Epidemiological features of calf mortality due to hemophilosis in a large feedlot

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Abstract

Hemophilosis was the most significant cause of mortality in fall-placed calves in a large feedlot in Saskatchewan, despite routine single immunization of calves with a commercial *Haemophilus somnus* bacterin on arrival. Common manifestations of fatal *H. somnus* infection were myocarditis and pleuritis; occasionally, thrombotic meningoencephalomyelitis (TME), peracute septicemia, and pneumonia were observed. Circumstantial evidence suggested that *H. somnus* may be a pathogen in polyarthritis. Death from pneumonia mainly occurred during the first five weeks in the feedlot. Death from myocarditis, pleuritis, TME, and septicemia, and euthanasia because of polyarthritis, occurred mainly after the third week in the feedlot.

The median fatal disease onset (FDO) for pneumonia was day 12; for septicemia, day 17; for polyarthritis, day 18; for myocarditis and pleuritis, day 22; and for TME, day 29. Calves that died from myocarditis frequently were found dead in their "home" pen; however, 88% of these animals had been treated previously. Fifty-seven percent of the calves that died from pleuritis were never treated, and those that died from TME or septicemia were either never treated or died shortly after initial treatment.

Résumé

Caractéristiques épidémiologiques reliées à la mortalité causée par la méningo-encéphalite thrombo-embolique chez des veaux dans un grand parc d'engraissement

La méningo-encéphalite thrombo-embolique fut la cause première de mortalité chez les veaux placés à l'automne dans un grand parc d'engraissement en Saskatchewan, et ce, en dépit de l'administration d'une dose d'un vaccin commercial à base d'un extrait bactérien d'*Haemophilus somnus*, à leur arrivée. Les manifestations les plus courantes de la maladie furent une myocardite et une pleurésie. Occasionnellement, des signes de méningo-encéphalite thrombo-embolique furent observés de même qu'une septicémie suraiguë et une pneumonie. Des évidences circonstancielles suggèrent qu'*H. somnus* peut être un agent pathogène dans le cas de polyarthrite. La mort par suite de pneumonie s'est produite principalement durant les cinq premières semaines au parc d'engraissement. La mortalité consécutive à une myocardite, une pleurésie, une méningo-encéphalite thrombo-embolique et une septicémie, ou suite à l'euthanasie pour cause de polyarthrite se produisit principalement après la troisième semaine passée au parc d'engraissement.

La période où débutait la mortalité, évaluée par la valeur médiane, suite à la pneumonie fut au jour 12; à la septicémie au jour 17; à la polyarthrite au jour 18; à la myocardite et pleurésie au jour 22; et à la méningo-encéphalite thrombo-embolique au jour 29. Les veaux ayant souffert de myocardite furent souvent trouvés morts dans leur enclos; toutefois, 88 % de ces animaux avaient été traités précédemment. Cinquante-sept pour cent des veaux morts de pleurésie ne furent jamais traités. Parmi ceux atteints de méningo-encéphalite ou de septicémie, certains ne furent jamais traités tandis que d'autres sont morts peu de temps après le traitement initial. *(Traduit par Dr Thérèse Lanthier)*

Can Vet J 1990; 31: 821-825

Introduction

Thrombotic meningoencephalomyelitis (TME), respiratory disease, myocarditis, polyarthritis, otitis, conjunctivitis, mastitis, and reproductive problems have been associated with *Haemophilus somnus* infection (1-20). The *H. somnus* disease complex has been reviewed (1-3).

In western Canada, hemophilosis has recently been recognized as a significant cause of mortality in fall-placed feedlot calves, despite routine immunization with commercial *H. somnus* bacterins (10-14). The respiratory form and various manifestations of the septicemic form, such as myocarditis and arthritis, have been reported with increasing frequency (1). Descriptions of the occurrence of the various syndromes of hemophilosis are infrequently reported (1,5,8-12).

