Research on the Familial Occurrence of Leftside Displacement of the Abomasum in Cattle

M. Stober, W. Wegner and **J. Lunebrink**
Hannover Veterinary College
Bischofsholer Damm 57
Hannover 6, Germany

As frequently observed in countries with an intensive milk industry, and also prevalent in the area treated by the Hannover Clinic, a leftside displacement of the abomasum has, according to our current knowledge, a rather complex etiology. The occurrence of the displacement obviously depends on the animal itself, and partially on its relation to environmental factors. It is also affected by nutrition (the feeding of rich concentrates), but without doubt the most important factor is the heavy lactation of the milk cow. In Table 1 the influence of the exo and endogenous factors are very strongly pronounced.

The question arises why some cows, with identical temperament and feeding and with identical environmental conditions, suffer from abomasum displacement (LDA) while others, in spite of the same milk yield (and with the same metabolic changes), remain healthy? As yet, little research has been undertaken to find a contingent genetically limiting predisposition in certain animals to this disease. In the opinion of Pinsent, Neal and Ritchie (1961) the occurrence of LDA in milk producing breeds points to the possible influence of hereditary factors. Although Dirksen (1962) denies the existence of predisposition in separate breeds, he found closely related connections between two of his LDA patients: the daughter of a cow which had repeated relapses of the disease, likewise developed LDA after her first calving. These observations led to his conclusion of an individual or familial disposition. In the 200 cases of LDA in Neal's research (1964) only milking breeds were represented, therefore the number of Jerseys was unproportionally high. Neal took into account the special concentrated feeding system in Jersey stock with high LDA frequency. Robertson (1968) found (with 202 cows with LDA) nearly equal breed distribution in the herds under consideration, and for that reason excluded breed disposition.

In a pedigree study with a three-generation comparison of the sires of 39 affected and 30 control cows, Martin (1972) established that the affected group had relatively fewer bulls in the pedigrees than the control group. All bulls appearing more than five times in the pedigrees of the affected group were recorded. There were eleven bulls, which were represented 37.2% of the time in the pedigrees of the affected cows and 33.3% in the control cows. Six of the 11 bulls were inter-related; they were present in 19.2% of the affected cow pedigrees and 8.8% in the control cow pedigrees. The relative risk of using a cow descended from one of these six bulls, according to Martin, is 1.47. The control animals came from stock which conformed as far as possible to the housing and feeding conditions of the LDA animals; they also showed the same age distribution and nearly similar milk production.

Research

From January 1, 1965, to April 30, 1971, 155 German Friesian cows with LDA were presented at the Hannover Clinic for which 362 ancestors (bulls) were traced. With the deduced hypothesis that specific pathogenic factors are of substantial importance in the occurrence of LDA (Table 1)–in opposition to Martin's research (1972)–control cows were chosen from the same stock as the LDA cows (elimination of variations in the environmental factors). Moreover, for each LDA cow, the comparable control cow was related in age and milk production, as well as type of feeding, etc. The ancestry of these animals was examined. The ancestors of 104 comparable pairs of cows (affected : control cows) were traced. In Table 2 the range is shown as extending to 43 comparable pairs in group with 8 bulls, group B with 59 pairs and 12 bulls and 102 pairs in group C with 8 bulls. In comparison with the range of all bulls it showed that out of 1138 possible appearances there were 228 bulls in both the LDA and the control cows. On the other hand the average frequency of appearance of 104 LDA cows showed 590 sires (1.93) and of the control cows 592 sires (1.92). The 362 with only LDA ancestors and the 364 with only control cow ancestors indicate an average frequency of appearance of LDA 1.17, (maximum 8) or control 1.28 (maximum 7). All bulls with 10 or more appearances (maximum LDA 23–control 18) belong to the already mentioned 228 sires, which are not only represented by the LDA cows but also by the control cow ancestors. Of these there were 16 LDA to the 11 control bulls; 223 appearances LDA to 148 control, or 19.6% to 13.0%.

