

A Giant Foreign Body Granuloma in a Chinese Monal (*Lophophorus lhuysii*) Caused by Gizzard Perforation

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ABSTRACT

Background: Chinese Monal (*Lophophorus lhuysii*) is an endangered bird that lives in high altitude areas of southwestern China. The only captive population of Chinese Monal in the world is in a reserve in Sichuan. Despite the great efforts made by the reserve and researchers, the population of captive Chinese Monal has increased slowly. Disease is one of the main factors causing the death of captive Chinese Monal, but there are few reports on their diseases. This study reports a rare case of gizzard perforation in birds and is the 1st reported death case of Chinese Monal, which can provide a reference for related clinical symptoms and pathological diagnosis of wild birds.

Case: The female Chinese Monal was rescued from a natural reserve and raised in the administrative center for a long time because it was unable to walk normally. On December 4th of the 3rd year, the Chinese Monal presented with severe loss of appetite, depressed spirit, unable to stand, and eventually died. We performed a necropsy on the Chinese Monal and observed and recorded the pathological changes. The tissues were collected to make pathological sections and stain for histopathological diagnosis. Necropsy observation revealed that the keel bone was abnormally protruded, the abdomen was significantly enlarged, a giant foreign body granuloma in the abdominal cavity was found closely adhered with the gizzard through a hole, and all intestinal segments were thin and stenosed. Histopathological observation revealed that the structure under the stratum corneum of the gizzard and the mucosa of all intestinal segments were not integrated, necrosis was found in the liver, vacuolar degeneration was found in pancreatic acinar cells, and the lymphocytes were significantly decreased in the cecal tonsil and spleen. These results suggest that the digestive system and immune system were damaged by the compression of foreign body granuloma.

Discussion: Compared to other causes of gastric perforation, accidental ingestion of sharp foreign bodies is relatively rare. Consistent with the existing reports of birds, foreign body granuloma is accompanied by gizzard perforation and is filled with contents. The foreign body granuloma was extremely large in this case, with a length of 16 cm and a weight of 500 g, reaching 1/5 of the body weight, occupying almost the entire abdominal cavity, causing severe compression on the abdominal organs. However, no foreign body was found in the necropsy, and it may have been crushed by gravel in the gizzard and excreted. We speculate that the cause of death based on the lesions found in necropsy and pathological diagnosis was as follows: a sharp foreign matter was ingested by Chinese Monal accidentally, causing perforation of the gizzard, and the leaked food stimulated the body to form a foreign body granuloma in the abdominal cavity. The volume of the foreign body granuloma gradually increased and compressed the abdominal artery, causing chronic mesenteric ischemia. The ingestion and digestion functions were impaired, inducing severely malnourished and extremely emaciated, finally leading to multiple organ failure and death. As a result, the captive environment is very important for animal health. In daily feeding management, more attention should be paid to the safety of the captive environment.

Keywords: Chinese Monal, gastric perforation, foreign body granuloma, clinical necropsy, pathological diagnosis.

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INTRODUCTION

The Chinese Monal is an endangered and endemic bird of China and has been listed on CITES Appendix I [4] and “Vulnerable” on the IUCN Red List [1]. Due to excessive human activities, ongoing habitat degradation and fragmentation, and other factors, its population density has been at a low level for a long time, attracting widespread attention worldwide [13,14]. As an essential means of protecting endangered wild animals, *ex-situ* conservation is significant in restoring their wild populations. Despite the great efforts made by the reserve and researchers, the population of captive Chinese Monal has increased slowly. According to the records in the reserve, disease is one of the main factors causing the death of captive Chinese Monal. However, researchers pay more attention to the reproduction of captive Chinese Monal, and lack of research on their diseases. There is only 1 report on the diseases of captive Chinese Monal so far [3], which is detrimental to its protection. Therefore, we report a rare case of a dead captive Chinese Monal with gizzard perforation to make a contribution to the limited literature in the field.

CASE

A female Chinese Monal was rescued from a reserve. She was very weak when rescued and could not move normally, and still did not recover after treatment, so she was raised in the administrative center for a long time, feeding peanuts, corn, cabbage leaves, and poultry feed every day. In May of the following year, the symptoms were aggravated, and she was difficult to walk. After drug treatment, the condition improved, but she still could not recover to the normal walking state. In early December of the 3rd year, she suffered a severe loss of appetite, a depressed spirit, and could not stand up. Although she was treated with drugs, the condition did not improve, and she finally died on December 4th.

