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Are Freshwater Sources in India Safe for Wildlife with Regard to Trematodiases?

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Review Article

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Abstract

Freshwater is necessary not only for drinking for humans and animals but also for agricultural and industrial purposes. If diverse snails (gastropods) and crabs or crayfish (crustaceans) are found in both these water bodies, various dangerous trematodiases caused by infection with trematode parasites may also be possible in humans and animals. In fact, these invertebrate species act as carriers or vectors of these parasitic diseases. In wild ruminants like antelopes and deer, the most common trematodiases are fascioliasis, amphistomiasis, paramphistomiasis, and schistosomiasis while in wild carnivores like lions and tigers, the most common trematodisis are paragonimiasis. These diseases are caused by infection with trematode (fluke) parasites *Fasciola* spp., *Amphistomum* spp., *Paramphistomum* spp., *Schistosome* spp., and *Paragonimus westermani*. These parasitic diseases are more dangerous and fatal to wildlife. The incidence of these parasitic diseases varies greatly from region to region and according to the animal species. However, these diseases are more prevalent in wild herbivores than carnivores and the peak infection of trematode parasites generally occurs after the monsoon and before winter. Though infection with these parasites may occur throughout the year. Trematodiasis not only causes ill health in wild animals but also reduces their population. Many times, outbreaks of these diseases also result in death of many wild animals. In fact, freshwater sources that contain various species of snails and crabs infected with trematode larvae are not at all safe for wildlife in terms of trematodiasis. Therefore, more research survey studies are needed from time to time on different species of wildlife living in different ecosystems of the country to find out the current status of these diseases. The results of these studies are useful not only in health policy making but also in the prevention and control of these diseases in wildlife in India. Although these diseases are treatable and effective drugs are also available for them, yet, awareness, vigilance, and regular monitoring are necessary.

Keywords: Freshwater Sources; Snails; Trematode Parasites; Trematode Larvae; Trematodiasis; Vectors; Wildlife; India

Introduction

It is well known that various freshwater sources whether lotic (springs, rivers, streams, etc.) or lentic (ponds, lakes, dams, etc.) are not only essential for drinking water in human beings and animals but are also useful and important in agricultural and industrial sectors. If the water from these sources is contaminated with toxicants and pathogens, it may not be safe for the health of humans and animals. In India, most of the groundwater is naturally contaminated

with fluoride toxicant [1-3]. Many freshwater sources have also been found to be naturally and anthropogenically contaminated with this toxic chemical [4,5]. Drinking of such fluoridated water for a long time is not safe for health and causes a serious disease called fluorosis in humans [6-13] and domestic animals [14-21]. If such water is consumed by wild animals, they also develop this disease [22,23].

Dracunculiasis, a parasitic disease caused by infection with the female nematode worm Dracunculus (*Dracunculus Medinensis*), was also endemic in India, especially in rural areas [24-26], although it has now been eradicated. In fact, the disease was also transmitted by drinking freshwater contaminated with Cyclops infected with the larvae of this parasite. Not only in India but also in other countries, freshwater sources populated by snail and crab species infected with trematode larvae are capable of causing a variety of trematodiases not only in humans [27] and domestic animals [28-35] but also in various species of wildlife [36-44] (Figure 1).

Figure 1: Most wild ruminants (antelopes and deer) (a-d) get infected with trematode parasites by eating contaminated aquatic vegetation, while carnivores (lions and tigers) (e,f) get infected with these parasites through contact with contaminated water and by eating contaminated meat of wild animals (preys).

