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SHORT COMMUNICATION

Reticular Diaphragmatic Hernia in Egyptian Buffaloes: Clinical, Hemato-Biochemical and Ultrasonographic Findings

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A B S T R A C T

This study was conducted to investigate the ultrasonographic findings of diaphragmatic hernia (DH) in buffaloes. Each 10 of healthy non pregnant, pregnant and buffaloes with DH were investigated. The most observed signs of DH were dullness, depression, inappetence, tympany and scanty feces. Reticulum of all buffaloes with DH was detected at the level of 4th/5th intercostal space (ICS) by ultrasonography. Contraction manner was either biphasic (n=6), monophasic (n=2) or non-motile (n=2). Contraction frequency was either reduced (n=6), normal (n=2) or increased (n=2). Also, hypoechoic inflammatory adhesion was found between reticulum and thoracic organs (n=6). Herniated reticulum was imaged beneath lung (n=6) and beneath heart (n=4). Hemato-biochemical analyses revealed significant elevations in total leucocytes, total protein, globulin and fibrinogen in comparison with control groups. Collectively, not only ultrasonography of DH in buffaloes was based on reticulum location at 4th/5th ICS, but also other investigations should be evaluated.

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INTRODUCTION

Diaphragmatic hernia (DH) is one of the thoraco-abdominal disorders inducing mortality in buffaloes (Mohindroo *et al*., 2007). It has been described as a congenital or acquired condition in bovine (Athar *et al*., 2010; Bellavance *et al*., 2010). Generally, violent trauma and increase of intra-abdominal pressure constitute main causes of diaphragmatic hernia in animals. Ultrasonography has been proven as an adjunct to clinical examination in cattle with different abdominal disorders (Braun *et al*., 2011). Recently, ultrasonography has been proven in diagnosis of DH in cattle (Kumar and Saini, 2012). To our knowledge, the little reports on ultrasonography of DH in cattle were focused only on reticular motility and location. Shape and frequency of reticular motility as well as its relation to surrounding thoracic organs as lung and heart have never been evaluated. Moreover, studies on buffalos' reticulum in healthy condition weren't investigated before. Therefore, the objectives of the study were an attempt to investigate the ultrasonographic and hemato-biochemical findings in healthy non-pregnant, pregnant buffaloes and those with DH.

MATERIALS AND METHODS

This study was carried out on 30 Egyptian buffaloes. Each 10 of healthy non-pregnant, pregnant and buffaloes with DH were investigated during the period extending from December 2011 to May 2013. The age of animals ranged between 2 to 10 years; and weighted 350 to 650 kg. Clinical examination and application of various pain tests were applied. Furthermore, ultrasonography was conducted for all animals using a 3.5 MHz convex transducer.

The reticulum was first examined from area just behind xiphoid cartilage at ventral midline then both sides of chest from 3rd to 7th ICS. Reticular shape, contour and motility per 4 minutes as well as relation to adjacent organs were assessed (Braun and Goetz, 1994). Moreover, two blood samples were collected from jugular veins. First sample was placed on EDTA tubes for the determination of hematocrit, erythrocytes, leucocytes and plasma fibrinogen. The second, without anticoagulant, was used for determination of serum total protein and albumin using test kits. Globulin was calculated through subtraction of albumin content from the total protein. Buffaloes with DH were diagnosed by using left flank

Table 1: Clinical findings of 10 buffaloes with diaphragmatic hernia in comparison with apparently healthy buffaloes (pregnant and non-pregnant)

