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Clinical, Laboratory And Ultrasonographic Investigations of Left Abomasal Displacement in Holstein-Friesian Cows

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Abstract

Eleven dairy cattle with left abomasal displacement were investigated. Thorough clinical examination was performed. Ultrasonography of left side abdomen from the 9th to 12th intercostal space (ICS) and ventral abdomen was applied on standing position using 3.5-5 MHz transducer. Blood, urine and ruminal samples were collected from the affected cattle for laboratory evaluation. Left flank laparotomy was applied on 8 cows to confirm and treat the cases while the other 3 cases had bad prognosis.

Clinically, the general condition and milk production were altered, feces was scanty and either soft or hard, ruminal motility was detectable but with lower number and strength and ping sound was detected over the 9th to 12th ICS by simultaneous percussion and auscultation.

Ultra-sonographically, the displaced abomasum was clearly visible between the left 10th and 12th ICS in all cows. Gas cap with reverberation artifact appeared at left dorsal region while the hypoechoic content of abomasum appeared at left ventral region. Echogenic bands of abomasal folds were observed in 4 cows. Pylorus was detected at left paramedian at area extended between umbilicus and left costal arch under the 9th to 11th ICS.

Laboratory findings revealed mild metabolic alkalosis, hypokalemia, hypocalcaemia, mild decrease in ruminal pH, increase in chloride content, prolonged time of methylene blue reduction time and ketonuria. In conclusion, ultrasonography not only considered as an easy, fast and accurate tool for diagnosis of LDA in cows but also it is a good decision tool.

Keywords: Holstein-Friesian, hypokalemia, hypocalcaemia, ketonuria, left abomasal displacement, Ultrasonography.

Introduction

Left displacement of the abomasum (LDA) occurs most commonly in high-producing adult dairy cows immediately after parturition. Approximately 90% of cases occur within 6 weeks following parturition. Occasional cases occur few to several weeks before parturition (Radostits et al., 2007). Evidence from epidemiological studies over the last 50 years has identified a variety of risk factors associated with the occurrence of LAD. Feeding rations high in carbohydrates, inadequate levels of roughage and crude fiber levels below 17% during the last few weeks of pregnancy are probably important dietary risk factors (Stengarde, 2010). Moreover, negative energy balance, hypocalcaemia, retained fetal membranes, uterine infections, dystocia and cow breed are the most risk factor related to the animal itself (Constable et al., 1992).

In cows with LDA, the abomasum becomes partially or completely displaced between the rumen and left abdominal wall, and the accumulation of gas leads to caudodorsal distension (Geishauser et al., 2000). The diagnosis is usually based on the results of double auscultation of the rumen and percussion and swinging auscultation over the left abdominal ribs (Mueller, 2011). Recently, ultrasonography is described as a useful tool for diagnosis of LDA in cattle (Braun, 2009).

The abomasum is clearly differentiated from adjacent organs because of its contents, which appear as a heterogeneous, moderately echogenic structure with echogenic stippling. The wall of the abomasum appears as a narrow echogenic line. Parts of the abomasal folds are visible occasionally as echogenic structures within the abomasum. It is present 15 cm caudal to the xiphoid cartilage to near umbilicus at ventral abdominal wall and extend laterally at left and right paramedian, but right extension is greater than left (Braun et al., 1997a; Braun et al., 1997b). In response to the expansion of the gravid uterus, abomasal length decreases and width increases during the last 3 months of gestation. The abomasum returns to its physiological position within 14 days after parturition (Wittek et al., 2007). Left abomasal displacement could be manifested by perforated ulcer and peritonitis (Muller et al., 1999).

The aim of this study was to ascertain the clinical, hematological, biochemical, urine and ruminal parameters alteration as well as ultrasonographic appearance in cattle with left abomasal displacement.

Material and Methods

A total of 11 Holstein Friesian dairy cows were admitted to Teaching Hospital- Faculty of Veterinary Medicine- Zagazig University- Egypt during the period from January, 2010 to January, 2014. These cows were admitted with a history of long period of indigestion, scanty feces and decreased milk yield. The body weight, age, occurrence with relation to production cycle, concurrent diseases and duration of illness were collected in Table (1).

