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# Association of Clinical, Laboratory and Ultrasonographic Findings in Egyptian Buffaloes (*Bubalus bubalis*) with Caecal and Colonic Dilatation

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**Abstract:** The present study was conducted to assess disorders of large intestine in Egyptian buffaloes (*Bubalus bubalis*) with special emphasis on the diagnostic value of ultrasonographic findings. The current study had established certain points or findings by the aid of ultrasonography which was very helpful in the diagnosis of caecal or colonal dilatation as well as enhancing its differentiation from other intestinal disorders. Buffaloes (n=40) were included in the study and divided into 2 equal groups: control healthy group (n=20) and diseased one (n=20). Diseased buffaloes were admitted to Veterinary Teaching Hospital at Assiut University-Egypt. These animals were subjected to clinical, laboratory and ultrasonographical examinations. The current study reported that rectal palpation allowed accurate diagnosis of caecal dilatation and was a more important diagnostic tool than swinging and/or percussion auscultation. The diseased buffaloes showed lymphocytic leucocytosis with significant hypoproteinemia and hypoalbuminemia with significant increase in blood serum activities of aspartate aminotransferase (AST) ($P<0.01$) and alkaline phosphatase (ALK) ($P<0.05$). Caecal and/or colonal dilatation in buffaloes were diagnosed based upon the use of ultrasonography and clinical laboratory tests. The dilated caecum and proximal loop of colon occupied the last right three intercostal space (ICSs) particularly their ventral part, intertangled with the liver dorsally in these ICSs. They also filled the whole right flank region. The dilated loop is situated immediately adjacent to the right flank region and make invisualization of loops and peristaltic movement of the small intestine and right kidney. The closest wall of the dilated caecum and proximal loop of the colon was imaged as thick semi-circular echogenic line with invisualization of the furthest wall and their contents due to the reverberation artifacts at the soft- tissue gas interface. Some of diseased cases included other affections such as liver abscess. In conclusion, the study stated several diagnostic findings of caecal and/or colonal dilatation in which clinical findings and laboratory indices were not characteristic, based mainly upon both of the acoustic windows for large intestine visualization and the characteristic ultrasonographic findings of caecal and/or colonal dilation.

**Key words:** Buffalo % Caecal Dilatation % Large Intestine % Ultrasonography

## INTRODUCTION

The applications of ultrasonography in bovine medicine involve diagnosis of cardiac [1] abdominal [3-7] and musculoskeletal examinations [8].

Caecal dilatation occurs primarily in dairy cattle in the first few months of lactation. The caecum may be dilated with gas or distended with ingesta and volvulus may occur. Clinically it is characterized by inappetence, drop in milk production, decreased amount of feces, a ping over

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the right upper flank and a distended right abdomen, easily recognizable viscus on rectal palpation. The prognosis is usually good if the diagnosis is made early [9].

In caecal dilatation without volvulus, there are varying degrees of anorexia, mild abdominal discomfort, a decreased milk production over a period of a few days and a reduced feces output [10, 11]. In some cases there are no clinical signs and the dilated caecum is found coincidentally on rectal examination. In simple dilatation, the temperature, heart rate and respirations are usually within normal ranges. A distinct ping is heard on percussion and simultaneous auscultation in the right flank region, extending forward to the 10th inter-costal space (ICS) [10].

In caecal volvulus, anorexia, ruminal atony, reduced amount or complete absence of feces, distended right flank, dehydration and tachycardia are evident, depending on the severity of the volvulus and the degree of ischemic necrosis. There may be some evidence of mild abdominal pain characterized by treading of the pelvic limbs and kicking at the abdomen. The ping is centered over the right para-lumbar fossa and may extend to the 10th and 12th ICSs. Fluid-splashing sounds are usually audible on ballottement and auscultation of the right flank [9, 10].