Before dissection, the body of the female Chinese Monal was thoroughly visually examined, and the nutritional status, skin, feathers, and eyes were observed. After the external visual examination, the skin was peeled off, the chest and abdominal cavity were opened, and the organs with

visible pathological lesions were observed and photographed. The liver, spleen, stomach, duodenum, jejunum, ileum, cecum, rectum, pancreas, cecal tonsil, and capsule were aseptically collected from the Chinese Monal for histopathological diagnosis. Tissue samples were fixed in 4% paraformaldehyde solution¹ for 24 h, dehydrated in an ascending series of alcohols (70%, 80%, 95% and 100%), cleared in xylene and embedded in paraffin wax.

Tissue sections were cut at 5 µm, stained with hematoxylin² and eosin² (HE), sealed with neutral gum, and observed under a light microscope³ and photographed.

The external visual examination showed that the Chinese monal was extreme emaciation, and the weight was 2.5 kg, significantly lower than the average 3.04 kg of healthy adult female Chinese Monals. There were no parasites in feathers and skin, no pathological changes in eyes and normal legs (Figure 1A). Necropsy observation revealed that the keel bone was abnormally protruded (Figure 1B) because of emaciation, the abdomen was significantly enlarged (Figure 1C). A giant spherical capsule in the abdominal cavity was found closely adhered with the gizzard through a hole (Figure 1D), occupying almost the entire abdominal cavity, with a length of 16 cm and a weight of 500 g, and filled with undigested feed (Figure 1E). All intestinal segments were thin and stenosed (Figure 1F), which was caused by long-term compression of the capsule.

Histopathological examination of the digestive tract revealed that the structure under the stratum corneum of the gizzard was not integrated (Figure 2A-B), and autolysis occurred in the mucosa of the duodenum, jejunum, ileum, cecum, and rectum, intestinal epithelial cells exfoliated, and the structure of intestinal villi was integrated (Figure 2C-G). Histopathological examination of the digestive gland showed necrosis in the liver (Figure 2H) and vacuolar degeneration in pancreatic acinar cells (Figure 2I). Histopathological examination of the lymphoid organs revealed that the lymphocytes significantly decreased in the cecal tonsil (Figure 2J) and spleen (Figure 2K). The capsule in the abdominal cavity was a typical foreign body granuloma (Figure 2L).



Figure 1. Pathological necropsy observation of the Chinese Monal. A- The body was extremely emaciated. B- The keel bone was abnormally protruded. C- The abdomen was significantly enlarged. D- The spherical capsule was connected to the gizzard through a hole (arrow). E- The interior of the capsule was full of undigested feed. F- Narrow intestine.

DISCUSSION

The stomach of birds is composed of proventriculus and gizzard. The proventriculus can secrete digestive enzymes and gastric acid. The gizzard grinds food through the mechanical movement of stratum corneum and gravel, making it easy to digest by thoroughly mixing food with gastric acid. Necropsy observation showed a giant spherical capsule closely adhered to the gizzard, filled with undigested feed. The reason for its formation may be that the gizzard is damaged, which leads to perforation. The small hole is gradually expanded due to the mechanical movement

of gizzard and gravel, and some undigested feed leaks out of the hole into the abdominal cavity, stimulating the body to form a foreign body granuloma to wrap the feed. As time passes, the feed leakage increases, and the capsule becomes larger.

Many factors can cause gastric perforation, such as peptic ulcer [12], malignant tumor [17], trauma [16], and accidental ingestion of sharp foreign bodies [15]. No ulcer or malignant tumor was found in the necropsy, so the gizzard perforation may be caused by mechanical injury. As the Chinese Monal was rescued from the wild, it was easy to be frightened and fly and

