

Tympany, Displacement and Torsion of the Abomasum in Calves: Pathogenesis, Diagnosis and Treatment⁺

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Introduction

Abomasal diseases in calves have increased in frequency as well as in variety during the last decade.^{2,3,4,5,8,9,10} Whereas formerly inflammations of different kind and origin predominated among the disorders of this organ, today various types of displacements due to or combined with tympany play an increasing role - at least among the patients of the cattle clinic of the University of Munich. Currently, abomasal diseases, as listed in Table 1, can be considered of clinical importance.

Table 1. Clinically important diseases of the abomasum in calves.

- Inflammations of different origin
- Ulceration/erosion
- Displacement to the left
- Tympany and displacement on the right side
- Tympany and torsion on the right side
- Incarceration in an umbilical hernia
- Strangulation by the rudimentary umbilical vein
- Dilatation

Incidence of abomasal displacements and ulcerations

Table 2 shows the frequency of abomasal displacements in calves as well as that of perforating abomasal ulcers (with or without displacement), during the period from 1990 to 1992 (3 years), among the inpatients of the Munich cattle clinic. The distribution by age is indicated in Table 3.

Table 2. Types and frequencies of abomasal displacements and perforating abomasal ulcers in calves up to 6 months of age, from 1990 to 1992 (3 years), among the inpatients of the Munich cattle clinic.

Left abomasal displacement	
uncomplicated	34
with perforating ulcer	22
Right abom. displacement + tympany	26
with torsion	24
Incarceration in an umbilical hernia	11
Perforating abomasal ulcer	76
	193

Table 3. Age distribution of calves with left displacement of the abomasum (n = 34), abomasal displacement and tympany on the right side (n = 26), and torsion of the abomasum (n = 24).

Diagnosis	Weeks					Months	
	2-4	5-6	7-8	9-10	11-12	> 3-4	> 4-6
Left displacement (n=34)	0	4	7	8	9	3	3
Tympany with right displacement (n=26)	2	4	11	0	5	2	2
Torsion (n=24)	3	4	7	2	2	2	4

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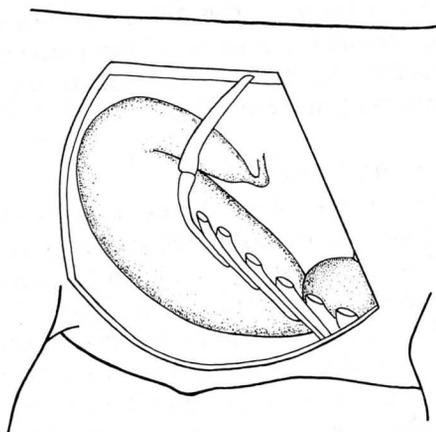
Abomasal tympany and displacement or torsion on the right side of the abdomen

(Tympania et dislocatio abomasi dextra sine aut cum torsione)

Definitions

Abomasal tympany with displacement - in its typical form - is characterized by a sudden accumulation of gas. The distending organ, mainly the Pars fundica, moves caudodorsally along the right abdominal wall to a position as shown in Figure 1. With proceeding displacement of the abomasum, the duodenum, which is fixed by a relatively short mesentery, becomes more and more twisted back on itself.

Figure 1. Abomasal tympany with right displacement.



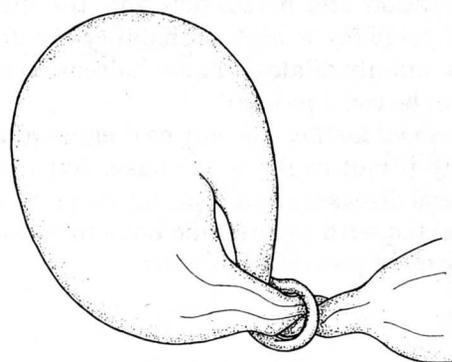
Abomasal torsion (also called abomasal volvulus) seems usually to be preceded by an enlargement and displacement of the organ, analogous to the pathogenesis in the adult bovine. The fundic part and the pyloric part, which build an u-shaped sack, rotate in a clockwise or anti-clockwise direction around their basis (abomaso-omasal junction and pyloro-dudenal junction) to 180°, 360° or even more (Fig. 3). The twisted abomasum is filled with gas and fluid, congested and, in advanced cases, infarcted (gangrene) (Fig. 4). In the very young calf also primary torsions - without preceding gas formation - seem to occur.

