

Gastric Ulceration and Gastritis in Three Wild Temminck's Ground Pangolins (*Smutsia temminckii*) under Rehabilitation in Zambia

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Abstract

Background: Wild rescued pangolins are known to adapt poorly in their captive environment, where many die under rehabilitation. Gastrointestinal disease and pneumonia are the most common causes of death in pangolins. However, literature on the pathology of gastric ulcers is rare.

Case presentation: The current case report describes the necropsy and histopathological evaluation of three Temminck's pangolins that died under rehabilitation in Lusaka, Zambia. Grossly, gastric ulcerations of the fundic gland mucosae were seen in the stomachs. Inflammatory cells and erosions of fundic gastric gland mucosa were seen on histopathology. The morphological diagnosis of gastric ulceration with gastritis was attributed to stress and inappropriate diet.

Conclusions: The findings are expected to increase knowledge in pangolin diseases

and thus, improve the conservation efforts to save the pangolin species from extinction.

Keywords: African Pangolins, Rehabilitation, Pathology, Gastric Ulceration, Zambia

Background

Pangolins are unique toothless and solitary myrmecophagous mammals with a natural distribution only in Asia and Africa; pangolins are the world's only truly scaly mammals [1]. There are eight extant pangolin species; four are native to Africa. These are: the Temminck's ground pangolin (*Smutsia temminckii*), Giant pangolin (*Smutsia gigantea*), Black-bellied pangolin (*Phataginus tetradactyla*) and *Phataginus tricuspis* also known as White-bellied pangolin or Tree pangolin [2]. Pangolins are endangered species that are facing varying levels of threats of extinction because of unsustainable poaching [3].

Of the four African pangolins, only the Temminck's and White bellied pangolin have a natural distribution in Zambia [2]. The increase in the numbers of pangolins being rescued from the illegal wildlife trade (IWT) in Zambia has led to an increase in pangolins requiring critical veterinary care. As a result, a rescue and rehabilitation programme for pangolins confiscated from IWT has been established in Lusaka, Zambia. However, pangolins are nocturnal and have a highly specialised diet of ants and termites. This causes poor adaptation under rehabilitation, mainly because of an inappropriate diet. As such, high mortalities have been recorded in pangolins under captive environment (Yang *et al.*, 2007; Zhang *et al.*, 2017).

Information on pangolin diseases is generally rare, especially in African pangolins. Of the recorded pangolin diseases, gastrointestinal disease is the most common cause of death in captivity [4, 5]. However, literature on the pathogenesis, gross and histopathological description of gastric ulcers and gastritis, which are the major causes of mortality in pangolins under captive care, is rare. Because of an increase in vulnerable pangolins that need rehabilitation and threats of further population declines, a better understanding of pangolin diseases and their fate under captive care is critical to improving their health care and conservation.

Case Presentation

The current report describes necropsy and histopathological diagnosis of hemorrhagic gastric ulcers and gastritis in three Temminck's pangolins that were rescued from IWT in Lusaka, Zambia. The first pangolin (P-1) was an adult

male that weighed 6.5kg. It appeared in good health on initial physical examination at the rehabilitation center, where attempts were made to mimic the animals' solitary and nocturnal nature and foraging to replicate their normal diet. However, the pangolin appeared lethargic on day 7 and was treated with amoxicillin (Dopharma, Zalmweg 24 4941 VX Raamsdonksveer, The Netherlands); 15mg/kg IM once daily for 5 days and Vitamin B-complex (Kyron Laboratories, 29 Barney Road, Johannesburg, Benrose 2094, South Africa, 0.5ml IM once). It did not respond well to treatment and was referred to the University of Zambia (UNZA), School of Veterinary Medicine for further treatment.

The second pangolin (P-2) was an adult female and weighed 8.7kg. It had a septic wound on the plantar aspect of the left forelimb and appeared lethargic. It was equally treated with amoxicillin for five days. The pangolin continued deteriorating and was referred to UNZA animal clinic at the same time as the first pangolin. Both pangolins were treated with cefotaxime (Necaxime®, Nectar Lifesciences Limited, Unit-VI, Village Bhatoli Kalan, India; 30mg/kg IV). Topical 10% povidone iodine solution (Mexo Impex Pvt. Ltd., A-205, V-Star Plaza, Chandavarkar Road, Borivali, Mumbai – 400 092, India) and 1% silver sulfadiazine cream (Laboratory and Allied Ltd, Plot 209/10349, Mombasa Road, Nairobi, Kenya) were applied on the wound (P-2). Ringer's Lactate Solution (IDC Ltd, Plot 363, 477, Industrial Road, Kabwe, Zambia) with 5% glucose up to 300ml was also infused intravenously. Both pangolins died the

following day. The third pangolin (P-3) was a juvenile male. It died on day one as it was in a poor body condition, anorexic and moribund.

