OMENTOPEXY FOR CORRECTION OF RIGHT ABOMASAL DISPLACEMENT: RESULTS IN 135 COWS

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ABSTRACT

One hundred and thirty-five cows were surgically treated for correction of right displaced abomasum (RDA) using the right flank omentopexy technique. In 33 cows an abomasal dilatation was diagnosed. Abomasal volvulus was found in 99 animals and omaso-abomasal volvulus in three. In-hospital mortality was 15% (n = 20). None of the cows with abomaso-omasal torsion survived. Ninety-seven percent (n = 32) of the cows with abomasal dilatation and 84% (n = 83) of the cows with abomasal volvulus were discharged from the clinic. Six months after surgery, respectively 94% of the cows with abomasal dilatation had survived. This percentage fell to 88.5% after another half year. For cows with abomasal volvulus, these survival rates were 74% and 62%, respectively. Regardless of the type of abomasal dislocation, 77% of the total group of animals survived after six months and 66% after one year. Six months after surgery, good milk production was reported in 67% (n = 58) of the surviving cows; this figure rose to 91% of the surviving cows (n = 63) after 12 months.

Keywords: Cattle - Surgery - Right abomasal displacement

SAMENVATTING

Bij 135 koeien werd een exploratieve laparotomie via de rechter flank uitgevoerd voor correctie van een lebmaagdislokatie naar rechts. Door omentopexie in de flankincisie werd een permanente fixatie van de lebmaag bekomen. Lebmaagdilatatie werd vastgesteld bij 33 dieren. Torsie van de lebmaag en torsie van zowel lebmaag als boekmaag werd gediagnosticeerd bij respectievelijk 99 en 3 koeien. Het sterftecijfer vóór ontslag uit de kliniek bedroeg 14% (n = 20). Geen van de koeien met een torsie van zowel de lebmaag als de boekmaag konden gered worden. Van de dieren met een lebmaagdilatatie of een lebmaagtorsie konden respectievelijk 97% (n = 32) en 83% (n = 83) ontslagen worden uit de kliniek. Van de koeien met een lebmaagdilatatie overleefden zes en twaalf maanden na de operatie respectievelijk 93% en 88%. Overlevingspercentages van respectievelijk 73% en 62% werden gerapporteerd bij dieren met een lebmaagtorsie. Ongeacht het type lebmaagdislokatie overleefden respectievelijk 77 en 66% van de koeien. Bij 67% en 90% van de behandelde dieren werden goede melkproductieresultaten vastgesteld respectievelijk 6 en 12 maanden na operatie.

INTRODUCTION

Right (RDA) or left (LDA) displaced abomasum is a frequently encountered and increasingly important pathological disorder in dairy cows (Fürll *et al.*, 1997). Due to permanent damage of the abomasal wall in long-standing cases of abomasal volvulus, RDA in particular is associated with surgical results ranging from (Constable, 1991a; Kümper, 1995a). Depending on the degree of abomasal torsion, clinical symptoms can vary from signs of general illness to severe hypovolemic shock. Conservative treatment has been described (Buchanan *et al.*, 1991; Roussel *et al.*, 1994), though surgical treatment is preferred because of the poor response and the high recurrence rate associated with conservative treatment. Several surgical techniques have been documented, including paramedian and right flank abomasopexy or omentopexy (Saint Jean *et*

al., 1987; van der Velden, 1990). This paper reviews short and long-term results in 135 cattle after surgical correction for RDA using right flank omentopexy.

MATERIALS AND METHODS

Out of 2110 cattle referred to the large animal surgical clinic between January 1993 and December 1996, a right abomasal displacement was diagnosed in 135 cows (6.4%). On admission to the hospital, the clinical history was recorded, if available. A tentative diagnosis was based on history and a standard physical examination. The latter included simultaneous auscultation-percussion, percussion of the liver field and rectal examination. Venous blood was taken to determine the packed cell volume (PCV) and base excess (BE). When hypocalcemia was suspected, calcium levels were measured. Urine was tested for the presence of ketones using the Na-Nitro-prussiate.

An exploratory celiotomy was performed in the standing animal using local infiltration anaesthesia (Xylocaine 2%; University of Ghent). The operations were performed by a total of 10 different surgeons. In nervous animals, xylazine hydrochloride (Xyl M®; VMD) was administered intravenously at a dosage of 0.05 mg/kg body weight (BW). In animals with signs of hypovolemic shock, hypertonic saline (7.2%) was infused (4 ml/kg BW) pre-operatively.

