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Opportunistic parasites associated mortality in a nutritionally compromised young wild Bengal tiger

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ABSTRACT

Present communication deals with unusual observations made during the post mortem examination of a sub-adult wild tiger from the Pilibhit Tiger Reserve of Uttar Pradesh (India). Physical examination revealed hide bound condition, dull appearance of body coat, old healed fracture of right radius and septic wound in right forelimb apart from a spine of porcupine piercing the nasal septum causing nose bleeding. Organ-wise inspection revealed presence of *Dirofilaria immitis* adult worms (n=3) in the right ventricle of the heart, *Physaloptera* sp. in the stomach, *Toxocara cati*, *Ancylostoma* sp., *Taenia* sp. and *Spirometra* sp. in the small intestine. Examination of intestinal content revealed eggs of *Paragonimus* sp. and *Trichuris* sp. along with large number of *Isospora* sp. oocysts apart from eggs of *Toxocara*, *Ancylostoma*, *Taenia* and *Spirometra*. The intensity of worms recovered (parasitic load) from the tiger in the present case was found to be surprising in the sense that despite of specific micro-environment requirement of each parasitic species, host allowed buildup of severe infection of almost all the parasitic genera. This situation might have arisen due to compromised immune status of the tiger due to prolonged starvation because of difficulty in catching the prey. All these parasites are present in the tiger reserve and pose a threat to this priceless animal species, especially if the host is immunocompromised.

Keywords: GI nematodes, Heart worm, Mortality, *Panthera tigris*, *Paragonimus*, Tapeworms

Bengal tiger (*Panthera tigris*), the largest living feline on the earth, holds top rank in the food chain of a given ecosystem (Kalaivanan *et al.* 2015). This animal species has got protection in schedule I of the Wildlife Protection Act of India (1972). Besides, to conserve a viable population in its natural habitat and to protect this animal from extinction, a tiger conservation programme 'Project Tiger' was also launched in the country in 1973. With the efforts of the Government machinery and different agencies involved, an increase in the tiger population from 1,706 in 2010 to 2,967 in 2018 was achieved. However, if we look at the reported causes of mortality of tigers in India, these include old age, territorial fights, injuries during hunting/ poaching, and infectious diseases (Kumar *et al.* 2016). Therefore, a thorough investigation of every event of mortality is needed to preclude the malicious and uncommon causes of deaths.

Amongst the infectious diseases, parasitic infections are the serious health concern both in wild and zoo settings. These infections are not only responsible for the morbidities of animals, but heavier infection may prove fatal also (Chhabra and Pathak 2013). Several reports on the occurrence of different parasites and/or parasitic diseases of tigers and other wild felids residing either in captivity or in the natural habitats are available from different parts of the country (Gaur *et al.* 1979, 1980, Muraleedharan and Iswaraiah 1984, Mandal and Choudhury 1985, Chaudhury *et al.* 1986, Arora and Das 1988, Sano *et al.* 1994, Parija and Bhattacharya 2001, Acharjyo 2002, Kumar and Rao 2003, Singh *et al.* 2006, Misra *et al.* 2008, Shafiya *et al.* 2018). In the natural habitats, these felids roam over larger areas, and thus it is a common belief that exposure to the different parasitic diseases should be less (Moudgil *et al.* 2015). However, such animals are continuously exposed to various vectors and intermediate hosts of different parasites. The present study deals with the recovery of 9 different types of parasites on post-mortem of a sub-adult tiger died in the Pilibhit Tiger Reserve of Uttar Pradesh (India).

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MATERIALS AND METHODS

Case history, post mortem examination and collection of biological materials: A sub-adult male tiger (age about 2 years), died in the forest area of Pilibhit Tiger Reserve (PTR), Pilibhit, Uttar Pradesh (India), was subjected to post mortem examination at the Centre of Wildlife, ICAR-IVRI, Izatnagar on 11 April 2018. The carcass was lean and thin with prominence of bony cage and very little amount of

Fig. 1. Carcass of wild tiger in hide bound condition (a), septic wound in right radius (b), spine of porcupine in nasal septum (c).

musculature above the same. On physical examination, old healed fracture in the shaft of radius bone of right foreleg with development of callus was noticed. A long standing deep seated septic wound with pus was also appreciated in the same leg. Further, a large size porcupine spine was also seen peeping through nostril which pierced the nasal septum and caused massive nose bleeding. Thereafter, internal organs (including different vital organs) were inspected carefully and any parasitic species present in particular organ(s) were collected for identification in the laboratory. Each compartment of the GI tract was visually inspected and parasites present, if any, were recovered maximally and transported to laboratory for their taxonomic identification. Other biological samples including intestinal contents and muscles were also collected to rule out bacterial, viral, parasitic and toxicological causes associated with the mortality of the animal.

