Hematological and Biochemical Evaluation in Holstein-Friesian Cows Before and After Surgical Correction of Left Abomasal Displacement on-Field Condition

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ABSTRACT

Left abomasal displacement (LAD) is a major disorder occurring in the postpartum period and causes confusion with metabolic diseases in high producing dairy cattle. Surgical correction of abomasal displacement is the most reliable method of treatment. This study aimed to evaluated some hematological and biochemical parameters before and after right omentopexy correction of LAD as well as evaluation of short and long term outcomes after surgery. The study included 85 lactating dairy cows (Holstein-Friesian) with LAD treated surgically with right omentopexy technique (LAD group) and 20 healthy dairy cows at 2-6 week postpartum (control group). In LAD group, the blood samples were collected before surgery (d0), after 3 days (d3) and 7 days (d7) post-surgery. Each sample was analyzed for complete blood count (CBC), serum total protein (TP), albumin (AL), globulin (GL), triglycerides (TG), cholesterol (CL), hepatic enzymes (AST, ALT, GGT), alkaline phosphatase (AP), C-reactive protein (CRP) and serum electrolytes as Na and K using commercial available test kits. There were significant hemocoagulation, anemia, and leukopenia with neutropenia in d0 in comparison to control group. Furthermore, there were hypoalbuminemia, hyperglobulinemia, significant decrease in serum triglycerides and cholesterol concentrations in cows at d0. There was significant increase in ALT, AST, GGT, AP and CRP while there were hypokalemia and hyponatremia in cows with LAD at d0. Hematological, biochemical, hepatic function alterations, and inflammatory reaction in LAD cows were relieved after 3 days of surgical correction indicating that these cows were restoring their physiological status and all cows were cured after one week of operation without any incisional complications (short term outcomes). The long term outcomes was also impressive as 94.1% were still alive in a good health condition without recurrent abomasal displacement, and 70.6% was confirmed to be pregnant within first three months follow up after surgical correction.

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1. INTRODUCTION

Left abomasal displacement (LAD) is one of the major disorders occurring 2-4 weeks postpartum in high producing dairy cattle and causes high economic loss in dairy industry (Radostits et al., 2007 and Basiri et al., 2013). Although the causes and pathogenesis behind LAD is not completely understood, there are many factors contributing in development of this disorder. Abomasal hypomotility is considered the most important factor which associated with hypocalcemia, hypokalemia and other concurrent diseases causing endotoxemia (Radostits et al., 2007). Ketosis or sub-clinical ketosis is also a common risk factor for LAD (Geishauser et al., 2000). During this period, the animal suffers from negative energy balance leading to fat mobilization from adipose tissues and production of high concentrations of nonesterified fatty acids (NEFA) in the blood (Van Winden et al., 2004; Cardoso et al., 2008; Zurr and Leonhard-Marek, 2012). The elevated concentration of NEFA is known to have a negative impact on immune and inflammatory function through the metabolic stress and production of reactive oxygen species (ROS) (Contreras & Sordillo, 2011 and Durgut et al., 2016). Elevated ROS enhance proinflammatory cytokines and acute phase proteins production (Yun et al., 2014). This inflammatory response can alter the gastrointestinal motility and may be induce further abomasal hypomotility (Fubini and Ducharme, 2016).

The surgical treatment was the most reliable and cost-effective mean of decreasing the financial loss incurred by abomasal displacement (Ruegg and Carpenter, 1989). The restoration of abomasal
motility should expel gas and allow it to return to its normal anatomic position (Trent, 2004). The right paralumbar fossa approach with omental fixation (right paralumbar fossa omentopexy) appears to be the most widely used surgical techniques (Connell, 1976 and Rohn et al., 2004). Omentopexy have been described to be more effective in LAD (Rohn et al., 2004).

Hematological and biochemical alterations associated with LAD can be more serious and have a negative impact on postsurgical outcomes (Mokhber et al., 2013). Moreover, postsurgical recovery is impeded until correction of metabolic abnormalities has been accomplished (Kaneko, 2014).

Therefore, the present study aimed to evaluate the changes in hematological and biochemical parameters before and after surgical correction of LAD using right paralumbar fossa omentopexy on-field condition to determine the postsurgical recovery and to evaluate the short and long-term outcomes after surgery.