The three pangolin carcasses were submitted to the pathology laboratory at UNZA School of Veterinary Medicine (Fig. 1). Waiver of ethics review was obtained from the University of Zambia Biomedical Research Ethics Committee (REF. No. 15-10-21). Permission to publish was obtained from the Zambian Ministry of Tourism and Arts, Department of National Parks and Wildlife (NPW 101/6/1).

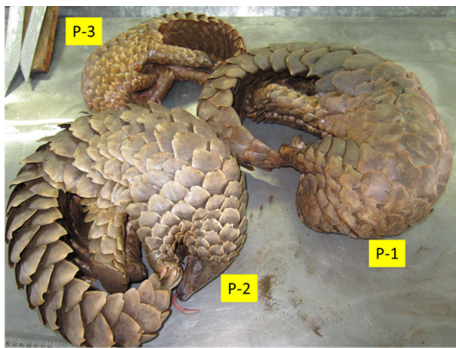


Fig. 1. Three pangolin carcasses that were submitted for post mortem examination

Figure 1 shows the carcasses of the three pangolins that died shortly after being rescued from the illegal wildlife trade in Lusaka, Zambia and were submitted to the pathology laboratory for necropsy. The figure shows pangolin 1 (P-1, male), pangolin 2 (P-2, female) and pangolin 3 (P-3, male).

Post-mortem examination of the three pangolins showed consistent findings of gastric ulcerations of the fundic gland mucosae, with hemorrhages and scarring in some sections (Fig. 2a-b). The stomachs mostly contained stones, sand and few insect exoskeletons (Fig. 2c). Hardened fecal matter, causing impaction up to the anal orifice with sand and soil were seen in the large

intestines (Fig. 2d). The findings in the current report differed from the normal stomachs that contained insect exoskeletons and covered with typical yellow keratinized epithelium seen in other Temminck's pangolins that were examined during the same period (Fig. 2e-f). Apart from hepatic and renal congestion, no significant lesions were seen in other organs. Samples of the stomach wall were processed for histopathology.

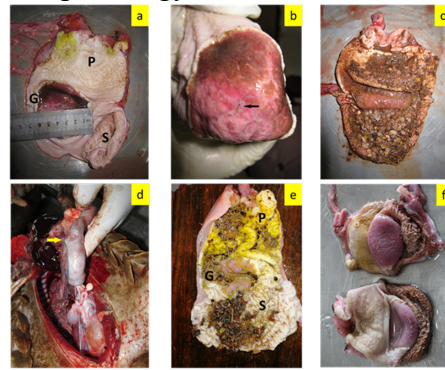


Fig. 2 (a - f). Post mortem findings of the pangolin carcasses showing gastric ulcers and fecal impaction.

Figure 2 shows the post-mortem findings of the three pangolin carcasses that were submitted to the pathology laboratory for necropsy. The single chambered stomach was divided into gastric sac (S), fundic gland tissue (G) and pyloric musculature (P). The main findings included hemorrhagic gastric ulcers (P-3) and scarring of the mucosa (P-2) of the fundic gland tissue (2a and 2b). In P-1, numerous pebbles in the stomach were seen (2c) as well as intestinal impaction (arrow) caused by fecal hardening (2d). Figure 2e and 2f show normal mucosa and the contents in the stomachs of different cases of pangolins were examined during the same period.

On histopathologic examination, the mucosae of the stomach sac and pyloric regions were partially covered

with a cornified, stratified squamous epithelium with thick muscular areas (Fig. 3a). Simple columnar epithelium, which contained numerous mucinous cells, lined the fundic gland tissue (Fig. 3b). However, the mucosal surfaces of the fundic gastric gland tissue were diffusely eroded, with marked infiltration of neutrophils and lymphocytes, intermixed with hemorrhages and fibrosis. Histopathology confirmed the morphological diagnosis of hemorrhagic gastric ulcers and gastritis. Other areas of the lobulated basal gland in the submucosal layer showed numerous infiltrations of inflammatory cells and shortening of glandular tubules (Fig. c-d).

