

Survey of Minnesota Dairy Veterinarians on the Occurrence of and Potential Risk Factors for Jejunal Hemorrhage Syndrome in Adult Dairy Cows

Sandra Godden, DVM, DVSc; Rod Frank, DVM, PhD; Trevor Ames, DVM, MS
Veterinary Teaching Hospital, University of Minnesota, St. Paul, MN 55108

Abstract

The Veterinary Teaching Hospital at the University of Minnesota has, over the past two years, recognized an increased rate of submission of cases of adult dairy cattle for a disease syndrome described as "jejunal hemorrhage syndrome". Two separate surveys were administered to Minnesota bovine practitioners, one by mail in March 2000, and the second at the annual conference of the Minnesota Veterinary Medical Association in February 2001. The objectives of these two surveys were 1) to gather preliminary data describing how frequently this disease syndrome is being diagnosed by dairy veterinarians and 2) to generate some hypotheses as to potential cow or herd management-related risk factors which may warrant future study. For the two surveys, between 50 and 59% of survey respondents reported having diagnosed one or more cases of jejunal hemorrhage syndrome (JHS) in the previous 12-month period. Many of these veterinarians reported its occurrence in multiple client herds, and between 40 and 56% reported the diagnosis of multiple cases in individual herds. The majority of respondents indicated that they believe this is an important disease syndrome that deserves further study. Potential cow and management-related risk factors for JHS that warrant future study include parity, stage of lactation, season, herd size and feeding management system.

Résumé

Le centre hospitalier universitaire de l'université du Minnesota a connu au courant des deux dernières années une hausse du taux d'admission de vaches laitières adultes ayant le syndrome de maladie décrit sous l'appellation du " syndrome hémorragique jéjunal ". Deux enquêtes ont été menées auprès de praticiens

bovins, l'une par courrier en mars 2000 et l'autre au congrès de l'association vétérinaire médicale du Minnesota en février 2001. Les objectifs de ces deux enquêtes étaient de 1) ramasser des données préliminaires décrivant la fréquence avec laquelle ce syndrome était diagnostiqué par les praticiens et 2) de produire des hypothèses sur les facteurs de risque reliés à la vache ou à la gestion du troupeau qui pourraient être le sujet d'études ultérieures. Au niveau des deux enquêtes, entre 50 et 59% des praticiens interrogés ont rapporté avoir diagnostiqué le syndrome hémorragique jéjunal au courant des 12 mois précédents. Plusieurs des praticiens ont rapporté sa présence dans des troupeaux de clients différents et entre 40 et 56% des praticiens ont rapporté le diagnostic de plusieurs cas au sein d'un même troupeau. La plupart des praticiens interrogés ont indiqué qu'il s'agissait là d'un syndrome de maladie important qui nécessiterait des études plus approfondies. Les facteurs de risque reliés à la vache ou au mode de gestion du troupeau méritant une étude approfondie sont la parité, le stade de lactation, la saison, la taille du troupeau et le système de gestion de l'alimentation.

Introduction

Jejunal hemorrhage syndrome (JHS), also referred to as "hemorrhagic bowel syndrome" or "acute hemorrhagic enteritis of the small intestine," has been reported with increasing frequency in Minnesota over the past two years. Several cases have been admitted to the Large Animal Hospital, and more than 35 cases have been submitted to the Veterinary Diagnostic Laboratory since October 1999. Many cases have been presented as part of a syndrome causing the death of significant numbers, or clusters, of adult dairy cows in affected herds. Diagnostic laboratories in other dairy states in-

cluding New York, Pennsylvania, Washington, Wisconsin, Colorado, Illinois and Iowa, have also reported a marked increase in the number of adult dairy cattle that succumb to this disease syndrome. While hemorrhagic enteritis has been reported in other species and in calves, published information describing JHS in adult dairy cows is limited.^{4,5,6,17} The purpose of this paper is to present a short review and a description of JHS cases that have been submitted to the Veterinary Teaching Hospital, as well as to present the results of two surveys of Minnesota bovine veterinarians.

