Beef: Feedlot Session I

An Update on the Etiology and Pathogenesis of Bovine Respiratory Disease

Dr. Bob Curtis, *Presiding*

Emerging Role of *Haemophilus somnus* in Previously Unreported Manifestations in Western Canada

S. C. Groom, *D.V.M., M.S.*
Alberta Agriculture
O. S. Longman Building
6909 - 116 Street
Edmonton, Alberta T6H 4P2 Canada

Introduction

This discussion will encompass personal observations and impressions developed from involvement in academic research and involvement with the diagnostic laboratory system in Alberta. The title should be interpreted as a question rather than a statement of fact. I have endeavoured to answer it and in the attempt stressed the importance of cautious investigation into the resolution of questions of feedlot health (disease). I have deliberately minimized the inclusion of information and opinions available from various published sources. An effort has been made to examine the roles of the practitioner and the diagnostic laboratory when making conclusions on feedlot health patterns. The role of *H. somnus* in several feedlot disease syndromes has been examined with suggestions on possible pathogenic mechanisms.

General Considerations

This organism has been associated with a wide array of disease conditions of feedlot cattle. One or two of these syndromes are appreciated readily as prevalent and, therefor, important causes of mortality and morbidity in the feedlot environment. Table 1 itemizes a number of disease syndromes.

Table 1. Common feedlot syndromes associated with *H. somnus* infection.

TEM (ITEME)	otitis externa
bronchopneumonia	laryngitis
myocarditis	conjunctivitis
pleuritis	arthritis
myositis	endotoxemia

"Old" Syndromes?

Thrombotic meningoencephalitits (TME) is likely a more appropriate term than ITEME. It's widely recognized as a singificant cause of feedlot mortality.[1] Excluding all causes of mortality from Bovine Respiratory Disease (BRD) TME is likely still the leading cause of feedlot mortality,[2] albeit of minor significance compared to BRD related mortality. The number of TEM submissions rose steadily from 1972 to 1980, leveling off in subsequent years. The number of TME submissions has been declining slowly in recent years. Why did the prevalence of TME increase through the 70's when it was first diagnosed in 1958, occurring sporadically throughout the 60's? Albertan feedlots were increasing in numbers and size in the late 60's and early 70's. The increasing number of submissions to the diagnostic laboratories may be due solely to the increasing numbers of animals in the feedlot environment rather than a "true" rising incidence of TME in the populations. The leveling off may be due to early recognition and successful treatment of cases in the feedlot. Vaccination is not widely utilized, therefore, its impact is difficult to determine. It is unlikely that increasing "herd immunity" was a factor because feedlot animals are not maintained year to year. Herd immunity and disease patterns generally hold only in relatively stable herd environments which the feedlot clearly is not. Is the decline in TME due to the nature of the animal's immune response or have changes occurred in the antigenic and biological characteristics of the organism? Are there specific strains causing TME? Are the encephalitic strains, for unknown reasons, declining in prevalence?

Haemophilus somnus is associated with BRD in some feedlots. It is difficult to establish the prevalence in cases

of BRD mortality and all but impossible at the present to establish its association with morbidity from BRD. The lesions are highly variable.[3] Pneumonia may vary from typical fibrinous bronchopneumonia to more suppurative bronchopneumonia. Lesions, however, are more commonly centered over bronchioles with severe bronchiolar damage. Spreading coagulation necrosis is not as commonly seen with *H. somnus* associated pneumonia. Culture is the only means of definitive diagnosis of its involvement in BRD. The ubiquitous *P. hemolytica*, however, is co-cultured from any of these cases. Prior treatment with antibiotic singificantly reduces the isolation of *H. somnus* from necropsy material, more so than *P. hemolytica* or *P. multocida*. Freezing material reduces the chance of isolation by approximately 50%. Sampling site also has a great influence on the isolation of *H. somnus*. Samples taken from the leading edge of the consolidation increases the probability of *H. somnus* isolation by 40%. Interestingly, TME is rarely concurrent with *H. somnus* associated pneumonia.[3] (Strain tropism?) The prevalence of *H. somnus* associated pneumonia diagnosed in the laboratory steadily increased from 1974 to 1986 and leveled off thereafter. Why the rise? The isolation rate of *H. somnus* from pneumonic lungs was relatively constant at 15% from 1977 to 1982. Part of the "apparent" increase in *H. somnus* pneumonias was our growing appreciation that *H. somnus* may indeed be involved in cases of BRD! How many of us would have accepted a diagnosis of *H. somnus* pneumonia in 1975 compared to 1982? Therefore, part of the "apparent" emergence of *H. somnus* as a "cause" of BRD in the feedlot was our growing acceptance of it as a potential pathogen. More perception that fact? How do we associate the prevalence patterns of TME and pneumonia? Can we associate them? Are the same strains involved in TME and pneumonia and is there strain tropism? How is the host's immune response involved in the changing disease patterns?

