Risk Factors for Downer Cow Syndrome

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ABSTRACT
A nested case-control study to detect risk factors for the development of the downer cow syndrome 30 d postpartum was conducted. Records from 2705 lactations from 12 Holstein dairy herds in the vicinity of Cornell University were collected prospectively between March 1981 and April 1985. Logistic regression was used to model the risk factors for downer cow syndrome. No confounding or modification effect by season of calving and parity was detected. The cumulative postpartum incidence rate for downer cow syndrome was 1.1%. Clinical hypocalcemia and stillbirth increased the risk of downer cow syndrome fivefold. An interaction term existed between dystocia and retained placenta.
(Key words: reproduction, postpartum disorders, downer cow syndrome)

INTRODUCTION
Downer cow is a general term that applies to any periparturient cow that is in sternal recumbency when the reason for the recumbency is unknown (4, 11). Milian-Suazo et al. (15) reported that more than one-half of downer cows were culled in the same lactation (15). Some researchers (7, 11) think that virtually all downer cow symptoms occur as a complication of hypocalcemia. Others (5, 6) have suggested that downer cow syndrome is more accurately a complication of recumbencies that are due to a variety of other causes (e.g., mastitis, metritis, calving paralysis, and milk fever). The incidence of downer cow syndrome among milk fever cases ranged from 4.5 to 14% (2, 7), but the incidence of downer cow syndrome was 2.1% for herds (6).

The objective of this nested case-control study was to identify risk factors for downer cow syndrome 30-d postpartum in 12 commercial New York State Holstein dairy herds.

MATERIALS AND METHODS
Data for this nested case-control study (a case-control study within a cohort study) were from an observational prospective study conducted between March 1981 and April 1985 in the vicinity of Cornell University. The 34 herds included in the parent study had at least 35 Holstein cows, primarily used AI, were subscribers to the New York State DHIA, and received monthly routine herd health visits from veterinarians of the New York State College of Veterinary Medicine at Cornell University. Information was gathered on the farm every 4 to 6 wk from barn books, DHIA records, and questions asked of the principle caretaker of the cows during the farm visits. Diagnoses were made by farmers, veterinarians, or both, and only the first diagnosis of each disorder postpartum was considered in the study. The veterinarians explained the definitions of the disorders to the farmers in order to standardize the information required from them. Other information on herd sampling, data collection, and data processing methods has been published previously (10).

Twenty-eight cases of downer cow syndrome were diagnosed between March 1981 and April 1985. Twenty-three of these cases were diagnosed during 30 d postpartum in 12 of the 34 herds; 5 cases of downer cow syndrome were diagnosed after 30 d postpartum.
The risk period for the study was defined as 30 d postpartum in order to study disorders that occur in relationship to parturition; therefore, only 23 cases of downer cow syndrome were considered in the analyses. In an attempt to control for heterogeneity of disease probability among herds, data for the study were restricted to the 12 herds in which ≥1 case of downer cow syndrome existed. All cows in these 12 herds that were not diagnosed as having downer cow syndrome were used as controls.

The proposed risk factors related to the dam and calf were the following: clinical (presumed) hypocalcemia, dystocia, retained placenta, metritis, uterine prolapse, clinical ketosis, left displaced abomasum, clinical mastitis, sex of the calf, stillbirth, and twinning.

Data Analysis and Variable Definition

The criteria for evaluation of the risk factors in the models were based on time sequence, biological plausibility, evidence from the published literature, and sample size (i.e., two or more cases in which the risk factor and downer cow syndrome were present). The assumed time sequence (the proposed risk factor had to precede the outcome) was checked in each record. Based on these selection criteria, the variables selected for analysis included clinical hypocalcemia, dystocia, retained placenta, sex of the calf, and stillbirth. All disorders were coded as yes or no, including dystocia (because no cases of dystocia assisted by the veterinarian accompanied cases of downer cow syndrome).

Clinical hypocalcemia was diagnosed when a cow showed a combination of weakness, nervousness, cold skin, anorexia, sternal recumbency, and favorable response to calcium therapy. Dystocia was defined as farmer-assisted delivery of a calf. Retained placenta was the retention of the fetal membranes for ≥24 h. A cow was classified as having downer cow syndrome if she made no response to calcium therapy and remained recumbent without apparent reason for ≥24 h after treatment. Sex of the calf was defined as all male (single and twin male calves were grouped into one category) and all female (single and twin female calves were grouped into one category). Stillbirth was defined similarly to sex of the calf, all alive or no stillbirth (alive single and twin calves were grouped into one category) and all dead or stillbirth (dead single and twin calves). Twins for which one calf was male and the other was female or one calf was alive and the other was dead were excluded because the findings for these groups could not be explained by the effect of one sex or one of the categories of stillbirth.

