INTESTINAL EMPHYSEMA IN A RABBIT DOE
(*Oryctolagus cuniculus*)

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ABSTRACT

Intestinal emphysema is a rare condition characterized by numerous thin-walled, gas-filled cystic structures, a few millimeters to several centimeters in diameter, in the gut wall and on the serosal surface. These are located mainly in the small intestine, although the large intestine, mesentery, and mesenteric lymph nodes may be involved. Microscopically, the gas bubbles are present within lymphatic vessels. A pleocellular inflammatory reaction may be evident in the walls of the cysts. This report describes a case of intestinal emphysema in a rabbit doe from an ecological farm and different etiologic causes are discussed. It is proposed that the intestinal emphysema may have been caused by a combination of bacterial, nutritional, and perhaps host factors. An unbalance diet may have been the leading factor.

Key words: Ecological farm, intestinal emphysema, pneumatosis cystoides intestinalis, rabbit doe.

INTRODUCTION

Intestinal emphysema is an uncommon disorder characterized by the presence of gas-filled cysts within the wall of some parts of the gastrointestinal tract. Similar cysts are frequently found in the mesentery adjacent to the affected intestine, and are occasionally found in other organs of the abdominal cavity, in the omentum or regional lymph nodes, or attached to any portion of the visceral or parietal peritoneum. Intestinal emphysema is also known as pneumatosis cystoides intestinalis, pneumatosis intestinalis, cystic lymphopneumatosis, and abdominal or intestinal gas cysts (YALE 1975).

Intestinal emphysema has been described as an infrequent condition in animals and it is usually an incidental finding in slaughterhouse (JONES *et al.* 1997). A similar condition also occurs in humans, where both fulminant and benign forms exist (HÖER *et al.* 1998). Fulminant intestinal emphysema is associated with an acute bacterial process, sepsis, and necrosis of the bowel, while benign intestinal emphysema can be totally

asymptomatic and observed as an incidental finding at laparotomy (GALANDIUK & FAZIO 1986).

Although numerous explanations have been advanced as to the cause of this condition, the etiology remains unknown (MCGAVIN *et al.* 2001). In the last decades the most widely accepted theories in human medicine include mechanical and bacterial causes (MCGAVIN *et al.* 2001).

This report describes a case of intestinal emphysema in a rabbit doe from an ecological farm and different etiologic causes are discussed. The special production conditions under which this particular animal was maintained make these observations of interest and provides additional information which may help to identify the factors associated with or contributing to this condition.

MATERIAL AND METHODS

The doe was a 15 months old female New Zealand white rabbit (*Oryctolagus cuniculus*). The animal lived with another 19 rabbit does in an ecological farm located in the province of Alicante, situated on the Mediterranean coast of Spain.

The does were fed with natural food consisting of whole barley and pea beans and alfalfa. However, the animals selected and ingested only the barley, and the pea beans were rejected. Therefore, the rabbits fed on a high-starch / low-fibre diet.

The twenty rabbits from the ecological rabbitrie showed good appetite but they had a chronic weight lost. The studied animal presented lethargy and seemed to be inactive. No other clinical abnormalities were noted.

The doe was euthanasied by an intravenous injection of barbiturate (Dolethal®. Vétoquinol SA, Lure, France), following the ethical guidelines of our institution.

A complete necropsy was performed and any gross lesions observed were recorded. Tissues were fixed in 10% neutral buffered formalin and dehydrated through graded alcohols before being embedded in paraffin wax. Several 4 μm thick sections were cut from each sample and stained with haematoxylin and eosin, van Gieson´s thrichromic, PAS and Gram methods.

RESULTS AND DISCUSSION

At necropsy, multiple 1-5 millimeters in diameter bubbles within the distal part of the jejunum and ileum were observed, giving the bowel a spongy crepitant touch on palpation. Cysts were not observed in the mesenteric lymphatic vessels or in the mesenteric lymph nodes. After the gut opening, the exposed mucosa showed an irregular surface due to numerous small cysts filled with gas, that were present in the

intestinal wall (figure 1). With the exception of the small intestine, the internal organs appeared normal at the time of necropsy.