Clinical investigation:

Full case history, thorough clinical examination, abdominal percussion and auscultation, assessment the circumference of the abdomen and assessment of the general systemic state including; rectal temperature, pulse and respiratory rates were recorded after the method described by Jackson and Cockfort (2002).

Ultrasonographic investigation:

The hair was clipped over the 9th and 12th intercostal spaces on the left side (Braun et al., 1997a) as well as ventral midline of the abdomen (Braun et al., 1997b). After application of coupling gel, a convex transducer 3.5 or 5 MHz (Pie Medical 240 Parus, Maastricht, Netherlands) was placed on the ventral midline and moved laterally to the left side until the abomasum could be imaged.

Table 1. History of 11 Holstein- Friesian dairy cattle with LDA

Case no.	Body weight (Kgs)	Age (year)	Duration after parturition	Concurrent diseases	Duration of illness*
1	455	8	3 weeks	No	3 days
2	550	6.5	2 weeks	No	4 days
3	600	7	1 week	Pneumonia	5 days
4	580	8	3 weeks	No	2 days
5	540	10	4 weeks	Mastitis+ peritonitis	6 days
6	500	12	2 weeks	Peritonitis	1 week
7	480	8	3 weeks	No	5 days
8	540	8	2 weeks	No	2 days
9	580	10	1 week	No	3 days
10	500	6	2 weeks	No	5 days
11	470	7.5	3 weeks	Peritonitis	1 week

*Estimated from the beginning of the disease until time of examination at student veterinary hospital- Zagazig University.

Laboratory investigations:

Blood analysis:

Two blood samples (10 ml each) were collected from each case: one placed in a plain tube, and the other in an EDTA tube. Erythrocytes, leucocytes count, haematocrit content and haemoglobin were carried out on the EDTA blood using an automated veterinary haematological analyzer (Vet Scan HM5, ABAXIS, Hungary). Blood pH, pCO2 and electrolytes (bicarbonate, sodium, potassium, calcium and chloride) were determined in the same EDTA sample by blood gas analyzer (ABL90 FLEX, Denmark). Blood samples were centrifuged at 1200 rpm for 10 min, and the serum samples were harvested and stored at -20°C for further biochemical analysis. Commercial kits were used to determine the concentrations of total protein, albumin, glucose, blood urea nitrogen (BUN), creatinine and activities of aspartate aminotransferase (AST) and alanine aminotransferase (ALT). Globulin concentration was obtained by calculating the difference between total protein and albumin.

Ruminal fluid analysis:

Rumen fluid was obtained by a stomach tube. The first obtained jets of ruminal liquid were discarded to reduce the effect of saliva dragged by the catheter. The liquid obtained was filtered through adaptation of double gauze inside a funnel. The pH was measured immediately after the collection of the sample using pH paper. Color, odor and consistency of ruminal sample as well as reduction time of methylene blue (RTMB) were assessed after Kelly (1979). Reduction time of methylene blue RTMB was assessed in two test tubes, one contained 10 mL filtered ruminal fluid and used as a blank and the other tube contained 0.5 mL of 0.03% methylene blue solution, to which 9.5 mL of filtered ruminal liquid was added. Time was measured from the moment the solution was mixed with the ruminant liquid. The recorded time corresponded to the final disappearance of the blue color, when compared to the blank tube.

Urinalysis:

Urine was collected through spontaneous urination (About 5ml was collected in a clean plastic container). Urinalysis reagent strips were used according to the directions of the manufacturer (Roche combur urine strips®, Boehringer Mannheim, Germany). This test was used to estimate the glucose and ketone bodies in the collected urine samples.

Results

Clinical findings:

The most prominent clinical signs in the diseased cattle were reduced appetite, decreased milk yield and disturbed general condition (dullness, unconsciousness and depression). Ping sound over the left 9-12th ribs was detected by simultaneous percussion and auscultation in 90.9% of the cases. Reduced number and strength of ruminal contraction (less than 2 contractions/ 2 minute) were recorded in 81.8 % of the cases. Scant soft feces, abdominal distension at the left dorsal site of the abdomen and ruminal fluid reflux via stomach tube were reported in 63.6% of affected cows. Other signs as systemic disturbances, pain reactions, and melena were also observed with variable degrees in complicated cases (Table 2).

