



## Clinico-biochemical and surgical evaluation of omaso-abomasal volvulus in cattle

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### ABSTRACT

The aim of the present study was to determine and characterize the clinical, hematological, biochemical parameters and outcome in cows suffering from Omaso-abomasal volvulus (OAV). Animals data were obtained from medical records of 60 adult dairy cattle suffering from OAV (Clinic for Ruminants, Justus-Liebig-University, Germany). For each case, history, age, results of clinical examination, hematological and biochemical findings were recorded and analyzed. Ages of animals were between 2.3 and 8 years, (mean 4.8). Compared with the respective normal range, there were significant increases of the heart rate, hematocrit, total bilirubin, urea blood, concentrations of bicarbonate and base excess. Serum chloride and potassium were significantly decreased in the majority of cows. In this study, dehydration, metabolic alkalosis, hypochloremia, hypokalemia and circulatory insufficiency were the major common findings in cows with Omasum-abomasal volvulus. Excessive stretching of the abomasal wall and long lasting strangulations at the torsion-sites must be avoided (surgery should be performed as soon after diagnosis of AOV as possible) and correction of these conditions with aggressive intravenous fluid therapy is necessary before the surgical intervention for correction of the hematobiochemical alterations.

**keywords:** abomasal, volvulus, cows.

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### 1. INTRODUCTION

Surgical abomasal disorders are important in dairy production. Although left displaced abomasum occurs more commonly and has a good prognosis, the prognosis may be more variable in cases of right abomasal disorders, which can be either dilated abomasum (RDA) or abomasal volvulus (AV). The AV generally has a less favorable prognosis than RDA because of various degrees of neurovascular and inflammatory damage that may occur in the abomasum (Sattler et al., 2000; Niehaus, 2008).

Abomasal displacement has a multifactorial etiology and constitutes the most common cause of surgical gastrointestinal disorders in dairy cattle (Smith, 1978; Fubini et al., 1991; Rohn et al., 2004). AV is a twisting of the stomach on the right side of the cow. The condition occurs less frequently than left displaced abomasum (Smith, 1978; Fubini et al., 1991; Rohn et al., 2004). The mortality rate for AV is higher than that for left displaced abomasum. When the twist of the abomasum exceeds 180 degrees (abomasal volvulus), the

twine gets more contracted, strangulating the abomasal nerves and blood vessels (Fubini et al., 1991; Meylan, 1999; Sattler et al., 2000). Abomasal displacement is characterized by dehydration and metabolic alkalosis due to continuous secretion of hydrochloric acid, sodium, potassium and chloride into the abomasum (Aksoy, 1981; Simpson et al., 1985; Braun et al., 1990; Smith, 1990; Constable et al., 1992; Kumper, 1995; Geishauser et al., 1996). When the abomasal volvulus is complicated by an omasal (RDAO) or an omasal and reticular involvement (RDAOR) the success of therapy decreases to about 40% (Buchanan et al., 1991; Constable et al., 1992; Kumper, 1995; Meylan, 1999; Rohn et al., 2004). While some animals die of hypovolemic or septic shock shortly after surgical correction of RDA/AV, others survive the acute postsurgical period but develop other related problems. The most frequent postoperative complication encountered with RDA/AV is a gastrointestinal dysfunction (Meylan, 1999). The aim of this study is to determine and

evaluate the clinical, hemato-biochemical and surgical findings of clinical cases of omaso-abomasal volvulus in dairy cows.

## 2. MATERIALS AND METHODS

Sixty adult dairy cows suffering from Omaso-abomasal volvulus (OAV) were included in this study. German Black Holsteins and German Red Holsteins were the two breeds included in this study. The ages of the animals were between 2.3 and 10 years. The majority of cows were diagnosed with OAV (n = 46) and right omasoabomasal volvulus (ROAV) (n = 14). Diagnosis of OAV based on clinical examination, position and direction of torsion. Type and degree of torsion were confirmed by right flank laparotomy.