In cattle with caecal dilatation, there is distension of the caecum, which may be accompanied by displacement, torsion or retroflexion of the organ and additional distension of the spiral colon [12]. With distension alone, the apex of the caecum is displaced toward or into the pelvic inlet. With torsion, the distended caecum rotates about its longitudinal axis and with retroflexion, the caecum folds dorsally or ventrally in the ileocaecal region, resulting in a cranial orientation of the apex. Caecal dilatation is associated with partial or complete cessation of the passage of intestinal contents [13, 14].

Haematological and blood biochemical analyses indices are not diagnostic for caecal dilatation but may be useful to estimate the severity of disease. For example, an elevation in the haematocrit may indicate dehydration and increases in the concentration of blood urea nitrogen may be a sign of prerenal azotemia [15, 16].

Trans rectal palpation of dilated caecum / colon and clinical signs of obstruction are usually diagnostic. In apparently healthy cows, ultrasonographic features of healthy and dilated caecum/colons has been well illustrated [3, 7]. Studies establishing ultrasound based prognostic indicators of cecal and colonic dilatation in bovine may be of great clinical merit. Research work on species (Cows versus buffalo) differences in the clinical presentation, hemato-biochemical profile or ultrasonographic features of diseased caecum may be a novel idea. Accordingly, the current study established certain points or findings by the aids of ultrasonography which might be helpful in the diagnosis of caecal or colonal dilatation in buffaloes as well as enhancing its differentiation from other intestinal disorders.

## MATERIALS AND METHODS

**Animals:** The study was carried out on forty buffaloes of different ages. They were divided into two groups: control group (n=20) and diseased group (n=20). The control group was selected from healthy buffaloes belonged to a herd at the Veterinary Teaching Hospital (VTH), Faculty of Veterinary Medicine, Assiut University, Egypt. The diseased buffaloes were admitted to the VTH with a history of anorexia, decrease fecal output and abdominal pain. Various degrees of abdominal distention, mucoid scanty faeces and reduction of milk production separately or collectively were also reported in some cases.

**Blood Sampling:** Whole blood and serum samples were collected and all precautions of sample collections and preparation for accurate evaluation of hematological and biochemical indices were taken into consideration according to Coles [17].

**Clinical Examination:** All buffaloes underwent a thorough clinical examination described by Jackson and Cockcroft [18]. The general condition, rectal temperature, heart rate, respiratory rate and lung sounds were determined. Swinging and/or percussion auscultation on both sides of the abdomen. Animals were treated in accordance with guidelines established by the Faculty of Veterinary Medicine, Assiut University Committee on Animal Care.

**Complete Blood Count (CBC) Assessment:** A fully automated blood cell counter machine, Medonic CA620 Vet hematology analyzer –Sweden, was used to determine various hematological parameters. Differential leukocytic count (DLC) was determined using four field meander method [19].

**Biochemical Assays:** Spectrophotometric method using Phillips PyeUnicam spectrophotometer (U.V. Visible Mod. 800) was adopted to determine serum concentrations of liver enzymes: aspartate aminotransferase (AST), (-glutamyltransferase (GGT) and alkaline phosphatase (ALK), serum Total protein, Serum albumin, cholesterol and triglycerides (TG). Serum globulin was determined by

subtraction of albumin from total protein and its value used to calculate albumin/globulin ratio (A/G ratio). All kits and reagents were obtained from Spectrum Reagents (Egyptian Company for Biotechnology, Egypt).

**Ultrasonographical Examination:** Diseased and healthy buffaloes abdominal contents[3, 20-25] were examined ultrasonographically using a 3.5 MHz Sector transducer (Scanner FF Sonic, Model UF-4000, Tokyo, Japan) to detect either the normal organs in the control animals or the affected one in diseased buffaloes. It was performed on standing non-sedated buffaloes after the application of transmission gel. The hair was clipped from the area where the transducer was applied; for obtaining optimal transmission of ultrasound waves, remaining hair may be removed a razor or depilatory cream. The examined organs included heart, reticulum, rumen, abomasum, omasum, spleen, liver, gall bladder, right kidney, small intestine (SI) and large intestine (LI) intestine. Dorsal and ventral parts of the right flank and the last 3 right ICSs was screened for determination of intestinal disorders.