The purpose of this retrospective follow-up study was to describe the occurrence of fatal disease associated with *H. somnus* in fall-placed calves in a large commercial feedlot in central Saskatchewan.

Materials and methods

Subjects

Auction market-derived calves (n = 6280) that entered a large, 10,000 head capacity commercial feedlot in central Saskatchewan during the fall of 1989 were studied. These calves were of mixed breeds and weighed 250-350 kg. Processing was performed within 24 h of arrival at the feedlot. All calves were uniquely identified with an eartag, branded, given 5 mL of vitamins A and D (Poten AD, rogar/STB, Pointe Claire-Dorval, Quebec) and 3 mL ivermectin (Ivomec, MSD Agvet, Kirkland, Quebec), and implanted with zeranol (Ralgro, I.M.C., Terre Haute, Indiana, USA).

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Supported by the Saskatchewan Agriculture Development Fund and the Saskatchewan Horned Cattle Trust Fund.

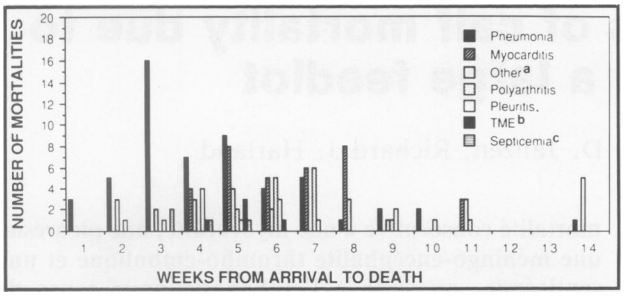

Figure 1. Mortality of feedlot calves by time period and disease. [a]Other = bloat, coccidiosis, peritonitis, mucosal disease, frostbite, osteomyelitis, trauma, unknown. [b]Thrombotic meningoencephalomyelitis. [c]*Haemophilus somnus* septicemia.

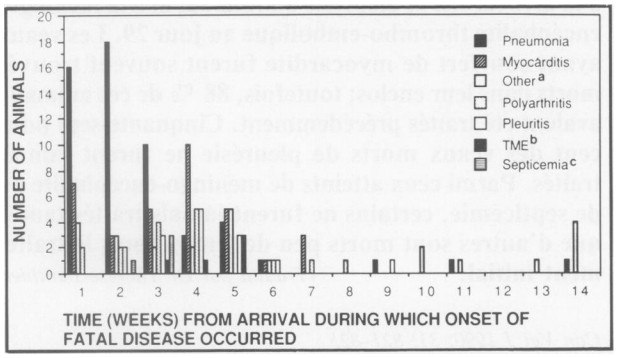

Figure 2. Onset of fatal disease in feedlot calves by time period and disease. [a]Other = bloat, coccidiosis, peritonitis, mucosal disease, frostbite, osteomyelitis, trauma, unknown. [b]Thrombotic meningoencephalomyelitis. [c]*Haemophilus somnus* septicemia.

and septicemia accounted for 37% (57/153) of fatal disease (Table 1). If polyarthritis was due to *H. somnus* infection, then hemophilosis accounted for 47% (72/153) of fatal disease.

Fibrinous bronchopneumonia was diagnosed by gross necropsy examination in 96% (53/55) of fatal pneumonia cases. Five calves that died from pneumonia also had polyarthritis and one had myocarditis. Pleuritis was the gross necropsy diagnosis in 14 cases, but in four cases there was also pneumonia, in two also pericarditis, and in one also laryngitis. Multiple lesions were also observed at gross necropsy in calves that probably died from various manifestations of *H. somnus* septicemia. Myocarditis was diagnosed by gross necropsy in 34 cases, but in five cases there was also pneumonia, in two also polyarthritis, in one also pleuritis, and in one also pericarditis. Fifteen calves were euthanized because of chronic polyarthritis, but at gross necropsy there was also pneumonia in nine cases, pleuritis in two, tracheitis in one, and myocarditis in one. Thrombotic meningoencephalomyelitis was diagnosed by histological lesions in five calves; in two cases there was also pneumonia, in two also myocarditis, in one also laryngitis, and in one also polyarthritis.

