Left Abomasal Displacement—a Retrospective Study of 315 Cases

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Left displacement of the abomasum (LDA) has become a common clinical problem of dairy cattle in the United States as noted by several workers (1,2,4,5,8,15). LDA is an abnormality in which the abomasum is found on the left lateral side of the abdominal cavity trapped between the rumen and the abdominal wall, rather than in its normal position on the anterior ventral floor of the abdomen. Usually, the abomasum in LDA is found filled with gas and fluid. Buoyancy is a probable factor in keeping the abomasum confined to the abnormal position once displacement occurs. The clinical findings and results of 315 cases referred to the author for examination during a three year period from July 1, 1971, to June 30, 1974, and subsequently diagnosed as having LDA are presented.

Materials and Methods

An abstract form (Figure 1) was prepared and used to compile the data relevant to each case admitted during the time period mentioned above. The case record was abstracted in each instance, and then the owner was contacted personally regarding the post-operative results. The abstract form was marked as follows to show information obtained.

yes; no; information unavailable or not recorded.

In addition to the questions posed by the abstract form additional ones generally were:

1. Did the cow have a dystocia or multiple birth prior to the occurrence of the LDA?
2. Was the cow recently purchased, shown, transported, or otherwise stressed just before calving or the occurrence of the LDA?
3. Has post-operative production been satisfactory?
4. Did the cow rebreed satisfactorily?

Blood and urine samples were collected for analysis before any treatment or surgery was instituted. All hemograms, blood gas analyses, electrolyte and chemical determinations, and urine sediment examinations were performed by The Ohio State University Veterinary Clinical Laboratory personnel. Blood samples for acid-base determinations were collected anaerobically by jugular venipuncture in heparinized syringes and were analyzed within ten minutes of collection using a blood gas analyzer.* Urinalyses were performed on samples of voided urine at the time of physical examination using reagent strips** to measure pH, ketones, occult blood, protein, and glucose.

Results and Discussion

The cattle were referred to The Ohio State University Veterinary Clinic from 41 of Ohio's 88 counties by local veterinary practitioners. The breed distribution was predominantly Holstein cows (82.9%) with Jerseys next in incidence (9.8%) (Table 1). The percentages roughly reflect the distribution of these breeds within Ohio and the practice areas from which the cases were referred. Most workers currently feel that there is no breed predisposition for LDA among dairy cattle, although such proposals have been made (10).

Nearly 56% of all cows admitted and diagnosed as having LDA were four to six years old (Table 2). This distribution probably reflects the age distribution within the herds from which the cases were referred. All patients were female in this series, although the condition has occurred in males. The mean age was five years. The fact that fewer cows over eight years of age were referred may reflect culling practices by the dairymen. The breed, sex, and age distribution compares with the data of Robertson in a retrospective study of 202 cases of LDA (15) and with the data of Martin in a study of 100 cases (7).

Sixty-nine percent of the cases in this study were seen during the first six months of each year (Table 3). The first half of the year in Ohio includes the

Table 1
Breed Distribution of Cows with LDA

Breed	1971-1972	1972-1973	1973-1974	Totals	
Holstein (H)	111	73	77	261	82.9%
Jersey (J)	12	8	11	31	9.8%
Guernsey (G)	2	7	3	12	3.8%
Brown Swiss (S)	4	3	1	8	2.5%
Ayrshire (A)	3	0	0	3	1.0%
Totals	132	91	92	315	100%

*Corning Model 165, Scientific Instruments, Medfield, Massachusetts.
**Ketostix and Labstix, Ames Company, Elkhart, Indiana.

