

Porcine colonic spirochetosis: A retrospective study of eleven cases

Christiane Girard, Thomas Lemarchand, Robert Higgins

Abstract

This retrospective study of porcine colonic spirochetosis was done in order to characterize the clinical signs, the macroscopical and microscopical changes, and the bacteriological results of cases observed in Quebec. Necropsy records of all cases of colitis were reviewed. Eleven cases with filamentous bacteria colonizing the colonic epithelium were selected. This condition was only observed in weaned piglets, and was associated with mild persistent diarrhea and growth retardation. Macroscopic changes were generally limited to the presence of soft to liquid colonic contents. Adherence of filamentous helicoidal bacteria to the apical surface of the colonic epithelium and mild diffuse infiltration of the colonic lamina propria by mononuclear cells were the main histological findings. Weakly β -hemolytic spirochetes were isolated in 6 cases.

This condition seems to be underestimated for various reasons, and it is possible that some cases diagnosed as nonspecific colitis or superficial colitis, in fact, represent later stages of porcine colonic spirochetosis.

Résumé

La spirochétose du côlon du porc : étude rétrospective d'onze cas

Cette étude rétrospective portant sur la spirochétose de côlon du porc a été effectuée afin de caractériser les signes cliniques, les changements macroscopiques et microscopiques et les résultats de bactériologie des cas observés au Québec. Les rapports de nécropsie de tous les cas de colite ont été revus et onze cas ont été retenus en se basant sur la présence de bactéries filamenteuses attachées à l'épithélium du côlon. Cette condition affectait des porcs sevrés et causait une diarrhée légère mais persistante et des retards de croissance. Les changements macroscopiques se limitaient habituellement à un contenu du côlon pâteux ou liquide. Des bactéries filamenteuses hélicoïdales adhérentes à la surface apicale de l'épithélium et une légère infiltration diffuse de la lamina propria par des mononucléaires étaient les principaux changements histopathologiques observés au côlon. Dans six cas,

des spirochètes faiblement bêta-hémolytiques ont été isolés.

La fréquence de cette condition semble sous-estimée pour différentes raisons et il est possible que certains cas diagnostiqués comme colite non spécifique ou colite superficielle représentent en fait des stades avancés de spirochétose du côlon du porc.

Can Vet J 1995; 36: 291-294

Introduction

Diarrhea, a major problem in weaned piglets, has been associated in Canada with different conditions, such as salmonellosis, dysentery, or porcine proliferative enteritis (1). In many cases of diarrhea, macroscopic and microscopic changes are limited to the colon and are not associated with any specific etiology. The diagnosis is usually limited to a morphological description, such as superficial or nonspecific colitis. In recent years, similar lesions have been associated with the presence of spirochetes, intimately adhered to the surface of the colonic epithelium, and the condition has been described as colitis associated with *Treponema (Serpulina) innocens* (2,3), or porcine colonic spirochetosis (4). The latter name was suggested since the definite taxonomic position and the pathogenicity of the weakly β -hemolytic spirochetes were not established, and because these cases strongly resembled cases of human intestinal spirochetosis (5). This condition was first reported in the United Kingdom, where it was referred to as spirochetal diarrhea (6,7).

We report findings of a retrospective study carried out on 11 cases of histologically confirmed porcine colonic spirochetosis detected over a 4-y period, in order to characterize clinical and pathological aspects of this condition as it has been seen in swine herds in Quebec.

Materials and methods

A retrospective study was carried out using records of pigs submitted for necropsy, from birth to adult age. Included were all cases originally reported as nonspecific colitis, probable swine dysentery, ulcerative and necrotizing colitis, colitis associated with the presence of weakly β -hemolytic spirochetes, or porcine colonic spirochetosis, and select cases of colitis associated with the presence of spirochetes intimately adhered to the colonic epithelium. Eleven cases were detected. Ten of

Department of Pathology and Microbiology, Faculty of Veterinary Medicine, University of Montreal, P.O. Box 5000, Saint-Hyacinthe, Quebec J2S 7C6

Table 1. Clinical and pathological data of 11 cases of porcine colonic spirochetosis

