

Ruminal impaction with an indigestible foreign body in long-tailed goral (*Naemorhedus caudatus*)

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Received March 14, 2023

Revised April 6, 2023

Accepted April 13, 2023

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A 6-year-old female long-tailed goral (*Naemorhedus caudatus*, goral) was admitted to the Gangwon wildlife medical rescue center due to severe starvation and hypothermia. The goral displayed clinical signs of severe weight loss, dehydration, lethargy, regurgitation, hypothermia, and bloating, with blood tests showing a decrease in albumin, calcium, glucose, and sodium. Supportive care was given through heating, oxygen supply, and fluid therapy, but the goral's condition worsened, and the goral died three days after admission. Radiographic and computed tomography scans revealed the presence of an indigestible foreign body (IFB) in the rumen, which was confirmed during the necropsy. The cause of goral's death was identified as chronic rumen impaction caused by the IFB (a ball of string), with other pathological findings including bloating, the presence of serous ascites, and congestion of digestive organs. Blood biochemical changes, clinical signs, and veterinary medical imaging diagnosis can be helpful in diagnosing ruminal impaction. This case report can provide valuable information for the diagnosis and treatment of ruminal impaction caused by IFB in endangered gorals, which may include rumenotomy or other surgical procedures.

Key Words: Ruminal impaction, Long-tailed goral, Indigestible foreign body, Wildlife, Ruminant

INTRODUCTION

Ruminal impaction is a condition that can occur in ruminants, such as cows, sheep, and goats, where the contents of the rumen become impacted, or stuck together, and cannot move through the digestive system (Abdullahi et al, 1984; Radostits et al, 1994). The rumen is the largest compartment of the stomach in ruminants and plays a crucial role in digesting plant material (LeBlanc et al, 2005; Smith, 2014). There are several factors that can contribute to rumen impaction, including inadequate water intake, a diet that is too low in fiber or too high in grains, changes in feed or grazing patterns, and stress (Kohli et al, 1998; Kumar and Tandon, 2016). Ruminal impaction can also occur due to the ingestion of foreign substances or the accumulation of ingested

materials such as hair or plastic, causing the stomach to expand and the feces to pass through almost or not at all (Abdullahi et al, 1984; Igbokwe et al, 2003).

Symptoms of ruminal impaction can include decreased appetite, decreased rumen contractions, reduced fecal output, abdominal distention, and weight loss (Radostits et al, 1994; Igbokwe et al, 2003; Smith, 2014). Ruminal impaction can lead to more serious health problems such as rumen acidosis, dehydration, and even death, and has been reported in various animal species (Reddy et al, 2004; Reddy and Sasikala, 2012; Kumar and Dhar, 2013; Abdelaal and EL-Maghawry, 2014). In the case of cattle, it has been reported that the collision of rumen contents with the anterior compartment and the resulting indigestion of the rumen can cause some degree of hyponatremia, hypokalemia, and

alkalosis (Radostits et al, 1994). Although there were no significant changes in blood urea, calcium, or magnesium concentrations, it is known that blood glucose levels are low (Llewellyn, 1976).

Animals raised in intensive agricultural systems typically do not have exposure to the waste, so these animals rarely experience foreign body syndrome (Priyanka and Dey, 2018). The long-tailed goral (*Naemorhedus caudatus*) is a representative wild ruminant animal in Korea that may be more vulnerable to foreign body ingestion because it grazes on the grass close to the ground in the wild environment. In this study, we present a case of ruminal impaction in long-tailed goral diagnosed using computed tomography (CT), blood tests, and autopsy.

CASE PRESENTATION

On September 20, 2022, a 6-year-old female long-tailed goral was rescued due to severe starvation resulting in a 50% reduction in normal body weight, and hypothermia, which made it difficult for it to stand in Goseoung-gun, Gangwon-do (latitude 37.8667008;

longitude: 127.7558784) and brought to the Gangwon Wildlife Medical Rescue Center at Kangwon National University. The main clinical signs of the goral were dehydration, lethargy, severe weight loss, regurgitation, hypothermia, and bloating. The blood test results indicate a decrease in levels of albumin, calcium, glucose, and sodium, and an increase in levels of alkaline phosphatase (ALP) and amylase (Ahn, 2022) (Table 1).

