CASE REPORT

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Management of Haemoproteus and Plasmodium co-infection in a monitor lizard (*Varanus niloticus*) in Ibadan, Nigeria

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Abstract

Haemoparasitic infections in reptiles are often considered minimally pathogenic but may contribute to clinical illness under specific conditions. This report describes the clinical presentation and response to antibiotic therapy in a 22-year-old captive Nile monitor lizard (*Varanus niloticus*) naturally infected with Haemoproteus and Plasmodium. The lizard required parasitological and haematological evaluations due to observed significant tick infestation, malnutrition, and lethargy. Both male and female *Aponomma* species were verified upon identification, while faecal analysis showed no helminth ova or protozoan oocysts/cysts. The haematological results showed borderline hypoproteinaemia, resolving anaemia, mild hyperfibrinogenaemia, and an inflammatory leukogram indicative of an ongoing, effective acute-phase immune response. The presence of inclusion bodies resembling Plasmodium and Haemoproteus in erythrocytes was observed by microscopic blood smear examination. Doxycycline (10 mg/kg every 48 hours) and nutritional assistance through oral delivery of a whole chicken egg were part of the treatment regimen. Phenylpyrazole spray (7.5 mg/kg) was used to control ectoparasites. By day nine post-treatment, haemoparasites were undetectable in blood smears, and haematological parameters showed improvement, suggesting ongoing recovery. This case highlights the potential clinical impact of Haemoproteus and Plasmodium in reptiles, underscoring the importance of targeted therapeutic intervention and supportive care in captive settings. To improve reptilian health management and stop disease progression in zoological collections, routine haematological and parasitological monitoring is essential.

Keywords: *Aponomma* species, Haemoparasite, Haemoproteus, Monitor lizard, Plasmodium

Introduction

A native or invasive reptile in several regions of the world, the monitor lizard (*Varanus niloticus*) is known to harbour both endo- and ectoparasites, as well as other microorganisms that affect the transmission of both the sylvatic and domestic cycles (Omonona *et al.,* 2019). Despite their documented detrimental effects on both wild and captive reptiles, haemoparasites are typically widespread and regarded as less pathogenic (Ferreira *et al.,* 2020), Haemoproteus and Plasmodium, the malaria-causing parasite, both belong to the order Haemosporida (*Apicomplexa*) (Valkiūnas & Iezhova, 2022). Their gametocytes are found within the red blood cells with residual pigment granules (haemozoin) from the incomplete digestion of haemoglobin.nlike Plasmodium, Haemoproteus parasites do not multiply in erythrocytes and cannot complete sporogony in mosquitoes but only in the host tissues. They are transmitted usually by Culicoides (*Ceratopogonidae*) and sometimes by louse flies (*Hippoboscidae*) (Valkiūnas & Atkinson, 2020). The study describes the clinical presentations and the response to antibiotic treatment of a captive monitor lizard (*Varanus niloticus*) that was naturally infected with Haemoprotues and Plasmodium- like inclusion bodies.

Case Presentation

History and management

A 22-year-old female Nile monitor lizard (*Varanus niloticus*), purchased by the University of Ibadan's Zoological Garden, was brought to the University's Veterinary Teaching Hospital after exhibiting signs of malnutrition, lethargy, and a severe tick infestation for four days. The lizard had been kept in a controlled environment with regulated humidity and temperature, and its feed had been carefully supervised. Anorexia was observed and at physical examination showed high level of tick infestation, accompanied with emaciation, and a marked decrease in activity, all of which pointed to a worsening health situation that needed immediate medical intervention.

In order to screen for protozoan oocysts and/or helminth ova, freshly voided faecal samples were taken from the housing environment and placed in sterile, labeled vials. For identification, ticks were meticulously extracted from the lizard's body and preserved in 70% alcohol. For haematological analysis, blood samples were aseptically collected using a sterile syringe and needle from the ventral coccygeal vein and placed into sterile vials containing EDTA (Campbell, 2015). All samples were transported to the Department of Veterinary Parasitology and Entomology Research Laboratory, University of Ibadan, for detailed screening and identification following standard parasitological procedures (Soares *et al.,* 2020; Davis & Garcia, 2023).

Faecal samples were analyzed using concentration techniques (floatation or sedimentation) to detect both helminth ova and protozoa oocysts. Ticks were identified under a stereomicroscope, while thin blood smears were immediately prepared, air-dried, methanol-fixed, and stained with Giemsa for microscopic examination under oil immersion using a ×100 objective. Haemocytometers were used to measure the number of red and white blood cells, while the microhaematocrit method was used to measure the packed cell volume (PCV). The cyanmethaemoglobin technique was used to determine the concentration of haemoglobin (Hb). Mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), and mean corpuscular haemoglobin concentration (MCHC) were calculated following standard protocols. Differential leukocyte counts (lymphocytes, heterophils, eosinophils, basophils, and monocytes) were performed using a light microscope under high-power magnification with oil immersion, and heterophil-to-lymphocyte (H/L) ratios were computed (Orakpoghenor *et al.,* 2019; Davis & Garcia, 2023).