Haemophilus somnus infection was associated with fatal disease in 43% (25/58) of the laboratory submissions by histopathology and microbiology (Table 1). *Haemophilus somnus* was the only organism cultured

Table 2. Treatment history of calves with fatal disease

Necropsy diagnosis	n	Number of treatments[a] 0	1	2	3
Pneumonia	55	9	33	11	2
Myocarditis	34	4	15	9	6
Polyarthritis	15	1[b]	12	2	0
Pleuritis	14	8	5	0	1
TME[c]	5	2	3	0	0
Hemophilus septicemia	4	1	3	0	0
Bloat	8	8	0	0	0
Other[d]	18	11[e]	7	0	0

[a]Number of times calves pulled from "home" pen as sick and treated for fatal disease
[b]Treatment history missing
[c]Thrombotic meningoencephalomyelitis
[d]Other = unknown (n = 6), coccidiosis (n = 3), peritonitis (n = 3), mucosal disease (n = 2), frostbite (n = 1), osteomyelitis (n = 1), trauma (n = 2)
[e]Treatment history missing for two calves

in the following cases: 3/10 pneumonia; 5/11 myocarditis; 1/3 pleuritis; 3/5 TME; and 3/3 septicemia. Both *H. somnus* and *Pasteurella multocida* were cultured in one case of pleuritis. *Haemophilus somnus* and *Pasteurella haemolytica* were cultured from one calf and *Mycoplasma bovis* was cultured from six calves that were euthanized because of chronic polyarthritis. Although *H. somnus* can be isolated from the nasal passages and reproductive tract of healthy calves, the successful culture of *H. somnus* from heart, joints, lung, brain, and other affected areas is strongly indicative of hemophilosis (1). Our results (Table 1) indicate that *H. somnus* is commonly associated with myocarditis, pleuritis, TME, and septicemia.

Death from pneumonia mainly occurred during the first five weeks in the feedlot (Figure 1). Death from myocarditis, pleuritis, TME, and septicemia, and euthanasia because of chronic polyarthritis, occurred mainly after the third week in the feedlot (Figure 1).

The median FDO for pneumonia occurred sooner postarrival than the median FDO for suspected cases of hemophilosis (Table 1). Sixty-two percent of the calves that died from pneumonia were first treated during the first two weeks of arrival, whereas only 29% of myocarditis, 27% of polyarthritis, 25% of septicemia, 7% of pleuritis, and 0% of TME were treated initially during the same time period (Figure 2).

Sixteen percent of the calves that died from pneumonia had never been treated for BRD, and 24% had been treated repeatedly (Table 2). Of those fatal pneumonic cases that had been treated, 59% (27/46) died within one week of initial treatment (Figure 3).

Calves that died from myocarditis frequently were found dead in their "home" pen (30/34), but the majority of these calves (88%) had been treated previously (Table 2). Death from myocarditis occurred a median of 18 days after initial treatment, but this time interval had a wide variation (Table 1, Figure 3).

Table 1. Occurrence of fatal disease[a] in 6280 calves at a Saskatchewan feedlot — September 1, 1989 to January 31, 1990

Necropsy diagnosis	n	FDO[b]	TDI[c]	DAD[d]	Hemophilosis confirmed[e]
Pneumonia	55	12:(1-30)	6:(0-31)	27:(13-52)	3/10
Myocarditis	34	22:(3-36)	18:(0-49)	42:(27-56)	10/11
Other[f]	18	31:(4-96)	1:(0-50)	48:(18-98)	0/12[g]
Polyarthritis	15	18:(5-41)	20:(0-43)	45:(31-60)	1/12
Pleuritis	14	22:(11-37)	0:(0-27)	32:(11-59)	2/3
Bloat	8	32:(10-73)	0:(0)	32:(10-73)	0/2
TME[h]	5	29:(19-29)	0:(0-1)	29:(26-32)	5/5
Hemophilus septicemia	4	17:(13-19)	4:(0-16)	22:(17-29)	3/3

