

Surgical Correction and Componential Analysis of Enterolith in Horse

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(Accepted: June 09, 2014)

Abstract : After clinical and laboratory tests of a 12-year-old warmblood horse (castrated male, 540 kg) displaying symptom of pain, a diagnosis of intestinal obstruction due to foreign substances like sand was made and an abdominal section and enterotomy were conducted to confirm and extract the intestinal stone (enterolith) on the right dorsal part of the ascending colon. The extracted intestinal stone was around 2.9 kg and greenish brown rugby ball sized (22 cm × 10 cm) stone. Analysis of the element components (EDX) using a scanning electron microscope revealed percentages of C (30.08%), O (39.85%), Mg (3.89%), P (11.15%), and Ca (11.16%) at a magnification of 400. This was the first example of a successful extraction and treatment of intestinal stone in a horse domestically and thereby has its significance.

Key words : enterotomy, enterolith, warmblood horse.

Introduction

Enteroliths refer to the mineral lumps that are formed in the large colon of horses. Most enteroliths generally indicate the process of foreign substances thickening into several layers within the intestines after the horse has swallowed foreign substances like wood fragments or hair. Enteroliths are composed of various mineral elements but most are composed of struvite (a hydrous phosphate of magnesia and ammonia) and vivanite (a hydrous phosphate of iron) (1,2,6).

A horse can have one or several enteroliths and the size can vary from the size of a bean to a baseball, and even bigger enteroliths sometimes form. It mainly appears in adult horses that are 10 years or older and it appears often in Arabians but almost never be in breeds like Quarter horses, Saddlebreds, and donkeys (8).

When the size of the enterolith gets bigger than the size of a golf ball, intestinal dysmotility occurs and continuous colic symptoms occur. In such cases, it is linked to weight loss caused by loss of appetite, and especially in cases where enteroliths are formed in parts where the diameter has become narrower as in the curvature of the large colon, necrosis of the intestinal membrane may occur due to abrasions and pressure so that often it leads to enterorrhesis and fatal peritonitis, and so when enteroliths are removed through a correct diagnosis before enterobrosia and surgical treatment, the prognosis is favorable for over 95% of the time. This case will help clinical prevention of domestic equine raised in riding place when it comes to chronic colic symptom diagnosed with

abdominal stone by surgical extraction and analyzing component of it.

Case

A 12-year-old, warmblood horse (castrated male, 540 kg) continued to show general symptom of increased water consumption, loss of appetite, and abnormalities to the digestive system involving a small amount of repeated diarrhea and constipation for over four weeks. Three days before being referred to the Korea Racing Authority's Jangsu stud farm, it manifested severe pain symptom including sweating, foot scratching and rolling. The practicing veterinarian intravenously injected 20 L of Hartman solution (CJ Cheiljedang, Korea) and 10 ml of Flunixin meglumine (Banamine[®]; 50 mg/ml, MSD, France), respectively, and orally 2 L of mineral oil after inserting a stomach tube. A day after feeding the mineral oil, the oil flowed out through the rectum, but there was no bowel movement and the horse was hospitalized as symptom recurred.

When admitted, the horse saw slightly increased heart rate of 50 pulses/min, but was confirmed to be in a good condition as it showed a 20 breaths/min, 37.9°C body temperature, a pink mucous membrane, and a CRT within one second. Although intestinal mobility was normal, a ping sound from the right flank could be detected.

There was no abnormal diagnosis following the examination to the rectum, but middle mesenteric tension increase and swelling to the cecum at the right side of the abdominal cavity were observed. The results of the ultrasonography revealed that obstructive pathologies including a portion of the large colon displaced to the outer side of the spleen and large colon

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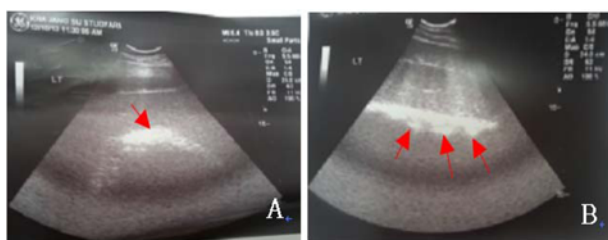


Fig 1. Ultrasonographic images of the large colon obtained from the horse at presentation. There were large colon thickening and sacculaton loss (arrow) (A), large colon hyperechogenic mass (arrow) (B).