Case no	Age (weeks)	Diarrhea	Weight loss	Other clinical signs	Pathological findings
1	5	+	+	Respiratory distress	None
2	6	+	+	Anorexia Respiratory distress Mortality	Mycoplasmal pneumonia
3	12	+	NR	Respiratory distress	Chronic polyserositis Purulent bronchopneumonia Influenza
4	12	+	+	Respiratory distress	Purulent bronchopneumonia Bronchiointerstitial pneumonia Porcine pleuropneumonia
5	8	+	NR	NR	Porcine proliferative enteritis
6	6	+	+	Respiratory distress Anorexia	Porcine pleuropneumonia Exudative glomerulonephritis
7	8	NR	+	Respiratory distress Mortality	Salmonellosis Proliferative and necrotizing pneumonia Arthritis (<i>Streptococcus suis</i>)
8	11	+	+	NR	Mild bronchopneumonia
9	12	+	+	NR	None
10	20	+	NR	NR	Gastric ulcer
11	12	+	NR	Respiratory distress Anorexia	Proliferative and necrotizing pneumonia

NR: not reported

them originated from the Faculté de médecine vétérinaire, Université de Montréal, from January 1988 through December 1993. The 11th case came from the records of the Laboratoire de pathologie animale, Ste-Foy, Quebec.

Pertinent clinical and bacteriological data were extracted from the case records. They included visualization of spirochetes in colonic content by dark field or Gram stain examination, isolation, and identification. Isolation had been carried out using either spectinomycin vancomycin colistin (SVC) agar (Sigma, St. Louis, Missouri, USA) (8) or BJ agar (9). In the latter, trypticase soy agar (TSA) (Difco, Detroit, Michigan, USA) had been replaced by blood agar base #2 (Unitath, Nepean, Ontario) and the fecal extract omitted (10). A rapid differentiation between *S. hyodysenteriae* and weakly β -hemolytic spirochetes had been achieved using the hemolysis and ring phenomenon tests, in conjunction with an indole spot test (11).

Tissue sections of colon were reevaluated histologically. When necessary, additional formalinized tissues were embedded in paraffin, sectioned at 6 μ m, and stained with either hematoxylin, phloxin, and saffron (HPS) or Warthin–Starry silver stain.

Results

Each submission comprised 1 to 5 piglets. Age of animals varied from 5 to 12 wk, with the exception of

1 submission of 20-week-old pigs (case 10) (Table 1). Clinical signs reported by the owner or referring veterinarian were mild diarrhea (10 cases), weight loss, or growth retardation (7 cases), and anorexia (3 cases). In cases 1–4, 6, 7, and 11, dyspnea, coughing, and pneumonia were also noted as a major complaint. Mortality was reported in cases 2 and 7. Different antibiotics, including tylosin and carbadox, had been used to control the diarrhea with inconsistent results.

In 7 cases (2–4, 6, 8–10), macroscopic changes in the intestinal tract were limited to a dilatation of the cecum and colon with soft to liquid, greenish or yellow, contents. No significant lesion in the colonic mucosa was detected. In case 1, blood and mucus were observed in the colon with multiple small erosions in the mucosa. Focal hyperemia of the colonic mucosa was noted in case 11. Diffuse thickening of the ileal and colonic mucosa was observed in case 5. Focal necrosis of the mucosa at the ileocecal junction was present in case 7. Diagnosis of porcine proliferative enteritis and salmonellosis had been made in cases 5 and 7, respectively. Other major findings are given in Table 1.

Histological changes in the colon were characterized by adherence of slender or filamentous helicoidal gram-negative bacteria to the apical surface of the colonic epithelium, causing a brush border effect (Figure 1). This adherence varied from multifocal to extensive. In case 7, this change was very focal and could

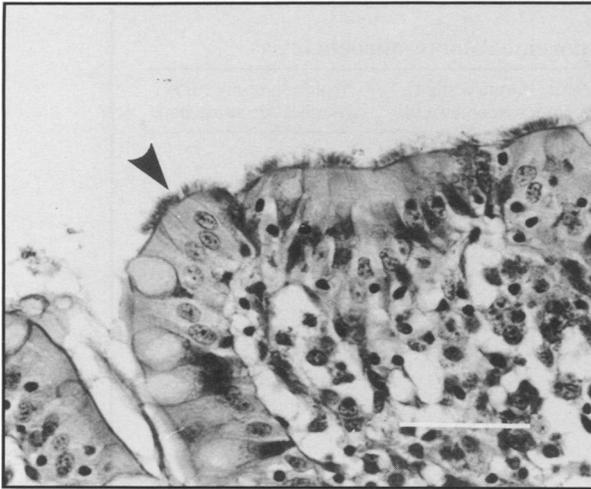


Figure 1. Extensive colonization of the colonic epithelium (arrow), with hyperemia and edema of the superficial lamina propria. Diffuse mononuclear cell infiltration is present. Hematoxylin, phloxin, saffron (HPS). Bar = 50 μ .

easily have been missed. The adherence of the spirochetes was limited to areas of mature superficial cylindrical epithelial cells; no such adherence was observed in areas where epithelial cells were immature, cuboidal, or squamous. Focal erosions of the mucosa were sometimes observed (Figure 2). Numerous spirochetes were also present in superficial debris and in the lumen of glands.