"New" Syndromes?

These syndromes that are in themselves not new, "appear" to be increasing in prevalence based on submission to the diagnostic laboratory. These three syndromes are likely sequelae resulting from *H. somnus* septicemia, without concurrent TME. Cases of myocarditis, pleuritis and extensive pulmonary congestions/edema have increased dramatically since 1984. From 1976 to 1983 there was a small, gradual increase but a doubling of the three syndromes occurred in 1984 with gradual increases in the last three years.

Submissions of *H. somnus* associated myocarditis have risen the most of the three syndromes. Cases of myocarditis frequntly have a short history, usually found dead. Some animals may display classical signs of heart failure ultimately leading to death in days and sometimes weeks. Grossly a single large focus of necrosis is seen in the left ventricle usually in the papillary muscle. Abscessation may occur and can be seen from the epicardial or endocardial surface but more commonly the myocardium must be incised to reveal the necrotic focus. Histological examination reveals widespread coagulation necrosis with neutrophil infiltration. Culture is required to confirm the diagnosis but negative culture occurs, particularly following antimicrobial therapy.

Acute fibrinous pleuritis in the absence of pneumonia and other sequelae of the septicemia with *H. somnus* is becoming more prevalent in our laboratory submissions. Clinically affected animals present either as a sudden death or a poorly responsive "pneumonia." Clinical examination, which may or may not be done confirms a diagnosis of pleuritis. Death usually occurs 1 to 2 days following onset of clinical signs, if they are observed at all. Necropsy examination reveals marked extensive acute fibrinous pleuritis with mild to moderate pulmonary congestion. The duration of the lesion is usually estimated between 2 and 5 days. Histological examination is non-specific and reflects the gross observations. *H. somnus* is frequently isolated from the subpleural tissue and less commonly from parenchymous organs particularly the lungs. Prior antimicrobial treatment greatly reduces the chances of isolation.

The last syndrome, which appears to be increasing is marked pulmonary congestion/edema. This is the single most significant gross and histological finding at necropsy. Clinically the animals are found dead without premonitory signs. The tentative gross diagnosis is frequently "interstitial pneumonia." The lungs have diffuse congestion and edema and fail to collapse. Histologic examinations, however, reveals that alveolitis is absent but intertitial congestion and alveolar edema is present. This type of lung has been associated with *H. somnus* septicemia and TME in the past. There is however, no localized lesion in the brain or elsewhere in this specific disease syndrome. The organism is commonly isolated from the lung.

These are the three syndromes that are "apparently" increasing in frequency in Alberta feedlot mortality. They are certainly increasing in prevalance in laboratory necropsy submissions, doubling in one year, 1984, with moderate increases in subsequent years. Why has this occurred? Is it a change in the host? Is it a change in bacteria? Is it a change at all?

It would seem unlikely that under "normal" conditons a disease syndrome would double in one year. It became apparent that the "Alberta" picture was distorted somewhat by the submission rate from three or four large feedlots. Submission rates from these few feedlots increased dramatically in 1984. Submission rates from other producers have been relatively consistent and have revealed

a slow steady increase in these disease syndromes which is more consistent with natural disease processes. These three *H. somnus* associated disease syndromes are increasing but precise rates, as they occur in the feedlot cattle population, are difficult to estimate based on laboratory submissions. The reasons for the increase are only speculative.