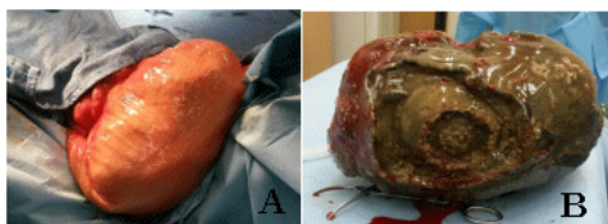


Fig 2. Intraoperative findings. Surgical exposure of the right dorsal part of the ascending colon (A). The enterolith was greenish brown rugby ball sized (about 22 cm × 10 cm, 2.9 kg) stone (B).

mucous membrane thickening and sacculaton loss could be observed (Fig 1), although pathologies to the small intestine were not confirmed. Clinical testing and ultrasounding made a diagnosis of intestinal obstruction due to foreign substances like sand, and an abdominal section and an enterotomy were made on the day of diagnosis.

The horse underwent surgery under a condition of general inhalational anesthesia. The general anesthesia process induced relaxation by intravenously injecting 1 ml of Detomidine hydrochloride (Domosedan[®]; 10 mg/ml, Provet Veterinary, Turkey) and after intravenously injecting 250 ml of Guaiphenesin (Giafen[®]; 100 mg/ml, BOMAC, New Zealand) at a speed of 0.8 ml/sec, the general anesthesia was conducted with an intravenous injection 22 ml of Ketamine HCL (Ketamine[®]; 57.68 mg/ml, Yuhanyanghang, Korea), and immediately the inhalational anesthesia device was connected so that the anesthesia could be maintained via a isoflurane inhalational anesthetic method.

Surgical area shearing and surgical area disinfection with Povidone iodine (Betadine[®]; Dongindang, Korea) and Alcohol (Green, Korea) were conducted, and afterward the operating surgeon conducted personal disinfection before entering into the operating room. The equine colic kit #5059 (Vet Surgical Resources, Inc. USA) was used for the operating drape, and the abdomen was opened with a abdominal median incision method using the scapel No. 20. A forward displacement was confirmed at the pelvic flexure of the large colon, and the displaced large colon was pulled so that it was returned to the correct position and afterward it was put on the colon tray. Severe bowel obstruction to the colon dorsal dextrum was confirmed and, to relieve the status of obstruction, an approx-

imately 10 cm enterotomy was conducted to the ventral area of the pelvic flexure and afterward a hose was inserted into the portion where the obstruction was discovered so that warm water could be sprayed to relax the coproma and remove it outside the section. However, an extremely large and hard lump was promoted on the right dorsal part of the ascending colon, and no change during the relaxation process was observed.

The incised intestinal wall underwent a 2 layer suture through a primary simple continuous method and a secondary invert mattress method using the vicrul 2-0 (ETHICON, Belgium), and a hard lump was found again in the right dorsal part of the ascending colon. The lump was cautiously squeezed to the diaphragmatic flexure and pulled outside of the abdomen (Fig 2A). An approximately 20 cm incision was made to the ventral area of the diaphragmatic flexure, and an about 2.9 kg, greenish brown rugby ball sized (22 cm × 10 cm) stone was removed (Fig 2B). One day after the operation, the heart rate of the horse was stabilized to 28/min, and abnormal symptoms including pain were not observed. The injection program after the surgery included, for 10 days, 35 ml of Amphoprim[®] (Trimethoprim 40 mg/ml, Sulphadimethylpyrimidine 200 mg/ml, Virbac, France) S.I.D. IV, 40 ml of Gentamicin[®] (Gentamicin sulfate 50 mg/ml, Daesung, Korea) S.I.D. IM, 30 ml of PPS[®] (Penicillin G 100,000 iu/ml, Daesung, Korea) S.I.D. IM, 12 ml of Banamine[®] (Flunixin meglumine 50 mg/ml, MSD, France) S.I.D. IV, and Hartman solution (CJ Cheiljedang, Korea) 20 L/day.