Review of the Jejunal Hemorrhage Syndrome

Clinical Syndrome and Treatment. Affected cows are often found dead (sudden death). Alternatively they may present recumbent and semi-conscious, or still standing, but very weak, shocky, and pale. Affected animals may exhibit sudden complete anorexia, a severe drop in milk production, signs of colic or ileus, and abdominal distension. Cows may show decreased fecal output, melena, or diarrhea containing either frank blood or blood clots. Affected cows are usually not pyrexemic. Treating acutely affected cows with antimicrobial agents and supportive therapy (e.g. anti-inflammatories, fluid therapy, dextrose) has generally been reported to be ineffective. Treatment with calcium has reportedly resulted in temporary improvement in the animal's general condition, but this is short-lived and death ensues shortly after.^{4,17} There is an extremely high case fatality rate, with reports of 85 to 100% of affected animals dying within 24 to 36 hours of the onset of clinical signs.⁴ On exploratory surgery or necropsy there are distinct sections of jejunum, sometimes three feet or longer, which are distended by a large amount of blood (Image 1). The intestine may contain either bloody or brown fluid or a large solid blood clot that obstructs the lumen (Image 2). Some veterinarians have reported limited success by removing the clot *via* enterotomy or by massaging the clot through the small intestine. However, the prognosis is still grave and spontaneous reoccurrence of the lesion following clot removal has been reported.⁴ While not observed in cases admitted to the Veterinary Teaching Hospital in Minnesota, intussusception associated with JHS has been reported in adult cows.⁴ Intussusception associated with enteritis has been previously reported in calves.²

Pathogenesis and Epidemiology. There are currently no published studies describing the pathogenesis of JHS in adult dairy cows. A review of 23 cases presented to the Veterinary Diagnostic Laboratory at the University of Minnesota between 1999 and early 2000 that showed typical gross lesions of either blood clots or bloody fluid in the jejunum yielded the following diag-

nostic findings: 100% of 22 cases tested were negative for *Salmonella* spp.; 100% of nine cases tested were negative for gastrointestinal parasites; and 100% of 18 cases tested were negative on virus isolation for bovine viral diarrhea virus (BVDV). Retesting using blood PCR has found only three cases positive for BVD. While the following additional tests were performed on only a small subset of these cases, those tested have also consistently been negative for *Yersinia* spp., *Lawsonia intracellularis* and corona virus. One finding that has been common to the vast majority of these cases (86%, or 19 of 22 cases tested) is the isolation of *Clostridium perfringens* Type A. This has been recognized in cases submitted live that were subsequently euthanized and fresh tissues collected, as well as in tissues submitted from animals that had died on the farm. Histologic examination of affected sections of intestine has occasionally shown various degrees of necrosis of the villus tips, sloughing of the villus epithelium, leukocyte infiltration of lamina

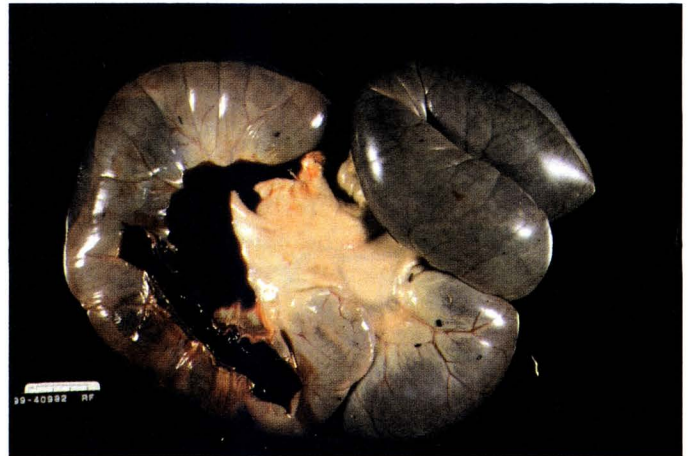


Image 1. Opened section of jejunum containing a large blood clot from a cow with jejunal hemorrhage syndrome.