**Statistical Analysis:** Data were analyzed using SPSS 16. All data were presented as mean ± standard deviation (SD). Analysis of variance of the obtained data was done and significance level was set at $P>0.05$. The significance of differences between the means at control group and diseased group was evaluated [26].

## RESULTS

**Clinical Findings:** The most common clinical signs associated with intestinal disorders included marked decrease of appetite, distended abdomen especially in the right side, associated with pain sensation on palpation and tensed abdomen. Some cases (n=11) expressed colic pain without defecation and straining. Rectal examination indicated empty rectum with the presence of mucus and dilated loop of caecum and/or colon. Body temperature, heart rate and respiration were usually normal with reduced (n=12) to absent (n=8) ruminal motility.

**Blood Picture and Serum Biochemical Analysis:** The hematological profiles (Table 1) in the diseased buffaloes showed lymphocytic leucocytosis. The blood serum biochemical levels (Table 1) showed significant hypoproteinemia and hypoalbuminemia with significant increase in blood serum activities of AST and ALK.

**Ultrasonographic Findings:** Ultrasonographic examination of the control group revealed that these animals had healthy normal reticulum, rumen, abomasums, omasum, spleen, heart, liver, Gall bladder, large intestine and small intestine.

Small (SI) and large (LI) intestine were imaged from the right flank region. The descending part of the duodenum was imaged from the dorsal part of the right flank region. It had echogenic envelop with diameter of 1.7- 4 cm and it also imaged from the ventral part of the last three right ICSs (Fig. 1a). The loops of jejunum and ileum were usually imaged from the dorsal right flank region between the caecum and/or colon and right abdominal wall (Fig. 1b, 2a). They were imaged in cross section as loops with two echogenic wall and echoic or hypoechoic contents. Their diameters were 2.5-4.2 cm (Fig. 1b). The normal peristaltic movement of the small intestine was clearly observed (Segmental vigorous contractions). The contents of small intestine were usually echoic (Fig. 1a) and sometimes imaged hypoechoic (Fig. 1b). The two walls (The closest and furthest ones from the transducer) of small intestine were imaged as echogenic wall.

In healthy buffaloes, the caecum and proximal loop of the colon and the spiral colon could be clearly imaged from the right flank region (ventrally). They were usually imaged medially to the loops of small intestine (Fig. 2a). The closest wall (To the transducer) of the proximal loop of colon and caecum was imaged as continuous echogenic line, slightly curved (Fig. 2a) or gar-land like appearance (Spiral colon) (Fig. 2b), meanwhile, the furthest wall of caecum and colon could not be imaged. The obtained results demonstrated that ultrasonography had a very important diagnostic and prognostic significance in detection and evaluations of large intestine disorders mainly caecal and/or colonal dilatation. The dilated caecum and proximal loop of colon occupied the last right three ICSs particularly their ventral part and intertangled with the liver dorsally in these ICSs (Fig. 3 and 5). They also filled the whole right flank region. The dilated loop is situated immediately adjacent to the right flank region and make invisualization of loops and peristaltic movement of the small intestine (Fig. 4). The closest wall of the dilated caecum and proximal loop of the colon was imaged as thick semi-circular echogenic line (Fig.3) with invisualization of the furthest wall and their contents due to the reverberation artifacts at the soft- tissue gas interface. The right kidney was not imaged (Fig. 4).

Table 1: Mean values± standard deviation of blood picture and serum biochemical indices in control (n=20) and diseased buffaloes (n=20)

