CYANIDE POISON

Poison :- Any solid, liquid or gas that, when introduced into or applied to the body can interfere with the processes of the cells of the organism by its own inherent chemical properties without acting mechanically regardless of temperature.

Xenobiotic :- Any substances, harmful or not, that is foreign to the body.

Sources of cyanide poisons/Etiology

- Plants
- Fumigants
- Soil sterilizer
- Fertilizer

And rodenticides (e.g calcium cyanomide) ingestion of plants that contains cyanogenic glycosides. These are examples by feed the fruiting.

- *Trigloclin maritims* (: arrow grass)
- *Hoecus lunatus* (velvet grass)
- *Sorghum spp.* (common sorghum)
- *Zeamays* (corn)
- *Linum spp* (flex)
- *Sambucus canadensis*
- *Pyrus malus apple*

- *Eucalyptus spp* At home cause to small animals or in implicated in toxicity.
- *Manihot esculantum*
- *Sorghum bicolar*
- *Pheseolus lunatus (*lime bear)
- *Passiflora feotida* (stinging poison flower)

Mechanism of Release of Cyanide and Cause of Toxicity

The cyanogenic glycosides in plants yield free hydrocyanic acid. (HCN).The free hydrocyanic acid also known as prussic acid, when is hydrolysed by B. *glycosidase* and *hydroxynitrite lyase* and when other plant cell structures are damaged e.g by freezing, chopping, chewing, stress frost, trampling etc The microbial flora and fauna that are inhabitants of the rumen would cause further release, thus discharging the free cyanide.

The toxic of HCN is attributed to the high affinity towards metalloporphyrin this contains enzymes. The HCN reacts with (Fe^{3+}) of cytochrome oxidase results in *CN-cytochrome oxidase complex*. This impairs respiratory electron chain resulting in *cytotoxic anorexia* and death.

PREDISPOSING FACTORS TO CYANIDE POISONING

1. Soil factors or edaphic factors

2. Season: - cyanogenic glycosides decrease in drought – stricken plants. More at rains or wet season when there are new shoot.

3. Herbicide Sprayer and Fertilizers: Increases the tendencies especially nitrates in phosphorus deficient soils. Cyanogene forage when sprayed with foliar herbicides such as 2,4– D, this increases the prussic acid concentrations for several weeks after application.

4. Feeding on frozen plants may cause a high release of cyanogenic glycosides.

5. Part of the plant eaten - for example in *Pyrus malus* the poison is more in the leaves and seeds and is less in the fleshy fruit.

6. Species factor: - It is common in large animals such as cattle (ruminants). The monogastrics are less likely to get poisoned. Hereford cattle - is the breed that is reported to be less susceptible than other breeds.

7. The processing of the material: when silage is not dried / increase toxicity if plant materials contain 20 mg HCN /100 gram, is considered toxic.

FORMS OF CYANIDES TOXICITY

Types:

1. **Acute:**
    - Excitement
    - Laccrimation
    - Hypersalivation
    - Bright red mucosa
    - Nystagmus
    - Death.
2. **Chronic**:
    - Urination
    - Incontenance

Clinical Findings Generally:

15 – 20 min to few hrs after the animal has consumed the forage.

- Excitement can be dinyolyed
- Rapid respiratory state
- Dyspnoea
- Tarchycardia
- Salivation
- Lacrimation (in excess)
- U – urination
- Vomiting (especially in pigs)
- Fasciculation in common and progresses to generalized spasm
- Animal staggers, struggles and falls.
- Asphyxra cyanides , the mucuos membrane bluish.(cyatonic)

The whole syndrome does not exceed 30-45min if lives up to 2hrs after onset of clinical signs, survives except if cyanide continuous absorbed from the gastro intestinal tract.

LESIONS

In acute and peracute cases, blood may be clear red initially but can be dark red if necropsy is delayed. Agonal haemorrhages in the heart.

- Mucuous membrame :- gzanotic

- Gastro intestinal
- Rumen may be distended with gas in the odour of “bitter almond”

Respiratory System

- Froth in trachea serosa surfaces of trachea mucosa and lungs may be congested or haemorrhagic.
- Liver:- Congestion with hemorrhages

C.N.S.

Multitude foci of degeneration or necrosis may be seen in the C.N.S. of dogs in chronically exposed to sublethal amount of cyanide.

Differential Diagnosis

- Nitrate poisoning
- Organophosphorus poisons
- Sulphur poison
- Nitrate poison.

Diagnosis

- Appropriate history
- Clinical signs
- Postmortem finding or necropsy
- Demonstration of cyanide poisoning in the rumen using smell “almond smell”

Taking appropriate samples, these samples include:

- Suspected plant

- Rumen and stomach content
- Heparinized whole blood
- Liver and muscle

Samples should be taken preferably not more than 4 hours after death.

Method of storage of samples used for diagnoses:

Sealed in air-tight container, refrigerated or frozen. In the absence of refrigeration, immersion of specimens in 1-3% mercury chloride.