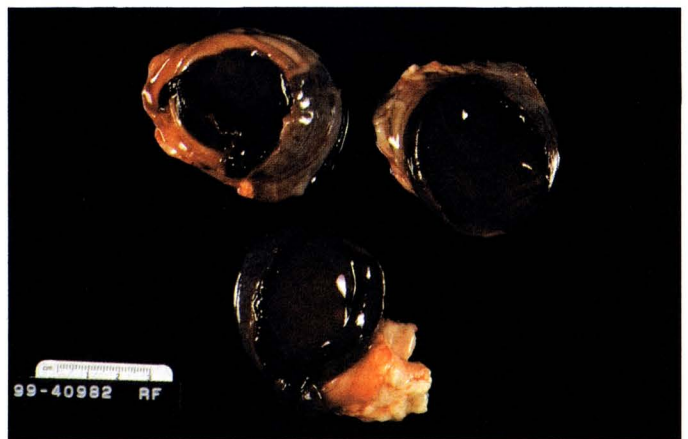


Image 2. Cross sections of jejunum containing a large blood clot from a cow with jejunal hemorrhage syndrome.

propria and reactive mesenteric lymph nodes. Often postmortem change is too advanced for adequate microscopic evaluation of intestines.

The significance of the isolation of *Clostridium perfringens* Type A in cases of JHS in adult dairy cows is unclear. One hypothesis as to the pathogenesis is a model similar to hemorrhagic enteritis caused by *Clostridium perfringens* Type C in fast-growing suckling calves, lambs, or piglets.^{1,6,7,10,11,14,18} *Clostridium perfringens* Type C will multiply rapidly and produce toxins under conditions of high carbohydrate and protein substrate availability. It is possible that this scenario could arise in the adult dairy cow in association with those same factors that lead to ruminal acidosis (i.e. feeding excess amounts of fermentable carbohydrates, insufficient effective fiber and/or inadequate rumen fiber mat, or ration sorting by cows).⁶ A second hypothesis is that improperly fermented ensiled feeds (e.g. in the case of poor silo or bunker management) may accumulate harmful molds, clostridial or other harmful bacteria, and possibly their toxins, that are then fed, preformed, to the cow. Kirkpatrick *et al*⁴ sought to investigate the possible role of both ruminal acidosis and clostridial contamination of poorly fermented forages in a case study of a 140-head herd of Brown Swiss cows that had experienced multiple cases of JHS.⁴ Because *Clostridium* spp. are normal inhabitants of soil, commensal intestinal organisms in normal animals, and are known to replicate rapidly in the intestinal tract after death, it is not clear if this pathogen is the primary cause of JHS; if it arises secondary to other predisposing changes; or if it is simply an incidental finding.^{1,14}

Reported effects of the toxins produced by *Clostridium perfringens* type A in mammals have included illness, diarrhea, accumulation of fluid in intestinal loops, congested mesenteric lymph nodes, edema and hypotension.^{9,13} Additional effects of the toxins may possibly include impaired gastrointestinal motility by inhibition of neurotransmitter release at the neuromuscular junction.¹⁶ Herholz *et al*³ suggested that the β -toxin, and not the α -toxin, was linked to intestinal disorders in horses.³ For the previously described cases of JHS at the University of Minnesota Veterinary Diagnostic Laboratory for which *Clostridium perfringens* Type A was isolated, 100% (17 of 17 reported) were positive for the gene encoding for α -toxin production and 40% (6 of 15 reported) were positive for the gene encoding for β -toxin production. No isolates (0 of 12 reported) were positive for genes encoding for beta-, epsilon- and iota- or enterotoxin production.

While the occurrence of JHS is often sporadic, there are also many reports of multiple cases or clusters of cases occurring within affected herds.⁴ Kirkpatrick reported that JHS may be responsible for an annual morbidity rate of 1 to 2% of the mature cow population on

affected dairy farms.⁴ The herd-level and cow-level incidence rate of JHS in Minnesota dairy herds has not been reported. Given that dead cows are not routinely necropsied on many dairies, this disease may be underreported. In addition to lacking good information about the disease incidence, we do not understand what cow or management-related risk factors may exist for JHS. Two surveys were administered to Minnesota bovine veterinarians in March 2000 and in February 2001. The first objective of this study was to gather preliminary data describing how frequently bovine practitioners in Minnesota have diagnosed this disease. This type of information is necessary to give some impression as to the frequency of diagnosis of JHS as well as to determine whether this apparently new disease syndrome is important enough to warrant the time and cost of a formal study. The second objective of the study was to generate some hypotheses as to potential cow or herd management-related risk factors that may warrant future study.