Symptoms

The signs depend on the degree of gas accumulation, how quickly it develops and on the degree of an eventual torsion. The following description refers to uncomplicated cases.

Acute abomasal tympany with displacement is often accompanied by a moderate degree rotation of the organ, that is, in the range of up to 180°. Therefore, these types of dislocations and slight torsions should be de-

Figure 3. Abomasal torsion of approximately 360° (as observed in a one week old calf).



scribed together. In the typical uncomplicated case, symptoms set in suddenly within an hour after milk intake. The animal's general state of well-being is markedly impaired, it shows restlessness and signs of colic (Fig. 5), such as muscle tremor, kicking of the legs, sweating and others, sometimes depression. Heart and respiration rates are increased. The most striking symptom is the bulging of the right flank or of the entire abdomen. Metallic sounds (steel band effect) can be heard over the right abdominal wall on auscultation with percussion and splashing sounds on ballottement. The nature of the faeces varies; often they are of dry consistency.

With increasing distension of the abomasum, the general state of the patient deteriorates rapidly: signs of shock, due to the compression of blood vessels, lung and heart, become evident and the animal dies.

In cases of a moderate abomasal distension the symptoms are not so marked and the disease can take a favorable course with spontaneous recovery. A protracted course over several days can be seen with a "secondary" tympany, often due to abomasal ulceration. Primary as well as secondary gas accumulations in the abomasum can be accompanied by ruminal tympany.

If the *torsion of the abomasum* has proceeded beyond 180° to 360° or even more, the course is usually peracute: severe colic, marked rightsided expansion of the abdomen, splashing sounds on the right on auscultation with ballottement, and eventually a "steel band" effect on auscultation and percussion, marked tachycardia (>140/min) and tachypnoea (>40/min). Defecation is reduced, and the faeces contain mucus and blood.

After a short period of time the patient will be in lateral recumbency showing signs of severe intoxication and shock.

Diagnosis and differential diagnosis

A quickly developing distension of the right abdomen soon after intake of milk, milk replacer or other

liquid feed containing non-soluble fermentable ingredients, and high metallic sounds over the whole right flank on auscultation and percussion give the diagnosis of *abomasal tympany* a high probability. As differential diagnosis, mainly dilatation and dislocation of the caecum has to be considered.

Abomasal torsion can only be diagnosed with some probability if met in the first phase. But even in this case, several diseases running a similar peracute course and connected with severe colic have to be included in the spectrum of possible diagnoses.

Those are:

- Intestinal mesenteric torsion (twisting of the intestinal mass around the cranial root of the mesentery)
- Volvulus of the jejunum
- Intestinal stragulations and incarcerations
- Caecal torsion
- Perforating abomasal ulcer

Haematological findings

Blood gas analyses have been evaluated in 21/26 patients with abomasal tympany and in 17/24 calves with abomasal torsion. The results are listed in Table 4. About half of the patients showed a moderate to marked metabolic alkalosis, whereas eight had a slight or severe acidosis. Seven of the latter were calves with abomasal torsion having advanced morphological alterations of the abomasal wall.

Table 4. Results of blood gas analyses in 21 calves with abomasal tympany and 17 patients with abomasal torsion.

