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Review Article

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Uses of Diagnostic Ultrasonography in the Diagnosis of Some Digestive Disorders in Cattle and Buffalo

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Abstract

The bovine sector represents an important part of the animal resources in Egypt, as it plays important role in supplying humans with a considerable part of their daily needs of animal-derived proteins via their milk and meat. However, such animal species can be exposed during their life to a wide range of digestive disorders, which affect animal performance and productivity. Ultrasonography plays an essential role in the accurate and rapid diagnosis of several diseases affecting cattle and buffaloes. In this review, we will highlight the role of ultrasonography in the diagnosis of digestive disorders in cattle and buffaloes.

KEYWORDS
Ultrasonography, Cattle, Buffalo, Digestive disorders

INTRODUCTION

Since there aren't many natural pastures in Egypt, the cattle industry is effectively integrated with farmland. Male animals and infertile females are fattened for meat, while female cattle and buffaloes are used for milk output. A total of 73.5 billion EGP, or about 23 percent, of all agricultural value, comes from cattle and buffaloes, of which 34 percent is milk output and 66 percent is meat production. In 2015, the average person consumed 11 kg of red flesh and 59 kg of milk (USDA, 2018).

The system for producing cattle is very diverse; it includes both big, integrated, specialized producers and small-scale farms and households that raise cattle and buffaloes. There are three primary methods of raising cattle and buffalo: intensive, semi-intensive, and extensive. (ASL2050, 2017).

The ruminant practitioner frequently treats stomach disorders. The main and secondary causes of forestomach disease in ruminant animals can be distinguished. The regular ruminal wall and contraction cycle as well as disruptions in the rumen's normal flora and fermentation processes are the primary causes of diseases of the forestomach. Anomalies in rumen constriction and/or fermentation that result from other systemic diseases lead to secondary disease of the reticulorumen. The complicated nature of stomach function and the intricate connections between fermentation and the contraction cycle must be understood. As a result, abnormal fermentation will ultimately result from diseases of contraction, and vice versa. (Nagy, 2017).

Contrary to the areas of canine and equine practices, the field of bovine diagnostic ultrasonography is still developing. Few places have currently conducted basic research on the topic, so there is a dearth of pertinent literature pertaining to baseline data. However, here is a review of the literature on different aspects of digestive and related disorders.

Use of ultrasonography in the diagnosis of digestive disorders in Cattle

The best diagnostic method for examining digestive problems in livestock is ultrasonography. Imaging reveals inflammatory fibrinous alterations and abscesses in animals with traumatic reticuloperitonitis. To evaluate the abomasum's size, location, and components, one can use ultrasonography (Braun, 2009).

For the evaluation of the size, location, and contents of the abomasum in cattle, ultrasonography is a useful method. With a 3.5 MHz linear transducer, the abomasum can be seen from the left and right paramedian regions, as well as from the ventral midline, about 10 centimeters caudal to the xiphoid process. With a 3.5 MHz linear transducer, the left side's last three intercostal spaces were used to diagnose the left displacement of the abomasum. The probe was moved from ventrally to dorsally while the transducer was kept parallel to the ribs (Braun *et al*., 1997).

In order to examine the large intestine in ten cows, Braun and Amrein (2001) used transabdominal ultrasonography on the right abdominal wall. To verify the *in-vivo* results, these cows were butchered and inspected once more in a water bath. The caecum, which ran caudo-cranially and had a diameter that ranged from 5.2 to 18.0 cm, was visible from the middle area of the abdominal wall. A substantial, echogenic, crescent-shaped line could be seen as the caecum's side wall. By advancing the transducer horizontally along the abdominal wall to the last bone, one could locate the spiral ansa of the colon and the descending colon,

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which were located dorsal to the caecum. The descending colon was posterior to the spiral ansa of the colon.