Table 2. Clinical findings of LDA in 11 Holstein-Friesian dairy cattle

Clinical findings	Number of affected animals	Percent of affected animals
Disturbed general condition (dullness, unconsciousness and depression)	11	100
Decreased milk production	11	100
Reduced appetite	11	100
Abdominal distension (at left dorsal site of the abdomen)	7	63.6
Scanty hard feces Scanty soft feces Diarrhea	3 7 1	27.2 63.6 9.1
Melena (dark tarry feces)	3	27.2
Systemic disturbance (temperature; respiratory rate; and pulse rate;)	3	27.2
Pain reactions (indicated by grunting, protrusion of tongue, rapid respiration)	2	18.2
Ping sound (by simultaneous auscultation and percussion over 9-12th ribs at left side)	10	90.9
Reduced number and strength of ruminal contraction (less than 2 contractions/ 2 minutes)	9	81.8
Recumbency	1	9.1
Ruminal fluid reflux via stomach tube	7	63.6

Ultrasonographic findings:

Abomasum with its characteristic features was detected in the left 10th and 12th ICS in all cows. At left dorsal region of this area, gas cap with reverberation artifact was observed while at ventral region; hypoechoic abomasal content was observed in all cases. The echogenic strips of abomasal fold were observed in 4 cases (54.5%). The displaced abomasum located between rumen and abdominal wall (Figures. 1 and 2). Pylorus was detected at left paramedian under the 9th to 11th ICS at area extended between umbilicus and left costal arch. Pylorus appeared as a circular, thick-walled, echogenic structure with an acoustic shadowing (Figure 3). Peritonitis was detected in 3 cows (27.2%) as echogenic bands of fibrin interspersed with hypoechoic exudate at ventral abdominal wall (Figure 4).

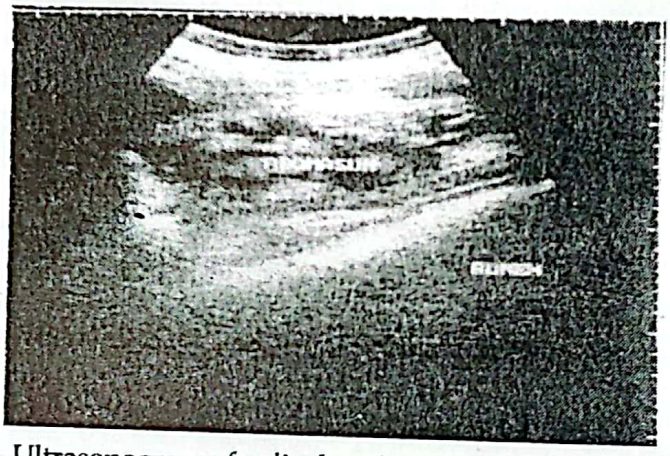

Figure 1. Ultrasonogram of a displaced abomasum showing the heterogenic appearance of the abomasum located between the rumen and the abdominal wall.

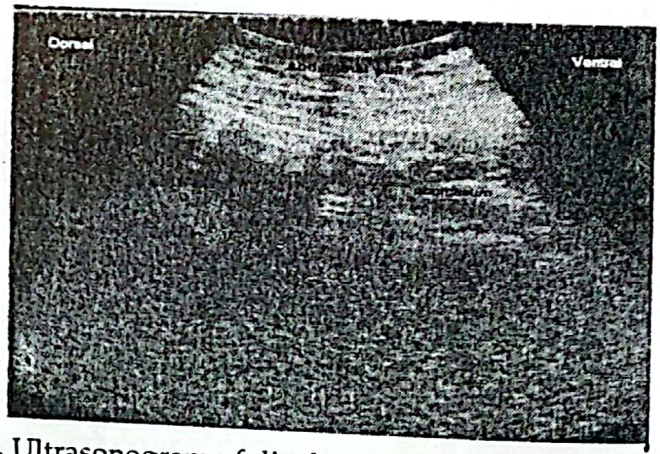

Figure 2. Ultrasonogram of displaced abomasum showing gas cap with reverberation artifact at dorsal region (arrows), hypoechoic abomasal content and echogenic strip of abomasal folds at ventral region.