Figure 1. Case Abstract Form – Left Abomasal Displacement

Case number: _____

Owner: _____ Referring veterinarian: _____

Address: _____ Address: _____

_____ _____

Telephone: _____ Telephone: _____

Animal identification: _____

Breed: _____ Age: _____

History		Clinical Signs		Concurrent Disease	
0 lactating	☐	0 L.D.A. ascult.	☐	0 metritis	☐
1 dry	☐	1 L.D.A. not auscult.	☐	1 mastitis	☐
2 pregnant	☐	2 diarrhea	☐	2 retained placenta	☐
3 0-2 wks. pre-partum	☐	3 constipation	☐	3 laminitis	☐
4 0-2 wks. post-partum	☐	4 depression	☐	4 pneumonia	☐
5 2-6 wks. post-partum	☐	5 fever	☐	5 peritonitis	☐
6 milk fever	☐	6 lameness	☐	6 endocarditis	☐
7 ketosis	☐	7 bloat	☐	7 atrial fibrillation	☐
8 metritis	☐	8 ruminations	☐	8 enteritis	☐
9 retained placenta	☐	9 _____	☐	9 _____	☐
Lab. Findings		**Lab. Findings (Urine)**		**Lab. Findings**	
0 leucopenia	☐	0 ketonuria	☐	0 hypocal.	☐
1 leucocytosis	☐	1 glycosuria	☐	1 normocal.	☐
2 normogly.	☐	2 proteinuria	☐	2 hypokal.	☐
3 hypogly.	☐	3 hematuria	☐	3 normokal.	☐
4 hypergly.	☐	4 hemoglob.	☐	4 hypochlor.	☐
5 base excess normal	☐	5 bacteriuria	☐	5 normochlor.	☐
6 acidosis	☐	6 casts	☐	6 normal bicarb.	☐
7 alkalosis	☐	7 acid urine	☐	7 increased bicarb.	☐
8 BSP t/2	☐	8 alkaline urine	☐	8 hyperphos.	☐
9 amylase	☐	9 _____	☐	9 _____	☐
Surgical Findings		**Post-op. Therapy**		**Post-op. Complications**	
0 peritonitis	☐	0 antibiotics	☐	0 surgical infection	☐
1 fat necrosis tumors	☐	1 oral fluids/electro.	☐	1 mastitis	☐
2 fat necrosis flecks	☐	2 glucose/fructose	☐	2 pneumonia	☐
3 friable omen.	☐	3 propylene glycol	☐	3 other inf. diseases	☐
4 liver adh.	☐	4 insulin	☐	4 hypocal.	☐
5 abom. adh.	☐	5 laxatives	☐	5 other metab. diseases	☐
6 retic. adh.	☐	6 choline/methionine	☐	6 death	☐
7 umbilical hernia	☐	7 vitamins	☐	7 drug reaction	☐
8 falciform ligament	☐	8 _____	☐	8 recurrence of displace.	☐
9 _____	☐	9 _____	☐	9 _____	☐

Additional comments: _____

recent transport (show, sale, etc.)? _____

period of time when cattle are more confined and fed stored feeds because of inclement weather. From 1972 through 1974 about 44% of the cows on DHIR test in Ohio calved during the first six months of each year. During periods of good weather some practitioners may treat such cases surgically, themselves, while preferring to refer them to a central hospital for treatment during periods of bad weather. However, our findings correspond with the data of Robertson (15), in which 60% of the cases occurred from November to April (55% in our series) and 72% occurred from November to May (68% in our series); to the data of Martin (7), in which 54% occurred through the months of February to May (53% in our series) and 64% from April to July (44% in our series); and to the data of Ide and Henry (6), in which 60% of the cases were diagnosed from February to the end of May.

Analysis of the clinical data has shown that 97.5% of the cows developing LDA were lactating and 91% were less than six weeks postpartum (Table 4). Milk fever or parturient paresis, ketosis, metritis, and retained fetal membranes were all frequently observed in the history of these cases. Robertson reported retained fetal membranes (36%) and metritis (24%) as the diseases most frequently occurring in cows before they were affected by LDA (15). In our series the figures for these diseases were 30% and 41% respectively. The incidence of multiple births was 8%, nearly three times the expected incidence in a population of dairy cattle (3) (Table 4). This observation may indicate that LDA is another disadvantage of twinning in dairy cattle. Twelve percent of the cases had a history of recent stress other than parturition, such as sale, movement to a show, vaccination, or other change of environment. At least 4% of the cases were preceded by dystocia other than multiple birth, although the calving history for all cows was not available.

LDA was not diagnosed by auscultation (12) before exploratory laparotomy in 11 (3.5%) cases (Table 5). Several other cases not included in this series were

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Table 2

Age of Cows with LDA.

Age (In years)	1971-1972	1972-1973	1973-1974	Totals	
1	0	0	2	2	0.6%
2	12	4	10	26	8.3%
3	13	9	4	26	8.3%
4	21	13	15	49	15.6%
5	25	33	23	81	25.7%
6	20	11	14	45	14.3%
7	8	5	11	24	7.6%
8	6	0	3	9	2.8%
9	1	2	2	5	1.5%
10	4	0	1	5	1.5%
11	2	0	0	2	0.6%
12	2	1	0	3	1.0%
Unknown	18	13	7	36	11.4%
Totals	132	91	92	315	100%

