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Arsenic Toxicosis in Animals: Mechanism Clinical Manifestations and Treatment Approaches for Arsenic Poisoning in Animals

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Review Article

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ABSTRACT

Arsenic is a naturally occurring element present in the earth in various form (arsenate, arsenite) contaminates soil, water and causes toxicity to animal as well as human beings. The main routes of exposure of humans and most animals to arsenic through the ingestion then absorption through the skin. Animals having Arsenic intoxication showing various form peracute, acute and chronic form. First treatment is to removal of contaminants, emesis is first step (in capable species), followed by

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activated charcoal with a cathartic and then oral administration of demulcents. If diagnosis were confirmed early treatment should be started with Dimercaprol, even is given within two hours after ingestion of the toxic metal. Intramuscular injection or intravenous injection in peanut oil because of water insolubility was the reason. Supportive therapy include fluid therapy produce additive effect and animal will improve the health condition.

Keywords: Arsenic toxicosis; clinical manifestations; fluid therapy; animal.

1. INTRODUCTION

Copper sulfides, lead, silver, and iron, arsenic with sulfides are commonly available metal amongst arsenic were found in many parts of Chhattisgarh State. It is predicted as human emissions of arsenic at 41,000 metric tons every year.

Arsenic in various forms/compounds were releases about 7800 metric tons every year. As confirmed the researchers that arsenic in marine encouraged the study of the accretion and of great value of its lethal effects of aquatic organisms (Bertin et al., 2013).

Generally arsenic was found in rotten areas and preferably in soils various concentration (1-100 million of ppm,). Agricultural wood preservative, killing the unwanted herb (herbicide), finishing agent for the goblet manufacturing, desiccant even than use with copper and lead mixtures for utility purpose arsenic is common one (Mandal, 2017; Neiger et al., 2004).

Aposhian et al., (1984) because arsenic intoxication in pregnant sows will damage the placental blood capillary to the extent that abortion be gain to occur in sows may be due to feed having the Arsenic content above the permissible limit. It is a naturally present metalloid (trivalent, pentavalent) present in water, soil even in crop when grown with arsenic rich soil or irrigated water having high arsenic content.

2. FACTORS IN ARSENIC POISONING

1. **Crops and Vegetables:** Due to high arsenic level insoil or water where these foods are grown or harvested, accumulate in certain foods, especially rice, vegetables, and seafood (fish and shellfish),Ingestion of these food items results arsenic poisoning.
2. **Medicinal use: Various medicaments contain** arsenic compounds were used in treatment as traditional medicines and. Improper or excessive use of these compounds could lead to arsenic toxicity.
3. **Occupational exposure:**Workers in pharmaceutical company, pesticide production factories are frequently expose to even industries such as mining, smelting, wood preservation, and electronics manufacturing may inhale arsenic-containing dust or fumes regular basis, leading to acute or chronic arsenic poisoning (Selby et al., 1977).
4. **Irrigated water :** Reserchers reported that some vegetables like lady's finger potato,arum,amaranth,radishcauliflower,brinjal found the high concentration of Arsenic due water irrigated these vegetables having high content of arsenic compound (Mandal, 1998).
5. **Environmental exposure:**Because of industrial emissions or contaminated soil can contribute to arsenic poisoning through the exposure of airborne arsenic particles in the environment.
6. **Skin contact: Occupational exposure:**Workers handling arsenic-containing materials or products (pesticides, wood preservatives) may absorb arsenic through their skin, leading to toxicity over time.
7. **Environmental exposure:**Arsenic-contaminated soil or water can also lead to dermal exposure, particularly in agricultural settings or areas with industrial contamination.
8. **Smoking:** Tobacco smoke may contain arsenic, contributing to exposure forsmokersand those exposed to passive smoking.
9. **Environmental sources:**Environment is polluted due to Arsenic and ts products either through the soil erosion or Volcanic eruption exert or human activities like mining, residuals of industries causes widespread contamination of air, water, and soil.WHO recommended as limit (0.01 mg L-1 for drinking water) (WHO, 1992).

3. METABOLISM OF ARSENIC

Methylation is very Important steps in Arsenic metabolism, glutathione conjugation is to be

intermediate steps in case of arsenic toxicity (Gonçalves et al., 2017). Researchers confirmed the importance of glutathione or S- containing compound called thiol compound in arsenic metabolism. Arsenic enters in to the body through the various routes 80% of the arsenic is bound to Red blood cells, then it distributes to tissues of the body, and produce its toxic effect through the DNA damage by exerting cytotoxic effect mainly inorganic form of Arsenic,(arsenite and arsenate). Ingested Arsenic after metabolism will accumulates in sweat glands, nails, hooves, and hair with long term exposure of animals and produce its chronic form of toxicity. Liver, kidneys, heart, and lungs having the highest concentration of Arsenic (Das et al., 2021).

4. CLINICAL SYMPTOMS

Generally arsenic toxicity in animals seen in three forms, Peracute,acute and chronic form. In per acute form animal died without showing any symptoms. In acute form of arsenic toxicity it affect directly to the blood vessels and damage the micro vascular integrity, causes seepage of transudes and animal will died due to loss of body fluid or shock (Valentine et al., 2007). Dehydration, weakness diarrhea and vomiting are the important symptoms were seen in affected animals (Mandal, 2017).