For each case, history, age, results of clinical examination and hematobiochemical findings were recorded and analyzed. Animal data obtained included heart rate, respiratory rate, temperature, rumen motility, fecal quantity in rectum and filling of the rumen. Whole blood and plasma samples were collected to evaluate the hematobiochemical findings which include Hematocrit, Total bilirubin, Urea, the venous blood gas values (pH value, bicarbonate content and base excess) serum levels of chloride potassium and sodium. Routine general clinical and laboratory examinations were performed from each case at the time of admission in the clinic (before the surgery). Surgery was performed according to the method described by Dirksen on the day of arrival. The surgical and survival information's were obtained from the medical records continuously. The abdominal explorations and short and long-term outcome were analyses. Owners of animals discharged from the veterinary clinic were contacted to obtain additional follow-up information regarding long-term survival and outcome.

## 3. RESULTS

### 3.1. Clinical findings

The major clinical signs were recorded in table (1). The rectal temperature varied from 37.5 °C to 40 °C. The mean of rectal temperature was within the normal range in 57 (95 %) cows while, hyperthermia in 3 cows (5%) was recorded. The heart rate varied from

60- 132 pbm. and it was significantly ( $P < 0.05$ ) increased in 29 cows (48.3 %) and decreased in 3 cows (5 %). The mean of respiratory rate was within the normal range in 47 cows (78.3%) while, there was significant ( $P < 0.05$ ) increase in the respiratory rate in 13 cows (21.7 %). Rumen motility was absent in 51 cows (85 %), while in 9 cows (15 %) were hypomotile with reduced strength of ruminal contraction. Fecal quantity in rectum was scanty in 49 cows (81.6 %) or absent in 11 cows (18.3 %). Rectal palpation of the dilated abomasums was available in 59 cows (98.3 %).

### 3.2. Surgical findings and outcome table (2)

The abdominal explorations revealed sever dilatation of abomasums in 43 cows (71.7%). The torsion degree was diagnosed by 180° in 45 and by 360° in 14 cows; while in one case the torsion degree was more than 360°. Forty-eight cows (80%) (38 cows recovered completely, 10 improved) were discharged home for further observation. Necropsy findings were only available for the cows that were not released from the clinic. Patients that died or were euthanatized in the clinic (12 cows) showed severe lesions of the abomasum, as ulcers, necrosis and abomasal impaction. six months after discharge, 34 cows (56.7%) were at their home farm and utilized performed normally. Six of the remaining 14 cows were culled because of other diseases (fertility disorders, mastitis, claw disorders).

### 3.3. Biochemical findings:

Compared with the respective normal range values, there were significant ( $p < 0.05$ ) increases of hematocrit ( $0.46 \pm 0.1/1$ ; varied from 0.30 to 0.55 l/l), total bilirubin ( $13.8 \pm 7.4 \mu\text{mol/l}$ ; varied from 5.3 to 36.8  $\mu\text{mol/l}$ ), urea ( $9.78 \pm 6.3 \text{ mmol/l}$ ; varied from 2.7 to 25.8 mmol/l), blood concentrations of bicarbonate ( $1.1 \pm 0.62 \text{ mmol/l}$ ; varied from 18.6 to 50.9 mmol/l), and base excess ( $5.75 \pm 7.03 \text{ mmol/l}$ ; varied from - 6.6 to 25.7 mmol/l). The mean of pH-value of venous blood ( $7.39 \pm 0.07$ ; varied from 7.22 to 7.49) and serum Sodium ( $135 \pm 13.1 \text{ mmol/l}$ ; varied from 128 to 145 mmol/l) had not significant changes. The obtained data indicated significant decreases ( $p < 0.05$ ) in serum chloride ( $87 \pm 13.07$ ; varied from 55 to 115 mmol/l) (60 % cases) and potassium ( $3.20 \pm 0.59$ ; varied from 1.72 to 4.58 mmol/l) in the affected cows (Table 3).

Table (1) Clinical findings of omaso-abomasal volvulus (N=60).