2. MATERIAL AND METHODS

2.1. Animals

The study included 20 healthy dairy cows at 2-6 week postpartum (control group) and 85 lactating dairy cows (Holstein-Friesian) with LAD (LAD group). All included cows with LAD were at postpartum stage. Their age was between 3-5 years old, and they had been lactating for 35 ± 23 days. The included cows were from 5 private farms in Ketor city, El-Gharbia government, Egypt in the period between May 2012 and May 2015.

A preliminary diagnosis was based on history, clinical findings, physical examination and simultaneous auscultation and percussion over the left abdominal wall in an area marked by a line drawn from the left tuber coxae to the elbow and from the elbow to the stifle between ribs 9 and 11 (Mokhber et al., 2013) in addition to rectal examination and finally the diagnosis was confirmed at surgery.

Pulse rate, respiratory rate, rectal temperature and rumen contractions were obtained immediately before surgery (d0) and after 72hrs (d3), and 168hrs (d7) of surgery.

2.2. Hematological and serum biochemical analysis

Jugular venous blood samples were obtained into plain tubes as well as EDTA tubes from control group and from LAD group (d0, d3, and d7). The serum was collected by centrifugation of blood samples at 3000 rpm for 10 min, and then sera were stored at −20°C until further analysis.

Each sample was analyzed manually for a complete blood count (CBC) (including differential leucocytes count) using light microscope with oil immersion lens. All serum concentrations of total protein (TP), albumin (AL), globulin (GL), triglycerides (TG), cholesterol (CL), aspartate aminotransferase (AST), alanine aminotransferase (ALT), Gamma-glutamyl transpeptidase (GGT), alkaline phosphatase (AP), and serum electrolytes as Na and K were analyzed spectrophotometrically by means of autoanalyzer (MCC-3000, China) using commercially available test kits supplied by Biomed diagnostics (Germany). C- reactive protein (CRP) was estimated with a commercially available bovine ELISA kit (CRP-11, Life Diagnostics, Inc., West Chester, Pennsylvania), according to the manufacturer’s instructions.

2.3. Surgical protocol (Right Paralumber fossa Omentopexy)

Owner consent was obtained before surgery. All surgeries were performed by one surgeon. The surgical protocol in this study was the same as mentioned by Dr. André Desrochers (Desrochers, A. and Harvey, D. 2002).

The procedure was performed on cow in standing position. Xylazine hydrochloride (Xyla-Ject, ADWIA Pharmaceuticals Co. Cairo, Egypt) was administered intravenously (I.V) at a dosage of 0.05 mg/kg body weight (BW).

After surgical preparation and local desensitization of the right paralumbar fossa, a 15 cm laparotomy incision was made at the center of the sub-lumbar fossa, 10 cm caudal to the most posterior aspect of the last rib. The left displaced abomasum was confirmed between the rumen and left abdominal wall.

Deflation of distended abomasum using a 14-gauge needle (guided by surgeon's hand) attached to a flexible tube was inserted into the dorsal aspect of the abomasal lumen (intramurally) to decompress the gas accumulated within the displaced abomasum. The gas was suctioned through the tube, causing the abomasum to deflate, gradually descend and move ventrally. Once the abomasum was sufficiently deflated, the needle and the tube can be withdrawn (Fig. 1).

The abomasum was pulled underneath the rumen from the left to the right ventral abdomen (Fig. 1). The greater omentum was exteriorized and the pig ear (fat fold in the greater omentum near the pylorus) (Fig. 2) and pylorus were identified (Fig.
3. The pyloric greater omentum was grasped toward the incision easily. Two stay sutures (anchoring sutures) were prepared, one cranially and the other caudally to the incision. The first cranial suture passed through the oblique muscles, the transverse muscle, and the peritoneum. The needle passed through the omentum then through the peritoneum, the transverse muscle, and the oblique muscles. The same procedure was repeated caudally to the incision to prepare the second caudal stay suture. Both sutures were then held by forceps.

An omentopexy was performed approximately 10 cm caudal to the pylorus, the greater omentum was tightly sealed using USP 1 vicryle in a continuous 'through and through' pattern that pass through the transverse abdominal muscle, the peritoneum, and the omentum. The omentum should protrude through the first muscular layer permitting a strong adhesion to the abdominal wall (Fig. 4).

After closure of abdominal muscles, both stay sutures (anchoring sutures) are closed (Fig. 4). The skin incision was closed using USP 1 vicryle in a ford interlocking suture pattern.