Radiographic findings revealed the presence of an indigestible foreign body (IFB) and gas shading throughout the gastrointestinal tract using the digital radiography system VXR-9M (DRGEM, Seoul, Korea) (Fig. 1A). For radiographic examinations, anesthesia was not performed. Rather, the subjects were restrained physically. CT scanning was performed using a Somatom Emotion 6 (Siemens, Munich, Bayern, Germany). The CT scan was performed under general anesthesia. Anesthesia was maintained with isoflurane (Ifran[®], Hana Pharm. Co. Ltd., Korea) in oxygen, after sedation with xylazine 0.25 mg/kg, intramuscularly (Rompun[®], Bayer, Germany). The CT scans confirmed the presence of an IFB in the rumen (Fig. 1B).

The primary focus of treatment was supportive care,

Table 1. Hematological and blood chemistry profiles in the long-tailed goral

Hematology values				Biochemistry values			
Variable	Unit	Value	Reference range ^{a)}	Variable	Unit	Value	Reference range ^{a)}
Leucocytes				Albumin	g/dL	1.8	2.15~4.00
White blood cell count	10 ⁹ /L	10.41	4.60~16.32	Alkaline phosphatase	U/L	412	84.50~374.00
Neutrophil	10 ⁹ /L	6.59	2.62~12.06	Alanine aminotransferase	U/L	72	36.50~237.00
Lymphocyte	10 ⁹ /L	3.39	1.08~6.06	Amylase	U/L	136	5.50~83.50
Monocyte	10 ⁹ /L	0.33	0.08~1.45	Total bilirubin	mg/dL	0.6	0.10~2.40
Eosinophil	10 ⁹ /L	0.05	0.01~1.03	Blood urea nitrogen	mg/dL	31	1.10~39.50
Basophil	10 ⁹ /L	0.00	0.00~0.20	Calcium	mg/dL	6.2	7.10~10.65
Erythrocytes				Phosphorus	mg/dL	2.8	1.80~7.70
Red blood cell count	10 ¹² /L	14.63	7.60~15.19	Creatinine	mg/dL	1.4	0.95~27.05
Hematocrit	%	39.12	23.90~53.15	Glucose	mg/dL	18	20.50~275.00
Hemoglobin	g/dL	12.9	8.90~18.05	Sodium	mmol/L	131	140.00~154.50
MCV	fl	27	27.00~41.55	Potassium	mmol/L	7.3	3.20~8.50
MCH	pg	8.8	9.10~19.60	Total protein	g/dL	6.6	5.90~7.55
MCHC	g/dL	33	29.50~62.50	Globulin	g/dL	4.1	2.65~4.25

^{a)}Refer (Ahn, 2022).



Fig. 1. The presence of an indigestible foreign body (white arrow) in (A) Thoracic radiograph and (B) CT scan of long-tailed goral.

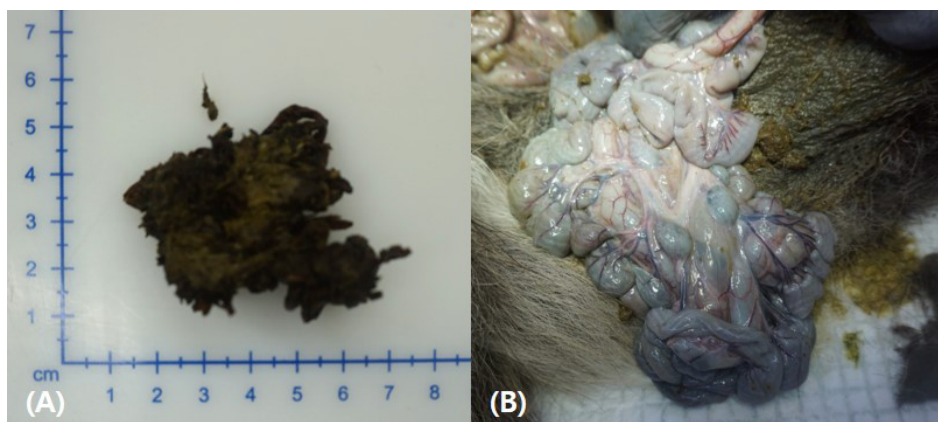


Fig. 2. The autopsy results showed (A) the indigestible foreign body (ball of string), and (B) the absence of feces in the intestine.