Not all pigs from a single submission had spirochetes adhering to the colonic epithelium (Table 2). Piglets without this change usually had immature superficial colonic epithelium. However, every piglet, with or without spirochetosis, had mild colitis with superficial edema of the lamina propria and diffuse infiltration of mononuclear cells between the crypts (Figures 1,2). Crypt epithelium was sometimes basophilic and exhibited numerous mitoses, indicating an accelerated turnover of those cells. Purulent exudate in the lumen of the colonic crypts was noted on many occasions.

Sections of colon had been submitted for bacteriological examination in 9 cases (Table 2). The presence of 3 to >100 spirochetes per microscopic field was observed in 6 cases. In 3 cases (1,7, and 11), smears were negative for spirochetes. Weakly β -hemolytic, indole negative and α -galactosidase positive, spirochetes were isolated in 6 cases (Table 2).

Discussion

The main clinical signs associated with colonic spirochetosis were mild persistent diarrhea, growth retardation, and partial anorexia. They were similar to, but less severe than, those reported for cases in the United Kingdom, where the occasional presence of mucus and blood in the diarrheic feces was observed (7). The importance of the colitis in causing growth retardation and anorexia is difficult to evaluate in our cases, since many piglets suffered other major problems. The mortality observed in 2 cases (cases 2,7) was associated with pneumonia and salmonellosis. This latter condition, as well as porcine proliferative enteritis, is often associated with colonic spirochetosis (7).



Figure 2. Brush border appearance of the colonic epithelium (arrow), with multifocal erosions (arrow), and accumulation of necrotic debris in the colonic lumen. The lamina propria is diffusely infiltrated by mononuclear cells. Hematoxylin, phloxin, saffron (HPS). Bar = 100 μ .

The macroscopic colonic changes observed in our cases were milder than those already reported by others in natural or experimental cases of porcine colonic spirochetosis (6,7) and in swine dysentery (1,12,13); thus, they were not very specific.

The observation of microscopic colonic lesions in porcine colonic spirochetosis was diagnostic for the condition and could not be confused with other colonic conditions. The extensiveness of the bacterial adherence to the superficial colonic epithelium varied from one case to another, but it seemed to depend on the presence of mature columnar superficial colonic epithelium. No such adherence is observed with *S. hyodysenteriae* (1,12,14). The morphological changes observed with colonic spirochetosis suggest that the colonization of the colonic epithelium is dependent on ligand-receptor interactions (adhesin) between the bacteria and the host enterocytes (15). Except for experimental reproduction of the disease by feeding pure cultures of weakly β -hemolytic spirochetes (7), little is known about the pathogenicity of this agent.

Porcine colonic spirochetosis is infrequently diagnosed in diarrheic pigs in Quebec, and its real occurrence is certainly underestimated for various reasons. From a clinical point of view, the diarrhea observed in this condition is persistent but mild, and pigs are not submitted for necropsy. In Canada, many herds are preventively or curatively treated against dysentery, and the antimicrobial agents used have been reported to be effective also against porcine colonic spirochetosis (7). Other important factors are the difficulty of demonstrating by microscopic examination the bacterial adherence,

Table 2. Bacteriological data on 11 cases of porcine colonic spirochetosis

Case no	Number of pigs submitted	Pigs with spirochetosis	Direct smears (Gram's stain) spirochetes/microscopic field	Isolation of a weakly β -hemolytic spirochete
1	2	1	0	-
2	2	1	15-20	+
3	2	1	NS	NS
4	5	3	100 20-30 NS	- - NS
5	1	1	10-20	+
6	2	2	NS	NS
7	2	1	0	+
8	3	1	7-10	+
9	2	2	8-10 5-7	+
10	2	2	20-25 0-3	-
11	2	1	0	+

NS: not submitted

which is sometimes focal and easily missed or restricted to some individuals in the same submission, and the difficulty of isolating the spirochetes associated with the condition. Bacterial isolation of weakly β -hemolytic spirochetes has limited value in the diagnosis of porcine colonic spirochetosis, since they are very heterogeneous (3,16,17) and pathogenicity seems to be restricted to some isolates.