Laboratory diagnosis and identification of parasites: Gross parasites were washed immediately with normal saline solution and group wise sorting was done before the microscopic examination of the specimens. Different nematode genera were examined by clearing with lactophenol, while tapeworms were processed for making permanent mount of the scolex region and mature segments, following the standard Borax carmine staining procedure. Intestinal contents were examined by flotation and sedimentation technique to record the eggs/ova/oocysts of the parasites. Muscle samples were examined microscopically using muscle-press technique as well as by artificial muscle digestion technique (acid-pepsin digestion) as suggested by ICT (http: //www.trichinellosis.org/) to detect *Trichinella* sp. larvae.

RESULTS AND DISCUSSION

Carcass of the wild tiger was debilitated (Fig. 1a) and the body coat was rough in appearance. Old fracture in shaft of the radius of right forelimb with callus formation and septic wound near to it was appreciated at visual inspection (Fig. 1b). Physical examination of different body parts yielded a large spine of porcupine peeping out from the left nasal cavity (Fig. 1c), causing severe nose bleeding. Examination of the heart yielded *Dirofilaria immitis* (n=3), whereas *Physaloptera* sp. from the stomach, *Toxocara cati*, *Ancylostoma* sp., *Taenia* sp. and *Spirometra* sp. from small

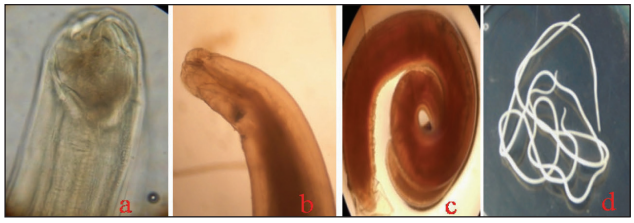

Fig. 2. Nematodes (gross) recovered from GI tract (a, *Ancylostoma* sp.; b, *Toxocara cati*; c, *Physaloptera* sp.) and heart (d, *Dirofilaria immitis*).

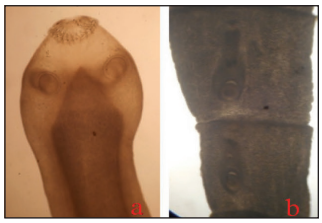

Fig. 3. Tapeworms recovered from GI tract (a, scolex of *Taenia* sp.; b, mature segments of *Spirometra* sp.).

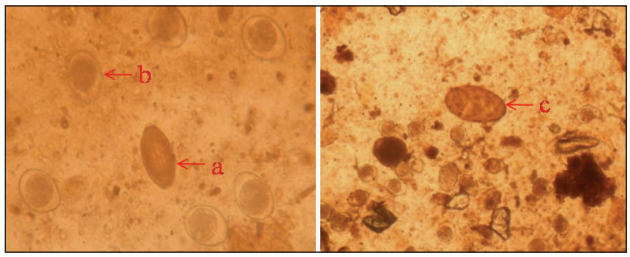

Fig. 4. *Trichuris* sp. egg (a), *Isospora* sp. oocyst (b) and *Paragonimus* sp. egg (c).

intestine (Fig. 2 a, b, c, d and Fig. 3 a, b) were recovered in large number. Examination of intestinal content revealed eggs of *Paragonimus* sp. and *Trichuris* sp. along with large number of oocysts of *Isospora* sp. (Fig. 4 a, b, c). Muscles samples were found negative for *Trichinella* sp. larvae in both compressorium method as well as in acid pepsin muscle digestion.

In the natural habitats, tigers predate on variety of prey species including mammals, reptiles, birds and fishes, which also acts as intermediate hosts for many parasites. Further, predation on the lower carnivores like jungle cat (*Felis chaus*), mongooses (*Herpestes* sp.) and leopard cat (*Prionailurus bengalensis*) etc., can further add parasitic

exposure, as lower carnivores diets in the forest mainly includes rodents, fishes, water snakes, frogs and crabs etc. Apart from that, tigers are also exposed to potential vectors and intermediate hosts (flies, ticks, mosquitoes) of different haemoparasites and helminths, in the process of searching food mainly near to human habitats or outskirts of the forest areas. Such haemoparasitic and helminthic infections had been recorded fatal in tigers by several workers in India (Gaur *et al.* 1980, Arora and Prasad 1989, Chattopadhyay 2000, Parija and Bhattacharya 2001, Manohar *et al.* 2003, Thilakan *et al.* 2007, Chhabra and Muraleedharan 2016, Singh *et al.* 2017).

