Chronic fluoride poisoning in domestic equines, horses (*Equus caballus*) and donkeys (*Equus asinus*)

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Abstract

Repeated chronic fluoride (F) exposure for prolonged duration through water, air, and food causes F poisoning in the form of fluorosis in both humans and domestic and wild animals. However, among domestic equine animals, horses (*Equus caballus*) and donkeys (*Equus asinus*), chronic F poisoning caused by industrial fluoride pollution and fluoridated drinking water has been well studied. But these studies in these animals are still very limited. On the other hand, the sample size of these animals in these studies is also very small. Nevertheless, these studies are important from the point of view of veterinary medicine and toxicology. In these animals, F-induced diverse toxic effects or pathognomonic signs such as dental motting or light to deep brownish staining on enamel surface of teeth, lameness, stiffness, skeletal abnormalities, crooked legs, hoof deformities, pain in joints, weight loss, unthriftiness, poor health, standing with an arched back, difficulty eating, rough hair coats, allergy or urticaria, anaemia, colic, diarrhoea, constipation, retention of urine, repeated abortions, and sterility have been reported. At the mean F concentration, in the range of 1.4 to 3.3 ppm in the drinking water, the prevalence of osteo-dental fluorosis in horses and donkeys has been found to be 78.7% and 100%, respectively. In present communication, chronic F poisoning in domesticated equine animals, horses and donkeys and its prevention in these animals have been focused. Simultaneously, research gaps have also been highlighted for researchers and veterinary scientists to do some advanced research works on these animals.

Keywords: Chronic fluoride poisoning, Dental fluorosis, Donkeys, Equines, Horses, Lameness, Non-skeletal fluorosis, Skeletal fluorosis

Introduction

It is well known that low concentrations of dietary fluoride (F) can be beneficial to animals [1]. But excessive ingestion/inhalation of F over a long period of time causes a devastating fluorosis disease not only in human beings [1-11] but also in various species of wild and domestic mammalian animals [12-22]. This disease is endemic in >150 countries [2]. In humans and domesticated animals, fluorosis is mainly due to chronic F exposure through fluoridated drinking water (hydrofluorosis) and industrial F pollution (neighbourhood in man and industrial fluorosis in animals). However, the maximum research studies on chronic F poisoning or intoxication (fluorosis) have been performed in bovine and flock ruminants [23-31]. These ruminants are most common domesticated animals raised in all over the world. But some larger domesticated animals such as the dromedary camel (*Camelus dromedarius*) and equus animals such as horses (*Equus caballus*) and donkeys (*Equus asinus*) are also raised but in limited numbers as compared to bovine and flock animals. Studies on chronic F poisoning or fluorosis in equine animals have also been done [32-40]. But these studies have been carried out in limited numbers of these animals. Due to the limited level of research work in limited number of equines, there is a lack of accurate information about natural chronic F toxicity in these animals. In present communication, chronic F poisoning in domesticated equine animals, horses and donkeys and its prevention in these animals have been focused. Simultaneously, research gaps have also...
been highlighted for researchers and veterinary scientists to do some advanced research works on F toxicosis in these animals.

**Chronic Fluoride Poisoning in Equines**

Acute, high F dose intoxications result in severe signs and rapid death in animals [1]. But chronic low F dose intoxication primarily causes various anomalies in teeth and bones. While small amounts of F improve the strength of hard tissues, teeth and bones, excessive amounts can cause lameness, stiffness, bone thickening, pain and difficulty in eating, weight loss, and poor health and growth rates [1]. In general, teeth are affected during the period of dental development, which is completed before 4-5 years of age in horses. If animals are exposed to excessive F, fluorotic dental lesions will not develop after permanent dentition [1,37].

Though, studies on chronic F poisoning in domestic equines, horses and donkeys are scanty [32-40]. However, these studies are important from the point of view of veterinary science and toxicology. In these animals, chronic F poisoning has been observed due to chronic F exposures through naturally or artificial fluoridated drinking water and industrial F pollution [32-40]. It is widely accepted that a dry weight dietary F tolerance of 60 ppm F has been recommended for horses by the US National Academy of Sciences since 1974 [41]. However, artificially fluoridated drinking water having F ≤ 1.3 ppm has also been found potential to cause chronic F poisoning in horses. In these animals F-induced dental molting or light to deep brownish staining on enamel surface of teeth, lameness, stiffness, skeletal abnormalities, crooked legs, hoof deformities, pain in joints, weight loss, unthriftiness, poor health, standing with an arched back, rough hair coats, allergy or urticaria, anaemia, colic, diarrhoea, constipation, retention of urine, repeated abortions, and sterility have been observed. Interestingly, after the termination of fluoridation in drinking water, some health complaints like colic, stiffness, lameness, and other reversible manifestations of fluorosis have been found gradually disappeared [35,37]. In this study the disappearance of lameness in horses after the termination of F exposure is a contradictory finding. Generally, once lameness develops it becomes permanent and remains in fluorosed individuals, like humans, for the rest of their lives [42-47]. However, it may be possible only at the initial stage of lameness in animals. Nevertheless, more studies on natural and experimental chronic F intoxication are needed in equine animals for the confirmation of reversibility of F-induced bony changes.