Clinical parameter	Number of cases (%)
<i>Rectal temperature °C</i>	
Normal (38-39.2°C)	57 (95 %)
Increased	3 (5%)
<i>Heart rate (beat / min); Normal (70 – 90)</i>	
Normal	28 (46.7 %)
Low	29 (5%)
Increased	3 (48.3%)
<i>Respiratory rate (breath / min) Normal (20-40)</i>	
Normal	47 (78.3%)
Increased	13 (21.7%)
<i>Rumen motility; Normal (2 to 3 contr. / 2min)</i>	
reduced (< 2 contr/2 min)	9 (15%)
Absent (0 contr. / 2 min)	51 (85%)
<i>Fecal quantity in rectum</i>	
Scanty	49 (81.6%)
Absent	11 (18.3%)
<i>Rectal palpation of the dilated abomasum</i>	
Available	59 (98.3%)
Not available	1 (1.7%)

Table (2) Surgical findings of omaso-abomasal volvulus (N=60).

Description	Number of cases (%)
<i>Degree of torsion</i>	
180°	45 (75%)
360°	14 (23.3%)
> 360°	1 (1.7%)
<i>Direction of the torsion</i>	
Rotation to the left (contra clockwise)	60 (100%)
Rotation to the right (clockwise)	0
<i>Type of torsion</i>	
(OAV)	46 (76.7 %)
(ROAV)	14 (23.3%)
<i>Abomasal Size</i>	
Moderately dilated	17 (18.3%)
Severely dilated	43 (71.7%)

Table (3) Serum values (Mean ± SD) of some biochemical parameters of omaso-abomasal volvulus (N=60). \* ( $P < 0.05$ ).

Parameter	Units	OAV & ROAV	Reference range (Velden 1975)	No. of cases with abnormal value
Haematocrit	l/l	0.41 ± 0.1*	0.30 – 0.40	40 (66.7%)
Total billirubin	µmol/l	13.8 ± 7.4*	0.9 -7.0	50 (83.3%)
Urea	mmol/l	9.78 ± 6.3*	1.7-7.5	40 (66.7%)
pH (blood)	value	7.39 ± 0.07	7.36 - 7.44	27 (45%)
Bicarbonate	mmol/l	31.5 ± 7.73*	20 - 30	26 (43.3%)
Base excess	mmol/l	5.75 ± 7.03*	-3 - +3	40 (66.7%)
Sodium	mmol/l	135 ± 13.1	135 -155	19 (31.7%)
Potassium	mmol/l	3.20 ± 0.59*	4 - 5	37 (61.7%)
Chloride	mmol/l	87 ± 13.07*	90 -110	40 (66.7%)

#### 4. DISCUSSION

Displacement of the abomasum is a condition in dairy cows resulting in economic losses and reduction of animal welfare. In this study, the records of 60 cases of OAV were reviewed. The clinical examination revealed, in the majority of cows, the rectal temperature (95%) and the respiratory rate (78%) were within the normal range. Three cows (5%) showed hyperthermia and a prolonged duration of the illness. Increased respiratory rate was recorded in 13 cows (21.7 %). The increased temperature values might have been due to septicemia accompanying concurrent parturition diseases, such as metritis, mastitis (Fubini et al., 1991; Constable et al., 1992). Increase of the respiratory rate was probably due to the increased pressure of the dilated abomasum on the diaphragm (Fubini et al., 1991; Meylan, 1999; Rohn et al., 2004). However, there was marked increase of the heart rate in 29 (48.3%) cases and 3 (5 %) of the cows presented bradycardia. Increased heart rate is common, and occurs in most cases of circulatory failure, abdominal pain and metabolic alkalosis (Smith, 1978; Simpson et al., 1985; Braun et al., 1990; Goetze and Müller, 1990; Breuking, 1991; Fubini et al., 1991; Rohn et al., 2004) which associated with omaso-abomasal volvulus.

Most of OAV- affected cows there is no ruminal motility in 85% or reduced motility in 15% and scanty feces in 81.7 % or fecal-free rectum in 18.3%, these findings are similar to those recorded by (Braun et al., 1990; Fubini et al., 1991; Meylan, 1999). The dilated abomasums were palpated rectally in 59 cows (98.3 %). The abdominal explorations revealed; (71.7 %) severe dilation of the abomasums (71.7 %). In all cows, the rotation was performed to the left (counter-clockwise, seen from rear) (Meylan, 1999).