5. EFFECT OF ARSENIC ON THE SKIN

Generally skin is more sensitive part of human body. hyper pigmentation, palmar, and solar Keratosis are the common symptoms seen in skin of affected animal /human being. Chronic form of as toxicity showed with various clinical symptoms known as Arsenicosis, which is associated with various systemic manifestations over and above skin lesion (Ghosh et al., 2014).

6. DEFICIENCY IN THE NERVOUS SYSTEM

If Feed or ground water having high content of arsenic reach to brain after crossing blood brain barrier thus produce ill effects include concentration,speech learning,conjugative ability, When pregnant mice expose to arsenic compound will reach to brain and affect their offspring (Verma et al., 2004).

Glutathione play an important role involved in the fighting against toxins. If Decreases in GSH levels after arsenic exposure are related to higher arsenic interactions with GSH. Experimentally proven that arsenic-infected rats and mice show the changes in dopaminergic, cholinergic, serotonergic, and glutamatergic systems.

7. EFFECT OF ARSENIC ON THE LIVER

Liver is the main organ of toxic metals metabolism, when enters in the body. Experimentally proven that arsenic produce deleterious effect to liver via change the liver structure, causes alteration in biochemical indicators like SGOT,SGPT,ALT, CPK etcwhich is main diagnostic sign. In case of ducks reduction in live weight as well as increase hepatic coefficient, histopathological alteration includes rupture of cell membrane, dissolution were also be seen in arsenic exposure.

8. EFFECT OF ARSENIC ON THE HEART

Animals commonly affected with arsenic poisoning when long duration of offered food and water, having arsenic above its permissible limit, will cause abnormality in myocardium with alteration in myocardium marker enzyme and cardiac histo-morphology in laboratory animals. In case of acute as toxicity produce edema of cardiac cell, atrophy of myocardial atrophy, infiltration of cell even than mirochondral damage also include in toxic effect of arsenic intoxication in animals.

9. EFFECT OF ARSENIC ON THE KIDNEYS

Kidneys are very much prone to arsenic-induced damage (Verma et al., 2004). Experimentally proven that arsenic produce toxic effect to nephrons via changes the kidney structure, causes alteration in biochemical indicators like SGOT,SGPT,ALT, CPK etc which is main diagnostic sign.

Experimentally increased level of blood urea, uric acid, and creatinine, which the main diagnostic compound in case of kidney damage through the metals were found in laboratory animals. Arsenic trioxide exert their ill effect by damaging the bone marrow, kidneys, and hampers hemoglobin metabolism (Young and Masijevsky, 1997), Arsenic trioxide affects bone marrow, kidneys, and hemoglobin metabolism.

10. LESIONS

When animals are died suddenly without showing the symptom due to continuous

Ingestion of feed having high content of arsenic may be due to in soil or irrigated water showing the lesions in the gastrointestinal tract with reddening with inflammation of gastrointestinal mucosa either in localarea or diffuse may occur, with development of edematous swelling, blood vessels rupture, starts with necrosis of epithelial tissues of adjoining region affected visceral. In cattle buffalo sheep and goat shows characteristic paintbrush lesions are main diagnostic feature (Lloyd et al, 1977). Diffuse inflammation of kidny liver, kidneys, and other visceral organs. The liver may have fatty degeneration and necrosis.

11. DIAGNOSIS

In case of poisoning primary treatment could be done on the basis of history clinical sign with chemical testing of biological fluid (urine, blood and gastrointestinal contents) if in per acute cases when sudden death of animal occur postmortem lesion is very important and helps for the treatment of rest animals. Hair samples testing in chronic cases provide the confirmatory diagnosis and take necessary action for prevention of same poisoning in in another herds.

12. TREATMENT

In metal especially in Chhattisgarh state there is Chowki, MohlaManpur are the areas of Rajnandgaon district having AS contamination is more than the permissible limit, so preventive measure should be adopted to avoid this situation. In case of sudden exposurefirstlyto removal of contaminants, emesis is first step (in capable species), followed by activated charcoal with a cathartic and then oral administration of demulcents. Dimercaprol is one of the chelating agent will conjugate with AS, can be given either intramuscular or n Vein directly.Resercher proven that curcumin (Haldi) is herbal compound can also be given @ 400 mg/kg will be very effective.

13. CONCLUSION

India Chhattisgarh, West Bengal etc are the common with permissible limit of o1100 pg/ in drinking water Arsenic even found in sea water also is also (5).Human activities will interfere the environment and affect the animal as well as human beings. various toxic metal including arsenic (AS) enter in to the biological fluids of animal, human beings either through the feed, fodder, soil usually dips, sprays, powders, or vegetation contaminated by pesticides containing arsenic.and produce deleterious effect.AS found in cattle, sheep, chicken and ducks even in fishes due to water contamination, threatening animal food safety, so it is of serious matter need to take steps to get rid off (Su et al. 2023). Nowadays various preparation available in market including curcumin (Haldi) is herbal compound can also be given @ 400 mg/kg will be very effective.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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