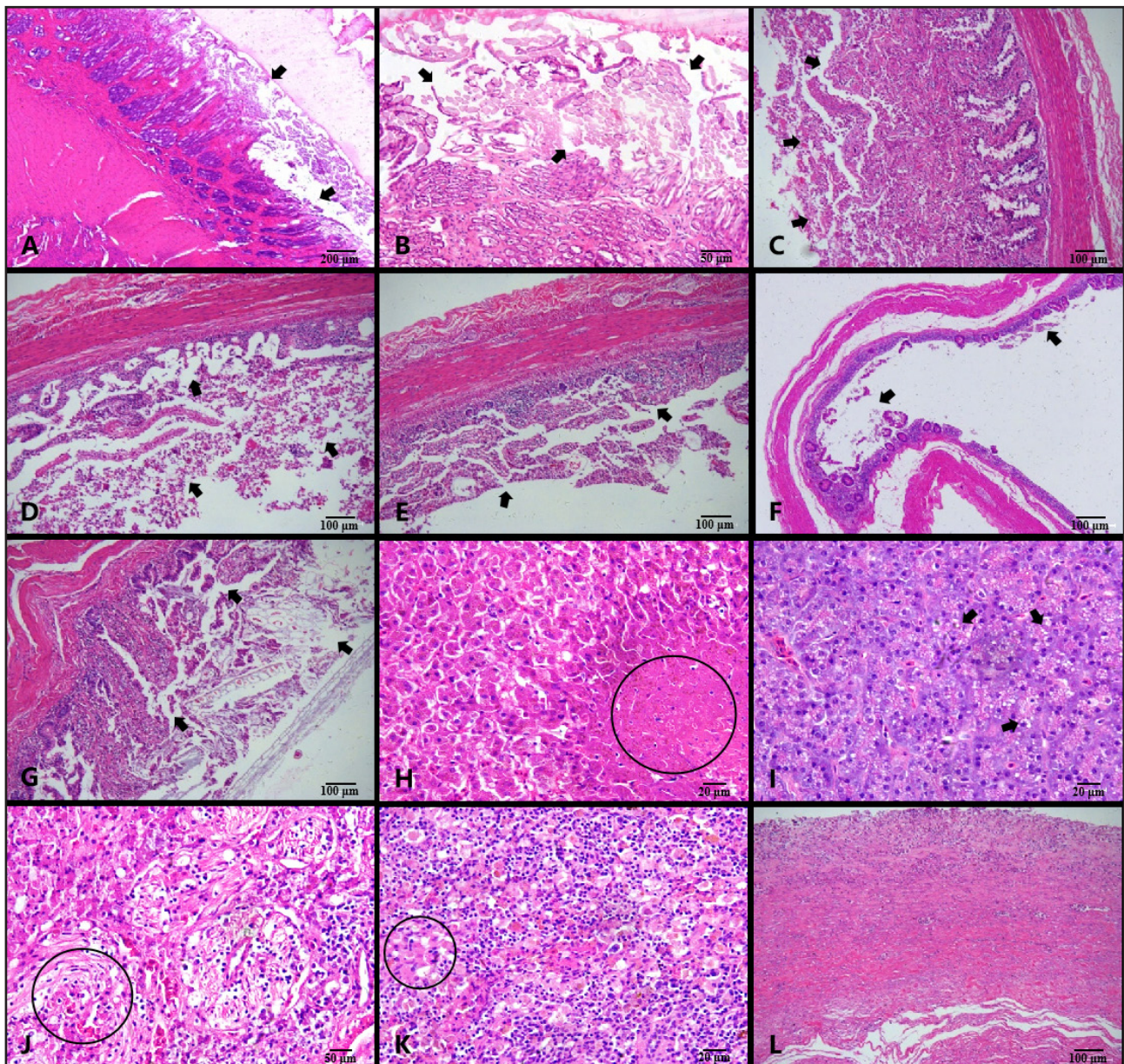


Figure 2. Histopathological observation of the gizzard, duodenum, jejunum, ileum, cecum, rectum, liver, pancreas, cecal tonsil, spleen, and capsule from the Chinese Monal. A & B Gizzard: the structure under the stratum corneum was not integrated (arrow) [HE; Scale bars= 200 μ m, 50 μ m]. C - G: Intestine (C. duodenum; D. jejunum; E. ileum; F. cecum; G. rectum): the villi were broken, and the structure was not integrated (arrow) [HE; Bar= 100 μ m]. H- Necrosis in the liver (circle) [HE; Bar= 20 μ m]. I- Vacuolar degeneration in pancreatic acinar cells (arrow) [HE; Bar= 20 μ m]. J- The lymphocytes were significantly decreased in the cecal tonsil (circle) [HE; Bar= 50 μ m]. K- The lymphocytes were significantly decreased in the spleen (circle) [HE; Bar= 20 μ m]. L- Foreign body granuloma [HE; Bar= 100 μ m].