Base excess (mmol/l)	≥ -15	> -15 to -8	> -8 to -3	-3 to +3	> +3 to +8	> +8 to +15	> +15
Tympania abomasi (n=21)	1	0	0	8	10	2	0
Torsio abomasi (n=17)	4	3	0	2	4	1	3

Treatment

Acute abomasal tympany with right displacement: A method, mainly used under field conditions, is the paracentesis of the bloated abomasum caudal to the right costal arch. Though this procedure has been successfully used in lambs¹ as well as in calves, there is no doubt, that this way of treatment carries a high risk of perito-

nitic. Furthermore, in cases in which actually a laparotomy would be necessary, time will be lost and the prognosis may change for the worse. The decision to perform a paracentesis, therefore, should be considered carefully and if so, all measures should be observed to prevent an infection of the peritoneum: a long thin needle should be used, so that the collapsing abomasum can be followed cranio-ventrally, careful preparation of the puncture site, intraperitoneal and systemic antibiotics.

Patients admitted to the clinic - if operable - were subjected to a right-sided laparotomy with the animal in lateral recumbency. The bloated abomasum was exteriorized (Fig. 2) deflated by paracentesis, the puncture site closed and the organ replaced in its physiological position. If the abomasum also contained much fluid, an abomasotomy was performed (or a trocar introduced) and the content siphoned off (Fig. 6,7).

Abomasal torsion: the acute symptoms make a prompt laparotomy essential. If the general status is markedly reduced, simultaneous fluid therapy is necessary to stabilize the circulation.

Pathogenesis and conclusions

In the majority of cases, the influence of the feeding regime seems to play a decisive role in the pathogenesis of abomasal tympany. With the exception of a few cases, the afflicted animals have been in the weaning period, receiving milk or milk replacer and solid feed as well. It is well known that this transitional stage is connected with many different digestive disturbances. Similar influences could also be demonstrated for the gas accumulation in the abomasum of artificially reared lambs.⁷ Furthermore, investigations in lambs have shown that the occurrence of abomasal tympany was related to the increase of gas-producing microorganisms in the abomasal content.⁶ Another important factor, also possibly depending on feeding errors, might be abomasal erosions and ulcerations, which inhibit the motor function of this stomach. By inspecting the organ from outside during operation, ulcers could be observed frequently. Finally, the rapid consumption of large quantities of liquid feed, in particular when it contains non-soluble, fermentable components, such as soybean, cereals or linseed meals, can have a triggering effect. In studies performed in lambs, abomasal tympany could be prevented by the addition of a 37% formaldehyde solution to the milk replacer at a quantity of 0.05% of dry matter volume.⁵

As can be concluded from the results presented in Table 5, there is a good chance to cure acute abomasal tympany by paracentesis via laparotomy. Two of the losses can probably be attributed to the percutaneous puncture before admission.

To secure a favorable prognosis in calves with abomasal torsion, they have to be operated on within a few

hours after the first suspicious signs. Otherwise, morphological alterations of the abomasal wall, due to obstruction of the circulation, will soon attain a degree that every treatment will be in vain.¹¹

Table 5. Outcome in 26 calves with abomasal tympany and 24 patients with abomasal torsion.

<i>Acute abomasal tympany (n = 26)</i>	
Euthanasia/slaughter immediately after admission	3
Operated	23
Euthanasia in tabulam	1
post operationem	4
Cured	18
<i>Abomasal torsion (n = 24)</i>	
Operated	24
Euthanasia in tabulam	6
Euthanasia/exitus within 24 h post operationem	4
later	6
Cured	8

Left displacement of the abomasum (Dislocatio abomasi sinistra)

Since the description of the first five cases in 1981² many calves with a left-sided displacement of the abomasum (LDA) could be observed among the inpatients of the Munich cattle clinic as well as by practitioners in the field. Therefore, it can be stated, that LDA in the calf is by no means unusual. Meanwhile, the knowledge concerning etiology, diagnosis and treatment could be enlarged.

