Semi-lethal Abnormality of Limbs in Jersey Cattle

Abstract

A condition is described in which nine female Jersey calves were born with congenital abnormalities of the musculo-skeletal system. The calves had little or no control over their legs and were unable to stand. The condition appears to be inherited but the mode is not clear from limited data. All 9 calves were sired by the same bull and were out of females related to the sire. This bull also sired twelve normal female and 18 normal male calves. Eight other bulls sired 33 normal calves during the same period. Five of the nine affected calves were born dead, a higher (P < .01) stillborn ratio than for unaffected calves.

Introduction

Documented cases of inherited congenital abnormalities affecting cattle are voluminous. Phenocopies have been induced experimentally or have occurred naturally as a result of environmental factors such as the ingestion of toxic substances, faulty nutrition, or radiation (4, 5, 6).

Many inherited abnormalities of the limbs of cattle have been reported. Some conditions were probably due to a simple autosomal recessive; others were probably caused by multiple factors. A condition descriptively similar to the abnormality in the present study was observed in a Holstein herd in Brazil (3). Two highly inbred (F ~ .64) full sib calves of opposite sex had abnormal flexion and splaying of the fore-legs. Both calves died shortly after birth.

Photographs and a description of abnormal Jersey calves born in a Kentucky herd (1) were indistinguishable from those of the present study. Out of 12 calves born during two months there were four abnormal males, four abnormal females, and four normal calves. During the six months following the abnormal births there were approximately 50 normal calves born in this herd.

A similar condition has also been reported in a Jersey herd in Kansas (2). Two female calves with ancestors common to calves in the present study were born with open, mobile joints. The shoulder joints were extremely loose, allowing rotation in many directions.

Materials and Methods

During the summer and fall of 1969, nine abnormal female calves were born in a registered Jersey herd in Utah. These were characterized by abnormal flexure and extension of the shoulder, elbow and hip joints. The limbs could be rotated in any direction. Five of the nine calves were stillborn. The live calves were never able to stand although two of them were kept alive for several weeks. These two live calves would lie in a state of sternal recumbency with their heads resting on the ground (Fig. 1). Their ability to eat was not affected.

Calves were normal in outward appearance except they had little or no control over the movement of their limbs and there appeared to be a lack of proper limb muscling. This lack of control and abnormality of the limbs led to calling the condition "limber legs".

Two of the affected calves were necropsied and studied. Grossly the condition was characterized by congenital abnormalities of the musculo-skeletal system. Muscles of affected limbs appeared atrophied, causing the joints to appear larger than normal. Manually limbs could be flexed, extended, and rotated without any difficulty or discomfort to the calf (Fig. 2). Histologically there were no discernible bone or muscle lesions in the two calves necropsied.

Bone marrow cells from the sternum of one affected calf were cultured for two hours in a Basal Medium Eagle (10% Fetal Calf) and colchicine solution. Following incubation in a hypotonic solution, cells were resuspended several times in a methanol acetic acid fixative. Two or three drops of the cell suspension were then transferred to a slide, the fixative burned off, the slide dried and stained with a Giemsa staining solution. Individual cells were photographed through a light microscope. Photographs were enlarged for more detailed observation of gross chromosomal morphology.

No apparent chromosomal abnormalities were found. All cells studied had a normal female karyotype consisting of 58 autosomes and one pair of sex chromosomes.

A survey of the farm where this occurred did not reveal any nutritional or management conditions that would explain the abnormality. There was no difference in feeding and man-
FIG. 1. Abnormal flexion and splaying of limbs in a Jersey heifer.

TABLE 1. Distribution of abnormal offspring by degree of relationship between sire and dam.

<table>
<thead>
<tr>
<th>Relationship to sire</th>
<th>Matings</th>
<th>Abnormal offspring</th>
</tr>
</thead>
<tbody>
<tr>
<td>.22-.26</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>.16-.20</td>
<td>11</td>
<td>5</td>
</tr>
<tr>
<td>.10-.15</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>.05-.07</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>.01-.04</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Totals</td>
<td>38</td>
<td>9</td>
</tr>
</tbody>
</table>

Seventy-two calves were born during the year with 49 arriving from July through November. All nine abnormal calves were born during this heavy calving season. Calves were sired by nine bulls, only one of which sired abnormal calves.

Results and Discussion

An arrow diagram showing related animals in the pedigree of affected calves is in Fig. 3. All affected calves were from the same sire. Seven were out of daughters of a paternal half-brother of the sire. One dam of an affected calf was a paternal sister to the sire while the remaining dam was remotely related to the sire. Inbreeding coefficients for affected calves ranged from 2.7 to 13.2%.

Thirty-eight pregnancies to the sire in question resulted in 39 calves including one set of twin males. The 39 calves included 18 males, 12 normal females, and nine abnormal females. Sixteen of the male calves were born alive and normal. Two male calves were dead at birth but showed no symptoms of "limber leg" which was readily distinguishable in female calves either dead or alive at birth. The distribution of abnormal offspring by degree of relationship between the sire in question and the 38 mates is in Table 1.

Breeding records indicate a high fertility for the sire and do not indicate fetal abortions which might be expected if genes causing this abnormality were lethal in any form.

Records on length of gestation were available for all matings except two which resulted in stillborn abnormal female calves. An analysis of variance showed shorter (P < .05) gestations for female (274 days) than for male calves (277 days). Differences (P < .01) in gestation length were found between abnormal (269 days) and normal calves (277 days) and...
between stillborn calves (262 days) and live births (278 days). Partial confounding of data among stillborn and abnormal calves complicates interpretation of the above results.

Calves with the abnormality may be less viable than normal calves. Five of nine abnormal calves were born dead as compared to two of 30 normal calves from the same sire. A chi-square test indicates a highly significant difference (P < .01) between these two stillborn ratios.

Inheritance as a simple recessive is questioned in this case because of the absence of the abnormality in male calves which deviated from expectation (P < .01) by a chi-square test.

The occurrence of a strikingly similar condition in males in a herd in Kentucky (2) also raises doubt as to a sex-limited mode of inheritance, provided the abnormality is the same in both studies.

The sire of the nine abnormal females was slaughtered prior to the birth of his first calves and none of his sons were saved, preventing any direct matings to test hypothesis of mode of inheritance. However, select matings of other closely related animals in the herd have been made. In the event that additional abnormal calves are born, more detailed studies of the musculo-skeletal system, nervous system, and pattern of inheritance are planned.

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References

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