| | Control | Caecal dilatation | P-value |
|---|---|---|---|
| T.WBCs (G/L) | 6.71±1.63 | 14.69±4.16 | P=0.021 |
| Neutrophiles (%) | 26.4±9.13 | 15±3.63 | P=0.025 |
| Lymphocytes (%) | 60.80±7.73 | 79.34±8.14 | P=0.042 |
| Monocytes (%) | 7.80±4.63 | 3.37±0.42 | P=0.10 |
| Eosinophiles (%) | 3.60±2.07 | 1.29±0.26 | P= 0.26 |
| Band cells (%) | 1.40±0.52 | 1±0.3 | P= 0.61 |
| Total proteins (g/L) | 94.7±10.7 | 64.34±6.36 | P= 0.032 |
| Albumin (g/L) | 55±8.4 | 28.84±2.14 | P= 0.023 |
| Globulin (g/L) | 45.7±4.6 | 36.5±3.3 | P= 0.45 |
| GGT (U/L) | 14.95±5.23 | 20.10±4.26 | P= 0.41 |
| ALK (U/L) | 36.11±8.40 | 62.48±5.95 | P= 0.011 |
| AST (U/L) | 32.92±4.77 | 90.38±9. 41 | P= 0.008 |
| Cholesterol (mmol/L) | 10.68±1.10 | 9.90±0.93 | P=0.61 |
| TG (mmol/L) | 3.62±0.2 | 3.06±0.82 | P=0.55 |

Significant (P< 0.05). Highly significant (P<0.01).

ALK means alkaline phosphatase, AST means aspartate aminotransferase, GGT means ã-glutamyl transferase, TG means triglycerides, T.WBCs means Total white blood cells count.

Table 2: Differential Diagnosis of caecal dilatation (n=20) in Buffaloes

| Site of the probe | Dorsal and ventral right flank over the dorsal and ventral last right 3 ICSs |
|---|---|
| *Relationship to other organs* | |
| 1. Duodenum | Not imaged |
| 2. Jejunum and ileum | Not imaged |
| 3. Large intestine | Imaged |
| 4. Right kidney | Not imaged |
| 5. Liver | Imaged Intertangled with the dilated caecum or colon |
| *Ultrasonogram* | Imaged immediately adjacent to the right flank region with thick semi-circular echogenic wall |
| 1. Image description | (closest wall). Invisualization of the contents and the furthest wall of the caecum. |
| 2. Number & diameter of dilated loops | 0 |
| *Peristaltic movement of SI* | Absent |

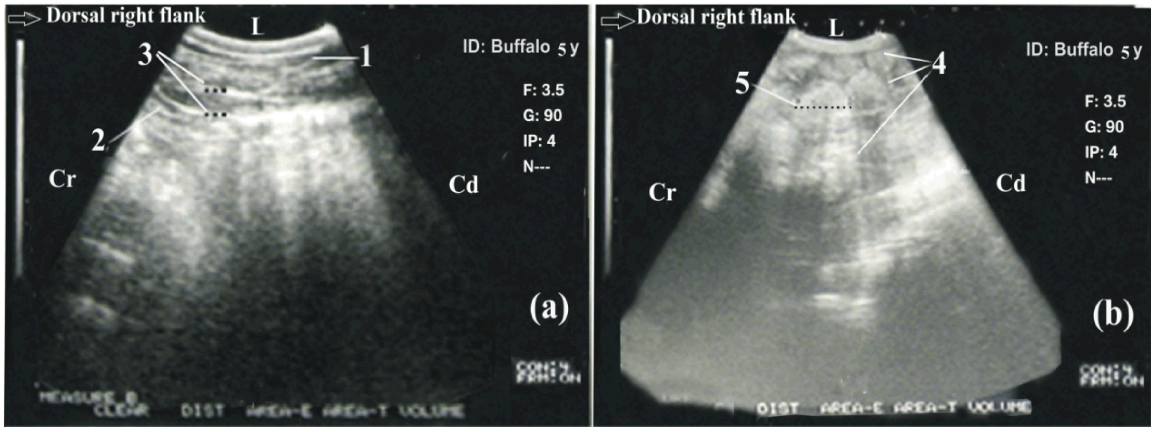


Fig. 1: Ultrasonogram in 3 year-old -healthy female buffalo imaged from dorsal right flank showed the descending part of duodenum (a)of 1.31 cm (An echogenic wall and echogenic envelop);loops of jejunum and ileum. They appeared as two echogenic wall with echoic or hypoechoic contents and of 3.18 cm (b). L: Left. Cr: Cranial. Cd: Caudal. 1: Abdominal wall. 2: Descending duodenum. 3: Diameter of descending duodenum = 1.31 cm. 4: Loops of jejunum and ileum. 5: Diameter = 3.18 cm