A 15-20 cm vertical right flank incision was made a hand's width caudal to the last rib extending to the level of the stifle joint. The abdomen was explored with the left arm/hand to determine the way and the degree of abomasal displacement and/or torsion. In cases of extreme dilatation, the abomasum was punctured and excess gas was removed. The puncture wound was closed using a purse string, simple inverting suture (Chromic catgut 2/0; Ethicon). After manual repositioning, the viability of the abomasum was assessed by looking for changes in colour and contractility. Before performing the omentopexy, the surgeon did a careful exploration of the abdomen to detect other possible complicating pathologies such as dilatation and/or torsion of the caecum, traumatic reticuloperitonitis, the presence of tears in the greater omentum and abnormalities of the uterus.

The omentopexy was performed by incorporating a 15-20 cm artificial rim in the greater omentum when suturing the peritoneum and transverse muscle (Chromic catgut 3 or 4; Ethicon). The rim was identified parallel and 2-3 cm caudal to the axis formed by the pars pylorica of the abomasum, the pylorus and the ascending part of the duodenum. The lower part of the rim was located few centimeters caudal to the pylorus, allowing good fixation of this structure to the abdominal wall. In cows with ketonemia, a 30% glucose solution (B23 Glucose 30%; Braun Pharma) was instilled intra-abdominally at a dosage of 2 l/500 kg BW. The flank incision was closed in a standard manner.

Postsurgical medical treatment included the use of systemic antibiotics ($4 \cdot 10^6$ IU benzylpenicilline and 4 g dihydrostreptomycine per 100 kg BW; Depomycine® 20/20; Mycofarm Belgium). Ketonemia was further treated by oral administration of propylene glycol (300 ml / 500 kg BW twice daily). Hypocalcemic cows were administered a calcium solution (100 ml / 100 kg BW Calcii-borogluconas®; Eurovet). Poly-ionic intravenous infusions for restoration of hydration status were administered when indicated. Immediately after surgery the animals were fed hay (three times daily). Depending on the animal's physical condition and milk production, concentrate feeding was gradually re-introduced. Any concurrent disease problem (e.g. metritis, mastitis, claw lesions) were treated as necessary.

The results were evaluated at the time of discharge, as well as 6 and 12 months after surgery. The long-term results were obtained by telephone inquiry. Farmers were asked to evaluate the milk production by comparing the patient's production with the herd's mean production and with the expected milk production of the cow if no abomasal displacement had occurred. Milk production was thus ranked as good, moderate or poor.

RESULTS

Animal characteristics and history

Over 60 % of the animals belonged to the Holstein-Friesian breed. Nearly 30% of the patients were East-Flemish cows, a local double purpose breed. White Blue cows were represented in 8.1% of the cases. Over 90% of the animals were between 2 and 6 years old. The mean age was 4 (± 2 sd) years. Most cases of right abomasal displacement were seen in the housing period with a peak in the month of March (Fig. 1). The mean duration of clinical symptoms before admission to the clinic was 3.7 (± 5.3 sd) days. In 3 animals the symptoms had been present for more than 3 weeks prior to referral. The clinical history usually revealed a decrease in appetite, a decrease in faecal output or diarrhoea, and a sudden drop in milk production. Melaena was found in 17 cows (12.6%).

One hundred eleven animals (82.2%) had no history of recurrent abomasal problems. Ten animals (7.4%) had a history of left displaced abomasum (9 cases in the current lactation, 1 animal in the previous lactation period). Seven of them had been treated conservatively. The other three had been treated surgically using the 'Utrecht method' respectively 6 days, 3 months and 1 year before arrival in the clinic. Four animals (3%) already had been treated for right abomasal displacement. In 2 of them the abomasum was

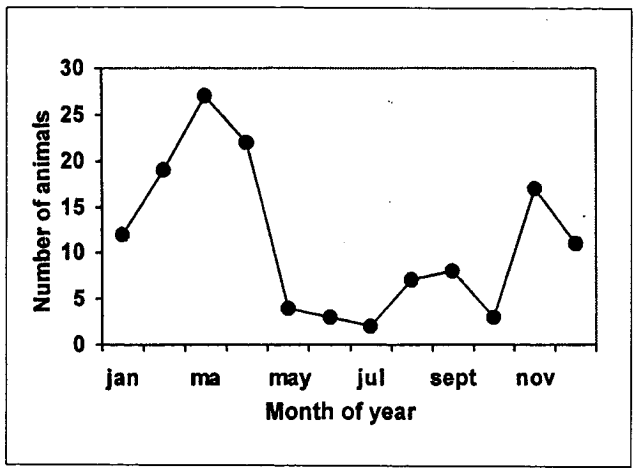

Fig. 1. Seasonal distribution of RDA in 135 cows.

surgically repositioned without a subsequent omentopexy respectively 4 and 8 days before relapse. In 1 animal omentopexy was performed during the previous lactation period. The fourth animal had already been operated two times for RDA, the last time 3 years before referral to the clinic. Information about the technique utilized was not available. One animal had a history of both left and right abomasal displacements. Information was lacking for 9 animals.