Symptoms	Non pregnant	Pregnant	Diaphragmatic hernia	
			Abnormal data	No. of animals
General condition	Good health condition, alert	Good health condition, alert	Dull and depressed	10
Appetite	Good	Good	Reduced	10
Tympany	Negative	Negative	Positive	10
Fecal consistency	Semi-solid	Semi-solid	Scanty soft	4
			Scanty hard	5
			Diarrhea	1
Regurgitation of food from mouth	Negative	Negative	Negative	6
			Positive	4
Respiratory distress and abnormal lung sound*	Negative	Negative	Negative	5
			Positive	5
Jugular pulsation	Negative	Negative	Negative	8
			Positive	2
Murmur heart sound	Negative	Negative	Negative	8
			Positive	2
Pain tests**	Negative	Negative	Negative	4
			Positive	6
Heart rate (beat/minute)	67.4 ± 9.02^{a}	67.5 ± 7.9^{a}	70.0 ± 5.2^{a} Not affected	7
			95.6 ± 4.9^{b} Increased	3
Respiratory rate/ minute	26.7 ± 2.9^{a}	24.8 ± 6.2^{a}	24.4 ± 1.4^{a} Not affected	7
			71.6 ± 14.9^{b} Increased	3
Rectal temperature ^{0}c	38.5 ± 0.1^{a}	38.4 ± 0.3^{a}	38.6 ± 0.2^{a} Not affected	7
			39.7 ± 0.3^{b} Increased	3
Ruminal movement/ 2minutes	3.7 ± 0.4^{a}	3.1 ± 0.5^{a}	3.5 ± 0.7^{a} Not affected	2
			1.0 ± 0.9^{b} Decreased	6
			6.5 ± 0.7^{c} Increased	2

Different superscripts in the same row indicate a significant difference at P<0.05; * Respiratory distress include dyspnea, nasal discharge and cough while abnormal lung sound include wheezes and crackling; ** Pain tests include back grip test, pole test and pain percussion on the xiphoid region

Table 2: Ultrasonographic findings of reticulum in 10 buffaloes with diaphragmatic hernia in comparison with apparently healthy buffaloes (pregnant and non-pregnant)

Symptoms	Non pregnant	Pregnant	Diaphragmatic hernia	
			Abnormal data	No. of animals
Contour of reticulum	Half-moon shape	Half-moon shape	Undulating/ straight	7
			Half moon	3
Manner of reticular contractions	Biphasic	Biphasic	Biphasic	6
			Monophasic	2
			Non motile	2
Number of reticular contractions/ 4 minutes	3.8 ± 0.63^{a}	3.5 ± 0.5^{a}	3.5 ± 0.70^{a} Not affected	2
			1.5 ± 0.5^{b} Decreased	4
			6.5 ± 0.70^{c} Increased	2
			Zero (Absent)	2
Adhesion with surrounding structure*	No adhesion	No adhesion	positive	6
Site of reticulum	Abdomen medial to diaphragm and extend laterally at right and left side between 6^{th}/ 7^{th} ICS (n=10)	Abdomen medial to diaphragm and extend laterally at right and left side between 6^{th}/ 7^{th} (n=4) and 5^{th}/ 6^{th} ICS (n=6)	Thorax visible from right side 4^{th}/ 5^{th} ICS	6
			visible from left side 4^{th}/ 5^{th} ICS	4
Relation to adjacent organs	Diaphragm, rumen and abomasum were adjacent to reticulum from ventral abdomen, spleen was adjacent to reticulum at left side and liver was adjacent to it from right side	As in non-pregnant	Beneath the lung	6
			Beneath the heart	4

Different superscripts in the same row indicate a significant difference at P<0.05. *Adhesion appeared by ultrasound as hypoechoic materials represent exudates between herniated reticulum and thoracic cavity.

laparorumenotomy. The data were statistically analyzed by one way-analysis of variance (ANOVA, IBM SPSS statistics, version 21). Data were expressed as a mean ±SD. The significance was declared at P<0.05.

RESULTS AND DISCUSSION

Diaphragmatic hernia was categorized as a serious thoraco-abdominal disorder of buffaloes. The clinical signs of dullness, depression, inappetence, tympany, scanty feces and regurgitation of food from mouth (Table 1) were in accordance with previous reports (Athar *et al.,* 2010). These findings can be attributed to impaired process of eructation and rumination as a complication of reticular herniation. Respiratory distress and abnormal lung sound in cases of diaphragmatic hernia has been also cited (Deshpande *et al.,* 1981). Moreover, signs of cardiac involvement were previously recorded (Szabo and Fischetti, 2014). This might be due to lung irritation or heart displacement by herniated reticulum. Additionally, positive pain tests referred to high DH prevalence following traumatic reticuloperitonitis (Saini *et al.,* 2007; Athar *et al.,* 2010). In this study, elevations of heart, respiratory rates and temperature were recorded in 3 buffaloes with DH. The inflammation and infection were regarded as major causes of systemic reactions. Ruminal hypomotility in DH is considered a sign of indigestion, while the hypermotile rumen might be due to development of vagal indigestion secondary to DH. With regard to ultrasonographic findings (Table 2), the normal