Finally, it is possible that some cases diagnosed as nonspecific colitis or superficial colitis represent later stages of porcine colonic spirochetosis, as the adherence of the spirochetes, at least experimentally, seems to be transient (6).

Acknowledgments

We thank Dr. Danielle Larochelle for submission of case 11 and Jacques Lagacé, Jules Deslandes, Line Pepin, Bibiane Pépin, and Jacinthe Cardin for technical assistance.

CVJ

References

1. Barker IK, Van Dreumel AA, Palmer N. Infectious and parasitic diseases of the gastrointestinal tract. In: Jubb KVF, Kennedy PC, Palmer N, eds. Pathology of Domestic Animals, 4th ed., vol 2. Toronto: Academic Pr, 1992: 141-318.
2. Spearman JG, Nayar G. Colitis associated with *Treponema innocens* in pigs. *Can Vet J* 1988; 29: 747.
3. Jacques M, Girard C, Higgins R, Goyette G. Extensive colonization of the porcine colonic epithelium by a spirochete similar to *Treponema innocens*. *J Clin Microbiol* 1989; 27: 1139-1141.
4. Girard C, Jacques M, Higgins R. Colonic spirochetosis in piglets. *Can Vet J* 1989; 30: 68.
5. Hovind-Hougen K, Andersen AB, Nielsen RH, et al. Intestinal spirochetosis: morphological characterization and cultivation of the spirochete *Brachyspira aalborgi* gen. nov., sp. nov. *J Clin Microbiol* 1982; 16: 1127-1136.
6. Taylor DJ, Simmons JR, Laird HM. Production of diarrhea and dysentery in pigs by feeding pure cultures of a spirochaete differing from *Treponema hyodysenteriae*. *Vet Rec* 1980; 106: 324-330.
7. Taylor DJ. Spirochetal diarrhea. In: Leman AD, Straw BE, Mengeling WL, D'Allaire S, Taylor DJ, eds. Diseases of Swine, 7th ed. Ames: Iowa State University Pr, 1992: 584-587.
8. Jenkenson SR, Winger CR. Selective medium for isolation of *Treponema hyodysenteriae*. *Vet Rec* 1981; 109: 384-385.
9. Kunkle RA, Kinyon JM. Improved selective medium for the isolation of *Treponema hyodysenteriae*. *J Clin Microbiol* 1988; 26: 2357-2360.
10. Achacha M, Messier S. Comparison of six different culture media for isolation of *Treponema hyodysenteriae*. *J Clin Microbiol* 1992; 30: 249-251.
11. Bélanger M, Jacques M. Evaluation of the An-Ident System and an indole-spot test for the rapid identification of porcine treponemes. *J Clin Microbiol* 1991; 29: 1727-1729.
12. Harris DL, Lysons RJ. Swine dysentery. In: Leman AD, Straw BE, Mengeling WL, D'Allaire S, Taylor DJ, eds. Diseases of Swine, 7th ed. Ames: Iowa State University Pr, 1992: 599-616.
13. Wilcock BP, Olander HJ. Studies on the pathogenesis of swine dysentery. I. Characterization of the lesions in colons and colonic segments inoculated with pure cultures or colonic content containing *Treponema hyodysenteriae*. *Vet Pathol* 1979; 16: 450-465.
14. Albassam MA, Olander HJ, Thacker HL, Turek JJ. Ultrastructural characterization of colonic lesions in pigs inoculated with *Treponema hyodysenteriae*. *Can J Comp Med* 1985; 49: 384-390.
15. Duhamel GE, Muniappa N, Tarara RP, et al. Comparative pathology of naturally occurring intestinal spirochetosis of human beings and animals (abstract). *Am Coll Vet Pathol* 45th annual meeting, *Vet Pathol* 1994; 31: 612.
16. Duhamel GE, Mathiesen MR, Schafer RW, Ramanathan M, Gohnson JL. Description of a new species of spirochete, *Serpulina coli* sp. nov. associated with intestinal spirochetosis of swine and human beings. *Proc Annu Conf Res Workers Anim Dis* 1993: 14.
17. Lee JI, Hampson DJ, Lymbery AJ, Harders, SJ. The porcine intestinal spirochaetes: identification of new genetic groups. *Vet Microbiol* 1993; 34: 273-285.