The use of retrospective studies from general laboratory case material, while useful must be employed cautiously. Material submitted to the diagnostic laboratory is extremely biased. Extrapolating laboratory trends to the feedlot cattle population must be made cognisant of the limitation of this material and the figures generated from them. The diagnostic laboratory must be used in a planned and comprehensive manner to adequately monitor disease and health in each feedlot. It is imperative that the field veterinarian utilise and assess the diagnostic laboratory information in this way to adequately evaluate health and disease trends and make appropriate observations and conclusions which will ultimately be used for management decisions.

Table 2. Host factors associated with disease resistance.

1. genetics
2. nutrition
3. Environment
4. Management
5. natural disease resistance
6. acquired disease resistance (± vaccination)

What changing host factors may account for this apparent change in resistance to bacterial infection, specifically *H. somnus* infection? Table 2 outlines six general host factors which directly or indirectly determine the development of disease subsequent to infection. It is unlikely that the genetics, nutrition, environment or management have changed enough to have a causal association with the apparent increase in the incidence of these three *H. somnus* disease syndromes. Natural disease resistance may be decreased by the introduction of younger animals into the feedlot environment. How much the average age has decreased over the last ten to fifteen years is not known but it has decreased. Vaccinations of any sort are utilized to try to assist or balance the animal's resistance to infection. The use of polyvalent vaccines against viral and bacterial antigens "may" enhance protective antibodies. Does it suppress protection or induce hypersensitive reactions? Does it stimulate the wrong antibodies or stimulate antibodies at the wrong time? The relationship and balance between mucosa and systemic immunity in the feedlot environment is an extremely complicated matter and at the present largely unknown. How is the cellular immunity involved in resistance? The answer to these questions and how they relate to the apparent emergence of these three *H. somnus* associated disease syndromes is unknown at the present time. The manipulation of the animal's immune system, however, may be very important in the changing disease patterns associated with any infectious agent.

The organism, *H. somnus*, may have altered its biological behaviour. Few if any infectious agent, either bacterial or viral, is associated with as many various disease syndromes in cattle as *H. somnus*. Bacterial heterogenety of *H. somnus* isolates seems a reasonable assumption. It is known that virulent and avirulent strains exist! A limited study by restriction endonuclease analysis has demonstrated that *H. somnus* isolates likely represent a very diverse group of organisms with marked genetic heterogenety (unpublished data). Also, antigenically it is a very diverse group.[1] Whether this antigenic and genetic heterogenety is correlated to the organism's biological behaviour is unknown but studies of human pathogens would suggest that it is a possibility. It may very well be that the population of *H. somnus* organisms is genetically diverse with selection directed towards strains which cause these three syndromes rather than the "classical" TME. Extensive genetic studies are required to prove or disprove this suggestion which may have a significant impact on the understanding of the organisms' epidemiology in the feedlot.

Conclusions

Based on submissions to the diagnostic laboratories in Alberta the incidence of TME has peaked and submissions are slowly declining. Pneumonia associated with *H. somnus* remains at previously reported levels and precise estimates of prevalence are difficult if not impossible to make. Three syndromes: myocarditis pleuritis, and marked pulmonary congestion/edema are apparently increasing in prevalance, based on laboratory submissions. Precise estimates are difficult because of the significant sampling bias of necropsy material. The importance of well organized field investigations by the practicing veterinarian to identify the role of these and other disease syndromes should be stressed. Studies should be co-ordinated between the practitioner and the diagnostic veterinarian with clearly defined objectives to identify prevalence, risk groups, and risk factors and, thereby, avoid erroneous conclusions. Management decisions, particularly as they relate to the judicious employment of vaccines, should be based on the results from well designed field studies on individual feedlots.

References

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