Table 3

Distribution of Cases by Month of Admission to the Veterinary Hospital

Month	1971-1972	1972-1973	1973-1974	Totals	
July	8	8	7	23	7.3%
August	3	13	14	30	10.0%
September	5	4	2	11	3.4%
October	3	4	7	14	4.4%
November	1	2	3	6	1.9%
December	4	5	3	12	3.8%
January	9	8	12	29	9.2%
February	15	10	7	32	10.2%
March	18	12	13	43	13.7%
April	30	14	6	50	15.8%
May	23	7	11	41	13.0%
June	13	4	7	24	7.6%
Totals	132	91	92	315	100%

Table 4

History of Cows with LDA

	1971-1972	1972-1973	1973-1974	Totals	
Total No. of cases of LDA	132	91	92	315	100.0%
Lactating	130	90	87	307	97.5%
Dry	2	1	5	8	2.5%
Pregnant	5	1	3	9	2.9%
0-2 weeks pre-partum	0/106	1/76	1/83	2/265	0.8%
0-2 weeks post-partum	58/106	40/76	64/83	162/265	61.1%
2-6 weeks post-partum	34/106	32/76	13/83	79/265	29.8%
Milk fever	9/88	9/66	10/72	28/226	12.4%
Ketosis	44/94	18/65	35/72	97/231	42.0%
Metritis	43/95	26/70	29/73	98/238	41.2%
Retained fetal membranes	24/88	25/69	20/72	69/229	30.1%
No. of calvings within a short time prior to LDA	127	89	89	305	
Calving twins	9	10	5	24	
Calving triplets	0	0	1	1	
Total multiple births	9/127	10/89	6/89	25/305	8.2%
Dystocia, not multiple birth	4	3	4	11/280	3.9%
Recent stress such as transport, sale, show, vaccination, change of environment, including cows owned by sale barn	17(12.9%)	7(7.7%)	13(14.1%)	37	11.7%
	9(6.8%)	6(6.6%)	8(8.7%)	23	7.3%

misdiagnosed as LDA prior to referral to the hospital. Diseases often confused with LDA were those causing inappetance and rumen stasis with accumulation of intra-ruminal gas. Examples included traumatic reticuloperitonitis, simple indigestion, abomasal torsion, peritonitis due to rupture or perforation of the abomasum or uterus, urethral obstruction and urinary bladder rupture (in a steer), and toxemia due to mastitis and/or metritis.

Of the 315 cases in this retrospective study 206 cows (65.4%) had 316 disease conditions diagnosed concurrently (Table 6). Metritis and mastitis were the most frequently diagnosed diseases in 43.5% and 19% of the total number of cases of LDA. These findings were also similar to those of Robertson in which metritis was diagnosed concurrently in 52% of 47 cattle and mastitis in 24% of cattle representing 23% of the total number of cattle diagnosed as having LDA (15). Pearson's findings were comparable (9).

Some cases of interest which illustrate the occurrence of other disease conditions with LDA follow. A cow and a heifer developed LDA with lameness of the left hind and left front legs respectively. These animals always lay on the right side. Two cows had confirmed cases of bovine virus diarrhea. Several other cases were suspected. One cow died before surgery with a central nervous system disturbance clinically and histologically diagnosed as pseudorabies, although not confirmed by culture.

Of the cases included in this study 143 had hemograms as part of the diagnostic evaluation. Of these, 24 had leucopenia (total white blood cell count less than 4000/mm^3), while 14 had leucocytosis (total white blood cell count greater than 12000/mm^3). These observations are noted in Table 7. Most of the cows with leucopenia has mastitis, metritis, or enteritis.

Serum glucose estimations were not performed in all cases and may have been influenced by treatment before admission. The findings are shown but definitive conclusions can not be made (Table 7).

Acid-base balance was not evaluated until late 1973, so sketchy information is available for this series of cases. Other workers have more thoroughly studied disturbances of acid-base balance in cows with LDA (11). Our results are shown in Table 7.