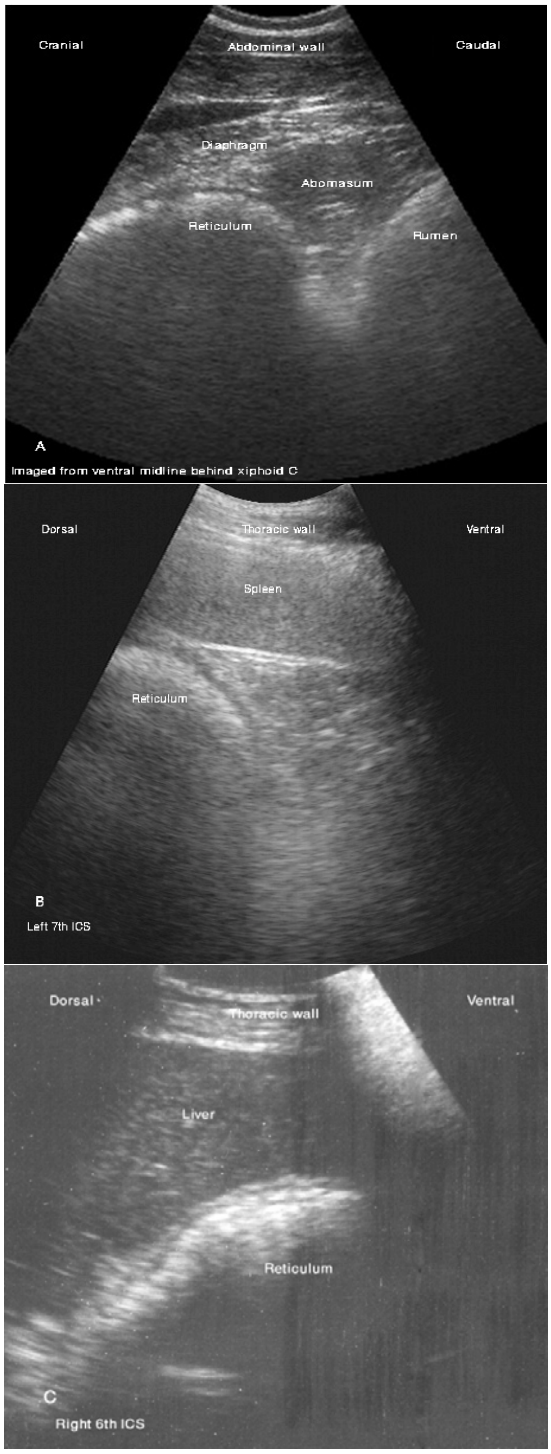

Fig. 1: Sonogram of normal buffalo's reticulum with its relation to adjacent abdominal organs (rumen, abomasum, spleen, liver). Imaged from ventral midline of abdomen (A), left 7th ICS (B) and right 6th ICS (C). Notice the half moon shape of reticulum.

reticulum appeared as a half moon shaped, contracted regularly with biphasic manner. These results were nearly close to the findings in cows (Braun and Goetz, 1994). Also, in buffaloes reticulum was freely movable in abdomen and imaged from area just behind xiphoid cartilage, laterally from both sides at 6th/7th ICS in 14 buffaloes (10 non, 4 pregnant) and at 5th/6th ICS in 6 pregnant ones. When it was imaged from ventral abdominal