In 67 cattle, Ramaprabhu *et al*. (2003) investigated the relative effectiveness of different diagnostic procedures for the diagnosis of traumatic reticuloperitonitis and associated syndromes. They claimed that ultrasonography is an outstanding tool for determining abscesses, fibrinous deposits, and reticular motility. They believed radiography to be the most effective technique for identifying metallic foreign bodies and gathering precise data on their location and character. Ultrasonography's main benefit is that it solves the issue of not only finding the lesion but also determining its size and extent; however, it was unable to detect any metallic objects, including magnets. They, therefore, concluded that even though radiography or ultrasonography by themselves only offers a certain amount of information, the two methods work well together.

Senna *et al*. (2003) assessed the diagnostic value of pericardiocentesis and ultrasonography for the diagnosis of pericarditis and traumatic reticuloperitonitis in livestock and buffalo (n=30). They concluded that the safest and least intrusive confirmatory tool for identifying traumatic reticuloperitonitis and pericarditis in cows and buffaloes is ultrasonography.

Ultrasonography, according to Braun (2004), is a crucial component of modern equine medicine. He proposed that a 3.5 MHz transducer offers sufficient depth and excellent resolution for diagnostic work, while a 2.5 MHz transducer can be used to examine structures that are more than 20 cm from the abdominal wall but has lower resolution. With a 5.0, 7.5, or even 10.0 MHz transducer, structures near the body's surface can be analyzed.

A six-year-old Holstein cow with signs of anorexia, depression, and ataxia underwent ultrasonography by Mohamed *et al*. (2004). An occupying bulk was visible on an ultrasonogram in the omasum. Following an autopsy, a pedunculated mass connected to the ventral omasal wall was found. Therefore, the least invasive diagnostic technique for finding gastrointestinal tumors and a range of gastrointestinal disorders in cattle was ultrasonography.

In a study of 23 cattle with left displaced abomasum (LDA), Afshari *et al*. (2005) concluded that the presence of gas in the abomasum was visible as a reverberation artifact over the left flank, and in some instances, it was also seen in the 11th and 12th intercostal spaces. On the 10th, 11th, and 12th ICS, the abomasum's contents ranged from hypoechogenic to echogenic, and the abomasum creases were easily discernible.

Braun (2005) concluded that abdominal ultrasonography was a superb diagnostic and prognostic instrument for determining whether the animal should be put to death, endure surgery, or receive medical care. This was especially true for calves that had traumatic reticuloperitonitis or abomasal displacement to the left or right.

According to Wittek *et al*. (2005), the ultrasonographic evaluation of the abomasum looked to offer a useful, quick, noninvasive, and precise technique for determining the volume, location, and emptying rate of the abomasum in calves.

Using a 3.5 MHz linear transducer in the intercostal spaces from dorsal to ventral on the right side, Braun and Blessing (2006) conducted an ultrasonographic examination of the normal omasum in 30 healthy cows. Each intercostal space's appearance, dorsal and ventral boundaries, and omasum size were assessed. Only the wall nearest to the transducer, which was visible as a thick echogenic line, could be seen as the omasum's crescent-shaped form.

In a study of 60 cases of reticular disorders in cattle, Kumar (2006) discovered that ultrasonography was a dependable diagnostic method for reticular diaphragmatic hernia, diffuse peritonitis, reticulophrenic adhesions, and related disorders.

Braun *et al*. (2007) used a 3.5 MHz linear transducer to ultrasonographically examine the omasums of 30 healthy cows and 55 cows with different gastrointestinal disorders on the right side of the body. From the fifth to the eleventh ICS, the omasum's size and dorsal and ventral borders were measured. In general, the healthy and abnormal heifers' omasums appeared identical on ultrasonography. The omasum was significantly smaller in some intercostal spaces in the cows with reticulo-omasal stenosis, right displacement of the omasum, abomasal volvulus, and ileus of the small intestine than in the healthy cows, whose omasum sizes ranged from 16.3 (1.5) cm to 56.9 (10.0) cm depending on the intercostal space.