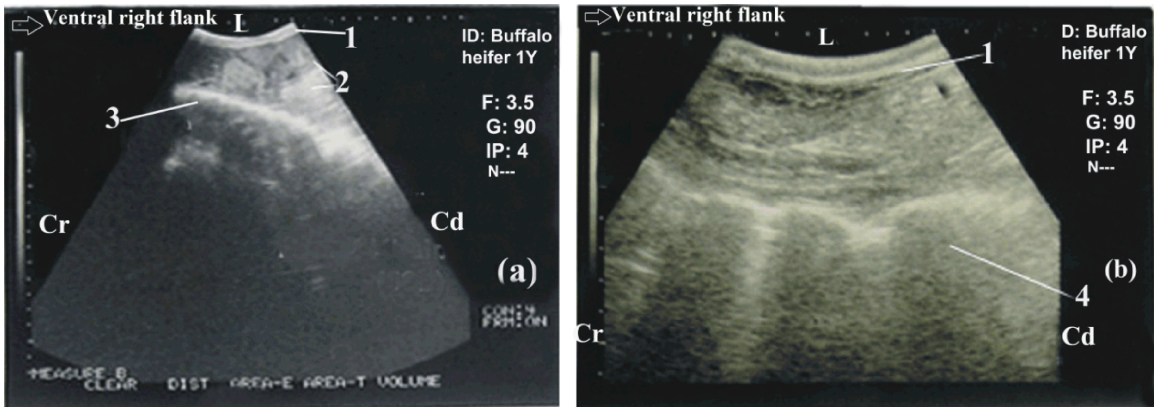


Fig. 2: Ultrasonogramin 4 year-old -healthy female buffalo imaged from the ventral right flank region showed large intestine with cross section in proximal loop of caecum and colon. They were usually imaged medially to the loops of small intestine (a). The closest wall (To the transducer) of the proximal loop of colon and caecum was imaged as continuous echogenic line, slightly curved (a) or gar-land like appearance [spiral colon] (b), meanwhile, the furthest wall of caecum and colon could not be imaged. L: Left. Cr: Cranial. Cd: Caudal.1: Abdominal wall. 2: Loops of jejunum and ileum 3: Proximal loops of caecum and/or colon. 4: Spiral colon (Gar-land like appearance).