Table 1

Summary of the Factors Which Play a Role in the Pathogenesis of LDA in Cattle (Collected from the Literature)

1. *Anatomical peculiarities:* lax structure of the poorly fibered muscle wall of the fundus of the abomasum; corpulence; entrance of the omaso-abomasal orifice laterally; relative freedom of motion of the abomasum section which is held by the reticulum.
2. *Mechanical influences:* hypotonicity of the abomasum with delayed ingestion passage and increased intra-abomasum gas accumulation because of specific factors (mentioned under C and D.) Stricture or induration of the pylorus or duodenum; raising of the rumen and cranial displacement of the rumen by the gravid uterus; parturition (pressure, rotation)–as when pinched off through calving-the rumen sinks to the abdominal floor; the shipping of cows in advanced pregnancy–steep sloping ramps; rotation over the dorsum to eliminate a uterine torsion by means of the "Brett rotation method"; placement on the right side for treatment of the hooves shortly before or after calving.
3. *Feeding:* The majority of the illnesses begin during the time of intensive winter stall (stanchion) feeding. In this case not only the composition of food (more concentrates and less crude fiber than on pasture), but also the restriction of food intake to twice or three times a day (instead of continuous feeding as when on pasture) gains significance. Insufficiently digested concentrated food particles in the abomasum favor mucous membrane ulceration and hypotonicity. The concentrated food further leads to a concentration of unstable fatty acids in the omasum and these again lead to weakened contractions; prolonged passage of food and increased production of gas because of the spilling over of bicarbonate from the reticulum; the metabolic alkalosis to be observed during winter stall feeding likewise produces a retardation of the passage of food in the abomasum.
4. *Physiological and pathological problems (stress situations):* The majority of the abomasal displacements occur during the stanchioned period, and indeed shortly before to a few weeks after calving, affecting predominantly older high producing milkers. Preceeding illnesses or simultaneously occuring endemic or common diseases can inhibit the tone of the abomasum and encourage displacement, therefore we are especially concerned with acetonemia, hypocalcemia, abortion, retained placenta, metritis, mastitis or toxemia, and also traumatic indigestion, vagus nerve injury, abomasal ulceration, etc. The same effect apparently may follow the purchase of animals before or after calving, which adds the additional burden of change and of transportation.

In Table 4 in the ancestor ranges of A, B, or C, each bull of the LDA group was assigned a corresponding appearance in the control group. Because of the materially inferior reproduction potential of female cows, the maternal component was disregarded, although in particular cases they may have contributed to the degree of affinity (relationship). They ascertained the index of kinship for each affected and each control cow, and the indices were finally subjected to the t-test (value).

The result of this evaluation showed that the LDA cows (and especially in the ancestor comparison A, B, C) were statistically more closely related than the corresponding control cow group. The comparison of the German Friesians, under the same conditions (housing, feeding, metabolism burden) of both the affected and the control animals (with high milk production) shows a predisposition for LDA in those cows whose ancestors are more closely related than in those with a lower degree of relationship. The individual research confirmed therefore the observations of Martin (1972) in Canada with other selected control animals. They agreed in attributing that LDA in cattle consists of, for an individual, a genetically dependent predisposition.

Summary

Evaluation of the indices of relationship (obtained by analysis of the male ancestry) of 104 German-Friesian cows with leftside displacement of the abomasum (LDA) and of 104 control cows showed that the former were significantly more closely related to each other than the latter. From this result, the conclusion is drawn that an individual and genetically linked predisposition for LDA does exist which increases with the degree of relationship, and which, under comparable exposition towards certain pathogenous factors (Table 1), does lead easier to LDA than in cows whose male ancestors are less closely related to each other.

Table 2

Summary of the range of comparison of origins of the male ancestors of the LDA and control cows (Range A: Bulls V_1, V_2, V_3, V_9, V_{10}, and V_{13}; Range B: Bulls V_1 through V_{12}; Range C: Bulls V_1 through V_8.