may hit the perches or rocks in the captive environment at high speed, causing body damage. However, no damage to the skin and feathers was found in the external visual examination, indicating that the gizzard perforation was not caused by trauma. Some cases of gastric perforation caused by accidental ingestion of foreign bodies in animals have been reported. A blue shark died of peritonitis and pericarditis caused by a

fishing hook perforating the gastric wall [2]. An Irish sport horse suffered septic peritonitis secondary to a perforating gastric foreign body [7]. Five blue peacocks died of gizzard perforation caused by accidental ingestion of iron nails on the farm, and the capsule connected to the gizzard in the abdominal cavity, which was consistent with our study [6]. Birds will ingest pebbles or gravel to help digest. The sharp foreign body may be

accidentally ingested and cause gizzard perforation. However, no foreign body was found in the necropsy, and it may have been crushed by gravel in the gizzard and excreted.

The compression produced by the capsule can cause stenosis of the celiac artery, blood flow abnormalities, and mesenteric ischemia [8]. According to the duration of symptoms, mesenteric ischemia can be defined as chronic and acute. Patients with chronic mesenteric ischemia will suffer abdominal pain, which usually begins 20 to 30 min after a meal and may last for 1-2 h, fear eating, and lose weight [11]. In addition, some food leaked from the gizzard, increasing the volume of the capsule and further reducing the food entering the intestines. The combination effect of chronic mesenteric ischemia and the capsule causes severe disorders of eating and digestion, leading to malnutrition and extreme emaciation.

The direct relationships between nutritional status and immunity have been confirmed by some studies. Malnutrition could lead to a decrease in the number of T cells and cause T cells to show a lower percentage of activated and memory cells, and activated T cells could not upregulate glucose metabolism to fuel effector T cell function, which increased the susceptibility to infection and showed poor NK cell responses during the resolution phase of infection [5,10]. It is consistent with the significant decrease of lymphocytes in the cecal tonsil and spleen observed in this case. However, in the histopathological diagnosis, no obvious inflammatory infiltration was observed, indicating that the death of the Chinese Monal was not caused by infection. It has been reported that severe malnutrition could lead to multiple organ failure and death [9]. Severe malnutrition depletes the body's energy and cannot meet the energy needs of the organs to perform normal functions. The compression of the capsule and the energy depletion of the body make some organs dysfunctional and in danger of decompensation. Liver necrosis and pancreatic acinar cells vacuolar degeneration were found in this case. As the volume of the capsule continues to increase, malnutrition and compression become more and more serious, and active drug treatment increases the burden of organs, resulting

in multiple organ failure and death, which may be the cause of death of the Chinese Monal (Figure 3).

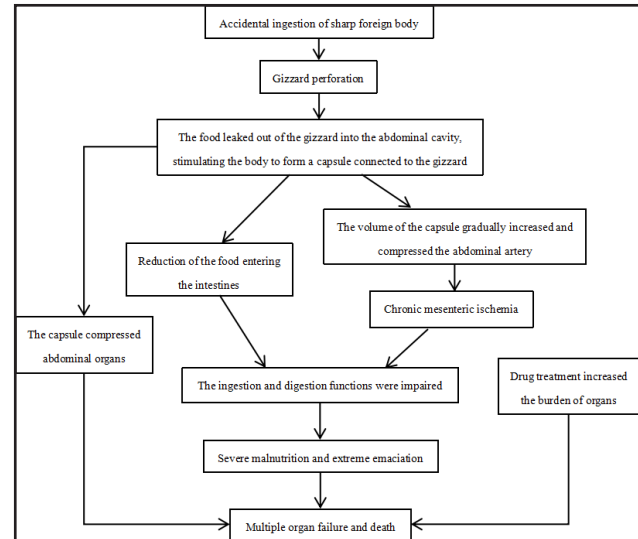


Figure 3. The cause of death of the Chinese Monal.

In conclusion, we speculate that the cause of death of the Chinese Monal (*Lophophorus lhuysii*) was gizzard perforation caused by ingestion of a foreign body, forming foreign body granuloma, compressing the abdominal organs, ultimately leading to multiple organ failure and death. Therefore, the captive environment is vital for animal health. In wildlife feeding management, the inspection frequency of the captive environment should be increased, especially the food. If foreign bodies are found to be removed in time, such cases can be prevented.

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Declaration of interest. The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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