Survey Methods and Analysis

Mail survey. A survey was mailed to 175 Minnesota bovine practitioners in March of 2000. The mailing list constituted veterinarians who had attended the Annual Minnesota Dairy Health Conference in May of 1999. The first section of the survey collected some information describing the clientele of all responding veterinarians (i.e. practice size, number of veterinary associates, number of dairy clients, and breakdown of dairy client herd sizes) and attempted to describe the frequency of diagnosis of JHS. Respondents were asked to describe, for the previous 12 months: 1) Had they diagnosed one or more cases of JHS? 2) What was the total number of cases diagnosed? 3) What was the total number of client herds affected? 4) Were multiple cases diagnosed in the same herd? and 5) In what seasons had they diagnosed JHS (report all seasons for which JHS had been diagnosed)? The case definition for JHS, for both surveys, was as follows: adult cows were found either dead or with acute onset of weakness, anorexia and possible recumbency. On exploratory surgery or necropsy, cases have distinct sections of jejunum that contain either a bloody fluid or a large blood clot obstructing the lumen.

The second section of the survey attempted to describe the characteristics of individual cows affected by JHS. Respondents who reported having diagnosed JHS in the first section were asked to recall the most recent case of JHS that they had diagnosed and then to describe the breed, parity and stage of lactation for that affected cow. Note that respondents were not asked "in which season they had seen their most recent case?", since, given that the survey was administered in March,

the results would undoubtedly be misleading and biased towards the most recent winter months. A measure of potential seasonality was obtained, instead, through the previously described question: "name all seasons in the last 12-mo. in which you have diagnosed JHS" (section 1 of survey). In the third section of the survey respondents were asked to describe some basic herd management characteristics for the same case of JHS that they had described in section two of the survey. Characteristics of interest included herd size, facilities, feeding management, forage sources and forage storage systems. Chi-square analysis was used to compare the survey data to reported averages for the State of Minnesota to investigate the potential role of the following cow- and herd-related risk factors of interest: parity, stage of lactation, herd size, and TMR vs component feeding. Reported Minnesota industry averages were used in these analyses to represent the 'unaffected' group.

MVMA conference survey. A short follow-up survey was administered to veterinarians attending a presentation on JHS in the bovine session of the annual conference of the Minnesota Veterinary Medical Association (MVMA) in February, 2001. This survey was limited to questions about the frequency of diagnosis of JHS in the previous 12 months: 1) Had they diagnosed one or more cases of JHS? 2) What was the total number of cases diagnosed? 3) What was the total number of client herds affected? and 4) Were multiple cases diagnosed in the same herd?

Survey Results

Respondent Characteristics and Frequency of Diagnosis of Jejunal Hemorrhage Syndrome

Mail survey. The response rate to the March 2000 mail survey was 23% (40 of 175). Of these, 34 were from veterinarians active in dairy practice and two were from the veterinary managers of large dairy farms. The rest were from veterinarians no longer active in dairy practice. Of those active in dairy practice, a median number of three veterinary associates (mean = 3.6; range 1 to 13) worked regularly with dairy clients within a given practice, and serviced a median number of 50 dairy clients (mean = 127; range 5 to 800). The percentages of all dairy clients falling within various herd size categories, as estimated by all respondents, were as follows: 21% with < 50 cows; 56% with 50 to 99 cows; 19% with 100 to 299 cows; 3% with 300 to 499 cows; and 1% with 500 or more cows. This distribution of herd sizes contained only a slightly greater proportion of larger herds as compared to Minnesota summary data: 61% at < 50 cows; 31% at 50 to 99 cows; 7% at 100 to 299 cows; 0.7% at 300 to 500 cows; and 0.4% at > 500 cows.¹⁹

Fifty percent (n = 18) of the 36 respondents active in dairy practice reported having diagnosed one or more cases of JHS in the previous 12 months, with respondents diagnosing a median number of 2.5 cases each (mean = 4.6; range 1 to 30). This represented a median of two client herds affected (mean = 2.3; range 1 to 8 herds) and a median of 2% of that respondent's dairy herd clientele (mean = 3%; range 1 to 11% of dairy clients). Respondents reported that the diagnosis of JHS had been confirmed by finding typical gross lesions after exploratory laparotomy or necropsy in 89% of these cases. When considering both types of respondents (those having and not having diagnosed JHS), the median number of cases of JHS was one case in the previous 12 month period (mean = 2.4; range = 0 to 30).