One hundred fourteen animals had calved before developing symptoms, and more than 70% of these had calved less than 1 month before referral. Nineteen animals were gravid, and nearly 50% of these were situated in the last trimester. No information was available for 2 animals.

Clinical signs

Mean values of body temperature, pulse and respiration rate are given in Table 1. One third of the cows were pyretic (≥ 39°C) on admission. High pulse (> 80 beats/min) and respiration rates (> 35 breaths/min) were seen more frequently in hypovolaemic animals. The distended abomasum could be felt during rectal examination in over 95% of the cases. In almost 90% of the patients, percussion of the right side of the abdomen could not identify the liver field. The haematological findings are presented in Table 2. A marked increase in the PCV due to hypovolemic changes was seen in 29 animals. Alkalosis was present in 53 cows. Concurrent diseases are listed in Table 3.

Lesions

Accompanying lesions encountered during exploratory celiotomy are illustrated in Table 4. Tears of the greater omentum were found in almost 20% of the cows. A variation from minor tears to complete avulsion of the greater omentum from the greater curvature of the abomasum was seen. Extreme tears were the direct cause of culling in 2 animals. Adhesions caused

Table 1. Mean (± sd) presurgical clinical findings in cows with RDA.

		Number of animals
Temperature (°C)	38.9 (± 0.7)	121
Pulse rate (beats/min)	86 (± 21.8)	131
Respiration rate (breaths/min)	32 (± 12.6)	99

Table 2. Haematological values in cows with RDA.

		Number of animals
Packed cell volume (L/L)	≤35	60
	35 - 40	36
	> 40	29
	Unknown	10
Base Excess (mmol/litre)	≤-3	16
	-3 - +3	44
	> +3	53
	Unknown	22

Table 3. Prevalence of concurrent disease problems in 135 cows with RDA (more than one disease can be present in the same animal).

Concurrent problems	Number of animals	%
Ketonemia	28	20.7
Metritis	12	8.9
Hypocalcemia	5	3.7
Mastitis	4	3
Claw problems	3	2.2
Atrial fibrillation	2	1.5
Right flank abscess	1	0.7
Aujeszky	1	0.7
None	83	61.5

by previous surgical intervention or abomasal ulceration or duodenal ulceration were encountered in respectively 3, 5 and 2 cows. Significant amounts of sand in the abomasum were palpated in 10 cows. In 1 of these animals the abomasum had to be emptied by gastrotomy to regain normal intestinal passage. A dilatation of the caecum was found in 9 cows. In only 1 cow was it necessary to make a small incision to empty the caecum before repositioning. Suction of caecal gas was necessary in the remaining 8 animals. A caecal torsion and multiple abdominal adhesions were found

Table 4. Intra-abdominal lesions accompanying RDA in 135 cows (more than one lesion can be present in the same animal).

Extra abdominal pathology	Number of animals	%
Tear of the greater omentum	26	19.2
Adhesions	10	7.4
Large amounts of sand in the abomasum	10	7.4
Caecal dilatation and/or torsion	9	6.7
Peritonitis	5	3.7
Partial rupture of the abomasal wall	4	3
Ruminal overload	1	0.7
None	78	57.8

in 1 animal. A surgical correction was not attempted due to the poor prognosis. Five animals with exudative peritonitis (fibrin clots) were treated by flushing the abdomen with sterile saline. The abomasal wall was partially ruptured in 4 animals. This was probably caused by accidental puncture of the extremely dilated abomasum during local infiltration anaesthesia. All ruptures could be sutured using a continuous inverting pattern (Catgut 2; Braun).

In 33 cows (24.4%) abomasal dilatation was diagnosed during surgery. In 99 animals (73.3%) the diagnosis of abomasal volvulus was made. In only 3 cows (2.2%) was the omasum involved in the torsion.