The major histologic abnormalities were numerous large endothelial-lined cystic structures surrounded by elastic fibers in the mucosa and submucosa of the small intestine. The majority of the cysts were in the lymphatic vessels of the lamina propria resulting in a marked deformation of the intestinal villi (figure 2). In the jejunum submucosa, cysts displaced portions of the Peyer's patches lymph follicles. The walls between the cysts in many cases contained a pleocellular inflammatory reaction characterized by a mixture of lymphocytes, macrophages and plasma cells. In the most severe affected areas also there was a mild hyperplasia of goblet cells. The cysts also were seen in muscular and serosa layers but they were lower and smaller.

Several gut sections showed numerous Gram-positive bacilli in the intestinal lumen but not in the cysts.

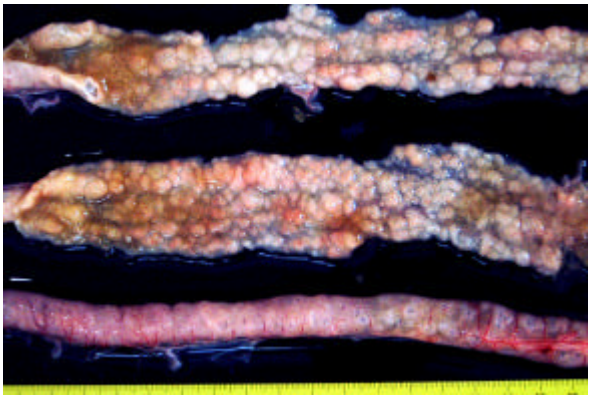

Figure 1: Gut closed (down) and opened (up). The bubbles can be observed through the serosal surface (down). The ileum mucosa shows an irregular surface due to the existence of numerous gas cysts within the intestinal wall (up).

No concurrent disorder of the gastrointestinal tract was present in this animal and no histopathological lesions in other organs were observed.

Intestinal emphysema is a rare condition in animals, found mainly in post-weaning pigs, although this condition has been also reported in sheep (JONES *et al.* 1997), chickens (GALANDIUK & FAZIO 1986) and laboratory rats (YALE & BALISH 1992). To our knowledge, this is the first report of the presence of intestinal emphysema in rabbits.

The lesion is usually an incidental finding in slaughtered animals (JONES *et al.* 1997) and it has not been associated with clinical disease (MCGAVIN *et al.* 2001). The rabbit doe studied was lethargic and suffered chronic weight loss. This slimming may be due to a malnutrition caused by an unbalance diet or by malabsorption caused by extensive

involvement of the intestinal mucosa. Nevertheless, clinical signs were not detected in pigs despite the fact that the intestinal lesion was similar or even more extensive (MEYER & SIMON 1977). These differences could be produced by a different location of macro and microscopical lesions. Whereas in pigs the majority of the cysts were in the large intestine (MEYER & SIMON 1977), in our case the cysts were located in the small intestine, principally jejunum and ileum. These last locations play an important role in the nutrient absorption. GALANDIUK and FAZIO (1986) reported that unless intestinal emphysema is located distal to the terminal ileum, symptoms are likely to be absent or very non-specific.

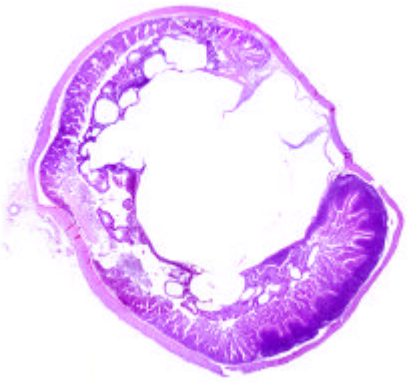

Figure 2: A section of ileum. Several vesicles mainly located in mucosa and submucosa. Dilation of lymphatic vessels and moderate infiltrate of mononuclear cells are in the lamina propria.

The histopathological lesions observed in this rabbit doe also were somewhat atypical compared with the lesions of intestinal emphysema in pigs (MEYER & SIMON 1977, MCGAVIN *et al.* 2001). In the doe, lesions were most prominent and serious in the mucosa of the small intestine rather than in serosa and no lesions were observed in large intestine, mesentery or mesenteric lymph nodes.