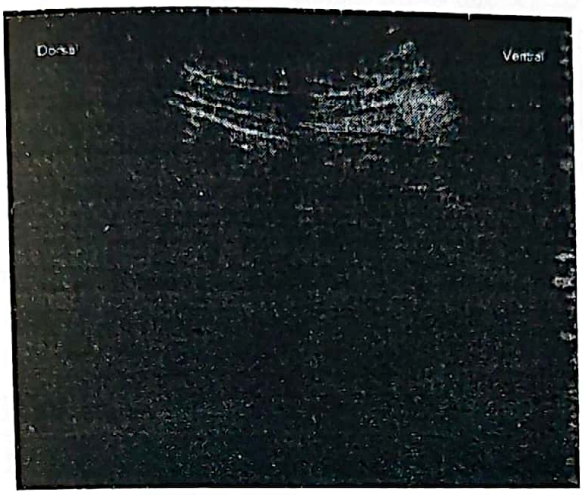

Figure 3. Ultrasonogram of displaced abomasum at left paramedian under 9th to 11th ICS showing a circular, thick-walled, echogenic pylorus with an acoustic shadowing (arrow).

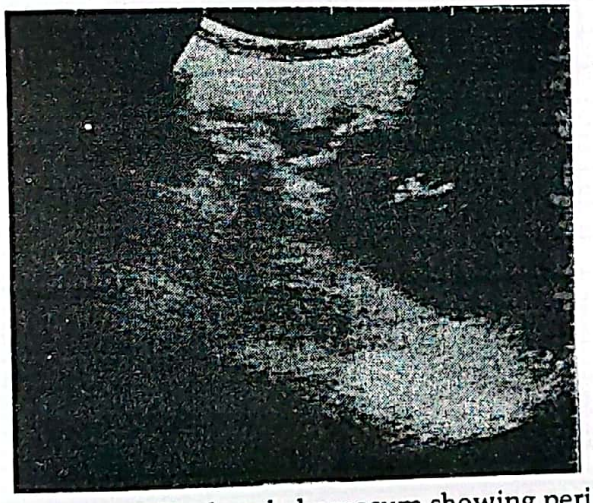

Figure 4.Ultrasonogram of displaced abomasum showing peritonitis as echogenic bands of fibrin (arrow) interspersed with hypoechoic exudate.

Laboratory findings:

As shown in Table (3) no changes were detected in all hematological data. Blood biochemistry revealed compensated metabolic alkalosis represented by elevation of pCO2 mmHg (46.5±5.6; reference range 34-45) and bicarbonate mmol/L (32.9±1.74; reference range 20-30), hypokalemia (3.05±0.46; reference range 3.9-5.8 mmol/L) and hypocalcaemia (0.9±0.14, reference range, 1.2-1.6 mmol/L). Ruminal liquid analysis showed watery consistency of ruminal fluid (slightly viscid in reference data), reduction in

pH (5.8±0.9; reference range 6.2-7.2), prolongation in time of methylene blue reduction test (13.0±4.2 minutes; reference range less than 3 minutes), and elevation of chloride content (55.0±2.48; reference range 10-25 mmol/L). Reduction in urine pH (6.51±0.7; reference range 7-8) and positive ketone bodies in urine samples were also recorded.

Table 3. Laboratory findings of LDA in 11 Holstein-Friesian dairy cattle.

Laboratory data	Mean±SD	Reference range*
Hematological data		
Erythrocyte count 10^{12}/L	9.79±0.43	5-10
Leucocyte count 10^{9}/L	7.82±5.2	4-12
Hemoglobin g/dL	11.03±0.78	8-15
Hematocrit %	34.01±3.2	24-40
Biochemical parameters		
Blood pH	7.4±0.08	7.35-7.50
pCO2 mmHg	46.5±5.6**	34-45
Bicarbonate mmol/L	32.9±1.74**	20-30
Protein g/L	75.0 ±5.0	57-81
Albumin g/L	32.0 ±7.0	21-36
Globulin g/L	34.3±0.05	36-45
AST U/L	110.7±3.9	78-132
ALT U/L	28.0±1.4	11-40
Glucose mmol/L	51.7±2.3	1.9-3.8
Urea nitrogen mmol/L	5.6±0.8	2-7.5
Creatinine µmol/L	142.1±0.07	67-175
Sodium mmol/L	136.09±4.5	132-152
Potassium mmol/L	3.05±0.46**	3.9-5.8
Calcium mmol/L	0.9±0.14**	1.2-1.6
Chloride mmol/L	98.4±1.2	69-110
Ruminal parameters		
Color	Green-dark green	Green-brownish green
Consistency	Watery	Slightly viscid
pH	5.8±0.9**	6.2-7.2
RMBT minutes	13.0±4.2**	Less than 3
Chloride content mmol/L	55.0±2.48**	10-25
Urine parameters		
pH	6.51±0.7**	7-8
Ketone urea	+(n=4), ++(n=5), +++(n=2)	Negative