[a]Values for FDO, TDI, DAD are median: (inner-80-percentile range)
[b]FDO = fatal disease onset: the day of first treatment of all calves that subsequently died or the day of death if never treated
[c]TDI = treatment-death-interval: time interval (days) between first treatment and death
[d]DAD = days from arrival to death
[e]Proportion of laboratory submissions associated with *Haemophilus somnus* infection by histopathology or microbiology
[f]Other = unknown (n = 6), coccidiosis (n = 3), peritonitis (n = 3), mucosal disease (n = 2), frostbite (n = 1), osteomyelitis (n = 1), trauma (n = 2)
[g]Culture of *H. somnus* not attempted
[h]Thrombotic meningoencephalomyelitis

All calves were immunized with 2 mL of a modified-live (MLV) infectious bovine rhinotracheitis (IBR) and parainfluenza-3 (PI3) viral vaccine (Bovilan-RP, Langford Inc., Guelph, Ontario), and 5 mL of a combined *H. somnus* and clostridial bacterin (Fermicon 7/Somnugen, Boehringer Ingelheim Animal Health, Burlington, Ontario). A rectal temperature was taken on all calves at processing; those with a temperature ≥40.5°C were considered sick with bovine respiratory disease (BRD) and treated by a standard treatment protocol. All other calves were treated prophylactically with 25–30 mL long-acting oxytetracycline (Liquamycin LA, rogar/STB).

Calves were housed in groups of approximately 200 head per pen and observed daily for illness. Individual health records were maintained on all sick calves. The case definition of BRD was: an appearance that was subjectively different from penmates; the absence of clinical signs attributable to any organ system other than the respiratory system; and a rectal temperature ≥40.0°C. A clinical diagnosis of polyarthritis was based on lameness and swollen joints. Calves that were depressed, incoordinated, recumbent, and opisthotonic were diagnosed as TME (1). Myocarditis, pleuritis, and peracute *Haemophilus* septicemia were diagnosed only at necropsy.

Mortality data and analysis

A routine necropsy was performed within 24 h of death. When the gross diagnosis was tentative, appropriate tissue samples were sent to the pathology laboratory at the Western College of Veterinary Medicine. The final necropsy diagnosis was based on the predominant lesion that probably caused death. *Haemophilus somnus* involvement was considered biologically possible in the following conditions: pneumonia, myocarditis, pleuritis, septicemia, TME, and polyarthritis. *Haemophilus somnus* infection was associated with these conditions by gross necropsy lesions, routine culture of *H. somnus*, and histopathology. The gross necropsy and histological lesions associated with *H. somnus* infection have been described previously (1,2,5,11,12,16–20).

All necropsy and case history data were collected and entered into a database manager system (Reflex, the Analytic Data-base System, Borland/Analytica Inc., Scotts Valley, California, USA). The day on which a calf died was defined as the number of days between arrival at the feedlot (day 0) and death. The day of fatal disease onset (FDO) was defined as the day of first treatment for subsequent fatal disease or the day of death if never treated (14). The FDO for calves that were first treated at processing was day 0. Four calves that died from pneumonia and one calf that died from myocarditis were treated for BRD at processing (day 0). The FDO for calves that died from myocarditis, pleuritis, TME, or septicemia was the day of first treatment for BRD or the day of death if never treated. The FDO for calves that were euthanized because of chronic polyarthritis was the day of first treatment for lameness or BRD. Based on our case definition, treatment for BRD could have been treatment for various manifestations of hemophilosis. The treatment-to-death interval was defined as the number of days between first treatment for fatal disease and death. The median and inner-80-percentile range were used to describe the central location of the data and the index of dispersion since the data were not normally distributed (21).