Trematodiases such as fascioliasis, amphistomiasis, paramphistomiasis, and schistosomiasis are more prevalent in wild herbivorous animals such as antelope and deer (Figure 1), while paragonimiasis is more common in wild carnivorous animals such as lion and tiger (Figure 1). In fact, these diseases are caused by infection with digenetic trematode parasites (flukes) *Fasciola* spp. (liver fluke), *Amphistomum* spp. (rumen fluke), *Paramphistomum* spp. (intestinal fluke), *Schistosome* spp. (blood fluke), and *Paragonimus westermanni* (lung fluke), respectively. Apart from these most common diseases, other types of trematodiases are also found in wildlife. These diseases not only cause morbidity and mortality in wild animals, but also affect their growth, reduced production yield and quality, loss of body weight, poor reproductive performance, digestive disturbances, long-term emaciation, and increased

susceptibility to other infections [45]. Indeed, these parasitic diseases are transmitted to wildlife by their specific vector species such as snails (gastropods) and crabs or crayfish (crustaceans) that are present in almost every freshwater body. But this is possible only when these vector species are infected with the larvae of trematode parasites. Therefore, the aquatic habitats in which these vector species are found are not safe for wildlife in terms of trematodiasis, which is the main focus of the present review.

Are Freshwater Sources Safe for Wildlife in Terms of Trematodiases?

In India, wherever wildlife is found, many bodies of seasonal and perennial freshwater are also present. These water bodies have their own ecosystems with a wide variety of species of snails and crabs or crayfish. Importantly, most snail species are habitat and trematodiasis specific [46-48]. However, many of them are widely distributed in different geographical areas and belong to the families Lymnaeidae, Planorbidae, Thiaridae (Melanidae), and Viviparidae of the class Gastropoda of the Phylum Mollusca. The most common snail species found in various freshwater bodies in the country where wildlife is present are *Lymnaea acuminate f. patula, L. acuminate f. chlamys, L. acuminate f. typica, L. acuminate f. rufescens, L. luteola f. australis, L. luteola f. typica, L. luteola f. impura, Gyraulus convexiusculus, Planorbis (Indoplanorbis) exustus, Faunus ater, Melania (Plotia) scabra, Thiara (Tarebia) lineata, Melanoide striatella tuberculata, Vivipara bengalensis* race *gigantica, V. bengalensis* race *mandiensis,* etc [49,50].

In fact, these molluscan gastropods are intermediate or secondary hosts of digenetic trematode parasites of wild animals and complete the life cycle of these parasites in them. In these hosts, different larval stages of these parasites such as sporocysts, rediae, and cercariae develop by asexual reproduction. Interestingly, each trematode species has its own characteristic type of cercarial larvae which differ in size, shape, specific morphological features, etc [51-63]. Most of these free floating cercariae are phototrophic and emerge from the snails in the mornings [64]. The most favourable or ideal time for most snail species to get infected with miracidium larvae of digenetic trematodes is the rainy season. In fact, faecal matter contaminated with trematode eggs is carried by rainwater to available freshwater sources where these eggs hatch into miracidia larvae which swim in water in search of a snail host. Eventually these larvae enter the body of the snails where these larvae multiply and develop into various forms of trematode larvae. Most snails release cercariae larvae in the post monsoon and pre-winter seasons [65-69]. The cercariae are free-living stages and float in water until they attach to a substrate such as leaves of aquatic plants or vegetation where they develop into cysts called metacercariae. These larvae are highly infective. These larvae enter the body of wild ruminants whenever they eat this contaminated aquatic vegetation. Eventually, these larvae reach their target organs where they grow and damage their tissues and ultimately cause trematodiasis in wild ruminants. There is no metacercarial stage development in schistosomiasis, the cercarial larvae penetrate the skin and enter the body while the cercarial larvae of *P. westermannii* directly invade tertiary crustacean hosts such as crabs or crayfish where these larvae develop into infective metacercariae [70]. When wild predators such as lions (*Panthera leo*) and tigers (*P. Tigris*) eat meat of prey contaminated with these metacercarial larvae, these larvae eventually reach the lungs of these animals and slowly grow into adults. The disease caused by them is called paragonimiasis. In general, herbivorous animals are relatively more susceptible to various trematodiases than carnivorous animals.

