

Morin M, Larivière S & Lallier R. Pathological and microbiological observations made on spontaneous cases of acute neonatal calf diarrhea.

*Can. J. Comp. Med.* 40:228-40, 1976.

[Dept. Pathology and Microbiology, Faculty of Veterinary Medicine, Univ. Montréal, St.-Hyacinthe, Québec, Canada]

This study revealed that the most important infectious agents implicated in neonatal calf diarrhea are the rotavirus, the coronavirus, the enterotoxigenic *Escherichia coli*, and the cryptosporidia. We found also that these enteropathogens are often involved in combination (for example, rotavirus + cryptosporidium). [The SCJ® indicates that this paper has been cited in over 130 publications, making it the most-cited paper for this journal.]

Michel Morin  
Department of Pathology and Microbiology  
Faculty of Veterinary Medicine  
University of Montréal  
St.-Hyacinthe, Québec J2S 7C6  
Canada

April 21, 1987

Until the early 1970s, most cases of infectious diarrhea in young calves were considered to be caused by pathogenic strains of *Escherichia coli*. In those days, new and exciting findings on old and recently recognized enteropathogens were reported in the literature. In the early 1970s, a reo-like virus<sup>1</sup> (now called rotavirus) and a coronavirus<sup>2</sup> were identified as a cause of neonatal calf diarrhea (NCD) by Charles Mebus at the University of Nebraska. In the same period, it was also found that coliforms causing diarrhea in calves produce a heat-stable enterotoxin<sup>3</sup> and bear K99 pili<sup>4</sup> for adhesion to the villi of the small intestine.

Reports on the occurrence of individual enteropathogens causing NCD were common in the literature, but we didn't have any idea on their relative importance in field outbreaks of NCD in conventional dairy and beef herds. Intestinal lesions caused by the enteropathogens had been reported mainly from calves infected experimentally with a single agent. In order to understand better the role and the importance of the various enteropathogens implicated in field outbreaks of NCD, a combination of diagnostic techniques (bacteriology, virology, and histo-

pathology) was used on diarrheic calves submitted for necropsy. I was responsible for the pathological and virological examinations, and S. Larivière and R. Lallier dealt with the *E. coli* work.

Our study refuted the old belief that septicemic colibacillosis was a common complication of NCD. A few years later, we performed a similar study on diarrheic calves from dairy herds only, and we confirmed our previous observations.<sup>5</sup>

I believe that the paper has been cited frequently because it shows clearly that NCD is a complex syndrome in which several infectious agents can be involved, either alone or more often in combination. Pathological observations reported in this paper have been used as a reference basis for several other works on natural and experimental cases of NCD.

Another important reason for the paper's popularity is that we demonstrated for the first time that cryptosporidia are an important cause of NCD. These organisms were detected by chance while I was performing histopathological examinations on the guts of the diarrheic calves. It was a great surprise to us because this agent had never been reported as an important cause of diarrhea in other species. Only sporadic cases of this infection had been reported in calves and other animals such as guinea pigs, monkeys, and turkeys. This observation has stimulated many works on this infection in calves, and in recent years cryptosporidia have been detected in several other species, including humans, where they can cause transient or chronic cases of diarrhea. It has been found also that cryptosporidiosis can be transmitted from calves to humans.

Our work was successful because we tackled an important problem on a global basis with a multidisciplinary approach. The kind of knowledge generated by this type of work is very important for those who must recommend rational approaches to the prevention and treatment of a multi-etiological syndrome like NCD. The importance of this knowledge is emphasized by the fact that studies with goals similar to those we had are still reported today.<sup>6,7</sup>

1. Mebus C A, Stair E L, Underdahl N R & Twiehaus M J. Pathology of neonatal calf diarrhea induced by a reo-like virus. *Vet. Pathol.* 8:490-505, 1971. (Cited 150 times.)
2. Mebus C A, Stair E L, Rhodes M B & Twiehaus M J. Pathology of neonatal calf diarrhea induced by a coronavirus-like agent. *Vet. Pathol.* 10:45-64, 1973. (Cited 85 times.)
3. Smith H W & Lingwood A. Further observations on *Escherichia coli* enterotoxins with particular regard to those produced by atypical piglet strains and by calf and lamb strains: the transmissible nature of these enterotoxins and of A antigen possessed by calf and lamb strains. *J. Med. Microbiol.* 5:243-50, 1972. (Cited 220 times.)
4. Orskov I, Orskov F, Smith H W & Sojka W J. The establishment of K99, a thermolabile, transmissible *Escherichia coli* K-antigen, previously called KCO, possessed by calf and lamb enteropathogenic strains. *Acta Pathol. Microbiol. Scand. B* 83:31-6, 1975. (Cited 225 times.)
5. Morin M, Larivière S, Lallier R, Bégin M E, Roy R S & Ethier R. Neonatal calf diarrhea: pathology and microbiology of spontaneous cases in dairy herds and incidence of the enteropathogens implicated as etiological agents. (Acres S D, ed.) *Proceedings: Second International Symposium on Neonatal Diarrhea*, 3-5 October 1978, University of Saskatchewan, Canada, Saskatoon: Veterinary Infectious Disease Organization, 1979. p. 347-69. (Cited 40 times.)
6. Snodgrass D R, Terzolo H R, Sherwood D, Campbell I, Menzies J D & Syngé B A. Aetiology of diarrhoea in young calves. *Vet. Rec.* 119:31-4, 1986.
7. Reynolds D J, Morgan J H, Chanter N, Jones P W, Bridger J C, Debney T G & Bunch K J. Microbiology of calf diarrhoea in southern Britain. *Vet. Rec.* 119:34-9, 1986.