Definition

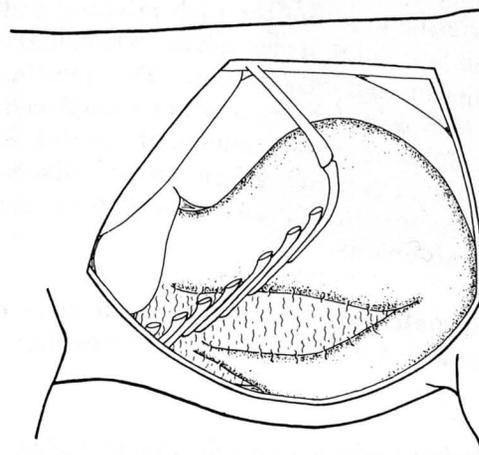
The abomasum - mainly the Pars fundica - is dilated, filled with gas and fluid and placed along the left abdominal wall, as shown in Fig. 8.

Symptoms

As indicated in Table 2, 22 of the 56 evaluated cases were accompanied by a perforating abomasal ulcer when admitted to the clinic. In these patients the signs of abomasal dislocation were mixed with those of the ulcerous perforation.

In uncomplicated cases (n = 34), the animal often show dullness, a reduced or varying appetite, and sometimes a tucked up abdomen. The heart rate is normal or increased, sometimes it is diminished (4/34 with bradycardia). Temperature and respiration frequency are usually within the normal ranges, unless a concurrent disease exists, e.g., a bronchopneumonia, as observed in several calves.

Figure 8. Left abomasal displacement in the calf (at an age of approximately 10 weeks).



At inspection, the left abdominal ribs appear to be arched and the abdominal wall bulged, the paralumbar fossa is flattened or even extended, conveying the impression of a ruminal tympany (which was actually present in only a few cases) (Fig. 10). Over the same area, metallic and splashing sounds can be heard on auscultation with percussion sounds or with ballotement (Fig. 11). Simultaneously, metallic or splashing sounds could be provoked also on the right side in 2 or 8 of the 34 evaluated calves respectively. Only a few patients showed rumen contractions. Quality and quantity of the faeces varied to a large extent; in three cases the faeces contained either macroscopically discernable blood or showed melena. The pH of the urine varied from 5 to >7, its specific gravity from 1000 to >1020.

Haematological findings

Whereas anaemia was observed in 5 of the 34 animals, 9 had haemoconcentration, and 7 showed both. Blood gas analysis, as performed in 28 patients, revealed in 12 animals a slight, in 3 a moderate and in 1 a severe metabolic alkalosis.

Rumen fluid findings

Samples were aspirated from 26 of these patients. Their pH ranged as follows:

pH	< 5	5.1 - 6	6.1 - 7	> 7
No.	1	6	15	4

The chloride concentration was determined in 19 samples with the following results:

Cl (mmol/L)	<30	30 - 60	60 - 90	>90
No.	9	3	4	3

Diagnosis and differential diagnosis

As experiences obtained during the past years have shown, the main diagnostic problem consists in identifying the origin of the high pitching and splashing sounds, auscultated over the left abdominal wall during percussion and ballottement: The question arises, whether they originate from either a displaced abomasum, the fluid containing rumen, or - with less typical sounds - from a pneumoperitoneum or a displaced caecum. Therefore, the following diagnostic procedure should be observed:

* Deep palpation of the rumen for solid content, which would - if positive - exclude splashing ruminal sounds.

* Introduction of a stomach tube to exclude or confirm rumen tympany and to aspirate rumen fluid. Thereafter auscultatory re-examination, to control, whether the metallic and splashing sounds can still be heard or have disappeared.

* Repeated rolling of the animal over its back with simultaneous massage of the abdomen (Fig. 12) followed by a recheck by auscultation. Remember: persistence of the suspicious sounds does not exclude left abomasal displacement, because the replacement by rolling can be hindered by peritoneal adhesions (consequences of deep ulcerations).