Interestingly, not only the adult trematode parasites cause various pathogenesis in their vertebrate hosts including humans, but their larvae are also highly pathogenic to their intermediate hosts and particularly they damage their hepatopancreas and gonads [71-77]. It is clearly evident that the freshwater sources in which snails and various species of crabs or crayfish infected with trematode larvae are found are not safe for the wildlife in the country in terms of various dangerous trematodiases. Even in humans and domestic animals such freshwater sources are not safe with respect to these diseases [78].

Can Trematodiases in Wildlife be Prevented and Controlled?

Yes, it is possible and with a little effort, awareness, vigilance, and regular monitoring, these parasitic diseases can be prevented and controlled from occurring in wildlife. However, these trematodiases have been considered as neglected diseases. Whether these diseases are endemic in wildlife areas or not can only be confirmed by coprological analysis or faecal examination of wild animals. This is the easiest, most practical, and cost-effective method. It does not require any special resources and can be trained or taught even to a less educated person. In this method, faeces of wild animals are randomly collected from different areas and then examined under simple microscope for the presence of eggs or ova of trematode parasites (Figure 2). Effective treatment of these parasitic diseases is available. Anthelmintic drugs can be used under the guidance of a veterinarian for the treatment of these diseases. Providing free drinking water to the intermediate host snails and limiting their population is also the ideal option for the prevention and control of trematodiases in wildlife. In future, vaccination is also the best option [79,80].

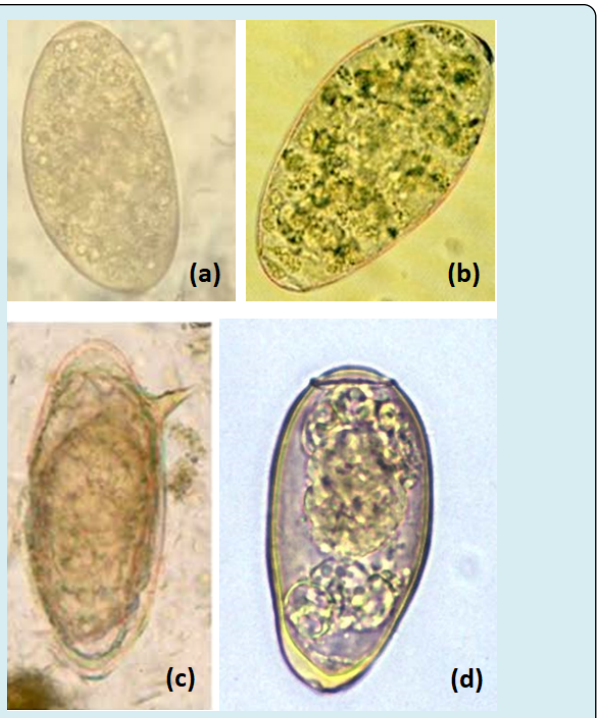

Figure 2: Eggs or ova of the most common digenetic trematodes found in the faeces of wildlife, (A) *Fasciola* spp., (B) Amphistome spp., (C) *Schistosome* spp., and (D) *P. westermani*.

Conclusion

India has many wildlife sanctuaries, reserves, national parks and forest areas that are home to diverse species of wild animals and also have various sources of freshwater. Most of these are home to species of snails and crabs or crayfish that are carriers of trematodiasis. In fact, these diseases develop due to infection with digenetic trematode parasites. Several studies show that thousands of wild animals in the country are suffering from these parasitic diseases that cause morbidity and mortality in them. This means that water bodies that have snails and crab species infected with trematode larvae are not at all safe for wildlife in terms of trematodiasis. However, these diseases can be easily prevented and controlled in wildlife as these diseases can be easily identified and effective treatments are available for them. Also, it is important that the health of these wild animals is checked from time to time. Along with this, awareness, vigilance, and regular monitoring are also necessary.

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