Laboratory findings regarding the urine were not completely available for all cases. During the first two years the urine was checked usually only for ketones,

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Table 5

Clinical Signs of Cows with LDA

	1971-1972	1972-1973	1973-1974	Totals	
Total number of cases of LDA	132	91	92	315	100.0%
LDA auscultated	129	85	90	304	96.5%
LDA not auscultated before surgery	3	6	2	11	3.5%
Rumination auscultated	33	25	53	111	35.2%
Fever > 102.4°F.	37	29	33	99	31.4%
Depression	36	27	19	72	22.9%
Diarrhea	25	19	30	74	23.5%
Constipation	4	3	4	11	3.5%
Bloat	3	1	1	5	1.6%
Lameness	5	1	6	12	3.8%
Miscellaneous signs	4	2	1	7	2.2%

Table 6

Concurrent Diseases of Cows with LDA

	1971-1972	1972-1973	1973-1974	Totals	
Total number of cases of LDA	132	91	92	315	100.0%
Disease condition					
Metritis	60	38	39	137	43.5%
Mastitis	29	13	18	60	19.0%
Enteritis	10	7	6	23	7.3%
Retained fetal membranes	5	6	4	15	4.8%
Peritonitis	2	3	8	13	4.1%
Laminitis	2	1	3	6	1.9%
Dermatitis	2	3	1	6	1.9%
Follicular cysts	0	3	1	4	1.3%
Penumonia	3	1	0	4	1.3%
Overgrown hooves	1	0	4	5	1.6%
Vaginitis/Vulvitis	0	1	2	3	1.0%
Marked anemia	0	1	2	3	1.0%
Atrial fibrillation	0	1	1	2	0.6%
Miscellaneous					
Digestive	2	0	3	5	1.6%
Uro-genital	6	1	0	7	2.2%
Integumentary	1	4	1	6	1.9%
Musculoskeletal	4	1	4	9	2.8%
Cardiovascular	2	3	0	5	1.6%
Nervous	2	0	1	3	1.0%
Cows that did not have concurrent diseases	45	34	30	109	34.6%

except in cases where urinary tract disease was suspected. The results were influenced by treatment administered to the cows before referral to the central hospital. The results of our findings of urinalyses are found in Table 8.

Electrolyte determinations were not complete in this series of cases, as they were mainly performed to determine the severity of illness. These findings are shown in Table 9.

Surgical findings of 312 cases of LDA are shown in Table 10. Adhesions of the liver to the parietal peritoneum or diaphragm, possibly as a result of liver abscessation, were noted most frequently (8%). Clinical diagnosis of peritonitis characterized by fibrinous exudation was also rather common (7.4%). Among the interesting findings were the following cases. One cow had multifocal granulomatous peritonitis of parasitic etiology. Another cow had subcutaneous emphysema over the dorsum of the back. At laparotomy gas was found trapped in the omentum near the LDA. Two cows developed right-sided abomasal torsion overnight while awaiting surgery. One cow had a wire protruding from the pyloric area of the abomasum.

The cecum and intestines of one cow were displaced to the right anterior dorsal quadrant of the abdomen. The omasum of another cow was twisted about 90 degrees counterclockwise. The omentum had torn away from the abomasum in one case, and the intestines had protruded through the rent. The greater omentum of one cow was adhered in an umbilical hernia and had to be extracted before the abomasum could be replaced.

Thirty-three or 10.5% of the cows in this series were treated as outpatients. Primarily, these cases had few serious concurrent diseases. They were in good physical condition, except for the LDA.

The post-operative therapy is given in Table 11. The use of sugar solutions intravenously and antibiotics systemically were most common. The sugar solutions were used as a treatment for ketosis, while in most cases the antibiotics were used to treat a concurrent infection such as metritis or mastitis.

Post-operative complications are shown in Table 12. The most common complication in the immediate post-operative period was mastitis (7%). Several of the cases were coliform mastitis which resulted in the death of the patient despite therapy. Surgical infection was usually confined to suppuration around one or more of the skin sutures, was not serious, and usually responded following suture removal.

Causes of death in 33 cases post-operatively and three cases pre-operatively are shown in Table 13. The recurrence rate and reasons are shown in Table 14. Recurrence is associated with stretching of the omentum or with the omentum tearing away from the

Table 7

Laboratory Findings of Cows with LDA

	1971-1972	1972-1973	1973-1974
Total number of cases of LDA	132	91	92
Normal white blood cell count	38/50	29/38	38/55
Leucopenia <4000/cmm	6/50	9/38	9/55
Leucocytosis >12,000/cmm	6/50	0/38	8/55
Normoglycemia 40-80 mg/dl	3/5	4/7	29/49
Hypoglycemia <40 mg/dl	1/5	1/7	7/49
Hyperglycemia >80 mg/dl	1/5	2/7	13/49
Base excess normal	----	3/4	19/29
Acidosis <-5.0	----	0/4	4/29
Alkalosis >+5.0	----	1/4	6/29