including heating, oxygen supply, and fluid therapy. Fluid therapy consisted of the supplementation of plasma, and relief of gastrointestinal (especially liver) symptoms was provided. Additionally, the belching of gas through abdominal massage was performed to alleviate bloating. Despite these efforts, the general condition of the goral deteriorated rapidly, and the animal died on the third day after admission. The necropsy results showed that the cause of the goral's death was chronic ruminal impaction and bloating caused by the IFB (ball of string) (Fig. 2A). Other pathological findings included bloating, the presence of serous ascites, the absence of intestinal contents, and redness of digestive organs, such as the omasum and liver (Fig. 2B).

DISCUSSION

Treatment for ruminal impaction typically involves a combination of fluid therapy, laxatives, and dietary changes (Radostits et al, 1994; Smith, 2014). In severe cases, surgery may be necessary to remove the impacted material. Prevention of rumen impaction involves providing animals with a balanced diet high in fiber and adequate water intake and avoiding sudden changes in feeding or grazing patterns (Nocek, 1997). However, it is not easy to manage through prevention in wild animals. The material found in the rumen of the long-tailed goral is waste material that wild animals living in the wild environment can easily encounter, such as those commonly found in mountains or agricultural land in Korea. Therefore, in order to protect the environment and pre-

serve wild animals, we need to actively seek alternatives for recycling and waste management.

The sex of the animal has a significant influence on the ingestion of foreign bodies and ruminal impaction. Female animals are more prone to ruminal impaction caused by foreign bodies than males (Remi-Adewunmi et al, 2004; Tiruneh and Yesuwork, 2010). In the case of female animals, various physiological factors contribute to the ingestion of foreign bodies. Increased nutritional demands during pregnancy and lactation, negative energy balance, and mineral deficiencies increase the appetite of these animals and encourage them to consume foreign bodies (Hailat et al, 1996; Ngoshe, 2012). The long-tailed goral in this case was also a female individual.

In order to alleviate hunger, animals begin to consume inanimate objects, leading to the development of foreign body syndrome (Tiruneh and Yesuwork, 2010; Ngoshe, 2012). Blood biochemical changes (hypoproteinemia, hypoalbuminemia, hypocalcemia, hypoglycemia, and hypophosphatemia) along with clinical signs and veterinary medical imaging diagnosis may be helpful in diagnosing ruminal impaction (Athar et al, 2010; Vanitha et al, 2010). Biochemical changes observed in clinical cases may be due to malnutrition and interference with ingestion in the gastrointestinal tract (Igbokwe et al, 2003). Hypoalbuminemia may be due to stress response to nutritional deficiencies and infections (Mayer et al, 1992). Hypoalbuminemia is often accompanied by hypocalcemia due to the binding of plasma albumin to Ca^{2+} , and hypocalcemia can also occur due to failure of calcium absorption caused by dietary deficiency and decreased rumen movement (Zilva and Pannall, 1984; Vanitha et al, 2010). In addition, hypoglycemia may be due to inadequate feed intake (Ramakrishna, 1994). The increase in amylase and ALP levels was due to digestive system problems caused by ruminal impaction (Athar et al, 2010).

Based on the observed symptoms and available evidence, it is postulated that the mortality of the long-tailed goral was attributed to ruminal impaction, a

condition arising from the partial obstruction of the digestive tract lumen by the rumen IFB. This obstruction disrupts the normal flow of digestion and causes ruminal bloat, ultimately leading to a fatal outcome. To the best of our knowledge, this is the first case report of goral ruminal impaction in Korea. Early blood tests and imaging, including CT, should be considered important for the diagnosis of this rare clinical disease, which can guide subsequent treatment and improve the prognosis. Additionally, our diagnosis of ruminal impaction in long-tailed goral provides valuable clinical experience, as they are natural monuments and endangered species.

ACKNOWLEDGEMENTS

The authors would like to express their deepest gratitude to Yanggu Long-tailed goral and Muskdeer Center for their valuable support for the rescue of goral and medical assistance.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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