In India, a study on chronic F intoxication in the form of osteo-dental fluorosis was performed in 23 domestic equus animals, 9 to 23 years old, including 14 horses (Equus caballus), and 9 donkeys (E. asinus) living in F endemic rural tribal areas of state of Rajasthan [38]. The mean F concentration in the drinking water sources in these areas is found to be in the range from 1.4 to 3.3 ppm. Eleven (78.7%) of these horses and all nine donkeys (100%) were found to be afflicted with mild to severe dental fluorosis. Their incisor teeth were light to deep brownish in colour. Also present as indications of more severe chronic F intoxication were irregular wearing and excessive abrasions of the teeth, deep dark-yellowish discoloration of exposed cementum and/or remaining enamel surface, and pronounced loss of tooth-supporting alveolar bone with recession of gingiva. Excessive hypoplasia and light brown-yellowish pigmentation on the enamel surface of incisors were also observed in 2 foals below the age of 2 months. Such dental anomalies have also been observed in horses drinking water artificially contaminated with F (0.9-1.1ppm) [37].

Among the mature horses and donkeys exposed to F through drinking water having F in the range of 1.4 to 3.3 ppm, the following manifestations of skeletal fluorosis have been reported: periosteal exostoses in mandibular regions, ribs, metacarpus, and metatarsus, intermittent lameness, hoof deformities, and hardness of tendons in the legs. Other signs of chronic F intoxication (non-skeletal fluorosis) were also observed in these animals, including colic, diarrhoea, urinary retention, repeated abortions, and sterility. The evidence of osteo-dental fluorosis in domestic horses and donkeys is reported for the first time in India, and this condition in donkeys is reported for the first time anywhere [48].

In addition to the F amount and its duration and frequency of exposure, the severity of F toxicity in both humans and animals depends on diverse determinants such as the density or rate of bio-accumulation of fluoride, chemical constituents in drinking water, age, gender, habits, food constituents, environmental factors, individual susceptibility and biological response or tolerance, health, and genetics of an individual [49-60]. However, in the context of F in drinking water, in horses, F tolerance is not yet clear. Therefore, more experimental studies on F intoxication in equines are highly needed. The findings of these studies are useful in understanding F toxicosis and also in formulating health policy for mitigation of F intoxication in these animals as these are economically valuable equines.

**Prevention of Chronic F Intoxication (Fluorosis) in Equines**

Horses and donkeys are counted among the valuable animals. If chronic F poisoning or fluorosis disease occurs in these animals, then there is a high possibility of economic loss to the animal parents. Therefore, to prevent this disease from occurring in these animals, it is necessary that F should not enter their body through any medium or sources. For this, these animals should be fed F-free food. Hydrofluorosis is not likely to occur if these animals are fed surface waters (ponds, reservoirs, dams, etc.) instead of groundwater (hand- pump and bore-well water) [61], in which the amount of F is found at the minimum level in the range of 0.01-0.3 ppm [2]. The rainwater harvesting and conservation is the most suitable and easiest way to get regular F-free drinking water for the animals. To protect these animals from industrial F pollution or exposure, keeping them in places without F pollution is not likely to cause industrial fluorosis. By giving nutritious food without F, the health of these animals remains at a high level; on the other hand, animals are also protected from fluorosis.

**Conclusion**

Chronic F intoxication (fluorosis) has also been found in equine animals, horses and donkeys, if exposed repeatedly and for a long time to various F sources such as fluoridated drinking water, industrial F emissions and F-contaminated foods. The pathognomonic signs or toxic effects of chronic F intoxication or poisoning in these animals are nearly identical to those found in other species of domestic animals (bovines, flocks, dromedary camels, etc.). But there have been very few studies on chronic F poisoning in these animals. Due to which F tolerance has not been assessed correctly. Sometimes the identification of dental fluorosis in these animals cannot be done correctly. That’s why it is very important to do experimental research works on chronic F poisoning in these animals. The findings of these studies are very useful in understanding of F intoxication and also helpful in controlling it in these economically valuable animals.
Conflict of Interest

The author declares no conflict of interest.

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