Mortality

In-hospital mortality was 14.8%. Nine cows were immediately euthanized following exploratory celiotomy because of serious pathology including severe haemorrhage shortly after detorsion, the impossibility of repositioning the abomasum because of adhesions or an accompanying volvulus of the omasum and rupture of the abomasal wall during manipulation. Despite intensive fluid therapy, 4 animals died a few hours after surgery because of shock. Four animals were euthanised respectively 2, 7, 14 and 18 days after surgery because of a rapid deterioration of their physical condition. Complete atony/ileus of the abomasum and a relapse of RDA due to avulsion of the greater omentum was diagnosed during a second exploratory celiotomy in respectively 2 and 1 animals.

Postoperative history and follow-up results

One hundred fifteen cows (85.2%) were discharged from the clinic (Table 5). Ninety-seven percent of the cows with abomasal dilatation were able to return to the farm, as compared to 83.8% of the cows with abomasal volvulus. Further information was lost in 5 cows. The mean duration of hospitalisation was 7.3 ± 3.5 days.

Six months after surgery, follow-up was available on 110 cows. Ten animals (9.1%) were removed from the farm during this period for several reasons, including sudden death (2), ruminal overload because of improper functioning of the abomasum (2), a severe teat wound (2), progressive deterioration of the physical condition (3) and age (1). One hundred cows (90.9 %) were still kept on the farm. Information on milk production was not available for 6 cows. Five of them belonged to the Belgian Blue breed; 1 Holstein cow was not lactating at the time of follow-up. Information on milk production was obtained for 94 cows. Production was considered good in 63 (67%), moderate in 24 (25.5%) and poor in 7 animals (7.5%).

Table 5. Lactation score 6 and 12 months after surgical intervention for RDA in cattle.

Age	Number of cows	Lactation score*		
		Good	*Moderate*	*Poor*
6 months	94	63 (67%)	24 (25.5 %)	7(7.5%)
12 months	64	58 (90.6%)	4(6.3 %)	2(3.1 %)

* Lactation score based on evaluation of the owner/farmer

Twelve months after discharge from the clinic, follow-up was available on 81 animals. Seven animals (8.6%) were removed from the farm for the following reasons: sudden death due to suspected abomasal problems (1), poor milk production (2), fertility problems (3) and chronic diarrhoea (1). Seventy-four (91.4%) of the animals were still present on the farm. All of these animals were in good physical condition. No information on milk production was available for 10 animals. Four of them belonged to the beef breed, while five others were being fattened because of bad milk production in the lactation period following surgery, fertility problems or for reasons of management. One animal was gravid at the time of follow-up. Information about milk production was obtained for 64 animals. Production was considered good in 58 (90.6%), moderate in 4 (6.3%) and poor in 2 cows (3.1%).

The overall outcome results 6 and 12 months after surgery were respectively 77% and 66.7%. Cows with abomasal dilatation survived in respectively 93.8% and 88.5% of the cases followed. The survival percentage of cows with abomasal volvulus was respectively 73.7% and 62.2%. None of the cows (3) with abomaso-omasal torsion survived.

Recurrent abomasal problems occurred in 7 animals. Three animals developed a left abomasal displacement respectively 2 days, 4 days en 1 year after the first intervention. No further problems were encountered in 2 of these cows after repeat surgery. One cow relapsed after the LDA was repositioned using the rolling procedure: it was slaughtered. Four animals had a relapse of RDA. One cow was subsequently slaughtered 3 days after surgery. Abomasal torsion was the cause of sudden death in two cows one year after the first intervention. A fourth cow relapsed after 1.5 years and was successfully treated in a conservative manner.

DISCUSSION

The incidence of abomasal displacement is still increasing. Fürll *et al.* (1997) stated that genetic changes in cows (intensive interbreeding of Holstein-Friesian in other cows) and specific feeding regimes (energy-rich, low crude fibre, introduction of total mixed rations) are the two most important causative factors. Over a 3-year-period a decrease in the number of cows referred to the clinic for treatment of LDA was observed (Vlaminck *et al.*, 1998). By contrast, the number of cows referred for treatment of RDA has been increasing in recent years. As the surgical technique for correction of LDA is straightforward and the success rate is high, most practitioners perform this operation in the field. The fact that the repositioning of RDA is technically more demanding, the aftercare is more intensive and the postoperative results are less good, means that the general practitioner is more inclined to refer to a specialized clinic.