Faecal examination showed no parasitic eggs or oocysts throughout the treatment period. Ticks were identified as male and female *Aponomma* species (Plate IA, IB & IC), characterized by their large, broad, ornate bodies with festoons and long, slender palps (O'Rourke & Lertpiriyapong, 2015). The haematological evaluation of the Plasmodium- and Haemoproteus-infected monitor lizard, before treatment at initial diagnosis and on the ninth day of treatment, revealed several diagnostic trends (Table 1). Total protein was slightly increased from the initial value but remained at the lower margin of the reference range, indicating borderline hypoproteinaemia. Prior to treatment, mild anaemia was evident, with low haemoglobin, packed cell volume, and red cell indices suggestive of hypochromic, microcytic anaemia. Post-treatment values indicated erythroid regeneration with improved haemoglobin and PCV. Leukocytosis with pronounced heterophilia and lymphopenia developed post-treatment, consistent with an acute inflammatory response. Marked thrombocytosis and elevated fibrinogen levels were also observed, indicative of inflammation and possible tissue repair processes. The eosinophil count increased slightly, likely reflecting parasitic stimulation. These post-treatment shifts signify a positive haematological response to therapy, indicating resolution of anaemia and activation of the innate immune system against ongoing parasitic and inflammatory challenges. Blood smear analysis revealed no tick-borne parasites but

Table 1: Haematological Parameters of the Monitor Lizard infected with *Plasmodium* and *Haemoproteus* species before and after treatment

Parameter	Reference Haematological Values	Before	After
Plasma colour	Clear to pale yellow	Normal	Normal
Total Protein (g/dL)	4.0 – 6.0	4.0	4.5
Fibrinogen (mg/dL)	10 – 100	0.07	106
RBC ($\times 10^6$/µL)	0.57 – 1.70	2.20	2.31
Hb (g/dL)	6.9 – 12.5	6.6	8.4
PCV (%)	24 – 31	21	25
MCV (fL)	148 – 491	95	108
MCHC (g/dL)	28.8 – 46.3	31	34
Platelets ($\times 10^3$/µL)	10 – 50	130	190
WBC ($\times 10^3$/µL)	1.60 – 2.30	7	8
Lymphocytes (%)	58 – 74	68	34
Heterophils (%)	13 – 34	18	62
Monocytes (%)	6 – 13	11	10
Eosinophils (%)	0 – 3	3	4
Basophils (%)	0 – 2	0	0

Note: Reference intervals extracted from Moustafa *et al*. (2013).