Of those having diagnosed JHS, 56% reported observing multiple cases on a single farm. When asked to report the seasons in which JHS had been diagnosed in the previous 12-month period (indicate all that apply), responses suggested a greater tendency for JHS to occur in the fall and winter months than in the spring and summer months (January – March = 35% (9 of 26); April – June = 15% (4 of 26); July – September = 23% (6 of 26); October to December = 27% (7 of 26). However, chi-square analysis showed there was no increased risk for JHS between fall and winter versus spring and summer months (Odds ratio = 1.6; 95% confidence interval = (0.93, 2.86). Plotting the occurrence of JHS by county, both for cases that had been submitted to the veterinary diagnostic laboratory and for the location of survey veterinary practices that had diagnosed the condition, showed that JHS has occurred throughout all the major dairy regions of Minnesota. When asked, 17 of 18 veterinarians that reported having diagnosed JHS indicated that they believed this to be an important disease syndrome that warranted further study (one was undecided).

MVMA conference survey. The response rate to the survey of practitioners at the bovine session of the annual meeting of the MVMA in February 2001 was considerably higher at 74% (37 out of approximately 50). These included three Wisconsin practitioners. Only three of the veterinarians completing the original mail survey were also listed among those completing the MVMA meeting survey. These three responses were omitted from analysis of the second survey. Thus, in addition to being completed 11 months apart, the two surveys were completed by two different groups of veterinarians.

The MVMA conference survey yielded remarkably similar results to the previous mail survey, with 20 of 34 respondents (59%) indicating that they had diagnosed at least one case of JHS in the previous 12 months. The median number of cases diagnosed was three (range 1

to 15), and the median number of client herds affected was two (range 1 to 4). Eight of these 20 veterinarians (40%) reported having diagnosed multiple cases in the same herd. In this survey 88% (30 of 34) of all veterinarians, including both those having and not having diagnosed JHS, indicated they believe JHS deserves formal study. Three percent (one individual) believed it did not deserve formal study and 9% (three individuals) were undecided.

Characteristics of Individual Cows Affected by Jejunal Hemorrhage Syndrome

In the mail survey of March 2000, Holstein cows accounted for 94% (n = 17) of JHS cases, with the remaining 6% (n = 1) being Jersey. As an aside, while none were reported in the mail survey, Brown Swiss cases have been submitted to the Veterinary Diagnostic Laboratory and have been reported by others.⁴ A total of 61% (11 of 18) of JHS cases were reported to have occurred within the first 100 days of lactation, 22% (4 of 18) occurred in mid-lactation (101-200 days-in-milk) and 11% (2 of 18) occurred in late lactation (> 200 days-in-milk). No cases were reported in the far-off dry period, but one case was reported during the close-up dry cow period (Figure 1). Chi-square analysis showed that there was a significant increase in occurrence of JHS for cows between 0 and 100 days-in-milk (DIM) versus cows in other stages of lactation (odds ratio = 5.6; 95% confidence interval = 3.0 to 10.1; assumption - MN average calving interval = 452 days).⁸ A significantly greater number of cases (94%, or 16 of 17 reported) occurred in second lactation and older animals than did in first lactation heifers (6%, or 1 of 17 reported; odds ratio = 28.4; 95% confidence interval = 6.5, 124.7; assumption - MN average = 36% of herd in first lactation).⁸

Characteristics of Management in Affected Herds

Respondents of the mail survey reported that affected cows came from herds ranging in size from less than 50 cows to greater than 500 cows (Figure 2). The distribution of herd sizes for these affected cows were as follows: 6% (n=1) with less than 50 cows; 33% (n=6) with 50 to 99 cows; 33% (n=6) with 100 to 299 cows; 11% (n=2) with 300 to 499 cows; and 17% (n=3) with 500 or more cows. When compared to the average distribution of all Minnesota dairy herds by herd size, chi-square analysis showed a significantly higher risk for JHS in herds with 100 cows or more as compared to smaller herds (odds ratio = 18.0; 95% confidence interval = 8.8, 37.0).¹⁹