Although a great deal of research has been done on the aetiopathogenesis of abomasal displacement, much remains unclear (Breukink, 1977; Varden, 1979; Constable *et al.*, 1992; Geishauser, 1995). The problem is most frequently encountered in breeds with high milk yields. Almost 90% of the animals in this study were dairy cows, two-thirds of which were Holsteins. Eleven animals (8.1 %) were pure beef cattle (Belgian White Blue). The highest incidence of RDA was observed during the housing period, with a peak in the month of March. This winter-spring pattern is also known from the literature (Espersen 1961; Breukink, 1977). More than 70% of the cows had calved less than one month before developing RDA. It is believed that changes in the food ration during the last stages of gravidity, intra-abdominal mechanical changes accompanying the immediate post-parturient period and metabolic changes because of fresh milk production are important factors in the pathogenesis of abomasal displacement. Concurrent disease problems can also contribute to the development of both RDA and LDA by influencing intestinal motility. These are more often found in LDA than in RDA (Geishauser, 1995). In 38.5% of the cows in this study, accompanying diseases such as ketonemia, hypocalcemia, metritis and mastitis were diagnosed, which is in accordance with the results of Constable *et al.* (1992). Metabolic disturbances and diseases of the genital tract or the mammary gland were observed most frequently (Table 3). This is in accordance with Muylle *et al.* (1989). The occurrence of these problems had little influence on the outcome. In a comparable study on LDA (Vlaminck *et al.*, 1998), concomitant disease problems were present in 68.5% of the animals.

The topographic pathways of abomasal displacement in the right half of the abdomen are more complex than in the left half (van der Velden, 1990; Kümper, 1995a). A distended abomasum easily rotates (*torsion*) around the longitudinal, vertical and horizontal axis in a counter-clockwise direction as viewed from behind. As a result, the passage between omasum and abomasum becomes hindered and is sometimes strangulated. When the volume of the abomasum increases, a second rotation around the vertical axis may occur, displacing the ascending part of the duodenum in a cranio-ventral direction to the level of the omaso-abomasal passage. This further aggravates the vascular and food passage disturbances. Hence the symptomatology varies depending on the degree of abomasal volvulus during RDA. In the case of simple abomasal dilatation and limited abomasal torsion (< 180°), the patient merely reflects a state of general illness comparable to what is seen in LDA. This is marked by a loss of appetite (especially concentrates), a decrease in faecal output and a sudden drop in milk production. Temperature, pulse and respiratory frequency, PCV and BE remain mostly within normal ranges. When this condition persists, dehydration and hypochloraemic alkalosis develop. More severe abomasal torsions (> 180°) is accompanied by more drastic changes in the animal's physical condition (hypovolaemic shock, etc).

Simultaneous auscultation and percussion, rectal examination and ultrasonography are important aids in the diagnosis and differential diagnosis of abomasal problems (Rebhun, 1991; Braun *et al.*, 1997). In this study, steel band sounds along the right flank were heard in all patients. In 90% of the cows, the liver field could not be detected during percussion of the right abdominal wall and thorax. This finding is correlated with the presence of a gas-filled organ between the abdominal wall and the right liver lobe. Rectal examination was straightforward in identifying the distended

abomasum in over 95% of the patients. No ultrasonographic examinations were done. In advanced cases of RDA, the proper fluid therapy should be administered prior to surgery.

When diagnosing RDA, practitioners do not have a wide choice of treatment options. Early stages of abomasal dilatation or low-grade abomasal torsion can be treated conservatively (van der Velden, 1990). This includes the total restriction of all food material for one or several days and the use of prokinetic drugs (Roussel *et al.*, 1994). Buchanan *et al.* (1991) observed a rapid recovery in 17 of 22 cows with RDA using hyoscine-n-butyl bromide. The prognosis must be regarded as poor, however, because of the high recurrence rate (van der Velden, 1981). Rolling techniques with or without blind abomasopexy are contra-indicated because of the risk of worsening an existing torsion (Espersen, 1964; Oehme, 1984). Paramedian omentopexy or abomasopexy have both been described but are not used in our clinic because of the risks induced by the dorsal recumbency position (Saint Jean *et al.*, 1987). The right flank omentopexy as described by van der Velden (1990) was used in this study. It can be done in the standing animal by one surgeon. This method provides the most thorough abdominal exploration, which is especially helpful in cows with undiagnosed concomitant intestinal problems. The disadvantages of this method are linked particulary to the body build conformation and the experience of the surgeon. A shorter built person will have more difficulties in repositioning a severe abomasal volvulus.