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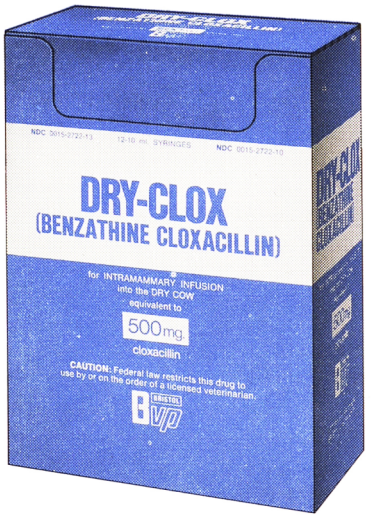

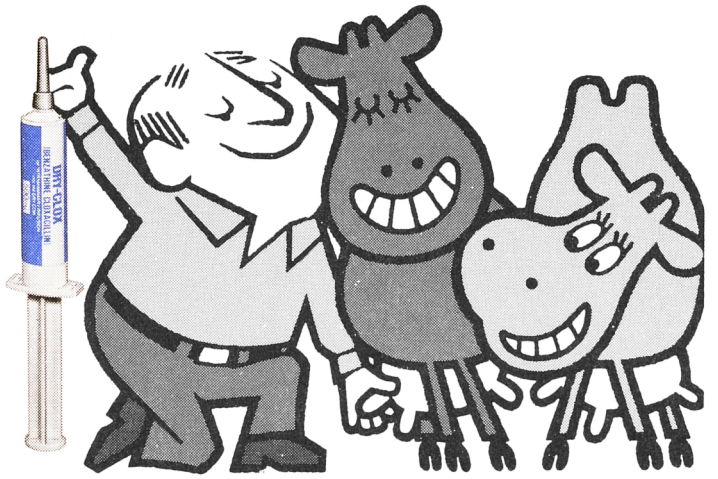

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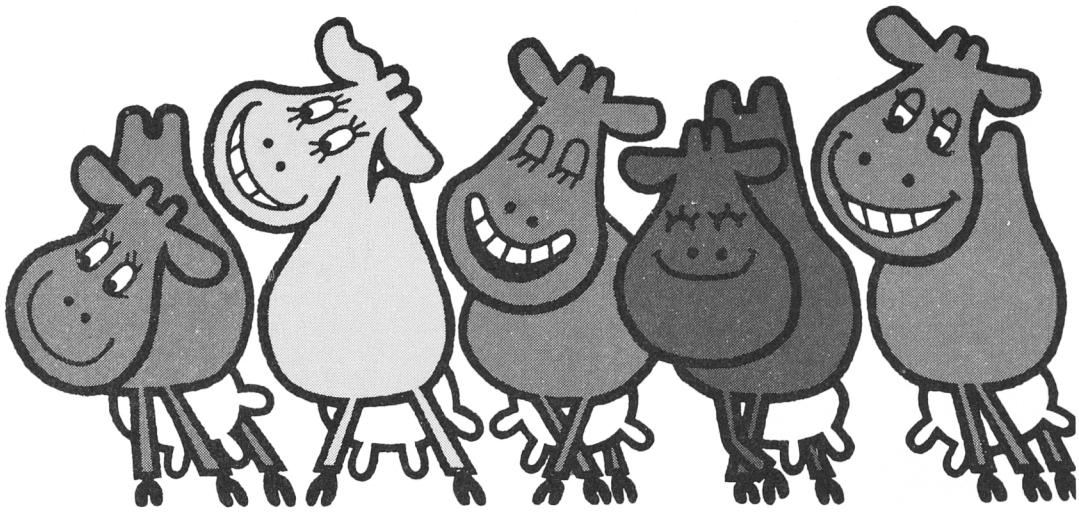

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3. Rosenzuaig, A. & Mayer, E., OBSERVATIONS ON THE EFFECT OF TREATMENT OF COWS AT DRYING-OFF ON THE INCIDENCE OF SUB-CLINICAL UDDER INFECTION IN TWO DAIRY HERDS. Rufuah Vet. 27 (1970).
4. Christie, G. J., Keefe, T. J., Strom, P. W., CLOXACILLIN AND THE DRY COW. VM/SAC, 69, No. 11, 1403-1408 (1974).

Precautionary Information: Warning—for use in dry cows only. Administer no later than 30 days prior to calving. Treated animals may not be slaughtered for food until 30 days after last treatment. Dry-Clox has the potential for producing allergic reactions. However, such reactions are rare.

Veterinary Products, Bristol Laboratories
Div. of Bristol-Myers Co.,
Syracuse, New York 13201.