Logistic regression was used to model the risk factors for downer cow syndrome and to obtain the odds ratios that measure the magnitude of the risk. An odds ratio of 1 shows no effect; odds ratios >1 indicate protective or increased risks. Modeling combined backward algorithms (for main effects) and forward algorithms (for second-order interactions; (12, 13)). All possible second-order interaction terms were evaluated; interaction terms that involved the confounding factors also were evaluated to check for possible effect modification. Possible confounding because of season of calving or parity was evaluated (12, 13).

Postpartum incidence rates and descriptive statistics were obtained using SAS [PROC FREQUENCY and UNIVARIATE; (16)]. The epidemiologic computer package EGRET (9) was used for the logistic regression models.

RESULTS

Descriptive statistics for some postpartum parameters and postpartum disorders for the study population are presented in Table 1. Numbers of records of cows with downer cow syndrome and other disorders or factors related to the calf are shown in Table 2.

No evidence of confounding or effect modification was found for season of calving or parity (3). An interaction term involving dystocia and retained placenta contributed significantly to the model (Table 3). Cows with retained placenta and dystocia were more likely to develop downer cow syndrome than were cows without either disorder.

Clinical hypocalcemia increased the odds for downer cow syndrome sixfold; stillbirth increased the odds fivefold (Table 3).

DISCUSSION

The results of this study support the importance of clinical hypocalcemia in the development of the downer cow syndrome but also indicate factors other than clinical hypocalc-
TABLE 3. Risk factors associated with downer cow syndrome in the multiple logistic regression.1  

<table>
<thead>
<tr>
<th>Main effects and interaction terms</th>
<th>OR3</th>
<th>95% Confidence interval (OR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical hypocalcemia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>5.6</td>
<td>2.1</td>
</tr>
<tr>
<td>No</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Stillbirth</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>4.9</td>
<td>1.9</td>
</tr>
<tr>
<td>No</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Dystocia, retained placenta</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes, no</td>
<td>6.1</td>
<td>2.1</td>
</tr>
<tr>
<td>No, yes</td>
<td>5.8</td>
<td>1.8</td>
</tr>
<tr>
<td>Yes, yes</td>
<td>5.7</td>
<td>1.0</td>
</tr>
<tr>
<td>No, no</td>
<td>1.0</td>
<td></td>
</tr>
</tbody>
</table>

12705 records.
2Odds ratio.

TABLE 2. Records of cows with downer cow syndrome and each possible risk factor.1  

<table>
<thead>
<tr>
<th>Possible risk factors</th>
<th>Downer cow syndrome</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes2</td>
</tr>
<tr>
<td>Clinical hypocalcemia</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>No</td>
</tr>
<tr>
<td>Dystocia</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>No</td>
</tr>
<tr>
<td>(farmer-assisted)</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>No</td>
</tr>
<tr>
<td>Retained placenta</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>No</td>
</tr>
<tr>
<td>Sex of the calf</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>No</td>
</tr>
</tbody>
</table>

1Some sample sizes differ because of missing values.
2n = 23.
3n = 2682.

The lack of reports associate stillbirth or retained placenta with the downer cow syndrome. Calving of dead calves (either single or twins) may prolong the period of the dam. Stillbirth may also account for a variable that was not considered in the study (e.g., intrauter-

Diseases were diagnosed by farmers and veterinarians. Veterinarians discussed standardization of diagnoses with the farmers. Inclusion of farmer diagnoses may increase the possibility of misclassification of cases. However, restriction of diagnoses to veterinarians only also could result in misclassification bias (systematic underestimation of those cases treated by the farmer without reports to the veterinarian), of which dystocia and retained placenta are examples. General (global) definitions were used for some disorders. The broad definitions used were the most meaningful to the farmer or the clinician, and their use increased the internal validity of the study.

Use of global definitions makes comparison of our results with those of other studies difficult. However, this problem exists for most field epidemiological studies (1, 8, 10, 14) that indicate useful trends that help farmers, veterinarians, extension workers, and dairy researchers understand or prevent disease occurrence (e.g., targeting cows for earlier detection and intervention).

CONCLUSIONS

We investigated the associations of clinical disorders commonly diagnosed and treated on...
farms by farmers rather than by laboratory technicians. Because associations with downer cow syndrome were found despite the possibilities of misclassification toward the null (i.e., toward no effect), these associations are evidently strong. We suspect that common causal associations may underlie clinical hypocalcemia, stillbirth, dystocia, retained placenta, and the downer cow syndrome.

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REFERENCES