Intra-abdominal lesions accompanying RDA were found in 57 animals: they included omental tears, periabomasal adhesions, sand impaction of the abomasum, peritonitis, partial abomasal wall rupture and ruminal overload. The forces accompanying abomasal dilatation and dislocation usually induce tearing of the greater omentum. This may have a considerable negative influence on the surgical outcome due to altered vascular supply to the abomasal wall (Pearson, 1973). In this study, two cows were culled because of major omental tears. In one of them, the greater omentum was completely torn off. In the second, the tear resulted in improper fixation and subsequent relapse. Ulceration of the abomasum is recognised as a causative factor in the pathogenesis of abomasal displacement (Dirksen, 1996). It can lead either to localized or generalized peritonitis with adhesion formation. The negative influence of large amounts of sand on abomasal motility has been mentioned in the literature (Geishauser, 1995).

In cases of extreme abomasal dilatation, gas was removed by suction through a 12G needle connected to a silicone tube. The fluid contents were not removed during the operation. It has been reported that postoperative normalization of deviations in the potassium and chloride blood concentrations as well as of the physical condition is faster when the abomasum is not emptied (Karatzias, 1991). In cases of extreme volvulus, the contents of the abomasum should be removed because they contain large amounts of toxins, which can be detrimental to the animal's physical condition.

Successful outcome results after surgical correction of RDA have been reported, ranging between 40% and 91% (van der Velden, 1981; Kümper, 1995a). The degree of strangulation accompanying an abomasal displacement greatly influences the surgical outcome, as is seen in this study. Positive outcome results between 85 and 91% have been reported for uncomplicated abomasal dilatations and torsions less than 180°. The success rate for cows with abomasal dilatation in this study is higher. In cases of abomasal torsion exceeding 180°, the success rates mentioned in the literature range between 64% and 75%, which is in accordance with the outcome at 6 months in this study. In cases of omasal involvement, a successful outcome of 40% has been reported (Kümper, 1995a; 1995b). In this study, no cows survived when the omasum was involved in the displacement; this was probably due to severe hypovolemic shock.

The mortality of the animals during hospitalisation was 14.8%. Constable *et al.* (1992) reported an in-hospital mortality rate of 23.5%. Most post-surgical fatalities have been associated with hypovolaemic shock accompanying abomasal volvulus and vascular or neurologic damage to the abomasal wall leading to atony, necrosis and peritonitis (Goetze and Müller, 1990; Constable *et al.*, 1991a).

Few animals were culled (9.1%) during the lactation period following surgical treatment. Comparable results were reported in a study on LDA by the same authors (Vlaminck *et al.*, 1998). Poor physical condition due to permanent abomasal damage was the main reason for culling. In the following lactation period, 8.6% of the remaining cows were further culled. The reasons for culling were mostly not associated with abomasal problems. Vlaminck *et al.* (1998) reported a good lactation score 6 and 12 months after surgical correction of LDA in respectively 79.6 and 97.2% of the cows. These scores are markedly higher than those reported in the present study (respectively 67 and 90.6%). Karatzias (1992) also reported lower milk production in cows surgically treated for RDA when compared to LDA operated cows. This can be explained by the more rapid deterioration of the cow's physical condition due to the presence of abomasal torsion. It requires a longer recovery period. Decreasing the period between the first appearance of clinical symptoms and surgical intervention facilitates surgical repositioning and limits possible complications due to sustained damage of the abomasal wall (van der Velden, 1990). Prognostic indicators including hydration status, heart

rate, period of inappetence, serum alcalic phosphatase activity, abomasal fluid volume and the quality of the abomasal wall can help in making the decision whether or not to continue treatment (Constable *et al.*, 1991a; 1991b).

A relapse of abomasal displacement was seen in 7 animals (5.4%), 3 with LDA and 4 with RDA. Saint Jean *et al.* (1987) reported a recurrence rate of 4% following the right flank omentopexy. This was associated with suturing the omentum too far caudally or dorsally from the pylorus, resulting in the omentum stretching out or tearing away from the surgical site, especially in friable, fatty omental tissues. Dilatation and partial torsion of the abomasum is still possible when the omentum is improperly fixed.

As it is better to prevent than to cure, it is very important to minimise the influence of the risk factors for RDA during the peri-parturient period. This includes proper food management (providing good quality roughage, gradually introducing concentrates and preventing sudden food changes) and the prevention or effective treatment of any concurrent disease problem. Although the outcome results are less good and the repositioning can be more difficult when compared to LDA, the early recognition of RDA in a cow can prevent severe pathological changes in the abomasal wall, thus positively influencing surgical outcome.

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