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Table 8

Laboratory Findings of Cows with LDA

	1971-1972	1972-1973	1973-1974
Total number of cases of LDA	132	91	92
Ketonuria	64/104	41/62	54/83
Glycosuria	4/21	9/46	11/79
Proteinuria	4/21	2/42	12/80
Hematuria	5/20	8/42	15/77
Hemoglobinuria	1/19	0/41	0/76
Bacteriuria	3/8	4/14	1/7
Casts	4/8	4/14	1/7
Acid urine	13/15	27/41	40/78
Alkaline urine	2/15	14/41	38/78

Table 9

Laboratory Findings of Cows with LDA

	1971-1972	1972-1973	1973-1974
Total number of cases of LDA	132	91	92
Hypocalcemia <9 mg/dl	8/12	4/6	27/53
Normocalcemia 9-12 mg/dl	4/12	2/6	26/53
Hypokalemia <3.9 mEq/l	1/3	3/3	23/37
Normokalemia 3.9-5.8 mEq/l	2/3	0/3	14/37
Hypochloremia <97 mEq/l	2/2	2/3	11/36
Normochloremia 97-110 mEq/l	0/2	1/3	22/36
Normal bicarbonate 17-29 mEq/l	0/1	2/4	20/29
Increased bicarbonate >29 mEq/l	1/1	2/4	6/29
Hyperphosphatemia >8 mg/dl	0/12	0/2	1/28
Normophosphatemia 2-8 mg/dl	12/12	2/2	27/28

Table 10

Surgical Findings in Cows with LDA

	1971-1972	1972-1973	1973-1974	Totals	
Total number of cases of LDA	131	91	90	312	100.0%
Surgical finding					
Liver adhesions	7	10	8	25	8.0%
Peritonitis	7	6	10	23	7.4%
Fat necrosis tumors	1	1	2	4	1.3%
Fat necrosis flecks	3*	3*	17	23	7.4%
Friable omentum	7	4	5	16	5.1%
Abomasal adhesions	1	2	2	5	1.6%
Reticular adhesions	4	0	7	11	3.5%
Falciform ligament	3	1	1	5	1.6%
Omental adhesions	4	5	1	10	3.2%
Rumen adhesions	2	1	0	3	1.0%
Umbilical hernia	0	1	0	1	.3%
Intestines displaced	1	0	1	2	.6%
Omasal torsion	0	0	1	1	.3%
Omental tear	0	1	0	1	.3%
Mesoduodenum tear	0	0	1	1	.3%
Incision colon-accidental	1	0	0	1	.3%
Incision rectum-accidental	0	1	0	1	.3%
Miscellaneous	0	3	9	12	3.8%
* not recorded regularly in 1971-1973					
Cows treated as outpatients	9	17	7	33	10.5%
	6.8%	18.7%	7.6%		

surgical site. Currently the recurrence rate is about 4%. Follow-up information was not available for 41 cases (13%).

Theories explaining the causation of LDA have been proposed, described, and summarized (1,7,11,15). Three basic theories ascribe an apparently increasing incidence of the disease to genetic factors, to mechanical factors, or to factors causing atony of the abomasum. More likely, the disease results from a combination of these factors. LDA is perhaps brought about by man's desire to breed highly productive dairy cattle and to develop them to the limits of their capability.

The genetic theory attributes an increasing incidence of LDA to selective breeding for cattle with the ability to produce more milk. A characteristic attendant to the selection for increased milk production is a larger, deeper, abdominal cavity capable of storing more feed. The larger abdomen in turn may allow more room for displacement of the abomasum. Recent work tends to indicate a genetically linked predisposition to the disease (7,17). Further study has demonstrated that cows with LDA do have larger abdominal cavities than control cows (18). In this retrospective study we noted several cases of LDA in maternal sisters and in dam-daughter-grandaughter groups when other females in a herd were not affected.

Mechanical factors favoring development of LDA include forward displacement of the abomasum produced by the gravid uterus in advanced gestation. The high incidence of twins in cows subsequently developing LDA tends to favor a mechanical theory. Confinement and lack of exercise probably influence the development of LDA, also. In a pilot study we performed in 1974 a tendency for increased incidence of LDA was noticed in herds that kept the dry cows confined to free stall (cubicle) housing as opposed to