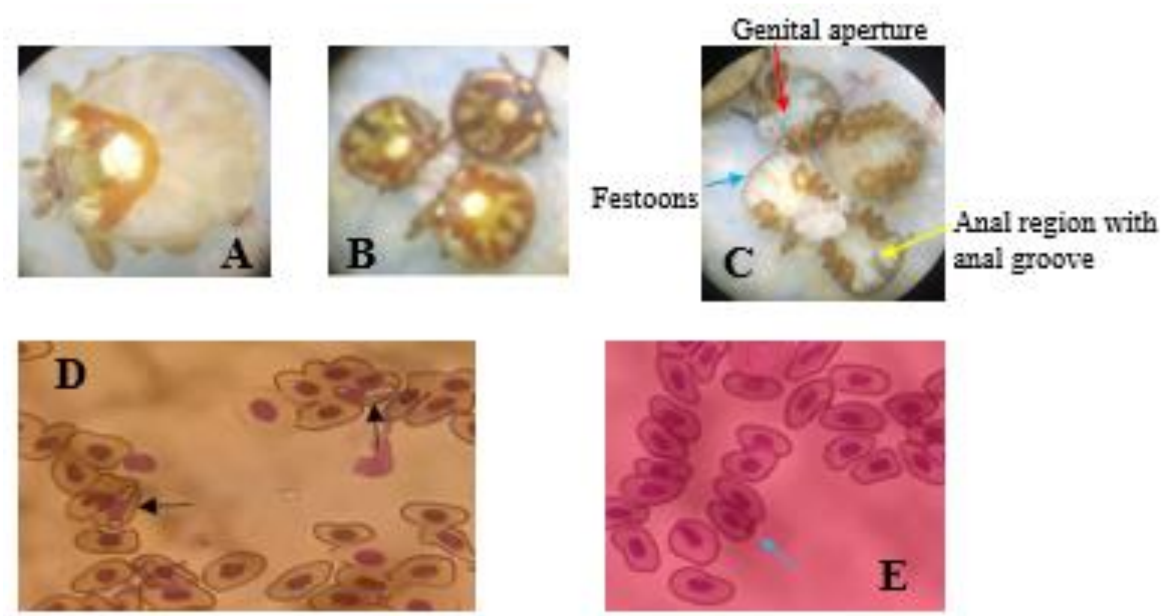

Plate I: Dorsal view of a female *Aponemma* species (A), Dorsal view of some male *Aponemma* species (B), Ventral view of some male *Aponemma* species (C), Elongated horseshoe-shaped gametocytes of *Haemoproteus* species (D), Inclusion of *Plasmodium* species (E)

the presence of Haemoproteus-like and Plasmodium-like inclusions within erythrocytes (Plate ID & IE), suggesting haemoparasitic infections transmitted by biting midges or louse flies, and mosquitoes. Based on the laboratory findings, the 7 kg animal was manually restrained for treatment. To facilitate oral medication, its mouth was held open using an improvised metal barrel (11 mm diameter, 100 mm length), secured with a surgical needle holder for handlers' safety. Doxycycline was administered at 10 mg/kg every 48 hours by delivering the drug directly into the oesophagus through the barrel's lumen. Subsequently, a whole chicken egg was cracked, and its contents were administered orally through the same barrel using a 10 mL plastic syringe. The egg served both as an excipient and a nutritional supplement. The animal was then held with its head slightly elevated for five to ten minutes to aid swallowing. After administration, the barrel was carefully removed using the needle holder (Plate II). To manage tick infestation, phenylpyrazole spray (7.5 mg/kg) was applied topically along the body from head to tail (twice with an interval of 7 days). Following treatment, the animal was released for observation. This approach ensured precise drug delivery while minimizing stress and maximizing therapeutic efficacy.

Following the fourth treatment on the ninth day after the initial diagnosis, a blood sample was obtained once again from the ventral coccygeal vein. Examination of fresh Giemsa-stained blood smears revealed no detectable haemoparasites.

This case describes haemoparasitic infection in a captive *Varanus niloticus*, characterized by Haemoproteus- and Plasmodium-like inclusions in erythrocytes. The clinical signs; anorexia, emaciation, lethargy, and severe tick infestation; reflect the known capacity of *V. niloticus* to harbour endo- and ectoparasites that influence sylvatic and domestic transmission cycles (Omonona *et al*., 2019). Although haemoparasites are often considered of limited pathogenic significance (Ferreira *et al*., 2020), their effects may intensify under captivity stress and concurrent ectoparasitism. The hypochromic, microcytic anaemia with reduced haemoglobin and PCV prior to treatment supports the disruptive role of haemoparasites in erythrocyte integrity (Valkiūnas and Iezhova, 2022).

Plate II: Blood collection from the ventral coccygeal vein (A), Improvised metal barrel to facilitate oral medication (B), Administration of drug through the barrel's lumen (C), Administration of nutritional supplement (D), Head held elevated to aid swallowing (E)

Post-treatment haematological changes, including erythroid regeneration, leukocytosis with heterophilia, lymphopenia, thrombocytosis, and elevated fibrinogen, indicated an acute inflammatory response and tissue repair, consistent with established reptilian haematology profiles (Campbell, 2015; Davis and Garcia, 2023; Ochuko Orakpoghenor *et al*., 2019). The modest eosinophilia suggested parasitic stimulation, while absence of gastrointestinal parasites (Soares *et al*., 2020) implicated haemoparasites and *Aponomma* ticks; identified by their ornate morphology (O'Rourke and Lertpiriyapong, 2015); as primary contributors to morbidity.

Therapeutic intervention with doxycycline and supportive care resulted in parasite clearance and clinical recovery by day nine, underscoring the effectiveness of antibiotic therapy in reptilian haemoparasitosis. The detection of *Haemoproteus* and Plasmodium-like inclusions highlights the possibility of multiple transmission routes, as *Haemoproteus* relies on biting midges or louse flies rather than mosquitoes for sporogony (Valkiūnas and Atkinson, 2020). These findings emphasize the potential pathogenic impact of haemoparasites when compounded by ectoparasite burden, as well as the necessity of routine monitoring for both endo- and ectoparasites in captive reptiles. Beyond the immediate clinical recovery, this case demonstrates the broader relevance of vigilant parasitological surveillance in maintaining reptile health and preventing transmission within zoological settings.

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