



First Report of Rabies in a Lioness and the Implication on Public health in Jos Zoological Garden, Plateau State, Nigeria

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ABSTRACT:

Lions (Panthera leo) are endangered animal species and survive well in the tropics. In captivity, they are susceptible to a lot of diseases including but not limited to rabies encephalitis. Rabies has been observed in free and captive carnivores more than any other mammalian species. We report confirmation of rabies as the cause of death of a 15-year lioness in Jos Zoo, Plateau state. Prior to the death of the lioness, the male lion had died a month earlier but rabies screening was not considered. Before death, both lions were weak, emaciated with complete loss of appetite, inability to drink water; severe dehydration, pale oral and ocular mucosa, and unsteady gait were observed. The lioness carcass was submitted to National Veterinary Research Institute (NVRI), Vom to investigate the cause of death and was confirmed rabies-positive by the Direct Fluorescent Antibody Test (DFAT). The lioness was born in the zoo therefore, possible sources of infection were considered to be rabid bats and rodents which probably had access to the lion's cage or infected animal carcasses fed to them. The loss of two lions in the tourist facility within the space of one month needs investigation to forestall future occurrence. Detail molecular study to characterize the virus and to also screen carcasses meant for their feeding are needed to mitigate the menace of diseases in the facility. The need for increased public awareness on the potential spread or outbreak of rabies among susceptible animals within and around the zoo is critical. The education of tourists to the zoo is essential to highlight measures to avoid animal bites from the captive wildlife through information signage. Routine vaccination of lion cubs and pre-exposure prophylaxis for zoo personnel is recommended. Wildlife escapes have been reported in both Wildlife Park and Jos zoo.

Keywords: Rabies, *Panthera leo*, Jos Zoo, DFAT, endangered species.

Introduction

Lions (*Panthera leo*) are considered iconic species of animals and are culturally respected world-wide. They are important for tourism and biodiversity conservation by balancing animal populations through predation (Groom *et al.*, 2014). Lions are listed as vulnerable (Bauer *et al.*, 2016) on the International Union for Conservation of Nature due to the global reduction of about 43% of the population in the past 21 years. From an estimated 400 000 lions in the 1950s, it is estimated that the current census of lions worldwide is down to approximately 23 000 to 39 000 mature lions (Bauer *et al.*, 2016). A number of factors such as illegal hunting, increased conflict with human beings due to competition for resources as human beings encroach wildlife habitats and disease threats, some of which are due to increased human and livestock interaction have contributed to a decline in lion populations in Africa (Chardonnet(ed) 2002).

Rabies has been a threat to lions and other African animals including humans (Dybas, 2009). It is transmitted through bite or scratch of infected animals. Rabies was first described in the Babylonian Codex written in 23 BC (Gard, 2014). Until the 19th century when Louis Pasteur developed a post-exposure vaccine, the disease has existed among human and animal population. The

wildlife populations especially in Africa have suffered from rabies infection (Marino *et al.*, 2017). Rabies has driven African wild dogs' local extinction in Kenya and Tanzania due to their social network (Ginsberg *et al.*, 1995; Vial *et al.*, 2006). "Tens of thousands of human deaths per year are attributed to rabies infections acquired from domestic dogs (*Canis familiaris*) (Fook *et al.*, 2014; Hompson *et al.*, 2015; Le and Nel, 2012)." The sylvatic cycle is maintained among wolves, foxes, skunks, jackals, and raccoons and is then transmitted to dogs and domestic animals at the wildlife-livestock interfaces or when dogs stray into parks and game reserves. In these wild animals, the rabies virus is maintained and transmitted to dogs or cats which in return, are transmitted to humans through bites (Cook and Zumla, 2009).

Rabies is also spread by bats especially in Latin America where Vampire bats serve both as vectors and reservoir hosts (Dantas-Torres, 2008). Insectivorous bats are significant reservoirs and vectors in the US (Smith *et al.*, 1995; Fu, 1997). Over 90% of rabies cases in India are from bites of domestic dogs (Ahuja *et al.*, 1985). Dogs are also important sources of rabies to livestock and pet animals. Worldwide, rabies has caused the death of over 55, 000 people annually, especially in Africa and Asia (WHO, 2010). However,

despite this high figure, there are countries that have been declared free of the disease such as Australia, New Zealand, Japan, Taiwan, Hong Kong, Singapore, Fiji, UK, Ireland, Norway, Sweden, Jamaica, and Barbados. In India, the islands of Andaman and Lakshadweep are rabies free (Taylor and Nel, 2015).