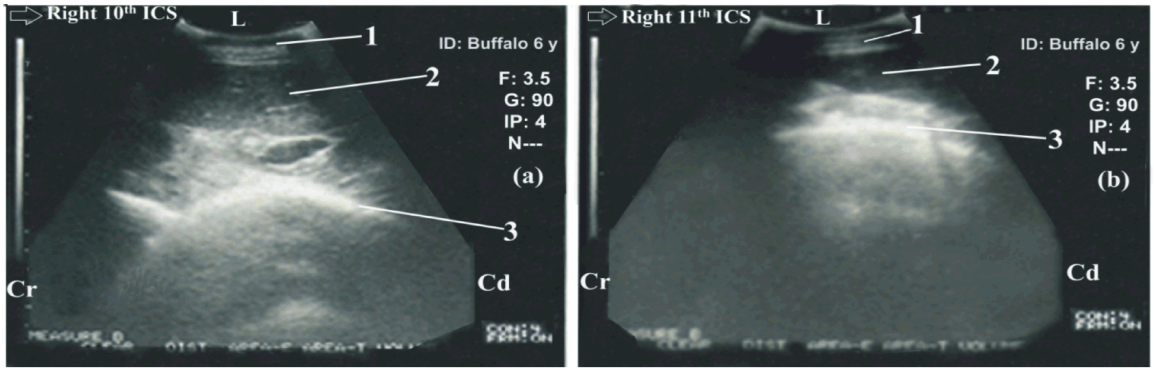


Fig. 3

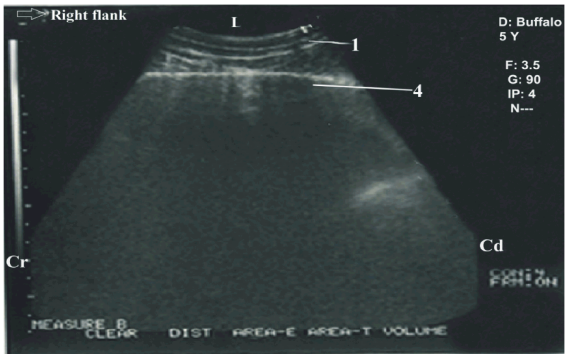


Fig. 4

Fig. 3,4: Ultrasonogram in a buffalo with caecal dilatation. It was imaged from the right 10th(a) and 11th(b)ICSs and from the right flank region(4).The dilated caecum and proximal loop of colon occupied the last right three ICSs particularly their ventral part and intertangled with the liver dorsally in these ICSs (a, b). They also filled the whole right flank region. The dilated loop is situated immediately adjacent to the right flank region and make invisualization of loops and peristaltic movement of the small intestine (4). The closest wall of the dilated caecum and proximal loop of the colon was imaged as thick semi-circular echogenic line (a, b) with invisualization of the furthest wall and their contents due to the reverberation artifacts at the soft- tissue gas interface. The right kidney was not imaged(4).L: Left. Cr: Cranial. Cd: Caudal. 1: Abdominal wall. 2: Liver 3: Dilated loops of caecum and/or colon intertangled with the liver. 4: Dilated loops of caecum and/or colon filled the whole right flank region with invisualization of right kidney and loops of small intestine.

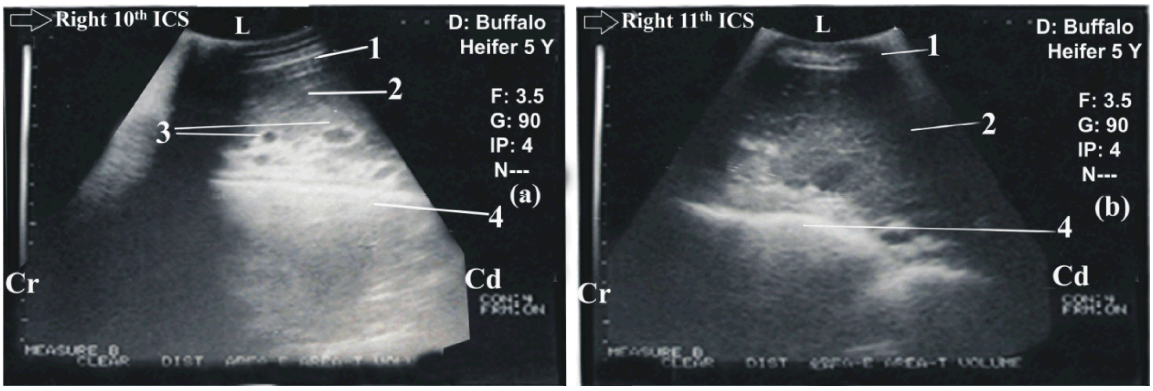


Fig. 5: Ultrasonogram in a buffalo with caecal dilatation and liver abscess. It was imaged from the right 10th(a) and 11th ICSs(b). The liver abscess appeared as anechoic structure with well distinct echogenic capsule which was clearly differentiated from normal parenchyma. L: Left. Cr: Cranial. Cd: Caudal.1: Abdominal wall. 2: Liver 3: Liver abscess. 4: Dilated loops of caecum and/or colon intertangled with the liver.

Some cases of caecal dilatation (n=3) was associated with liver abscess that was imaged as well-developed defined echogenic capsule with hypoechoic contents (Fig. 5). Small liver abscesses may be seen, incidentally, associated with dietary causes.