*Radostits et al., 2007

**Detectable changes between examined cattle compared to reference range

Discussion

Production diseases including displaced abomasum (DA) in dairy cows continue to be a cause of economic loss for the dairy industry and an animal welfare concern. In the present study, a total of eleven Holstein-Friesian dairy cows with LDA were clinically, ultrasonographic and laboratory investigated.

The most prominent clinical signs were reduced appetite and milk yield, ping sound over the left 9-12th ribs by simultaneous percussion and auscultation, disturbed general condition, scant soft feces and reduced number and strength of ruminal contraction. All these clinical findings were nearly similar to those recorded by (Mueller, 2011).

Distension of abdomen at left dorsal area was observed in 63.3% cases. The gas-filled abomasum caused bulging of the left abdominal paralumbar fossa just caudal to the last rib (Radostits et al., 2007). Positive ping sound could be detected in severe ruminal atony (El-Attar et al., 2007), but in ruminal atony, this sound was heard over the left flank region. In LDA, this sound was heard at the area extended from 9th to 12th ICS. Thus, hearing of ping sound with detectable ruminal sound is considered pathognomonic for LDA. Other signs as systemic disturbance, pain reaction, and melena were observed with variable degrees and indicated bad prognosis. This result is in accordance to Braun et al. (1997a) who recorded disturbance in heart rate, respiratory rate and rectal temperature in complicated cases. In our study, disturbance in systemic states, pain reaction and melena were observed only in cases complicated with peritonitis secondary to LDA with perforated ulcer. By ultrasonography, the abomasum is found ventrally and caudal to the sternum at healthy condition (Braun et al., 1997b) and is generally characterized by homogeneous contents with moderately echogenic stippling.

In the present study, the abomasum with its heterogenic appearance was detected in all cows at the area of the left 10th and 12th ICS. This result is similar to OK et al., (2002). Gas cap with reverberation artifact appeared at the left dorsal region. This artifact is caused by the reflection of the ultrasound waves by abomasal gas and reverberation between the transducer and the abomasal surface. It appeared as lines of varying echogenicity running parallel to the abomasal surface and became weaker as the distance from the transducer increased (Braun et al., 1997a). Echogenic bands of abomasal folds were observed only in 4 diseased cows.

This result is in accordance with (Braun et al., 1997b). In our study, pylorus appeared as a circular, thick-walled, echogenic structure with an acoustic shadowing at left para-median under the 9th to 11th ICS at area extended between umbilicus and left costal arch. The observation of pylorus at this area confirmed the LDA. Normally, the pylorus is visible from the 10th intercostal space, 33 cm caudal to the xiphoid process and 26 cm to the right of the ventral midline (Braun et al., 1997 b; Braun, 2009). The useful uses of ultrasonography in this investigation not only for diagnosis of LDA but also for detecting the complications resulted from this condition. Peritonitis appeared in 3 cases as echogenic bands of fibrin interspersed with hypoechoic exudate. Peritonitis was recorded in calves as a complication of LDA (Muller et al., 1999; Altan et al., 2012; Grosche et al., 2012). Detection of peritonitis by ultrasound did not confirm that it is originated from LDA or perforated abomasum; because it also could be originated from traumatic reticulo-peritonitis (Abdelaal et al., 2009; Braun, 2009; Scott, 2012; Aref and Abdel-Hakiem, 2013).