Results

A total of 1870 calves (27%) were treated for BRD during the follow-up period, September 1, 1989 to January 31, 1990. During this time frame, 153 calves died (2.4%). Pneumonia was the predominant necropsy diagnosis (36%, 55/153), but if disease from *H. somnus* infection was grouped together, then hemophilosis was the major cause of death. Myocarditis, pleuritis, TME,

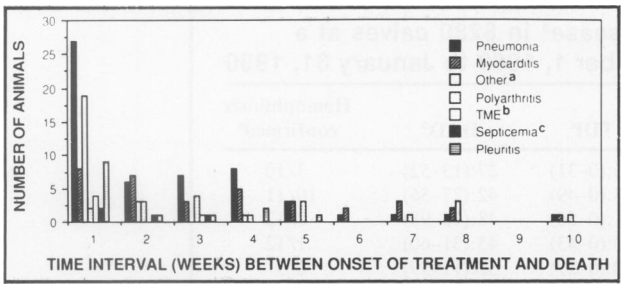

Figure 3. Time interval between onset of treatment and death. [a]Other = bloat, coccidiosis, peritonitis, mucosal disease, frostbite, osteomyelitis, trauma, unknown, [b]Thrombotic meningoencephalomyelitis. [c]*Haemophilus somnus* septicemia.

Following chronic illness (Tables 1 and 2, Figure 3), calves with polyarthritis were euthanized because they could no longer get up. These calves had been placed in a "chronic" pen and usually were not treated repeatedly because past feedlot experience suggested a poor response to a sustained treatment period.

The majority of calves that died from pleuritis (13/14), TME (3/5), and septicemia (3/4) were found dead in their "home" pen. Fifty-seven percent (8/14) of the calves that died from pleuritis were never treated (Tables 1 and 2). Calves that died from TME or septicemia were either never treated or treated for only a short time prior to death (Tables 1 and 2, Figure 3).

Discussion

Hemophilosis was the most significant cause of mortality in fall-placed calves in a large feedlot in Saskatchewan, despite routine single immunization of calves with a commercial *H. somnus* bacterin on arrival. Myocarditis and pleuritis were the most common manifestations of *H. somnus* infection, although TME, peracute septicemia, and pneumonia were observed occasionally. It has been hypothesized that the reasons for the increase in these various manifestations of hemophilosis may include the increased use of mass treatment and vaccination programs, the ability of the organism to adapt; or the evolution of different virulent strains (1,19).

Gross necropsy lesions of myocarditis and severe fibrinous pleuritis are quite distinctive and highly suggestive of hemophilosis (1,11,17). In this study, the association between myocarditis, pleuritis, and *H. somnus* was frequently confirmed by histopathology and microbiology. Several observations provide circumstantial evidence that *H. somnus* may be a pathogen in polyarthritis: 1) the increased incidence of polyarthritis when other manifestations of hemophilosis are prevalent; 2) the similar FDO of polyarthritis, myocarditis, pleuritis, and septicemia; and 3) the presence of multiple lesions in the joints, heart, lung, and trachea, which is common in hemophilosis. *Haemophilus somnus* was isolated infrequently from diseased joints, but this was not unexpected in calves with chronic disease that had been treated with antimicrobials (1,9). Although *Mycoplasma bovis* was cultured in six cases of polyarthritis, we do not know the role of *H. somnus* and *M. bovis* in polyarthritis in feedlot calves. *Haemophilus somnus* can cause fibrinous bronchopneumonia (16–18), and we may have underestimated its significance in BRD because of too few laboratory submissions and difficulty in isolating this bacterium (1,9,18).

Bovine respiratory disease apparently occurs before other manifestations of hemophilosis (1,5,9), and it has been hypothesized that BRD may increase the risk of hemophilosis or be the first sign of *H. somnus* infection (1,9). We cannot test either one of these hypotheses in the feedlot because no accurate method of determining cause-specific morbidity currently exists. The fatal disease onset of myocarditis, pleuritis, septicemia, and TME suggests that hemophilosis mainly occurs during weeks 3–5 after arrival in the feedlot (Figure 1). It has been reported that incubation of infection in hemophilosis may be as short as two days or as long as 21 days, depending on stress and immune status of the infected calf (9).