Another way of diagnosis is by estimating the amount of cyanide in the food.

1. >220ppm cyanide on HCN is considered very dangerous.
2. 750ppm HCN is considered hazardous
3. 500-750ppm is doubtful
4. <500ppm is considered safe.
5. <100ppm is considered very safe.

Picrate Paper is used to test the plants materials in stomach/rumen.

TREATMENT

What is used are as follows:

- $NaNo_3$ – sodium nitrate
- Sodium thiosulphase
- Dimethyl amino phenol (DMAP) or Hydroxalamine

Sodium Nitrate – (1 of 100ml of distilled water or isotonic solution) 20mg/kg. It could be repeated for 2-4hours or as needed.

Sodium thiosulphate at ≥500mg/kg I.V. plus 30g/cow to detoxify the rumen.

The basis of the use of $NaNo_2$ is I.V bring about vasodilatation and counteracts the CN induced – vasospasm.

It combines with haemoglobin (Hb) and converts it to methaemoglobin (Fe^{3+}) competes with cyanide complexed cytochrome oxidase so preventing the combination of HCN in the cychrome oxidase.

So, the sodium thiosulphate should be immediately given to detoxify the *cynamethaemoglobin* so that the already discharged cyanide from this compound *cynamethaemoglobin* react and combine with *thiosulphate* to produce *Thiocynate*. Artificial respiration with oxygen 100% should also be given along with sodium nitrate and sodium thiosulphate.

The use of sodium thiosulphate will fix the HCN present in the rumen as free cyanide in the blood decreases, additional cyanide dissociate from cyamethaemoglobin.

REVISION HINTS

1. List scientific names of 10 plants that might cause cyanide poisoning
2. Discuss cyanide poisoning under the following headlines:
    - Sources
    - Predisposing factors
    - Diagnosis
    - Sample collection
    - Treatment
3. Write short notes on the following:
    - Estimating cyanide in pasture
    - Diagnosis of cyanide poisoning
    - Mechanism of toxicity of cyanide
    - Treatment
    - Supportive treatment.
4. Read between the lines to know all nerves of enzymes involved, doses of various regimens used for treatment of cyanide poisoning.

NITRATE/NITRITE POISONING

Animals resistant to nitrate poisoning are Equids:

Animals susceptible include: Ruminants, especially cattle, the reason is the microflora reduces the nitrates to Ammonia, young pigs are also vulnerable to this.

Note: Usually, questions are asked why is it that nitrites are treated with nitrates, the nitrite is an intermediate product. But is 10 times more toxic than nitrates.

Forms of toxicity

Acute, sub-acute, or chronic form of toxicity.

Acute toxicity – Effects:

- The cellular basis is this – Nitrate converted to nitrite ion and combines with Hb, iron is converted to Ferric state this form Methaemoglobin when there is 80% or >methaemoglobin.
- Secondary effect is Nitrate has vasodilatory effect and would interfere with Metabolic protein enzymes.
- It irritates the mucosal lining and causes abdominal pain and diarrhea.

The subacute/chronic effects:

- Lowered milk production
- Minor transitory goitrogenic effects.
- Abortion
- Fetoxicity
- Increase susceptibility to infection.

Chronic form controversial and lowered milk production does not occur in chronic form of the disease.

Source of nitrates/aetiology:

Fertilizers.

Preservatives, (prickling and bines)

Machination

Gun powder

Unacclimated animals might feed on plants containing this include:

- Zea mays

- Sunflower
- Sorghum
- Cereal grasses (oats, millet and rye)

Factors that affect Nitrate poisoning

1. Excess nitrate in plants is associated with damp weather condition and cool temperatures of $55^{o}F(13^{o}C)$.
2. In drought especially when plants are immature.
3. Decreased light, cloudy weather and shading associated with crowding conditions can cause increase in nitrates poisoning.
4. Edaphic factors : Low soil that is deficient in trace elements like m*olybdenum* and in macro elements like *sulphur* or *phosphorus*.
5. Anything that stunts growth increases nitrate accumulation in the lower parts of the plants.
6. Herbicides.
7. Nitrates are accumulated in lower stalks but are lesser in leaves and upper stalk.

Clinical finding/Percentage Methaemoglobin

- Rapid weak heart beat
- Subnormal body temperature
- Weakness
- Dyspnoea
- Tachypnea
- Brown or muddy cyanotic, mucous membrane.
- Frequent urination (Methemoglobinaemia)

Signs of non plant sources are:

- Pains, abdominal discomfort, diarrhea salivation, vomiting

The Acute form occur when 80% or haemoglobin is converted to Methemoglobin 58%, this would result to dyspnea or dyspnoea. The lung would later recover but later worsen to Interstitial Pulmonary emphysema; If conditions are favorable, patient may recover in 10-14day but in adverse condition animal die.

Lesions:

- Chocolate – brown colour, although dark red lines may also be seen.
- Pin point haemorrhage in Serosal.