2.4. Postsurgical procedures

Postsurgical medical treatment included the use of systemic antibiotics (Pentomycin®, AM Trading, 1ml/25kg BW), anti-inflammatory (Finadyne®, Schering-Plough, 1ml/45 kg BW), and IV fluid therapy such as ringer solution 1 litter and 25% glucose 500 ml. All cows were fed on hay for the first three postoperative days.

Physical examinations were performed daily every morning for 3 days after the day of surgery (day0), including body temperature, heart and respiration rate, and rumen contractions. Daily milk yield was recorded after surgery.

2.5. Follow up

The short-term outcomes were obtained for one week post-surgery by in farm visit and checking for the appetite, milk production as well as thorough physical examination.

The long-term outcomes were obtained by in farm visit and owner telephone inquiry about general health condition, reproductive performance of the cows following surgery, and whether they were going to continue in the herd.

2.6. Statistical analysis

All the data were analyzed using SPSS statistical software, version 16 (SPSS Inc., Chicago, Illinois). The data from the control group and cows with LAD before and after surgical treatment at different times were analyzed using the student's t test, whereas, ANOVA was also used to analyze the data from cows with LAD group at three different time points (d0, d3 and d7). The data were considered significant when p < 0.05.

3. RESULTS

All involved dairy cows had signs of sharp drop of milk production 3-6 weeks after calving, inappetence and a decrease in fecal output or sometimes diarrhea. The mean duration of clinical symptoms before surgery was 48 ± 22.6 hours. By physical examination, pulse rate, respiratory rate, rectal temperature and rumen contractions were (72±8 beat/min, 24±6/min, 38.5±0.24°C and 1±0.5/2min) respectively. Simultaneous auscultation and percussion revealed an area of high-pitched metallic tinkling sound presented above or below the line extended from the tuber coxae to the elbow between 9-11 intercostal spaces on the left side.

The mean duration of surgical operation was 38±8.3 minutes. After surgery, the short term outcomes were measured or observed during the seven days post operation. The animal returned to its normal appetite with significant increase in ruminal contraction (2.6±0.6/ 2min) after 3 days of surgical treatment (Table 1). Milk yield increased gradually in the three successive days following surgery. No incisional complications were observed within 7 days following surgery.

For long term surgical outcomes, 100% of cows in the study had no recurrent abomasal displacement in one year following up after surgery. From all surgically treated LAD cows, 60 (70.6%) were confirmed to be pregnant, 11 (12.9%) bred and confirmed to be non-pregnant, and 14 (16.5%) not bred at the postoperative first three months follow up. Five cows (5.9%) were culled in the first five months post-surgery for other several reasons such as (septic arthritis, severe impaction) while 80 cows (94.1 %) were still alive and in good health condition.

3.1. Hematological and biochemical changes

The mean ±SD of the hematological parameters in healthy cattle (control group) and cattle with LAD before and after different time of surgery is presented in Table 2. Cows with LAD had a significant decrease (P<0.001) in the RBCs count, and hemoglobin concentration at d0 and begin to increase gradually till reach the normal value at d7. There was a significant increase (P<0.001) of PCV% in cows with LAD at d0 compared to control and then it decreased gradually after surgery but still
Table 1: Clinical parameters in both healthy control and cows with left abomasal displacement (mean values ±SD)

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Control</th>
<th>Before</th>
<th>LAD Omentopexy after 3d</th>
<th>after 7d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pulse rate /min</td>
<td>69.00 ± 9.00 a</td>
<td>72.00±8.00 a</td>
<td>71.00±5.00 a</td>
<td>69.00±7.00 a</td>
</tr>
<tr>
<td>Respiratory rate/min</td>
<td>22.00± 3.00 a</td>
<td>24.00±6.00 a</td>
<td>25.00±3.00 a</td>
<td>21.00±5.00 a</td>
</tr>
<tr>
<td>Rectal temperature</td>
<td>38.36± 0.19 a</td>
<td>38.00±0.24 a</td>
<td>38.33±0.10 a</td>
<td>38.40±0.10 a</td>
</tr>
<tr>
<td>Rumen contractions/ 2min</td>
<td>3.80 ± 0.70 a</td>
<td>01.00±0.50 b</td>
<td>02.6±0.60 a</td>
<td>03.30±0.20 a</td>
</tr>
</tbody>
</table>

A,b,c,d different letters in the same raw indicates a significance difference (p > 0.05) between groups.