The torsion degree ranged from 180° (n=45), 360° (n=14) and 450° in one case. In this study, the definitions stated by (Meylan, 1999) were adopted to establish the types of volvulus. Based on the surgical findings, the Omaso-abomasal volvulus (OAV) was diagnosed in 46 cows and reticulo-omaso-abomasal volvulus (ROAV) 14 cows. When the twist of the abomasum exceeds 180 degrees (abomasal volvulus), the twine gets more contracted, strangulating the abomasal nerves and blood vessels (Wallace, 1989; Meylan, 1999; Sattler

et al., 2000). In the present study, the majority of cows showed metabolic alkalosis (66.7 %), dehydration (66.7%), hypochloremia (66.7%), hypokalemia (61.7%), however, 4 cows showed metabolic acidosis. Subsequent occlusion of the duodenum and omasal-abomasal or reticulo-omasal junction might have lead to accumulation of abomasal fluid and metabolic alkalosis might be attributed to loss or sequestration of abomasal HCl, and the relative excess of HCO<sub>3</sub><sup>-</sup> (Braun U et al., 1988; Buchanan et al., 1991).

In response to dehydration-induced hypovolemia, aldosterone stimulates the kidneys to retain Na<sup>+</sup> and water (Smith, 1978; Simpson et al., 1985; Braun et al., 1990; Constable et al., 1991; Kumper, 1995). Chloride loss is from gastric secretions due to reflux of abomasal fluid (internal vomiting), malabsorption in the lower gastrointestinal tract, or chloride sequestration in the rumen or abomasum. Therefore, HCO<sub>3</sub><sup>-</sup> is the anion which is reabsorbed with Na<sup>+</sup>, decreasing the urine pH. Sodium (and water) can also be reabsorbed via exchange with intracellular K<sup>+</sup> or H<sup>+</sup>. In the presence of hypokalemia, K<sup>+</sup> is unavailable for exchange. Therefore, H<sup>+</sup> ions are exchanged with Na<sup>+</sup>, creating acidic urine (Braun U et al., 1988; Braun et al., 1990; Goetze and Müller, 1990; Smith, 1990; Constable et al., 2013).

Dehydration and anaerobic metabolism due to reduced peripheral perfusion is often observed in the latter stages of abomasal volvulus (Breuking, 1991; Sattler et al., 2000). The majority of cows mobilized body fat as indicated by increased of the serum levels of total bilirubin. The high diagnostic value of total serum bilirubin (Hjortkjaer and Svendsen, 1979). in cows with abomasal volvulus, may be the result of a partial bile duct obstruction (Smith, 1978; Hjortkjaer and Svendsen, 1979; Fubini et al., 1991; Rohn et al., 2004).

When the twist of the abomasum exceeds 180° (abomasal volvulus), the twine gets more contracted, strangulating the abomasal nerves and blood vessels (Trent, 1990; Meylan, 1999; Sattler et al., 2000). In this study, Short-term survival rate and long- term survival rate is higher than that given in previously published reports (Meylan, 1999). However, definition of outcome or duration of follow-up may be different from one study to another and making difficult comparisons.

The most frequent postoperative complication encountered with abomasal volvulus is a gastrointestinal dysfunction (Meylan, 1999; Sattler *et al.*, 2000; Zadnik, 2003b). All patients that died or were euthanized in the clinic showed severe lesions of the abomasum, as ulcers, necrosis, peritonitis, omasal impaction and abomasal impaction which may be due to sequestration of the abomasal contents (Breuking and Kuiper, 1980; Braun *et al.*, 1990). Abomasal volvulus in cattle is characterized by rotation of the proximal duodenum, abomasum, and omasum. The mortality rate for abomasal volvulus is higher than that for displaced abomasum when the abomasal volvulus is complicated by an omasal or an omasal and reticular involvement the success of therapy decreases to about 40% (Kuiper, 1980; Meylan, 1999).

## 5. Conclusion and recommendations

Dehydration, metabolic alkalosis, hypochloremia, hypokalemia and circulatory insufficiency are the major common findings in cows with abomasal volvulus. However, some animals die of hypovolemic or septic shock shortly after surgical correction of OAV. Excessive stretching of the abomasal wall and long lasting strangulations at the torsion-sites must be prevented (surgery should be performed as soon after diagnosis as possible) and according to the available clinico-laboratory alterations, associated with OAV, correction of these conditions with aggressive intravenous fluid therapy containing potassium chloride and correction of alkalemia and dehydration is recommended.

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