There was a clear distension of lymphatic vessels of the mucosa lamina propria forming endothelial-lined cystic structures. It has been reported that the marked involvement of the mucosa supports the idea that gases are absorbed directly from the intestine (MEYER & SIMON 1977). In opposition to our findings, HÖER *et al.* (1998) reported two cases of intestinal emphysema where they identified the cysts as pseudocysts with no epithelial or endothelial outlining. These authors hypothesized that gas followed a breach of mucosal integrity, infiltrated the mucosa and these gas-filled gaps were organized secondarily by histiocytes and multinuclear giant cells. Neither ulcers, erosions nor other microscopical lesions were observed in the mucosa of the rabbit doe.

Although numerous explanations have been advanced as to the cause of this condition, the etiology remains unknown (MCGAVIN *et al.* 2001). In human medicine fulminant and benign forms have been reported. Many authors believe that there are different mechanisms for both forms (GALANDIUK & FAZIO 1986). Five possible causes have been

proposed: mechanical, bacterial, nutritional, chemical and neoplastic (KOSS 1952). Dietary and biochemical theories are similar, and postulate that an acidic milieu, resulting from increased lactic acid levels due to a particular diet or disturbed carbohydrate metabolism, leads to decreased carbon dioxide and oxygen resorption with cyst formation (GALANDIUK & FAZIO 1986). In humans, chemical, nutritional and neoplastic theories have had little support in recent years (YALE & BALISH 1992). Currently, mechanical theory is the most popular. According to this theory, gas is forced into the cysts along the intestine in one of two ways. In the first way, pulmonary alveoli rupture occurs in patients with chronic lung disease, and air escapes from the thorax by dissecting along the aorta and mesenteric blood vessels to the bowel. In the second way, intraluminal intestinal gas passes through a mucosal tear or ulcer to reach the submucosa (YALE 1975). In the studied rabbit neither pulmonary lesions nor intestinal ulcers were seen after necropsy and microscopical studies.

In the last decades bacterial theory has gained support when intestinal emphysema was produced in the germfree rats after the monocontaminating its peritoneal cavity with either *Clostridium perfringens* or *Clostridium tertium*, but not after monocontaminating with several other common gastrointestinal organisms (YALE & BALISH 1992). However, MEYER and SIMON (1977) hypothesized that the intestinal emphysema observed in a gnotobiotic pig may have been the consequence of the enteric disease resulting from an experimentally induced *Escherichia coli* infection.

It is hypothesized that the intestinal emphysema observed here may have been the consequence of a combination of bacterial, nutritional and individual causes. It is known that some enterobacteria (*Escherichia coli*, *Clostridium perfringens* or *Clostridium tertium*) induce marked gastric dilation, congestion and intestinal emphysema in germfree pigs (MEYER & SIMON 1977) and rats (YALE & BALISH 1992). It has been reported that an increase in the dietary starch level is accompanied by a reduction in the fibre level, which alters the retention time of digesta in the final part or ileum and caeco-colic segment considerably and, as a result, the fermentation activity. Low fibre/high-starch led to a rise in lactate concentration and a fall in the molar proportion of butyrate and propionate, as well as a drop in the lypopolysaccharid content. This produces a change in the microflora, with stimulation of the Gram-positive bacteria to the detriment of the Gram-negative bacteria (BLAS & GIDENNE 1998). There were a large number of Gram-positive bacilli in the intestinal lumen of several histological sections of the rabbit studied.

It has been reported that host factors such as carbohydrate intolerance may also have a significant role either alone (AZIZ 1973) or in combination with bacterial enteric pathogens (MEYER & SIMON 1977).

CONCLUSIONS

It is proposed that the intestinal emphysema may have been caused by an intestinal disbiosis resulting from a high multiplication of germens promoted by a diet that is hypercaloric and rich in carbohydrates.

Although only one rabbit doe was studied, and it is not possible to determine if all ecological farm rabbits were affected of intestinal emphysema, higher fibre and lower starch levels in diet were recommended to resolve the malnutritional problems of the remaining animals and to prevent new cases of intestinal emphysema.
In conclusion we can say that the etiology of intestinal emphysema in this rabbit is not clear although a combination of bacterial, nutritional, and perhaps host factors should be considered. An unbalance diet may have been the leading factor. Intestinal emphysema should be considered as well in the diagnostic approach when assessing intestinal rabbit pathology.

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