The operation area was disinfected everyday using Povidone iodine (Betadine[®]; Dongindang, Korea), and a bag was used for ten days after the operation to prevent abdominal edemas.

A hand drawing exercise was conducted for ten days twice a day after the operation, and feeding was tempered for three days after the operation and fresh water was provided. After the end of the tempered feeding period, hay was fed and ten days after the operation, a normal amount of hay was fed. At 18 days after the operation, the stitches to the skin suture area were removed and the horse was released healthily.

The extracted abdominal stone (enterolith), after undergoing element component analysis using a scanning electronic microscope (FE-SEM, Hitachi S-4300 model, Japan), was found to have amounts of C (30.08%), O (39.85%), Mg (3.89%), P (11.15%), Ca (11.16%) at a magnification of 400.

Discussion

Although there is nothing clearly acknowledge for the pathogenesis of abdominal stones in horses (6), the three factors of diet, management, and heredity increase the possibility of occurrence. The dietary cause can be distinguished into cases when a large amount of alfalfa is fed, bran with abundant phosphate is fed, and a large amount of mineral that is not melted into water is fed as an additive (1,3-5). It has been reported that the main factors are the consumption of nitrogen,

magnesium, and phosphorus from water and fodder (8,9). Prevention involves the promotion of the acidification of the colon content and the diluted feeding of minerals (5). In the present case, enterolith was revealed an about 2.9 kg and greenish brown rugby ball sized (22 cm × 10 cm), and to have large amounts of C (30.08%), O (39.85%), Mg (3.89%), P (11.15%), Ca (11.16%). To the author's knowledge, the present case is the first report of equine enterolith which is considered as an extremely rare in size and weight in Korea. Management factors involve cases where horses raised in the stable and freely fed hay and concentrated fodder due to lack of exercise have an extended period in which the digested content remains in the intestines, which increases the occurrence of intestinal stones (7). Although hereditary causes have not been proved, there is a hypothesis in which intestinal stones are formed when there is an electrolyte migrational disorder of the intestinal wall cell due to a hereditary flaw, and the ammonia occurring from the digestion of calcium and protein resulting from the alfalfa does not escape through the intestinal wall but is combined with foreign substances within the intestines.

Abdominal radiographs are much more likely to identify these large enterolith due both to increased density of the objects and location within the abdomen (10) as this case.

Advanced clinical areas like the American has been reported many occurrences involving enteroliths and euthanasia due to the economic burden of the owner, but domestically this case is significant in that it is the first example of successfully extracting and treating the intestinal stone of a horse.

Acknowledgment

This research was supported by the Technology Development

Program for Agriculture and Forestry (312062-05-1-SB020), Ministry for Agriculture, Forestry and Fisheries, Republic of Korea.

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만성적인 산통증상 발현마의 장결석 외과적 치료 및 성분 분석

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요약 : 산통 증상을 보인 12세된 웹블러드(거세, 540 kg) 말로부터 임상검사 및 실험실 검사결과 모래 등 이물에 의한 장폐색으로 진단하여 개복술과 장절개술을 실시한 결과 장결석을 확인하여 적출하였다. 적출한 장결석은 약 2.9 kg, 녹색, 럭비공 크기(22 cm × 10 cm)였다. 주사전자현미경(FE-SEM, Hitachi S-4300모델)을 이용하여 원소성분(EDX)을 분석한 결과 400배율에서 C(30.08%), O(39.85%), Mg(3.89%), P(11.15%), Ca(11.16%)가 높게 나타났다. 국내 말에서 크기가 가장 큰 장결석 적출 및 치료가 성공적으로 진행된 최초의 예로서 그 의미가 있다고 볼 수 있다.

주요어 : 개복술, 장결석, 웹블러드 말