

Case Report

Colonic Volvulus in a Cynomolgus Monkey (*Macaca fascicularis*)

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Abstract

A five-year-old male cynomolgus monkey (*Macaca fascicularis*) with loose stool from two days before dying was observed with dark blood-like watery diarrhea. The animal was not used in the toxicology study as its body weight (4.5 kg) was lower than that of male monkeys of the same age. Gross examination revealed a clockwise rotation of the colon accompanied by a dark-reddish change and distention. After fixation, a pink, small, distorted and semi-hard foreign body was found in the lumen of the colon along with dark blood-like watery contents. Examination of the cage revealed that the foreign body was the one of the pieces of the hard rubber chew toy, which is given to monkeys as an environmental enrichment device in our facility. Microscopic examination revealed severe congestion and hemorrhage accompanied with distended veins mainly in the mucosa in the colon. There were no regenerative or proliferative lesions such as a granulation tissue or hypertrophic smooth muscle between the proximal and distal regions of the colon and the rectum. Therefore, the animal was pathologically diagnosed as having colonic volvulus of an unknown cause. This is the first case of colonic volvulus in a cynomolgus monkey. When spontaneous occurring intestinal volvulus in monkeys given environmental enrichment devices are experienced in future, it is necessary to recognize the possibility that environmental enrichment devices, wherein it is possible to chew and ingested part of the device, may be a risk factor concerning colonic volvulus in cynomolgus monkeys.

INTRODUCTION

Intestinal obstruction is widely reported in many species including humans, and can be induced by volvulus, torsion, hernias, intussusception and strangulation [1,2]. Volvulus can also develop with physical obstruction caused by intestinal foreign body or neoplasm [3]. Volvulus in the large intestine is rarely seen in nonhuman primates, except for cecal volvulus of an unknown origin in African green monkeys (*Cercopithecus aethiops*) [3]; however colonic volvulus in nonhuman primates has not been reported.

Cynomolgus monkey (*Macaca fascicularis*) is the most commonly used and purpose-bred nonhuman primate for nonclinical toxicity studies. In order to promote the psychological well-being of these animals, various types of environmental enrichment devices are given to the animals. However, a few reports pointed out that nonhuman primate have been injured by these devices due to ingestion [4-7]. Here in, we describe a case of colonic volvulus speculated to be related to an environmental enrichment device in a cynomolgus monkey.

MATERIALS AND METHODS

A five-year-old male cynomolgus monkey (*Macaca fascicularis*) with loose stool from two days before dying was observed with dark blood-like watery diarrhea. The animal was not used in the toxicology study as its body weight (4.5 kg) was lower than that of male monkeys of the same age, housing, and cared according to the principles outlined in the guidelines for the care and use of laboratory animals prepared by the Japanese Association for Laboratory Animal Science and our laboratory. All organs sampled at necropsy were fixed in 10% phosphate-buffered formalin, embedded in paraffin wax and stained with hematoxylin and eosin for histological examination.

RESULTS AND DISCUSSION

Gross examination revealed a dark reddish change with distention by gas and small amount of dark-reddish watery intestinal content (4.0 cm maximum diameter, 45 cm length), and a clockwise rotation of the colon (Figure 1). Increased dark-reddish abdominal fluid (20 mL) was also observed. The mesentery of the rotated colon and the colonic lymph node were

congested. There was no adhesion or mass in the abdominal cavity. In addition to the abdominal changes, dark reddish change in the lung with increased yellow thoracic fluid (20 mL) was observed. After fixation, at the trimming of the colon for histologic examination, a pink, small, distorted and semi-hard foreign body (1.0 x 1.0 x 1.0 cm) was found in the lumen with dark blood-like watery contents (Figure 2). Examination of the cage revealed material that was found in the cages with the same properties and color as the foreign body in the colon. The material was a hard rubber chew toy, which was given to the monkeys as an environmental enrichment device in our facility. The devices found in these cages varied in size with teeth marks, suggesting that they became smaller by being bitten and chewed, and one of the pieces was ingested and reached the colon in this animal (Figure 2).

Microscopic examination revealed severe congestion and hemorrhage accompanied with distended veins mainly in the mucosa in the colon (Figure 3). These changes extended to the mesentery and the colonic lymph node. The mucosa was necrotic and the remaining mucosal epithelial cells with the fragmented nuclei were found only at the crypt. Bacterial colonies were found in the necrotic mucosa in the colon; however, suppurative inflammatory cells did not infiltrate around these colonies. There were no regenerative or proliferative lesions such as a granulation tissue or hypertrophic smooth muscle between the proximal and distal regions of the colon and the rectum. Besides, as thickening of the intestinal wall due to transmural hemorrhage or edema was not observed, the lesion was suggested to be of a

