander** contains potent **cardiac glycosides** that alter sodium-potassium ATPase leading to altered excitability. Lawn/garden clippings fed to livestock are a frequent source of these plants. Other plants which contain cardiac glycosides include foxglove, azalea, laurel, lily-of-the-valley, **milkweed**, and dogbane. Bufo toads also secrete similar toxins.

**Oleander** – Digitoxin glycoside. Popular ornamental. Very toxic, 1 leaf will kill 200lb calf. Death dt ventricular fibrillation. Bradycardia, GI upset. Tx w/ atropine for bradycardia, antiarrhythmics (lidocaine, phenytoin, propranolol) for ventricular fibrillation. Supportive for GI upset, including K<sup>+</sup> supplementation, activated charcoal, cathartic. Don't stand near smoke if burning.

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### Question

You examine a group of sixty 4- to 7-month old dairy calves which appear small and thin. The owner says that in the last few weeks several have developed diarrhea and quit eating, and two have recently died. You note some sunburned white areas on the skin, all are thin, and several are very weak. You do a postmortem examination on the worst and find a small hard liver. The biopsy looks as shown in the photo with fibrosis, bile duct proliferation, and megalocytosis. What is your diagnosis?



- Black disease
- Gossypol toxicity
- Pyrrolizidine alkaloid toxicosis
- Mycotoxicosis
- Oleander toxicity

**Explanation** - PZAs inhibit mitosis of hepatocytes, so they cannot multiply. As they age, they become large (megalocytes) and when they die they are replaced by fibrous tissue. Bile ducts proliferate as a nonspecific response to hepatic damage. You then look at some of the older alfalfa bales he was feeding to these calves and find loads of *Senecio vulgaris*, a PZA containing plant. Aflatoxins (a mycotoxin) from *Aspergillus* and other fungi can cause liver lesions that are similar, but most pathologists think that finding megalocytes is diagnostic for PZA toxicity.

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### Question

Chronic intermittent hematuria in beef cattle grazing a western US pasture has been noted by the owner. You pass an endoscope on one such cow and find hemorrhagic cystitis. Which of the following is the most likely causative agent?

- Paraquat
- Gossypol

- Bracken fern (Pteridium aquilinum)
- Salmonella dublin
- Fumonisin

**Explanation** – **Bracken fern** contains a number of toxic compounds that contribute to this syndrome. In addition, bovine papilloma virus-2 can also contribute to cause bladder carcinomas when bracken toxins are present. Other effects of bracken include **immunosuppression** and **low lymphocyte and neutrophil numbers**.

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### Question

An adult 3-year old Suffolk ewe presents to the hospital with an acute onset of depression, icterus, pallor, and cold extremities. The 10 sheep have been housed in a small corral for the last several years, and are regularly vaccinated against common Clostridial diseases (last vaccines given 6 months previously). The owner has been supplementing his sheep's grass hay with grain formulated for his steers. What is the most likely diagnosis?

- Copper toxicity
- Clostridium perfringens type A (yellow lamb disease)
- Liver flukes
- Carbon monoxide poisoning

**Explanation** - The correct answer is **copper toxicity**. To determine this, think about the clinical signs and the fact that steer feed contains too much copper to be safely fed to sheep. As a result of eating feed too high in copper (**sheep being the most susceptible species**) the liver copper levels build up until suddenly released causing **massive hemolysis** and resulting icterus. This is often fatal. Copper toxicity causes hemoglobinemia, hemoglobinuria, and, renal failure. Carbon monoxide toxicity is unlikely in outdoor animals and will not cause all the clinical signs mentioned. Onion poisoning can cause hemolytic anemia, but these sheep are confined and were not known to be exposed to onions. There has been no possible exposure to liver flukes (wet areas with snails). C perfringens types C and D vaccines were given (no type A vaccines are sold in the US), and yellow lamb disease is highly unlikely in a 3-year old sheep.

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### Question

It has been a particularly dry fall. A small herd of Rocky Mountain range cattle of mixed breeding have become emaciated in early winter, as the feed supply has diminished. The owner reports that several were ataxic and all appeared lethargic. On physical exam you also note that several appear to have aborted. You ride out into the pasture with the owner and note the plant in the photo predominates at this time of year. You believe that the plant shown may be incriminated in the problems. What is the plant?



- Larkspur
- Locoweed
- Lupine
- Groundsel
- Death camas

**Explanation** - **Locoweeds** are of the genera Astragalus, Oxytropis, and Swainsona, and many species contain a chemical which **inhibits alpha-mannosidases** and causes widespread neurovisceral cytoplasmic vacuolation and emaciation, as well as **abortion and nervous system abnormalities**. They tend to grow in the arid west, and are often eaten when other forage becomes scarce. Horses can also be affected.