In Europe, 10,104 cases of rabies have been reported in cats from 2000 to the third quarter of 2009 (WHO, 2009). However, there is no specific cat rabies cycle known worldwide (Bunn, 1991; Niezgodna *et al.*, 2002), and this species of animals get infected only following exposure to other rabid animals (Mutinelli, 2010). There are cases of frequent transmission of rabies from stray dogs (Bharti *et al.*, 2015; Garba *et al.*, 2015) to different species of wildlife, especially non-human primates thought to be free from the disease. The brain samples of some wild animals such as Langoor (*Semnopithecus entellus*) and Himalayan Palm Civet (*Paguma larvata*) had tested positive by FAT and microscopic examination of Brain tissue (BT).

Though rodents and lagomorphs have been considered not be natural reservoir of rabies (Winkler, 1972), the reliability of the report is limited, as there is concern about rabies in rodents and lagomorphs (Winkler, 1972). There are reports of exposure to rabies by humans from rabid rodents

and lagomorphs (Stuchin *et al.*, 2018; Hareza *et al.*, 2023). Rodents and lagomorphs may contribute to the burden of rabies in humans and animals even though they represent low risk for the disease transmission (Winkler, 1972). "In addition, because of the close cohabitation of some rodent species with human populations and the high incidence of rodent bites, public health officials are frequently asked to evaluate the need for rabies post-exposure prophylaxis (PEP) after human contact with these animals (Childs *et al.*, 1997)." Most cases of rabies have been reported in Northeastern and Mid-Atlantic states in the United States due to the spillover of the variant from Raccoon (Krebs *et al.*, 1994; Jenkins and Winkler, 1987).

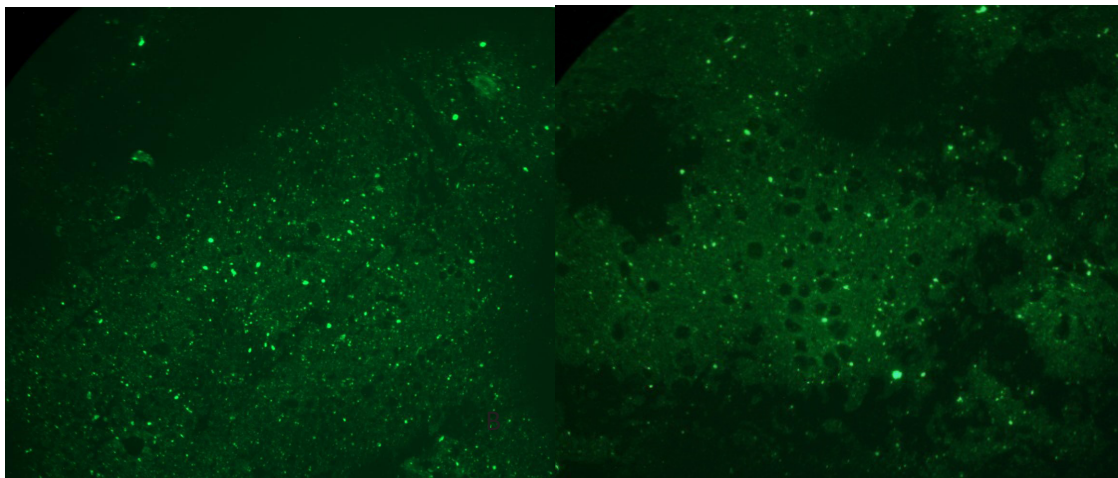
CASE HISTORY AND CLINICAL OBSERVATION

A lioness aged 15 years old and weighing about 100 kg was observed to be critically ill. It was off-feed, emaciated, weak, dehydrated, had unsteady gait, bruises all over the body, and severe wounds on the ear due to fly-bite dermatitis. Attempts to tranquilize and rehydrate was difficult as access to it was not possible. It was found dead after several attempts at accessing it in the cage. The lioness was routinely fed on goats, beef and donkey meat at about 5kg per day for 2-3 days in a week. The brain sample was taken

to the Rabies Diagnostic Laboratory of the National Veterinary Research Institute, Vom after post mortem was conducted on it. FAT was used as described by Dean *et al.*, (1996). The sample tested positive for rabies (Plate 2A) as the assay was validated by positive control (Plate 2B) and negative control (Plate 2C).



Plate 1A: Showed how emaciated, unsteady gait and dehydrated the lioness was prior to death



A

B

Plate 2A: Test (lion brain tissue specimen) stained with FITC anti-rabies conjugate showing immunofluorescence. 2B: Positive control specimen stained with FITC anti-rabies conjugate showing apple-green immunofluorescence.