Lesions in the heart and joints are observed in eight hours to three days after experimental infection with *H. somnus* (15,16), yet in our study, death from myocarditis and euthanasia of calves moribund with polyarthritis tended to occur a few weeks after initial treatment. Immunization of calves with an *H. somnus* bacterin and antimicrobial treatment may have prevented "sudden death" from *Haemophilus* septicemia and resulted in the development of subacute syndromes (1). Another explanation is that we have incorrectly assumed that initial treatment for BRD was treatment for hemophilosis. Calves may have been treated initially for "fever" that was unrelated to *Haemophilus* infection. Therefore, the FDO and treatment-to-death interval for specific causes of mortality may be inaccurate. Peracute *Haemophilus* septicemia and TME were observed a few weeks after arrival in the feedlot, which suggests that routine single immunization with an *H. somnus* bacterin and mass treatment of calves with oxytetracycline on arrival at the feedlot did not eliminate carriers of *H. somnus*.

Satisfactory control and prevention of hemophilosis is difficult. Traditionally, constant surveillance of calves and early treatment have been recommended (4). Although *H. somnus* is generally susceptible to most antimicrobials, response to treatment has been reported to be variable (1,2,11). The treatment response and case fatality risk, however, remain largely unknown because of our inability to clinically differentiate the etiology of depressed and febrile calves. Calves with TME, septicemia, and pleuritis often were found dead in their pen, before therapy was initiated. It is difficult to explain why calves that died from severe fibrinous pleuritis were infrequently observed ill prior to death. Prophylactic mass medication with antibiotics in the feed, or giving calves injections of long-acting antimicrobials during the periods of greatest risk of *H. somnus* infection, may reduce losses from hemophilosis (7).

The best preventive measure against *H. somnus* infection may be immunization with an *H. somnus* vaccine prior to infection. The FDO of hemophilosis suggests that immunization of calves once on arrival may allow sufficient time for most calves to develop

a protective immune response prior to infection. Ideally, the bacterin should be given prior to entry to the feedlot, but often this is not possible. Various studies (13,14,22–26) have shown a reduction in overall morbidity and mortality with one or two injections of commercial bacterins, yet hemophilosis remains a significant cause of mortality in vaccinated feedlot calves. Research must be aimed at increasing our understanding of the pathogenesis of hemophilosis and at developing new, more effective vaccines against *H. somnus* infection.

Acknowledgements

We thank the hospital crew and Ms. Gwen Clavelle at Clavelle Farm Ltd., and Ms. Susan Bohse for their enthusiastic participation in data collection. Dr. Hugh Townsend and the pathologists at the Western College of Veterinary Medicine provided the back-up diagnostic work, for which we are grateful. Financial support was provided by the Saskatchewan Agriculture Development Fund, and the Saskatchewan Horned Cattle Trust Fund. CVJ