Thirty-nine percent (7 of 18) of case cows were housed in tie stall facilities, while the remaining 61%

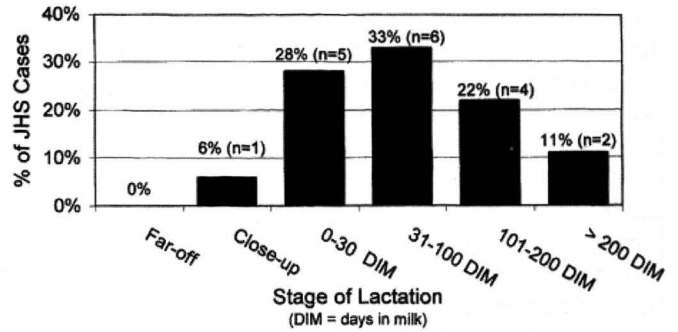


Figure 1. Veterinarian survey results: Frequency of cases of jejunal hemorrhage syndrome by stage of lactation.

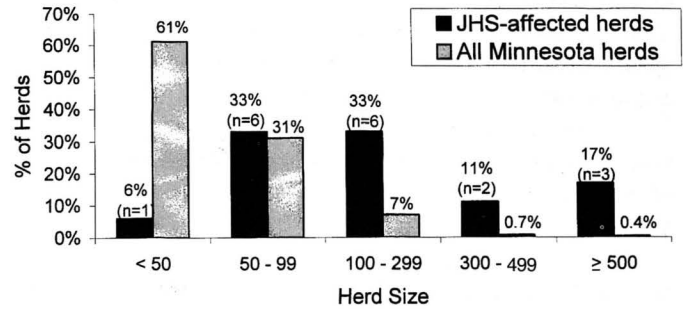


Figure 2. Veterinarian survey results: Frequency of cases of jejunal hemorrhage syndrome by herd size.

(11 of 18) were housed in free stall facilities. A significantly higher percentage (83%, or 15 of 18) of affected herds fed a total mixed ration (TMR), as compared to herds using component feeding (17%, or 3 of 18; odds ratio = 8.0; 95% confidence interval = 4.3, 14.9; assumption - 38% of MN dairies feed a TMR).¹⁵ Forages fed in affected herds at the time of the most recent case of JHS were typical of the upper midwest and included haylage, corn silage and dry hay. Haylage in affected herds was reported to be stored in tower silos (50%), bunker silos (33%) and plastic bags (17%). Corn silage in affected herds was reported to be stored in tower silos (38%), bunker silos (46%) and plastic bags (15%).

Discussion

Frequency of Diagnosis of Jejunal Hemorrhage Syndrome

The first objective of this study was to gather some preliminary descriptive information on how frequently JHS is diagnosed by Minnesota bovine veterinarians. This was meant to provide an approximate measure of prevalence of this disease syndrome, as well as to serve as a guide for whether formal study of this disease syndrome is indicated. Fifty percent of respondents to the mail survey reported having diagnosed one or more cases of JHS in the previous 12 months. However, it is pos-

sible that those who had previously encountered this disease syndrome would be more likely to take an interest and respond to the survey, making it appear that the frequency of diagnosis of JHS is higher. Due to the low response rate (23%) and the possibility of response bias, we were cautious about using this information to estimate the frequency of diagnosis of JHS and its importance to Minnesota dairy producers. A second attempt at collecting this type of information was made by administering the second short survey to a different group of practitioners attending the bovine session of the annual meeting of the MVMA in February 2001. While the opportunity for self-selection and response bias (they had to walk into the room and they had to complete the survey) was still present with the second survey, this risk was considerably reduced given the very good turnout and the high survey response rate (approximately 74%).