Diagnosis:

1. The specimen that is most preferred is plasma for pre-mortem specimen analysis of Plasma-protein-bound nitrate, because if the blood is clot, nitrate could be lost in the clot if serum was collected.
2. Other specimen may be postmortem
3. Methaemoglobin analysis (not reliable).

Interpretation: If the nitrate present in while blood other postmortem specimens is indicative of nitrate poisoning.

Post mortem specimens

Specimens to be taken are as follows:

- Ocular fluids
- Fetal pleural fluid.

- Thoracic fluids
- Fetal stomach content
- Maternal uterine fluid.

Method of storage and preservation

- Frozen in clean plastic or glass containers labeled before submission.
- Blood collected whole for methaemaglobin analysis is not frozen.

4. Standard analytical methods are required.
5. Field test for nitrate (presumptive) dipsticks are used to determine nitrate values.

Differential diagnoses

* Cyanide * pesticides * toxic gas

* Urea * toxic gases * H_2S and carbon monoxide

Some infectious diseases could be confused and non infectious.

Non infectious diseases:

- hypocalcemia

- Hypo magnesemia
- Pulmonary endenomatosis

Treatment of Nitrate poisoning

Low I.V. injection of methylene blue in distilled water or isotonic saline should be given of 22mg/kg or depending on severity of exposure. Lower dosage may be repeated in 20-30minutes. If the initial response is not satisfactory, higher dosage can be used.

Control: Animal may adapt to high nitrate content in feed, especially grazing summer animals such as sorghum Sudan hybrid.

- Multiple small feeding help animals adapt.
- Balanced diet and trace element and this prevents metabolic disorders and predisposed to this poisoning.
- High-nitrate forage may also be harvested and stored as ensilaged rather than dried hay or green shop, this reduces the nitrate content.

Revision Questions;

1. Discuss Nitrate poisoning under the following headlines

    a) Predisposing factors.

    b) Mechanism of toxicity

    c) diagnosis.

    d) Treatment.

2a. In which way is nitrite and nitrate related and discuss the mechanism of toxicity of nitrates and nitrites.

2b. Discuss the forms of toxicities of nitrates.

2c. Differentiate the clinical signs of cyanide poisoning and nitrate poisoning.

2d. Discuss the control of nitrate poisoning.

3. Discuss the diagnosis of nitrate poisoning.

OXALATE POISONING

An oxalate poisoning is a salt of oxalic acid this include potassium oxalate and sodium oxalate.

Aetiology:

A. Plants (natural source)

1. *Amaranthus retroflexus*
2. *Spinacia aleraces.*
3. *Beta vulgaris*
4. *Oxalis spp. O. corniculata O. latifolia*
5. *Caladnium spp*
6. *Mexican breadfruit (Monstera spp)*
7. *Setaria spp.*

B. Metabologically synthesized - Formed during the metabolism of ascorbic acid, this forms the insoluble form of the salt or urolithic

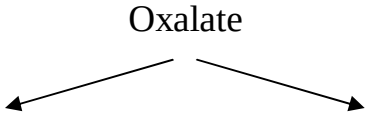
C. Oxalic acid (ingestion).

FACTORS AFFECTING OXALATES POSIONING

Annulus spp. – Cat and dog are susceptible to insoluble form while large animals to soluble.

- Animals left to move from one place to the other.
- Unacclimated animals might pick and eat plants that are poisonous.
- Extreme system of husbandry.

It is important to not that:



Soluble oxalates — insoluble oxalates

MgO_{x1} sodium oxalate and NH_4O — calcium oxalate

Insoluble form of calcium

Signs –

- Irritated oral mucosa stomatitis, that is Dysphagia

- Anorexia or animal go off feed. – It causes some nervous signs such as depression, convulsion may occur due to altered level of consciousness due to acidosis and cerebral damage.

- Stranguria; dysuria.

Soluble form of poisoning (Oxalate Mg, NH_4 Na)

- It causes hypocalcemia in ruminant as a result of acute poisoning
- Muscle weakness
- Recumbency
- In horses, it causes *Ostedystrophia fibrosis* when the horses take oxalate rich forage or long-term ingestion of plant.

Lesions:

- Slugging off the mucosa of oral cavity stomatitis, increased salivation.

- Precipitation of crystals in the kidney.

- Haemorrhages in central nervous system.

- Nerves, bones especially in horses.

Histopathologically

Cerebral nervous cell degeneration.

Haemorrhages

Necrosis, Nephritis

Urolith deposition.

The degeneration of the tubular cells lining of nephrons thus, results to the destruction of Mitochondria in the cells.

Diagnosis:

- History
- Clinical surveying
- Taking samples -

    a) Plant or food of animal

    b) Urine

    c) Blood

    These are analysed in the laboratory

P.M.

Histopathology

Treatment:

If the commercial form is ingested lime or calcium hydroxide solution should be given. This reacts with acid to produce insoluble form of calcium oxalate.

Use methol or eucalyptus oil to soothe the buccal cavity.