+ If the diagnosis cannot be made by the aforementioned methods, the examination should be continued by percutaneous puncture in the suspicious area and comparison of the punctate with the aspirated rumen fluid: pH, chloride concentration and further criteria as color, smell, viscosity, titratable acidity.¹² Furthermore, there has to be taken into account, that cow's milk, milk replacer and, in particular, oral rehydration solutions (ORS) have relative high chloride concentrations, which might influence the Cl-content of the rumen fluid. Nevertheless, it is safe to assume, that a pH below 4 and a chloride concentration higher than 90 mmol/L clearly indicates an abomasal fluid. In milk-fed calves, in particular in those with ruminal drinking, chloride concentrations of the rumen fluid between 40 and 60 mmol/L can occur.

* In the case that blood gas analysis can be performed, the findings of a marked metabolic alkalosis would support the suspicion on LDA.

* If the diagnosis remains dubious in spite of the diagnostic measures listed before, it should be secured by sonography, laparoscopy or laparotomy.

As described above, sometimes metallic and/or splashing sounds can be provoked on both sides of the abdomen. As observations in laparotomized patients have shown, such findings mainly originate from a simultaneous dilatation of the caecum.

Treatment

Usually the first step is to roll the animal over its back while the veterinarian tries to massage the displaced abomasum from left to right by respective ballottement of the abdomen (Fig. 12). After this procedure has been repeated two to three times, the animal is allowed to get up and the result is checked by auscultation along the left abdominal wall in the usual manner. In uncomplicated cases, the displaced organ can usually be replaced into its normal position in that manner. The animal must be re-examined on the next and the following days to be sure that no relapse has occurred. In that case, the treatment by rolling can be repeated one or more times. It depends on the general status of the animal, and the other circumstances of the specific case, how long this conservative therapy should be continued. Based on the experience of the author, the conservative treatment should not be repeated more than three times, though, in isolated cases, a permanent cure could not be achieved until the fifth rolling. One should make it a rule, however, to shift early to surgical therapy.

The patients, evaluated in this casuistic, were operated from the right side, with the animal in lateral recumbency. After an incision along the right costal arch the manual repositioning is carried out and after that the abomasum is inspected from outside for pathological alterations. When closing the peritoneal wound the greater omentum is fixed with the same suture, in order to perform an omentopexy.

Table 6. Treatment results of 34 calves with LDA (without perforating ulcer).

<i>Treatment by rolling and massage</i>	21
Cured	19
not cured	2*
<i>Operation after unsuccessful treatment by rolling</i>	6
cured	5
not cured	1
<i>Operation without preceding conservative treatment</i>	7
cured	4
not cured	3

*Two animals which could not be cured on the conservative way had to be euthanatized for concurrent diseases.



Figure 2. Severe gaseous distension of the abomasum in a calf; intra-operative status.

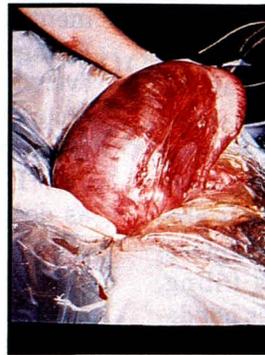


Figure 4. Abomasal torsion of 360°; intra-operative status.



Figure 5. Calf with abomasal tympany showing distension of the right abdomen and colic.

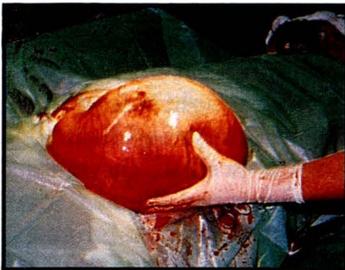


Figure 6. Abomasal tympany and fluid accumulation; intra-operative finding.

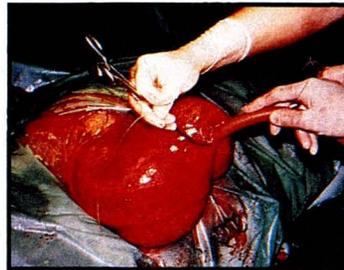


Figure 7. Case of figure 6: The liquid content is siphoned off.