Table 2: Hematological parameters in both healthy control and cows with left abomasal displacement (mean values ±SD)

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Control</th>
<th>Before</th>
<th>LAD Omentopexy after 3d</th>
<th>after 7d</th>
</tr>
</thead>
<tbody>
<tr>
<td>RBCs count (x10^6/μl)</td>
<td>06.8 ± 0.19 a</td>
<td>05.10±0.71 b</td>
<td>05.50±0.32 c</td>
<td>06.9±0.33a</td>
</tr>
<tr>
<td>Hb gm%</td>
<td>12.95± 0.31 a</td>
<td>11.86±0.21 b</td>
<td>12.30±0.40 a</td>
<td>12.8±0.67 a</td>
</tr>
<tr>
<td>PCV %</td>
<td>35.40± 0.70 a</td>
<td>38.00±2.10 b</td>
<td>36.00±1.20 c</td>
<td>35.0±0.74 d</td>
</tr>
<tr>
<td>TLC (x10^3/μl)</td>
<td>6.03 ± 0.26 a</td>
<td>04.90±1.20 b</td>
<td>06.00±0.80 c</td>
<td>7.90±0.11 d</td>
</tr>
<tr>
<td>Neutrophils (x10^3/μl)</td>
<td>02.03±0.10 a</td>
<td>01.80±0.10 b</td>
<td>02.70±0.20 c</td>
<td>2.50±0.5 d</td>
</tr>
<tr>
<td>Lymphocytes (x10^3/μl)</td>
<td>04.00±0.07 a</td>
<td>02.11±0.85 b</td>
<td>03.20±0.10 c</td>
<td>4.00±0.9 a</td>
</tr>
</tbody>
</table>

A,b,c,d different letters in the same raw indicates a significance difference (p > 0.05) between groups.

Table 3: Biochemical parameters and C-reactive proteins in both control and cows with left abomasal displacement (mean values ±SD)

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Control</th>
<th>Before</th>
<th>LAD Omentopexy after 3d</th>
<th>after 7d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total protein (g/dl)</td>
<td>06.35±1.27 a</td>
<td>06.25±0.05 a</td>
<td>06.58±1.01 a</td>
<td>06.15±0.13 a</td>
</tr>
<tr>
<td>Albumen (g/dl)</td>
<td>03.5± 0.06 a</td>
<td>02.99±0.31 b</td>
<td>03.00±0.14 b</td>
<td>03.50±0.05 a</td>
</tr>
<tr>
<td>Globulin (g/dl)</td>
<td>02.95±1.13 a</td>
<td>3.05±0.82 a</td>
<td>03.85±0.97 b</td>
<td>02.90±0.74 a</td>
</tr>
<tr>
<td>A/G ratio</td>
<td>01.2 ± 0.38 a</td>
<td>0.96±0.10 b</td>
<td>00.77±0.17 b</td>
<td>1.20±0.06 a</td>
</tr>
<tr>
<td>Triglycerides (mg/dl)</td>
<td>41.00±6.30 a</td>
<td>31.51±5.73 b</td>
<td>39.10±6.67 c</td>
<td>40.10±6.00 c</td>
</tr>
<tr>
<td>Cholesterol (mg/dl)</td>
<td>145.5±6.7 a</td>
<td>122.8±8.8 b</td>
<td>130.8±9.81 c</td>
<td>145±14.17 a</td>
</tr>
<tr>
<td>AST (IU/L)</td>
<td>53.60±7.91 a</td>
<td>130.5±6.21 b</td>
<td>100 ±6.29 c</td>
<td>92.90±5.90 d</td>
</tr>
<tr>
<td>ALT (IU/L)</td>
<td>28.10±4.69 a</td>
<td>127.0±8.73 b</td>
<td>105±6.52 c</td>
<td>105±3.82 d</td>
</tr>
<tr>
<td>GGT (IU/L)</td>
<td>30.00±0.83 a</td>
<td>40.50±3.57 b</td>
<td>34.00±2.41 c</td>
<td>30.00±1.17 d</td>
</tr>
<tr>
<td>AP (IU/L)</td>
<td>93.5±11.90 a</td>
<td>135±38.00 b</td>
<td>120.7±9.98 c</td>
<td>132±12.01 d</td>
</tr>
<tr>
<td>CRP (µg/ml)</td>
<td>30.00±5.1 a</td>
<td>60.00±4.40 b</td>
<td>50.00±9.90 c</td>
<td>40.00±9.90 d</td>
</tr>
<tr>
<td>K (mmol/l)</td>
<td>4.10±0.25 a</td>
<td>03.89±0.45 b</td>
<td>4.60±3.43 a</td>
<td>03.9±3.28 a</td>
</tr>
<tr>
<td>Na (mmol/l)</td>
<td>135±0.38 a</td>
<td>129.0±3.28 b</td>
<td>135±3.43 a</td>
<td>136±0.28 b</td>
</tr>
</tbody>
</table>