A

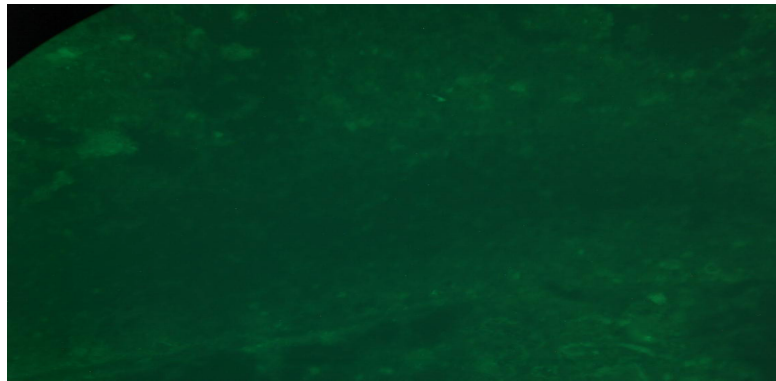


Plate 2C: Negative control specimen stained with FITC anti-rabies conjugate showing no immunofluorescence

DISCUSSION

Cases of rabies have been reported in all continents except Antarctica, with over 95% of death in humans in Asia and Africa. Rabies is not a problem of dogs alone. Records at the King Edward Memorial Pasteur Institute and Medical Research Institute, Shillong India have shown a positive microscopic finding in the brain sample of two Bengal tigers in Assam (Garnharm, 1988). The first tiger case in 1943 was reported to have severely mauled 18 people in just over 24 hours without any attempt to eat the victims before it was killed. The second case was in 1950 where the tiger terrorized the inhabitants of about six villages attacking 14 people. At least five heads of cattle, a dog and one person were killed on the spot and two others died in hospital the following day. Cases of leopards dying ostensibly due to rabies were also reported in south India during the British colonial period (Garnharm, 1988). The lion, tiger, leopard, hyena, wolf, and jackal are susceptible to rabies as they largely prey upon domestic animals, including dogs which are carrier of rabies virus. Rabies has threatened lions in the Serengeti National park, Tanzania along with other African animals including humans (Dybas, 2009).

This is the first reported case to the best of our knowledge of rabies in a captive lioness in Nigeria. The lioness was born in Jos zoo and according to the zookeepers, it has not been exposed to other animals like dogs and cats that are known to be carriers of the rabies virus in Nigeria apart from bats. The Jos zoological garden has been a sanctuary for the Egyptian fruit bats (*Rousettus aegyptiacus*) for years (Ameh *et al.*, 2022). Data from a study carried out in Ibadan (Western Nigeria)

showed the presence of rabies virus neutralizing antibodies in the sera of fruit bats (Aghomo *et al.*, 1990). Could it be that a weak bat fell in the lion cage and due to the curiosity of the bat was beaten? Could rodents be involved in the transmission of this rabies? Goats, donkeys, death animals, and fetuses are sources of meat for the lions in the zoo. Could it be that a rabid animal was fed to the lions? Prior to the death of the lioness, the male had died a month earlier but the brain sample was not submitted by the zoo management as rabies was least expected among other diseases. These questions need investigation to ascertain the source of the disease as the zoo is a place of tourist importance. Also, it is an educational establishment as children from various schools visit for educational purposes. The Faculty of science of the University of Jos and other colleges of animal health and production do approved research projects for their students in the establishment. This case may be the first of its kind and detail molecular study needs to be done to characterize the virus. Detail surveys of the brains of goats, donkeys, cattle, and sheep that are used to feed the lions need to be collected over a one-year period to screen for rabies to determine the source of the disease. A survey needs to be done by trapping rodents around the lion cage and to also screen a population of the

migratory bats for rabies antigen.

Finally, this case highlights the need for increased public awareness for the potential for lion-related rabies in Jos zoological garden. Enurah *et al.* (1988) had diagnosed rabies in civet cat in this same zoo. Occupational exposures to rabies among zoo workers is possible especially where breach of bio-safety and biosecurity precaution exist (Rabinowitz and Conti, 2010; Marsh and Babcock, 2015; Murthy *et al.*, 2015). There have been reported cases of human death due to attack by lions in Nigeria (Omonona *et al.*, 2018) and the most recent was the dead of a zooworker at the Obafemi Awolowo University.

Primary prevention is critical including routine pets (dogs and cats) vaccination at the periphery of the zoo, pre-exposure prophylaxis for persons at highest risk in the zoo, and the need to fence the zoo to prevent entry of stray dogs. Community and tourists education/enlightenment is required to highlight measures to avoid animal bites from the captive wildlife through information sign posts.

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