Table 11

Post-operative Therapy in Cows with LDA

	1971-1972	1972-1973	1973-1974	Totals	
Total number of cases of LDA	131	91	90	312	100.0%
Therapy					
Glucose and/or fructose	106	60	74	240	77.0%
Antibiotics systemically	110	56	69	235	75.0%
Oral fluids/electrolytes	32	40	30	102	33.0%
Propylene glycol	50	2	3	55	18.0%
Corticosteroid	16	9	3	28	9.0%
Insulin	8	13	14	35	11.0%
Choline/methionine	15	11	1	27	8.7%
Vitamins	34	35	45	114	36.5%
Calcium	8	5	4	17	5.4%
Antihistamines	2	6	3	11	3.5%
Laxatives	3	5	2	10	3.2%
Antibiotics in utero only	3	1	6	10	3.2%
Estradiol	7	12	2	21	6.7%
Miscellaneous	12	8	15	35	11.0%
Cows not treated post-operatively	6	8	3	17	5.4%

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Table 12

Post-operative Complications in Cows with LDA

	1971-1972	1972-1973	1973-1974	Totals	
Total number of cases of LDA	131	91	90	312	100.0%
Complication					
Surgical infection	4	3	6	13	4.1%
Mastitis	13	6	3	22	7.0%
Pneumonia	1	2	0	3	1.0%
Other infectious disease	5	5	2	12	3.8%
Metritis	2	2	1	5	1.6%
Parametritis	0	1	0	1	.3%
Enteritis	1	1	1	3	1.0%
Reticulitis	0	1	0	1	.3%
Hypocalcemia	3	3	0	6	1.9%
Other metabolic diseases	5	2	6	13	4.1%
Fatty liver	1	1	2	4	1.3%
Ketosis	1	1	4	6	1.9%
Hypomagnesemia	1	0	0	1	.3%
Drug Reaction	1	2	2	5	1.6%
Follow-up not available	29	10	2	41	13.0%
Recurrence of LDA	7	3	0	10	

Table 13

Causes of Death in Cows with LDA

Deaths before surgery

1971-1972, 1/132, .8%. Metritis/mastitis/ret. fet. memb./traumatic gastritis.

1973-1974, 2/92, 2.2%. 1. Pseudorabies and 2. Enteritis

Deaths after surgery

1971-1972, 17/131, 13.0%.

1-4. Coliform mastitis-Klebsiella/Pseudomonas/Proteus
5. Mastitis/perforation of trachea by stomach tube
6-7. Enteritis
8. Septicemia/possible bovine virus diarrhea
9. Fatty liver/metritis/nephrosis
10. Fatty liver/hemorrhagic enteritis
11. Fatty liver/metritis/septicemia
12. Toxemia/peritonitis
13. Traumatic gastritis
14. Perforating abomasal ulcer
15. Slaughtered-lymphosarcoma
16. Drug overdose by owner one month post-operatively
17. Undetermined-no post mortem

1972-1973, 5/91, 5.5%.

1. Fatty liver
2. Endometritis
3. Peritonitis-no post mortem
4. Traumatic reticulitis/fibrinous pericarditis
5. Peritonitis/extensive adhesions between the abomasum and rumen, abomasum and abdominal wall broken down at the time of surgery in order to replace the abomasum

1973-1974, 11/90, 12.2%.

1. Mastitis-Corynebacterium
2. Gangrenous mastitis
3. Fatty liver metritis
4. Salmonellosis
5. Chronic ketosis
6. Calcium overdosage
7. Toxic hepatitis/propylene glycol toxicity

8-11. Undetermined

Table 14

Recurrence of LDA in Dairy Cows

1971-1972

1. Cow fell down after surgery-omentum may have torn loose; redisplacement occurred soon and cow was slaughtered
2. Recurred at next calving; cow was rolled and recovered; she calved once more with no problem
3. Recurred at next calving-reason undetermined
4. Recurred in three months; reoperated
5. Recurred at next calving; reoperated-omentum stretched
6. Recurred two calvings later-sold
7. Recurred in a few weeks-omentum friable

1972-1973

1. Recurred at next calving-omentum stretched
2. Recurred following conservative therapy
3. Recurred two calvings later; reoperated-omentum not attached

Recurrence percent figured on the basis of number recurred divided by number operated minus number died. 10/279-3.6%.

Recurrence percent figured on the basis of number recurred divided by number operated minus number died minus number for which a followup was not available. 10/238-4.2%.

herds where the dry cows were kept in loose housing without free stalls.