Of interest was that the two surveys, while they were from two different years and two different groups of veterinarians, yielded remarkably similar results. In the first and second surveys 50% and 59% of respondents, respectively, indicated that they had diagnosed one or more cases of JHS in the previous 12 months; a median number of three cases each were diagnosed (survey 1: range 1 to 30; survey 2: range 1 to 15); a median number of two herds each had been affected (survey 1: range 1 to 8; survey 2: range 1 to 4); and 56% and 40% of respondents, respectively, indicated that they had diagnosed multiple cases in individual herds. While there is probably a low annual incidence rate of JHS for the entire population of adult Minnesota dairy cows at risk, the results of these two surveys do indicate that there are a large number of dairy veterinarians dealing with this disease in multiple client herds, that multiple cases occurring in many herds make this an economically important disease in affected herds, and that dairy veterinarians believe this to be an important disease that warrants further research.

Characteristics of Cows and Herds Affected by Jejunal Hemorrhage Syndrome

No formal epidemiological study has previously described possible cow or management-related risk factors for JHS. The second objective of this study was to generate some hypotheses as to potential cow or herd management-related risk factors that may deserve future study. Analysis of the responses from the mail survey showed a much higher frequency of JHS in older cows (second lactation or greater). These findings are consistent with a case study of a single herd of 140 Brown Swiss cows that had experienced multiple cases of JHS, in which it was reported that the syndrome had affected only older cows.⁴ The authors of the latter study speculated that this apparent association could be due to

higher milk production or higher dry matter intakes in the older animals.⁴ This hypothesis deserves further study.

The mail survey results also suggested that, while JHS occurs throughout all stages of lactation, it appears to occur with greater frequency in animals in early lactation (0 to 100 DIM). While no statistical relationship existed between season and occurrence of JHS, there was a trend for an increased rate of occurrence in the fall and winter months. Both these previous relationships should be interpreted with caution, however, given that the survey was administered in March and given that they could be confounded by seasonal calving patterns.

The study findings indicate that JHS has occurred across the major dairy regions in Minnesota and in dairy herds managed under a variety of systems: in large and small herds, in free stall and tie stall facilities, and in herds using a variety of fermented forage storage systems (tower silo, bunker silo, or plastic bags). There appeared to be an increased rate of occurrence of JHS in herds milking greater than 100 cows and in herds feeding TMRs.

Given that this was a small preliminary survey and given the relatively small numbers of cases used in the analyses, readers should be cautious in their interpretation of these preliminary results since there is ample room for introduction of bias and confounding in the study. For example, it may be that larger herds are more likely to engage in the routine practice of having the veterinarian necropsy all dead animals than are smaller herds. Similarly, larger herds are more likely to have adopted TMR feeding programs than are smaller herds. Another reason for caution when interpreting these odds ratios comes from the fact that it was assumed that the Minnesota averages used in their calculation represented unaffected herds. Of course this will not be true since at least some small percentage of these herds will likely have been affected. This assumption would bias results by tending to inflate the calculated odds ratios. Despite these cautions, however, the survey results did demonstrate some definite trends in the occurrence of JHS that would suggest that some characteristics such as season, parity, stage of lactation, herd size, and feeding management system, may be important risk factors for this disease syndrome. This preliminary information may guide future studies.

Conclusions

Jejunal hemorrhage syndrome was reported to have been diagnosed by 50 to 59% of respondents, of whom 40 to 56% reported multiple cases in individual herds. This indicates that this disease syndrome can be economically important in affected herds. The ma-

jority of Minnesota dairy practitioners responding indicated that they believe JHS to be deserving of formal study. The survey technique was successful in serving as a first step in the process of generating hypotheses as to possible cow and management-related risk factors for JHS. Possible risk factors for JHS that deserve investigation in future studies include parity, stage of lactation, season, herd size, and feeding management system. This type of epidemiological research will be necessary before we can describe the risk factors, causes and pathogenesis of JHS.

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Abstract

Jugular Venous Emboli of Brain Tissue Induced in Sheep by the use of Captive Bolt Guns

M. H. Anil, S. Love, C. R. Helps, J. L. McKinstry, S. N. Brown, A. Philips, S. Williams, A. Shand, T. Bakirel, D. Harbour

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Emboli of central nervous tissue were detected in the jugular venous blood of two of 15 sheep stunned with a conventional cartridge-operated captive bolt gun and in two of 15 sheep stunned with a pneumatically acti-

vated gun. No emboli were detected in arterial blood from these sheep or in venous blood from sheep stunned electrically. Emboli from an animal with BSE could transmit the disease to people.