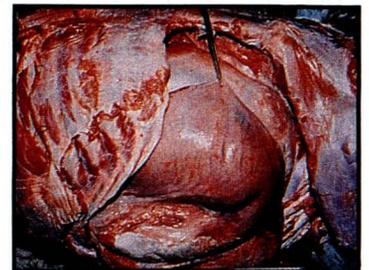


Figure 9. Necropsy finding of a left abomasal displacement in a 10 weeks old calf; The pyloric part is covered by fibrinous exudate, due to a perforating ulcer.



Figure 10. Left displacement of the abomasum in a 9 week old calf; The left abdominal ribs are markedly arched and the paralumbar fossa indicates slight tympany.



Figure 11. Examination of the left abdomen for abomasal displacement or ruminal contractions by auscultation with ballotement.



Figure 12. Conservative treatment of LDA in the calf by rolling it over its back and simultaneous massage of the abdomen.

Pathogenesis and conclusions

As can be concluded from the anamnestic data (Tables 7, 8), nutritional influences seem to play an important role also in the pathogenesis of the left-sided displacement of the abomasum. However, the kind of such nutritional factors and their mode of action seem to be different from those obviously active in acute abomasal tympany. It is true that in the left-sided displacement gas accumulation occurs too. The gas filling, however, develops slowly, and apparently it does not depend on increased gas production but on hampered gas transport due to reduced motor activity of the organ. In that regard, erosions and ulcerations of the abomasal mucosa obviously play an important role, as the high number of left-sided displacements connected with perforated ulcers (22/56, Table 2) indicates. Such morphological alterations may become effective either by local immobilisation of the abomasal wall or via the nervous regulation by the vagus nerve.

Table 7. Available anamnestic data on the origin of 30 calves with left displacement of the abomasum.

Reared by the owner	12
Purchased for fattening prior to hospitalization	17
≤ 1 week	2
1 - 2 weeks	4
≥ 2 - 4 weeks	6
no specification	5

Table 8. Preceding feeding regimes of 34 hospitalized calves with uncomplicated left displacement of the abomasum.

Feeding regime	Number	Liquid feed		
		2x3 L	2x4 L	> 2x4 L
Skimmed milk and solid feed	2	1	1	-
Cow's milk and solid feed	5	1	2	2
Nutrient meals in liquid form and solid feed	1	-	-	1
Milk replacer and solid feed	22	11	8	3
Solid feed	4	-	-	-

In an earlier publication on the first five cases of left-sided abomasal displacement in calves, the opinion has been expressed that the left displacement should only occur if size and weight of the rumen exceeds that of the abomasum. According to experiences gained since, this opinion can not be upheld in that form. Displace-

ment of the abomasum in calves can also be seen in very young animals at the age of two to three weeks. However, the majority of the cases reported in this paper occurred during the weaning period (Table 3), when the forestomachs are in the phase of their development.

Provided there are no complicating diseases, such as deep or perforated ulcers causing peritoneal adhesions, bronchopneumonia or other disorders, there are good chances for successful treatment. Under those prerequisites, more than 80% of the calves with left-sided abomasal displacement can be cured. Considering the different aspects of the disease in the young bovine we can state that many similarities to the left displacement of the abomasum in adults do exist.

Summary

Clinical experiences with abomasal displacements in calves up to 6 months of age are reported on the basis of an evaluation of 34 cases of uncomplicated left-sided displacement of the abomasum, 26 cases of abomasal tympany with displacement on the right side of the abdomen, and 24 abomasal torsions, observed in 1990/91/92. Relevant clinical findings as well as the methods and results of treatment are described. Final remarks include ideas on the possible pathogenesis of each of the three abomasal diseases.

Key words

Calf - abomasum - tympany - displacements - torsion

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