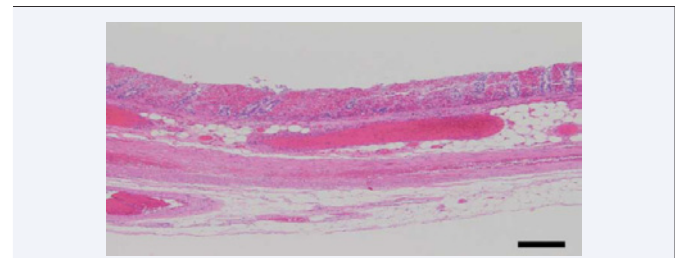


Figure 3 Histologic appearance of the colon. Severe congestion and hemorrhage accompanied with distended veins are observed mainly in the mucosa. The mucosa is necrotic and the remaining mucosal epithelial cells are found only at the crypt. HE. Bar, 200 μ m.

short duration. In addition to the changes described above, mild edema in alveolus was observed in the lung.

Intestinal obstruction and injury due to foreign body originating from environmental enrichment devices have been reported in nonhuman primates; piece of wire and wood pine fragment in the stomach in rhesus monkeys (*Macaca mulatta*), straw in the colon in a vervet monkey (*Chlorocebus aethiops*) and sisal rope fibers in a cynomolgus monkey [4-7]. Sharp-pointed foreign bodies may become impacted in the intestine and cause pressure necrosis with ulceration and possibly perforation. Blunt foreign bodies which become impacted cause acute or chronic obstruction depending on the size and location [1]. In the present case, there were no lesions indicating physical injury to the intestinal wall or chronic obstruction at the colon due to pieces of foreign body. Therefore, the foreign body could not be judged as the primary cause of colonic obstruction and volvulus pathologically, and the animal was diagnosed as having colonic volvulus of an unknown origin.

Large intestinal volvulus has been well documented in humans. Predisposing factors include anatomical abnormality, pregnancy, fibrous adhesion after surgery and secondary to inflammation, functional obstruction, and physical obstruction caused by intestinal foreign bodies and neoplasms [3]. However, in this monkey, pathological examination revealed that there were no findings suggesting any of these factors.

It is interesting that predisposing factors of gastric dilatation and volvulus of dogs include the gastric foreign body and the underweight [8,9]. The monkey of this study had a piece of the toy in the colon, was underweight compared to males of the same age, and a few adipose tissues were found in the abdominal cavity at necropsy. Therefore, it may be possible that this cynomolgus monkey had possible predisposing factors of intestinal volvulus; intestinal foreign body, and a low body weight.

CONCLUSION

To the authors' knowledge, this is the first report of colonic volvulus in a cynomolgus monkey. When spontaneous occurring intestinal volvulus in monkeys, which are given environmental enrichment devices are experienced in future, it is necessary to recognize the possibility that the environmental enrichment devices which can be bitten, chewed, and ingested, may be one of the risk factors of the colonic volvulus in cynomolgus monkeys, although the cause of the colonic volvulus is unknown in the present case.

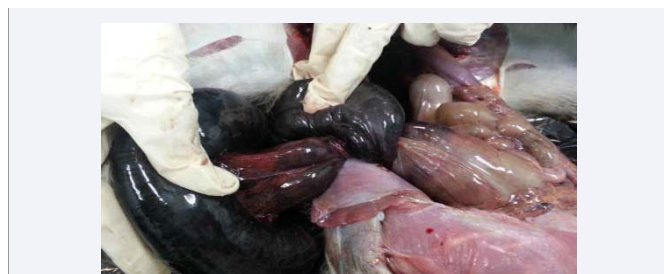


Figure 1 Opened abdominal cavity. A clockwise colonic rotation with dark-reddish change and distention are present.

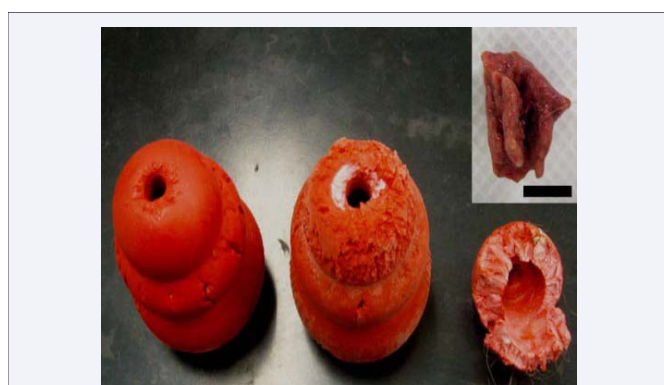


Figure 2 Various size and tooth marks-attached hard rubber chew toy, which is given to the monkeys as one of the environmental enrichment devices in our facility. (Inset; foreign body in the colon. Bar, 5.0 mm).

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