A,b,c,d different letters in the same raw indicates a significance difference (p > 0.05) between groups.

Significantly high at d7. A significant decrease (P < 0.001) in the total leukocyte count (TLC) was detected with neutropenia in cows with LAD at d0. The TLC and neutrophils increase gradually after surgery and they still significantly high at d7. In addition, the alteration in biochemical changes were recorded in Table 3, which showed a non-significant changes in in serum total protein before and after surgery while serum albumin was significantly decrease (P < 0.001) at d0 and d3 post-surgery and returned to its basal value after d7. The decline in serum albumin concentration was associated with significant (P < 0.001) elevation in serum globulin and significant decrease in A/G ratio at d0 and d3 post-surgery. Triglycerides and cholesterol were significantly (P < 0.05) decrease in cows with LAD at d0 and after surgical correction; their concentration began to increase gradually till d7 post-surgery and reached to baseline levels.
AST, ALT, GGT, and AP showed a significant increase in their activities in cows with LAD which began to decline gradually but they were still significantly high till d7 post operation. Moreover, C-reactive protein (CRP) showed a duplication of its concentration in cows with LAD at d0 which decreased gradually after 3 and 7 days post-surgery, but still significantly higher in comparison to control group. There were significant ($P < 0.05$) decrease in serum sodium and potassium concentrations before surgery d0 and began to increase gradually after surgery.

4. DISCUSSION
Abomasum displacement is a diseased condition causing confusion with metabolic diseases in dairy cows as it is frequently affected high lactating dairy cattle postpartum (El-Deen and Abouelnasr, 2014). It is a worldwide disease and its incidence varies considerably in different countries, under different management, and different feeding conditions (Stengardel, 2010). LAD seems to occur more frequently nowadays in Egypt due to intensive rearing of pure foreign breeds of high milk production.
In the present study, the incidence of LAD in those 5 high-producing dairy farms in Ketor city, El-Gharbia government was varied between 3-9% per year which could be attributed to the bad management practice and poor feeding program during transition period.

In this study, rectal temperature, pulse and respiration rate of the affected cows with LAD were within the physiological reference range before and after surgery as reported by other previous studies (Wittek et al., 2009, and El-Deen and Abouelnasr, 2014). While another study (Mokhber et al., 2013) recorded an increased body temperature, heart rate, and respiratory rates in LAD-affected cows. Ruminal movement was reduced in the diseased cows at d0 then they improved after the surgical correction of LAD. This could be attributed to ruminal and abomasal atony resulting from subclinical hypocalcemia which could be associated with abomasal displacement occurrence (Jorgensen et al., 1998).

Surgical correction of LAD is a common therapeutic procedure for cattle practitioners. Metabolic alterations associated with the disease have been reported in previous studies (Klevenhusen et al., 2015). The hematological parameters showed significant decrease in RBCs and Hb concentrations which indicate clinical anemia in the affected cows at d0 and began to improve after surgery. This could be attributed to a bad nutritional status in the affected cows in the present study. Most cases of LAD occur in the postpartum period and inanition during this period leads to serious metabolic consequences as the postpartum energy imbalance is mostly influenced by feed intake. Prolonged periods of bad appetite lead to the same consequences (Rohn et al., 2004).

In the present study, there was leukopenia and neutropenia in cows with LAD at d0 in comparison to control group and this is coincided with previous study (Zadnik, 2003). This decrease in leukocytes and neutrophils could be attributed to the small capacity of bone marrow reserve for granulocytes in cattle resulting in an initial neutropenic rather than a neutrophilic reaction in an early inflammatory process as well as neutrophil numbers decrease in the postpartum period (Gilbert et al., 1993), and in lactating cows and cattle with metabolic diseases (Wood & Quiroz-Rocha, 2010 and Roland et al., 2014).