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### Question

A group of Angus heifers were turned into an old corral area 8 hours earlier in the day. Now one heifer has convulsed and died and several have dyspnea, polypnea, and weakness. You arrive and, after a quick physical exam on one, take a blood sample, which is chocolate-brown in color. The plants shown in the photo contain what toxic principle?



- Tryptophan
- Nitrate
- Cyanide
- S-methylcysteine sulfoxide
- Oxalates

**Explanation** - The plant shown in the picture is Amaranthus. Amaranthus is commonly called pigweed and accumulates nitrates. **Nitrates** are converted in the rumen to nitrites, which convert hemoglobin to methemoglobin (Fe+3), which cannot bind or transport oxygen. Even if you cannot identify the plant in the photo, the chocolate-brown color of the blood should lead you to the correct answer of nitrate poisoning.

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### Question

Which of the following contains a pneumotoxin?

- Nightshade
- Lupine
- Water hemlock
- Ponderosa pine needle
- Perilla mint

**Explanation** - The correct answer is **perilla mint**. Usually, cattle will not eat this plant unless there is no other green feed to choose from. The pneumotoxicant results in an atypical pneumonia, and mortality is pretty high since there is no good treatment for exposure.

Ponderosa pine needles cause abortion in the last trimester and retained placentas.

Lupine is a cause of "crooked calf disease" which leads to arthrogryposis, malpositioning in the uterus, and cleft palate.

Nightshade is an atropine containing plant which can cause CNS signs such as dilated pupils, progressive paralysis, and depression.

Water hemlock is extremely toxic (especially the leaves). Clinical signs occur as fast as six hours post ingestion. You will see grand mal seizures, salivation, tachypnea, tachycardia, birth defects similar to lupine, and death.

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### Question

You have diagnosed nitrate poisoning in a group of yearling cattle which were grazing Sudan grass (see photo). Which of the following is the most effective treatment?



- Digitalis
- Cobalt
- Methylene blue
- Sodium thiosulfate
- Calcium gluconate

**Explanation** - Methylene blue is usually administered IV as a 1% solution, with a total dose of 5 to 15 mls to cattle, for treating nitrate toxicosis.

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### Question

You are called by a beef rancher located in the northern California oak foothills one day in March after an unusual spring snowstorm that dumped a foot of wet snow two days earlier. You are asked to diagnose and treat several calves in the 3- to 5- month old age range which are listless and weak. You do a physical exam and find elevated heart and respiratory rates, but normal rectal temperatures. The most remarkable finding is marked edema of the perineum and vulva of the calves (see image). What is the best diagnosis based on these signs and history?

- Clostridium hemolyticum infection (redwater)
- Acute oak toxicosis
- Lead toxicity
- Malignant catarrhal fever
- Bovine virus diarrhea



**Explanation** - The reason that **oak toxicosis** may occur in this scenario is as follows: the snow knocks down the budding oak limbs which are eaten by curious calves who cannot reach the grass. The calves develop both **renal and GI signs as the tannins damage the mucosa**. Many develop **hemorrhagic diarrhea** and **renal tubular necrosis**. Some tannins are hydrolyzed in the rumen to gallic acid and pyrogallol, which are both very toxic to the renal tubules. Treatment is aimed at flushing out the toxins (intravenous fluids) and protecting the gastrointestinal tract. Prevention is best; and the animals will avoid eating the oak if they are offered hay immediately during the storm.

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### Question

A farmer who raises valuable registered Holstein cattle calls you in a panic to tell you that he has just mistakenly orally administered a gallon of propylene glycol to a 600kg cow with constipation, thinking it was mineral oil. He asks what toxic effects this could have and what you can do about preventing/minimizing the toxic effects. Of the following choices, what is the correct treatment at this point?

- Intravenous and oral fluids to cause diuresis
- Calcium gluconate IV
- Urinary acidification using an anionic diet
- General anesthesia to prevent seizures
- Large doses of NSAIDs every 8 hours

**Explanation** - This amount of propylene glycol is likely to cause several problems: first the **CNS effects of depression and disorientation**, next at **12 to 24 hours come cardiovascular and pulmonary signs**, along with **severe metabolic acidosis**. From **24 to 72 hours renal toxicity** may predominate due to tubular damage.

The best treatment is **diuresis using isotonic sodium containing fluids** for the next several days. Since there metabolic acidosis, using **sodium bicarbonate** and some **IV glucose** to help maintain blood glucose are also helpful. You can also bind some of it in the rumen by giving **activated charcoal immediately**, but propylene glycol is poorly bound to charcoal. By three days the propylene glycol and toxic products are usually eliminated. Daily checks on the serum creatinine can help determine when fluids can safely be stopped.

In humans they might also use a drug called **Fomepizole** ( Antizol) and/or **IV ethyl alcohol** (600-800 mg/kg IV) and dialysis if needed. Other recommendations include the B vitamins thiamine and pyridoxine.

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