Atony of the abomasum with subsequent accumulation of fluid and gas may be a prerequisite for displacement of the organ (11). Atony can be produced by many factors including electrolyte disturbances (1,5,11), high levels of volatile fatty acids in the digestive tract (1,11), or increased levels of histamine associated with tissue damage in concurrent diseases such as mastitis, metritis, or indigestion (1). A decrease in abomasal emptying rate was recently demonstrated in cows with experimentally induced alkalosis, in cows treated with atropine, and in cows with distilled water, basic buffer, or butyric acid infused intra-abomasally (11). Certainly, clinical hypocalcemia was frequently observed in the cows in our series prior to the development of LDA. Many of the cases had severe concurrent illnesses which may have contributed to abomasal atony.

The importance of an exploratory laparotomy at the time of surgical correction of LDA can not be overemphasized. Many disease conditions were diagnosed which would have been overlooked. Right flank laparotomy and omentopexy were performed in all of the cases in this retrospective study similar to previously described techniques (2,4).

The hemograms performed on the cows presented with LDA reflect changes associated with concurrent diseases. Leucopenia accompanied many severe toxemias, while leucocytosis accompanied those more chronic infections or cases of peritonitis. In many cases the concurrent diseases were diagnosed only by laparotomy. Marginal hypocalcemia was found in many cases. This finding was attributed to inappetance and reduced feed intake associated with LDA. Hypokalemia was also observed and may have resulted from the same cause. Statistical comparison between these findings and those of Robertson (14) was not made, since our sample size was small and

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biased. Ketonuria was observed in 64% of the cases in this study compared with 72% in Robertson's study (14). However, results may have been influenced by treatment of the cows prior to admission.

The clinical, surgical, and laboratory findings influenced the type of treatment administered pre- and/or post-operatively in the cases reviewed in this study. In several cases surgery was delayed while concurrent diseases (infectious or metabolic) were treated. There may be a tendency to operate too soon in some of the cases referred to the central hospital. Many cows are critically ill at the time of referral and their condition must be stabilized before surgical intervention can be undertaken.

In the past few years there has been a trend in my therapy away from propylene glycol and corticosteroids. Rather, I use rumen transplants, insulin and glucose, and vitamins more often. Choline and methionine were used less frequently in the last year of the study because of increasing costs. Post-operative therapy in these cases was similar to that reported by Gabel (2), Hoffsis (4), and Robertson (13).

Post-operative complications were largely due to diseases present at the time of surgery with the exception of mastitis or clinical hypocalcemia, which developed in six cases.

The recurrence rate following the right flank omentopexy was figured two ways. In the first instance the percent was calculated by taking the number of cases which recurred and dividing it by the total number operated minus the number that died soon afterwards. The percent was 3.6%. In the second instance the total number which recurred was divided by the number operated minus the number which died minus the number for which a follow-up was not available. The percent recurrence was 4.2%. These percentages compare favorably with those reported for similar or dissimilar procedures performed by others (16).

In almost all instances post-operative production was satisfactory in cows following surgical correction of LDA. Several cows produced over 20,000 pounds of milk in that lactation. Others produced satisfactorily but did not reach their potential until the succeeding lactations. Figures were not available for all cows in this series. As in Weaver's study (19), cows with severe concurrent diseases at the time of surgery had less satisfactory production post-operatively.

Information could not be obtained regarding the future fertility in all cows following the occurrence of LDA and surgery. Many cows had decreased fertility as evidenced by prolonged inter-calving intervals. Some cows were culled for this reason rather than for poor production. Weaver's observations were similar (19). The reason for infertility was not clear in all cases. However, the concurrent metritis in many cases or the debilitation caused by the LDA may have contributed more to decreased fertility than the surgical procedure.

Of special interest was the group of cows presented with the clinical sign of diarrhea. These cows do not respond as well to therapy and surgery for LDA as do other cows according to some practitioners. In our retrospective study the death rate was twice as great in cows presenting with the clinical sign of diarrhea. The rate of recurrence of LDA in such cows was about the same.

Summary

A retrospective study of 315 cases of LDA was conducted. Dairy cows seem prone to develop LDA near, at, or soon after parturition at a mean age of five years. Ketosis, metritis, retained fetal membranes, and milk fever along with other stresses were frequently noted in the history of cows diagnosed as having LDA. Concurrent diseases such as metritis and mastitis were commonly diagnosed. Liver adhesions were noted frequently at the time of exploratory right flank laparotomy and omentopexy. Post-operative therapy often included systemic administration of sugar solutions and antibiotics. The most common complication post-operatively was mastitis. The recurrence rate following the procedure was about 4%. Generally, post-operative recovery and production were satisfactory, except in cases of cows presenting with a clinical sign of diarrhea, in which the death rate was twice as great. Causative factors were discussed in relation to this series of cases.

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