Mild hemoconcentration with increase in PCV % in cows with LAD at d0 were characteristic findings. These parameters tended to become normal within a few days after surgery. This is attributed to mild to moderate dehydration in affected cattle with LAD as was reported previous studies (Zadnik, 2003 and Rohn et al., 2004). Hemoconcentration in cows with LAD results from trapping of fluid in the displaced...
abomasum and blockage of the transport of fluid into the duodenum (Geishauer and Seeh, 1996). On the other side, the biochemical parameters showed mild hypalbuminemia at d 0 without significant changes in total protein in comparison to healthy cow. This indicated an acute inflammatory response which albumin is considered as a negative phase protein which is down regulated by inflammation (Tothova et al., 2014). Parallel, there were hyperglobulinemia and decrease in A/G ratio which indicate the inflammatory process (Steven et al., 2013).

Biochemical analyses evidenced hepatic cell injury (significant increase of hepatic enzymes (AST, ALT, GGT, AP) and liver dysfunction (hyypoalbuminemia, marked decrease serum triglycerides and cholesterol concentrations) suggesting a severe impairment of protein and lipid metabolism. This could be attributed to hepatic dysfunction in cows with LAD which associated with hepatic lipidosis. These results were agreeable with those of (OZkan and Poulsen, 1986, Zadnik, 2003, and El-Attar et al., 2007). In the present study, Hyponatremia and low serum potassium levels were recorded in cows with LAD at d 0. The significant reduction of sodium electrolyte in cases of LAD could result from the metabolic acid–base imbalance due to the duodeno-abomasal reflux (Geishauer and Seeh, 1996). Hypokalemia is due to decreased intake of feeds high in potassium, sequestration of potassium in the abomasum, and dehydration (Constable et al., 2013).

The underlying metabolic alterations in LAD lead to immune response and release of acute phase proteins causing an inflammatory condition which likely to force the body to hemostatic control through minimizing the tissue injury and enhance tissue repair (Amadroi, 2016). There have been few studies to assess the acute phase protein in cow with LAD (Mamak et al., 2013). C-reactive protein (CRP) is one of the major acute phase proteins (APP) which were synthetized in liver in response to mononuclear cells stimulation and responsible for minimizing tissue damage, and facilitating tissue repair and regeneration (Lee et al., 2003). In the present study, there was a significant increase of CRP in cows with LAD at d 0 which decrease gradually after surgery but still higher than control group after 7 post-surgery. This expressed the acute inflammatory response against metabolic alterations resulting from hepatic injury and tissue damage due to metabolic stress.

In the present study, the short term outcome was 100% as all surgically treated cows were cured after 7 days of surgical correction. The short term outcome can be assessed clinically by returning of the cow to its normal appetite, milk yield and digital clinical parameters such as (heart rate, respiratory rate, rectal temperature and rumen motility) after 3 days of surgery. None of LAD cows in the study had recurred. This is differ from other studies using the same surgical approach or using two-step laparoscopic-Janowitz technique which showed 1.8% and 0.25% of cows with LAD had recurred respectively (Verhoef, 2005, and Sexton et al., 2007).

The long term outcomes were impressive as 94.1% were still alive in a good health condition without recurrent abomasal displacement, and 70.6% was confirmed to be pregnant within one year after surgical correction. This is approximately equal to the previous studies that recorded 79% and 88% of cows confirmed to be pregnant after left paralumbar omentopexy (Vlaminck et al., 1998 and Sexton et al., 2007).

In this study, the culling was 5.9% in the first five months post-surgery which was lower than that reported in previous study which recorded 25% culling after one year of surgical correction of LAD using omentopexy fixation technique (Vlaminck et al., 1998).

On the basis of the present results, it can be concluded that LAD was associated with hematological and biochemical alterations as well as acute inflammatory response. Most of the metabolic alterations can be relieved after three days of surgical corrections. The changes in the pattern of serum biochemical constituents throughout this study indicated the recovery of diseased cows and the significant effect of surgical operation.

5. REFERENCES


Wittek, T., Lucher, L., Alkaassem, A., Constable, P. 2009. Effect of surgical correction of left displaced abomasum by means of omentopecty via right paralumber fossa laparotomy or two-step laparoscopy-guided abomasopexy on postoperative abomasal emptying rate in lactating dairy cows