## DISCUSSION

The reported clinical signs associated with caecal dilatation in buffaloes were also reported in cattle [9, 12, 16]. On rectal examination the distended caecum can usually be palpated. In simple dilatation, with minimal quantities of ingesta, the caecum is enlarged and easily compressible on rectal palpation. In caecal volvulus, the viscus is usually distended with ingesta and feels enlarged and tense on rectal palpation. Rupture of the distended caecum may occur following rectal palpation or transportation of the animal. This is followed by shock and death within a few hours [9]. The current study reported that rectal palpation allowed accurate diagnosis of caecal dilatation and was a more important diagnostic tool than swinging and/or percussion auscultation [11, 16].

The hematological profiles in buffaloes with caecal dilatation reported lymphocytic leucocytosis. In contrast, hematological values are normal in most affected cattle unless there is necrosis of the caecum accompanied by peritonitis [16].

The blood serum biochemical levels of the diseased buffaloes in the current study showed significant hypo-proteinaemia and hypo-albuminaemia with decreased A/G ratio. Contrary, an increase in total plasma protein (TPP) and plasma fibrinogen (PF) levels were recorded among cattle with traumatic reticuloperitonitis and those with other gastrointestinal diseases [27, 28]. Albumin is a marker of acute phase response and is called negative because its levels decrease which agree with the current results. In nearly all animal species, albumin represents the major negative acute phase protein (APP) which, during the APR, decreases in blood concentration and may represent either selective loss of albumin due to renal or gastrointestinal changes or a decrease in hepatic synthesis [29].

As well as, serum concentrations of total proteins and globulins in the intestinal disturbances elevated in large ruminants [30].

The present study reported significant increase in blood serum activities of AST and ALK. Although the blood serum concentration of both cholesterol and triglycerides in diseased buffaloes showed insignificant changes compare to healthy group but. the total serum cholesterol level decrease during acute inflammatory degenerative disease and enteritis [31]. The results of haematological and blood biochemical analyses are not diagnostic for caecal dilatation but serve to estimate the severity of disease. For example, an elevation in the haematocrit may indicate dehydration and increases in the concentration of blood urea nitrogen may be a sign of prerenal azotemia [15, 16].

In healthy buffaloes, The caecum and proximal loop of the colon and the spiral colon could be clearly imaged from the right flank region (ventrally). The closest wall (to the transducer) of the proximal loop of colon and caecum was imaged as continuous echogenic line or slightly curved, meanwhile, the furthest wall of caecum and colon could not be imaged [3].

The obtained results revealed that ultrasonography confirmed detection and evaluations of large intestine diseases particularly caecal dilatation in buffaloes. In case of caecal and/or colonal dilatation, the dilated caecum and proximal loop of colon occupied the last right three ICSs particularly their ventral part and intertangled with the liver dorsally in these ICSs. They also filled the whole right flank region. The dilated loop is situated immediately adjacent to the right flank region and make invisualization of loops and peristaltic movement of the small intestine. The closest wall of the dilated caecum and proximal loop of the colon was imaged as thick semi-circular echogenic line with invisualization of the furthest wall and their contents due to the reverberation artifacts at the soft-tissue gas interface. The right kidney was not imaged through the right paralumbar fossa acoustic window. Similarly, the dilated caecum can always be seen from the lateral right flank region [7, 14] and sometimes, may be imaged from the last right ICSs [32]. The dilated caecum and the proximal loop of the colon were situated immediately adjacent to the right abdominal wall. The wall of the dilated caecum and proximal loop of the colon closest to the transducer only were visualized ultrasonographically and appeared as thick, echogenic, semi-circular lines [32]. Moreover, some cases of caecal or colonal dilation was associated with liver abscess. Liver abscess description was mentioned in cows [4].

## CONCLUSION

The current study reported that rectal palpation allowed accurate diagnosis of caecal dilatation and was a confirmatory diagnostic tool in addition to rectal palpation, swinging and/or percussion auscultation. Depending on the laboratory tests used in diseased Buffaloes for diagnosis of caecal and/or colonal dilation, clinical findings and laboratory indices were not specific and not recommended for future differential diagnosis.

**Authors' Contribution:** Authors have conducted the study equally and discussed the results, read and approved the final manuscript.

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