In the present case, recovery of 9 different types of parasites or their stages raised some basic questions on host-parasite relationships for example: how many types of parasitic genera and/or species can co-exist in the small intestine of wild carnivores and whether micro-environment created by a group of parasites will be suitable for the survival of others. The parasites recorded in the study were *Paragonimus* sp. (trematode/ fluke), *Taenia taeniaformis* (cestode/ true tapeworm), *Spirometra* sp. (cotylodes/ false tapeworm), *Toxocara cati*, *Ancylostoma* sp., *Physaloptera* sp., *Trichuris* sp., *Dirofilaria immitis* (all nematodes) and *Isospora* sp. (protozoan/ coccidian parasite). Bulk recovery of gross parasites, viz. *Taenia taeniaformis*, *Spirometra* sp., *T. cati* and *Physaloptera* sp. from the GI tract indicated severe infections in the small intestine and stomach of the animal. It is worth mentioning here that, all above parasites have indirect life cycle and thus role of intermediate hosts are very much important. Further, larval stages of *Spirometra* sp., and *T. cati* do have zoonotic potential for human being. In the life cycle of *Taenia taeniaformis* (the common tapeworm in cats), rodents and lagomorphs (rabbits) play crucial role (intermediate host); whereas for *Spirometra* sp. fishes, reptiles and amphibians acts as second intermediate host. *Toxocara cati*, has complex type of life cycle (transmammary and paratenic host mediated), where mice, wild birds, earthworms and cockroaches are involved as paratenic hosts. *Physaloptera* sp. does require coprophagous beetles as intermediate host. In general, infection of *Physaloptera* sp. is asymptomatic but some time it causes chronic vomiting, melana and anaemia (Norsworthy 2006). However, literature also says that a single worm can also induce vomition in cats (Abu-Madi *et al.* 2010).

Recovery of *D. immitis* from the right ventricle (heart) at necropsy gives an indication of mosquito bites leading to endemic heart worm infection in carnivores in the natural habitat of tiger. Although, prevalence of heart worm infection in cats is reported to be much lower than dogs but it has been found fatal in tigers, where it is responsible for severe pulmonary congestion and hemorrhage (Atkins *et al.* 2005). Detection of large number of the eggs of *Paragonimus* sp. at fecal examination indicated that tiger had acquired infection through predation of mammals that consume crabs (intermediate host of lung fluke). Direct predation on crabs might be another possibility for acquiring *Paragonimus* sp. infection in the animal. Moderate recovery of *Ancylostoma* sp. in the heavily parasitized small intestine might have further worsened the condition. This parasite is voracious blood sucker and causes severe anaemia and digestive disturbances in parasitized animals. Above all, presence of very large number of the oocysts of *Isospora* sp. seems to be indicative of compromised immune status of that animal.

Published literature also proves that tigers are very often acquiring infections of different helminths and haemo-parasites and the most common are: *Toxocara cati*, *Toxascaris leonina*, *Ancylostoma caninum*, *A. tubaeforme*, *Gnathostoma spinigerum*, *Brugia pahangi*, *Toxoplasma gondii* and *Trichuris vulpis* (Soulsby 1982). In a study from Arignar Anna Zoological Park (AAZP), Chennai (Tamil Nadu), *Toxascaris* sp. infection was found predominant in the tigers from both zoo and rescue centre (Balaji *et al.* 2017). Mixed infection of *Toxascaris* sp. and strongyle worms was also recorded in 5 samples out of 15 examined. Another study from Tadoba National Park (Maharashtra, India), revealed that parasitic infections involving intermediate hosts were most dominant in tigers over the parasites with direct life cycle (Marathe *et al.* 2002). The reason for the above might be low stocking density of tigers in the natural habitats to acquire parasitic infection from each other. Arjun (2017) conducted scat analysis of tigers and observed that tigers of Wayanad wildlife sanctuary of Kerala are the hosts of different endoparasites, viz. *Diphylobothrium latum*, *Paragonimus westermani*, *Taenia* sp., strongyle sp. and *Trichuris* sp., with their respective incidence of 55.0, 41.6, 10.0, 6.6 and 3.3%, respectively. Similarly, Ananda (2016) recorded mixed infection of strongyle species, *Toxocara* sp., oocysts of coccidian and *Spirometra* sp. eggs in tiger.

In conclusion, recovery of 9 different endoparasites or their stages from a tiger of Pilibhit Tiger Reserve (Uttar Pradesh) indicates that severe parasitic infection may also be observed in wild animals in their natural habitats. Possible reason for build of severe parasitism in this case might be the sole dependency of ailing tiger on the smaller size prey for the survival, which were potential source of many parasitic infections, being the paratenic hosts. Compromised immune status of the animal might have allowed development of too many parasites in a single host. Thus, a comprehensive study needs to be conducted in PTR to record the diversity and impact of parasitic infections in carnivores in general and tiger in particular before formulating suitable managemental and control strategy for parasite control.

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