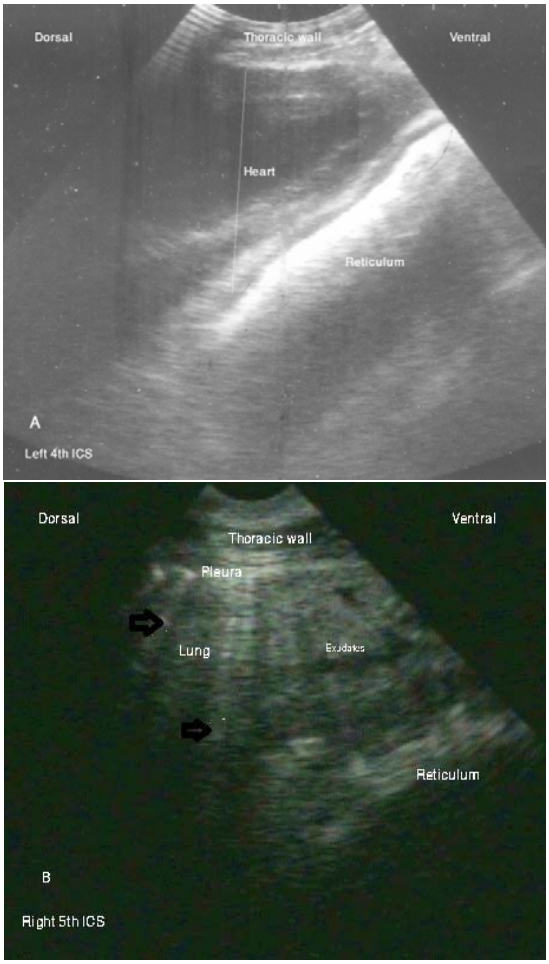

Fig. 2: Sonogram of herniated buffalo's reticulum at thoracic cavity (heart and lung) imaged from left 4th ICS (A) and right 5th ICS (B). Herniated reticulum appears undulating (A) and half-moon shape (B). The comet tail artifact (arrows) and hypoechoic exudates indicate adhesion between lung and herniated reticulum (B).

wall, it was located immediately adjacent to diaphragm, abomasum and rumen. Moreover, it was neighboring to spleen and liver when imaged from left and right sides, respectively (Fig. 1).

Appearance of a biphasic reticular motility and half-moon shaped of its contour in the thoracic cavity 4th/5th ICS confirmed the DH (Kumar and Saini, 2011). In the present study, monophasic or absence of reticular motility and undulating contour of reticulum were also observed in thoracic cavity of buffaloes with DH. Therefore, the reliability of ultrasonography in diagnosis of DH based on its location and manner of contraction was doubtful. Other findings including the relation of reticulum with thoracic organs (lung and heart) and position of reticulum at both sides of thorax seen necessary to confirm DH. In this study, herniated reticulum was imaged beneath lung (n=6) and beneath heart (n=4) with or without hypoechoic inflammatory exudates (Fig. 2). The hemato-biochemical findings of diseased animals' revealed leukocytosis, significant increase in protein, globulin and fibrinogen when compared with controls (Table 3). Generally, this result was observed in cattle with chronic inflammatory conditions as in traumatic reticuloperitonitis.

Table 3: Hematological and biochemical findings in non-pregnant, pregnant buffaloes and those with diaphragmatic hernia

Variable	Non pregnant	Pregnant	Diaphragmatic hernia
Erythrocyte count (10^{12}/L)	6.27±0.84[ab]	5.93±0.56[a]	6.77±0.93[b]
Leukocytes count (10^{9}/L)	6.73±1.1[a]	6.37±0.54[a]	10.51±3.2[b]
Hemoglobin (g/dl)	11.76±0.68[a]	11.08±1.06[a]	11.52±1.05[a]
Hematocrit (%)	31.6±2.5[a]	30.2±2.5[a]	31.8±2.2[a]
Total protein (mg/dL)	70.6±6.3[a]	68.7±8.4[a]	83.4±12.6[b]
Albumin (mg/dL)	40.5±2.6[a]	38.5±7.5[a]	37.7±6.7[a]
Globulin (mg/dL)	30.0±4.4[a]	30.2±4.3[a]	44.6±6.7[b]
Fibrinogen (mg/dL)	4.02±0.15[a]	4.02±0.14[a]	5.25±0.54[b]

Different superscripts in the same row indicate a significant difference at P<0.05.

Of interest, laparorumenotomy provided a powerful confirmation of diaphragmatic hernia in all buffaloes. The higher incidence of hernial ring was predominant at right side (n=6) than left one (n=4). In the present study, presence of foreign bodies and peri-reticular adhesion in 6 animals indicated high DH prevalence following traumatic reticuloperitonitis.

Conclusion: The reliability of ultrasonography in diagnosis of DH was doubtful when it was depending on reticular location and manner of contraction. But it was more reliable to detect the relation of reticulum to adjacent thoracic organs then, observe its motility inside the thoracic cavity.

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