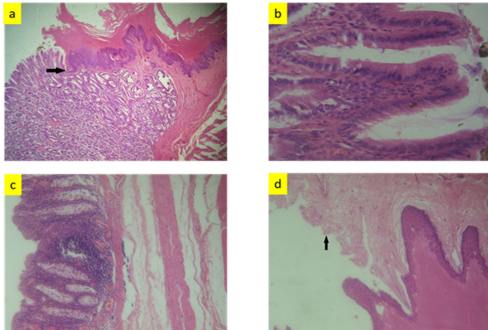


Fig. 3 (a - d). Histopathological findings in stomach of the three pangolins.

Figure 3 histopathology (H & E) of the pangolin stomach showing cornified, stratified squamous epithelium of the pyloric region (x10, a). The junction between the pyloric region (upper right side of a) and the fundic gastric gland (lower left side of a) is boarded by an arrow. The fundic gastric gland tissue was lined by simple columnar epithelial surfaces (x40, 2b) but some sections showed marked infiltrations of neutrophils and lymphocytes (x10, 2c). Areas of fibrosis were seen at the junction between the pyloric and fundic gastric gland tissues and at the surface of the fundic gastric gland (x10, 2d).

Discussion and Conclusions

The current report describes pathological findings in three Temminck's pangolins that died shortly after being rescued from IWT in Lusaka, Zambia in 2019. Based on necropsy and histopathology, a morphological diagnosis of gastric ulceration with gastritis and intestinal impaction was established. The cases described in the current report further highlight the difficulties in rehabilitation of pangolins [4]. Gastrointestinal ulcerations generally occur when the gastric mucosa's blood flow, mucus layer and epithelial cell turnover are impaired [6]. In wild animals, physiological stress, infections, parasites, neoplasia, foreign bodies, and so on, are some of the reported causes of gastric ulcers [7, 8]. In the current report, no obvious gross lesions or intestinal parasites were observed in the gastrointestinal tract.

In Asian pangolins, major causes of mortality have been investigated in the animals [9, 10], where successes in rehabilitation have also been recorded [11]. However, lack of information about diseases in African pangolins, as well as limited resources and lack of expertise in pangolin diseases complicate clinical management and rehabilitation of the species. The consistent finding of gastric ulcers and gastritis in the three pangolins in the current report could be attributed to stress because of their inability to adapt to captive care coupled with dietary changes. Pangolins endure remarkable stress such as confinement, starvation and thirst whilst in transit and custody of poachers, thus, complicating their rehabilitation after rescue. Similar findings attributed to stress were seen in Asian pangolins in captive care [9, 10]. Recently, successful

clinical management of gastrointestinal ulceration in a rescued Chinese pangolin was reported in Laos [12].

Although it's not unusual for myrmecophages to ingest soil/sand during feeding, increased ingestion has been reported under conditions of stress or nutritional deficiencies [5, 11]. Therefore, the fecal impaction seen in the current case report could equally be attributed to ingestion of increased amounts of stones and sand, which formed impactions in the rectum.

In conclusion, gastrointestinal diseases caused by an inappropriate diet and other stressful conditions are a major challenge of pangolin rehabilitation under captive care. Correct diagnosis and appropriate clinical management are critical in improving survival rates of pangolins under captive care. In the current case, limited information and initial lack of expertise in pangolin diseases could have significantly contributed to the inadequate clinical management and poor survival of the animals.

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Ethics Approval

Waiver of ethics review was obtained from the University of Zambia Biomedical Research Ethics Committee (REF. No. 15-10-21).

Permission to Publish

Permission was obtained from the Ministry of Tourism and Arts, Department of National Parks and Wildlife, Zambia.

Competing Interests

The authors declare that they have no competing interests.

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Authors' Contributions

John Yabe conducted the post-mortem examinations of the pangolins, histopathological examinations and was a major contributor in writing the manuscript. David Squarre provided initial treatment of the pangolins at the rehabilitation center, assisted with post-mortem examination and the development of the manuscript. Jackson Katampi provided initial treatment of the pangolins at the rehabilitation center and assisted with post-mortem examination. Rachel Mwenda assisted with post-mortem examination of the pangolins and edited the final version of the manuscript. Ntombi B. Mudenda provided treatment of the pangolins at the University of Zambia Veterinary Clinic and edited the final version of the manuscript. Audrine Nkana assisted with post-mortem examination of the pangolins. Suwilanji Sichone provided treatment of the pangolins at the UNZA-Vet clinic. Titus Kaira processed samples of the pangolins for histopathological examinations. All authors read and approved the final manuscript.

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