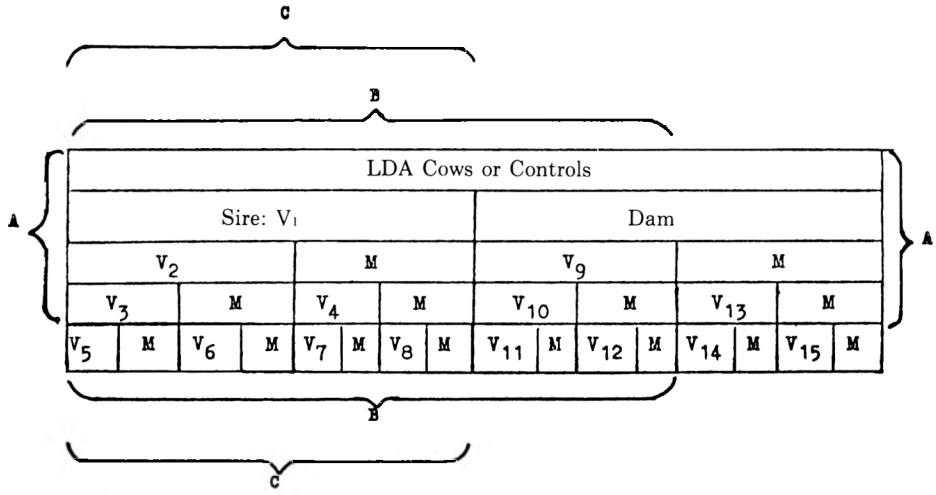

Table 3

Summary of the Frequency of Entry of the Sires of the LDA and the Control Cows (Total No.: 104 Comparable Pairs)

Male ancestors	Bulls sampled within the frame of all data		Bulls which appear as ancestors in the LDA cows as well as the control cows		Bulls which appear as ancestors only in the LDA cows or the control cows	
Compared groups	LDA	Control	LDA	Control	LDA	Control
Number of male ancestors per corresponding cow group (% of all bulls)	590 (100 %)	592 (100 %)	228 (38,7 %)	228 (38,6 %)	362 (41,3 %)	364 (41,4 %)
No. of appearances of these bulls (% of all appearances)	1138 (100 %)	1138 (100 %)	714 (62,7 %)	672 (59,0 %)	424 (37,3 %)	466 (41,0 %)
Avg. No. of times of appearance per bull (Variance)	1,93 (1–23)	1,92 (1–18)	3,13 (1–23)	2,95 (1–18)	1,17 (1–8)	1,28 (1–7)
Male ancestor appearing 10 and more times (in % of bulls)	16 (2,7 %)	11 (1,9 %)	16 (7,2 %)	11 (5,0 %)	– (0 %)	– (0 %)
No. of appearances of these bulls (% of all appearances)	223 (19,6 %)	148 (13,0 %)	223 (31,1 %)	148 (22,0 %)	– (0 %)	– (0 %)
Avg. No. of times of appearance per bull (Variance)	13,9 (1–23)	13,4 (1–18)	13,9 (1–23)	13,4 (1–18)	– (0)	– (0)

Table 4

Summary of the Statistical Evaluation of the Mean (Mean Value), Standard Deviation, and t-value of the Kinship Index. (* = slightly significant; *** = Highly Significant)

Sample size of the male sires	A		B		C	
Compared groups	LDA Cows (43)	Control Cows (43)	LDA Cows (59)	Control Cows (59)	LDA Cows (102)	Control Cows (102)
Medium index of kinship	10,49	9,21	39,32	33,66	43,11	25,34
Variance	(7–18)	(7–14)	(14–99)	(13–65)	(11–66)	(8–62)
s	2,57	2,14	15,53	13,17	11,06	10,66
t	2,509*		2,134*		5,766***	

Selected References

Dirksen, G. (1962). Habil-Schrift, Hannover. - Martin, W. (1972). Canad. Vet. J., 13, 61-68. - Neal, P. A. (1964). Nord. Vet-Med., 16 Suppl. 1, 361-366. - Pinsent, P.J.N., Neal, P.A. and Ritchie, H. E., (1961). Vet. Rec., 73, 729-735. - Robertson, J. McD. (1968). Am. J. Vet. Res., 29, 421-434.

The English translation was prepared by Mrs. Laverne Jones, Oklahoma State University Library, Stillwater, Oklahoma.