References

1. Harris FW, Janzen ED. The *Haemophilus somnus* disease complex (Hemophilosis): A review. Can Vet J 1989; 30: 816–822.
2. Humphrey JD, Stephens LR. *Haemophilus somnus*: A review. Vet Bull 1983; 53: 987–1004.
3. Stephens LR, Little PB, Wilkie BN, Barnum DA. Infectious thromboembolic meningoencephalitis: A review. J Am Vet Med Assoc 1982; 178: 378–384.
4. Blood DC, Radostits OM. Veterinary Medicine. 7th ed. London: Baillière Tindall, 1989: 700–704.
5. Panciera RJ, Dahlgren RR, Rinker HB. Observations on septicemia of cattle caused by a *Haemophilus*-like organism. Pathol Vet 1968; 5: 212–226.
6. Corbeil LB, Widders PR, Gogolewski R, Arthur J, Inzana TJ, Ward ACS. *Haemophilus somnus*: Bovine reproductive and respiratory disease. Can Vet J 1986; 27: 90–93.
7. Keister DM. *Haemophilus somnus* infections in cattle. Compend Contin Educ Pract Vet 1981; 3: S260–S270.
8. Beeman KB. *Haemophilus somnus* of cattle: An overview. Compend Contin Educ Pract Vet 1985; 7: S259–S262.
9. Bio-Ceutic Laboratories clinical review. No. 16–42. The bovine *Haemophilus somnus* complex: A clinical review. Vet Med 1975; 73: 1311–1316.
10. Saunders JR, Thiessen WA, Janzen ED. *Haemophilus somnus* infections I. A ten year (1969–1978) retrospective study of losses in cattle herds in western Canada. Can Vet J 1980; 21: 119–123.
11. Guichon PT, Pritchard J, Jim GK. *Haemophilus somnus* myocarditis in a feedlot steer. Can Vet J 1988; 29: 1012–1013.
12. Janzen ED. Myocardial lesions caused by *H. somnus* in cattle. Can Vet J 1987; 28: 208.
13. Saunders JR, Janzen ED. *Haemophilus somnus* infections II. A Canadian field trial of a commercial bacterin: Clinical and serological results. Can Vet J 1980; 21: 219–224.
14. Ribble CS, Jim GK, Janzen ED. Efficacy of immunization of feedlot calves with a commercial *Haemophilus somnus* bacterin. Can J Vet Res 1988; 52: 191–198.
15. Dierks RE, Hanna SA, Dillman RC. Epizootiology and pathogenesis of *Haemophilus somnus* infection. J Am Vet Med Assoc 1973; 163: 866–869.
16. Pritchard DG, Shreeve J, Bradley R. The experimental infection of calves with a British strain of *Haemophilus somnus*. Res Vet Sci 1979; 26: 7–11.
17. Andrews JJ, Anderson TD, Slife LN, Stevenson GW. Microscopic lesions associated with the isolation of *Haemophilus somnus* from pneumonic bovine lungs. Vet Pathol 1985; 22: 131–136.
18. Potgieter LND, Helman RG, Greene W, Breider MA, Thurber ET, Peetz RH. Experimental bovine respiratory tract disease with *Haemophilus somnus*. Vet Pathol 1988; 25: 124–130.
19. Groom SC, Little PB, Rosendal S. Virulence differences among three strains of *Haemophilus somnus* following intratracheal inoculation of calves. Can J Vet Res 1988; 52: 349–354.
20. Little PB. *Haemophilus somnus* complex: Pathogenesis of the septicemic thrombotic meningoencephalitis. Can Vet J 1986; 27: 94–96.
21. Feinstein AF. X and ipr_p: An improved summary for scientific communication. J Chronic Dis 1987; 40: 283–288.
22. Hall RF, Williams JM, Smith GL. Field evaluation of [a] *Haemophilus somnus* bacterin. Vet Med 1977; 72: 1368–1370.
23. Morter RL, Amstutz HE. Evaluating the efficacy of a *Haemophilus somnus* bacterin in a controlled field trial. Bovine Pract 1983; 18: 82–83.
24. Stephens LR, Little PB, Humphrey JD, Wilkie BN, Barnum DA. Vaccination of cattle against experimentally induced thromboembolic meningoencephalitis with a *Haemophilus somnus* bacterin. Am J Vet Res 1982; 43: 1339–1342.
25. Groom SC, Little PB. Effects of vaccination of calves against induced *Haemophilus somnus* pneumonia. Am J Vet Res 1988; 49: 793–800.
26. Williams JM, Smith GL, Murdock FM. Immunogenicity of a *Haemophilus somnus* bacterin in cattle. Am J Vet Res 1978; 39: 1756–1762.