Unlike Abdel-Raof and Ghanem (2007), our results showed no hematological changes in cattle with LDA. In contrast, biochemical data showed elevation in the level of bicarbonate. This result indicates that affected cows had metabolic alkalosis (Basoglu et al., 2014). Metabolic alkalosis occurs in cows with LDA due to loss of acid through sequestration of hydrogen chloride into abomasum. Loss of chloride is mainly accompanied with potassium loss and the condition is characterized by hypokalemic, hypochloremic alkalosis (Radostits et al., 2007; Constable et al., 2013). In agreement with Abdel-Raof and Ghanem (2007) hypocalcemia was recorded in our study. Radostits et al. (2007) stated that hypocalcemia which occurs commonly in mature dairy cows at the time of parturition, has been suggested as an important contributing factor in LDA and the abomasal motility is altered when the calcium level is below 1.2 mmol total calcium/L. In the present study, moderate to severe ketonuria was always present but the blood glucose level was within the normal range. This result is in accordance with El- Gharieb et al., (1996). Ketonuria is a manifestation of ketosis which occurs in concurrent with LDA. It also may be secondary to LDA due to starvation and negative energy balance or precede LDA and predispose to it (Stengarde, 2010; Stengarde et al., 2010). The pH of urine was lower in animals with LDA. Aciduria could be attributed to sodium retention and hydrogen excretion by urine due to dehydration (Radostits et al., 2007).

Watery consistency of ruminal fluid, prolonged methylene blue reduction time, mild decrease in ruminal pH and increase level of chloride ruminal content are in agreement with DeCardoso et al. (2008). According to Kelly (1979), the prolonged time of methylene blue reduction test and watery consistency of ruminal fluid indicate poor anaerobic fermentation in the rumen. Therefore, in the present work, there was loss in the ruminal microflora of the animals with LDA. Meanwhile, mild decrease in ruminal pH and elevation of ruminal chloride concentrations are contributed to abomasal reflux (Muller, 2011).

Conclusion

The results of this study indicate that ultrasonography is a valuable diagnostic tool for diagnosing LDA and its complication in cows.

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فحوصات سريريه ومعملية وبالموجات فوق الصوتيه لمرض انزياح المنفحة الايسر فى أبقار الهوليشتين فريزيان

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صمم هذا البحث لاثبات اهمية بعض الفحوصات السريرية والمعملية بالموجات فوق الصوتية لتشخيص مرض الانزياح الايسر للمنفحه. لهذا الغرض استخدمت 11 بقرة تعانى من هذا المرض. تم تسجيل نتائج جميع الفحوصات. وبناء على النتائج تم اتخاذ القرار بالتدخل الجراحى لثمانية حالات فقط و لم يتم التعامل مع الثلاث حالات الاخرى نظراً لتدهور حالتهم الصحية. سجلت النتائج السريريه تدهور فى الحالة العامة للحيوان ونقص فى كمية انتاج اللبن بالاضافة الى قلة الروث. حركة الكرش كانت قليلة وضعيفة وسماع صوت رنان مسموع فى المنطقة التى تقع بين الضلع التاسع والثانى عشر من الجهة اليسرى للحيوان وذلك باستخدام السماعة والطرق اليدوى معاً. أما الموجات فوق الصوتية فأثبتت وجود المنفحة فى نفس مكان وجود الصوت الرنان وتميزت المنفحه عن الاعضاء المجاورة فهناك محتوى رمادى الشكل يمثل الغذاء فى الجزء السفلى وهناك غازات فى الجزء العلوى والتى ظهرت على شكل انعكاسات تلى بعضها البعض. تمثلت النتائج المعمليه للمرض فى قلوية الدم- نقص فى البوتاسيوم والكالسيوم ونقص طفيف فى الاس الهيدروجنى لمحتوى الكرش- زيادة فى نسبة الكلوريد بالكرش- زيادة الوقت اللازم لاختزال الميثيلين الازرق المخفف 0.03% بالاضافه الى وجود اجسام كيتونية فى البول. نستخلص من نتائج البحث ان الموجات الفوق صوتية تعد طريقه سهله ومؤكدة لتشخيص هذا المرض فى الابقار وأيضا يساعد على اتخاذ القرار المناسب اما بالتدخل الجراحى أو الذبح.