By using transrectal ultrasound, Karapinar and Kom (2007) identified an intestinal intussusceptions instance in a cow. The impacted intestinal segment's longitudinal views showed a hypoechogenic center and several echogenic parallel densities. The bowel walls were indicated by the hyperechogenic densities, and edema was suggested by the hypoechogenic lines.

Thirteen buffaloes with traumatic reticuloperitonitis were subjected to an ultrasonographic evaluation by Kumar *et al*. (2007). They discovered the loss of smooth reticular contour, absence of biphasic reticular motility, and movement of the reticular wall with each respiration. As crucial diagnostic criteria for reticular adhesions, the presence of reticular motility on clinical examination and omasal motility on ultrasonogram with the lack of reticular motility were both used.

When 20 buffaloes suspected of having reticulo-diaphragmatic hernias underwent ultrasonographic evaluation, Mohindroo *et al*. (2007) concluded that the existence of reticular motility within the thoracic cavity was a crucial indicator for the diagnosis of reticulo-diaphragmatic hernia in buffaloes. The method also overcame the intrinsic drawbacks of radiography and casting a sick patient during an advanced pregnancy.

In a cow with a diaphragmatic hernia, Saini *et al*. (2007) used ultrasonography to diagnose the condition. They hypothesized that the existence of reticular motility at the level of the 4th and 5th ICS was a sign of reticular herniation into the thorax.

According to Streeter and Step (2007), the typically relaxed reticulum can be seen on an ultrasonogram as a crescent-shaped line that runs next to the diaphragm and cranioventral to the body wall. For the identification of traumatic reticuloperitonitis and its complication, omasal transport failure, ultrasonography may be used. The omasum's rounded form could be seen, but neither its contents nor its leaves could be seen, nor could any intrinsic contractile movements be seen. It is also possible to identify abomasal disorders like impaction, ulceration, adhesions, lymphosarcoma, ostertagiasis, and organ displacements.

Udehiya (2007) performed an ultrasonographic evaluation of 34 instances of reticulo-omasal disorders in cattle and concluded that a 3.5 MHz microconvex transducer was sufficient for scanning the reticulum, omasum, and peritoneal cavity in cattle. For the diagnosis of diffuse peritonitis, reticular diaphragmatic hernia, and other conditions, ultrasonography was found to be accurate.

In 30 healthy cows, Braun and Rauch (2008) used ultrasonography to assess reticular motility during rest, eating, ruminating, and stress. They found that the reticulum contracted in a biphasic pattern, with the first contraction being incomplete, followed by a period of incomplete relaxation and the organ returning to its initial position. During rumination, a biphasic contraction preceded an imperfect regurgitation contraction.

El-Khodery and Sato (2008) found that ultrasonography is a useful non-invasive technique for objectively assessing reticular

motility in response to the administration of different doses of metoclopramide and neostigmine in an experimental study on 10 Holstein Friesian cows. They concluded that neostigmine and metoclopramide do not increase reticular contraction rate or intensity.

Ultrasonography can be a useful adjunctive method in the preoperative diagnosis of duodenal obstruction in cattle, according to Lejeune and Lorenz (2008). The results of the ultrasonography allowed for the exclusion of alternative explanations like right abomasal displacement and pyloric stenosis.

Mohindroo *et al*. (2008) performed a three-phase ultrasonographic examination of the omasum in cows and buffaloes. Phase I (omasum taken from a cadaver), Phase II (omasum of cows and buffaloes that appeared to be in good condition), and Phase III (cows and buffaloes with thick echogenic walls and leaves). At the beginning of the omasal contraction, the omasum looked to be very large and close to the transducer, but as the contraction went on, it retracted away from the transducer. Cows' omasal contractility was less pronounced than it was in bulls. However, it was discovered that ultrasonography was ineffective for objectively determining the degree of omasal impaction. Furthermore, Singh (2008) examined 50 instances of reticular, omasal, and abomasal disorders in cattle and reported that a 3.5 MHz microconvex transducer is sufficient for scanning these areas in cattle. Diagnosis of diaphragmatic hernia, reticulophrenic adhesions, omasal impaction, and abomasal impaction/dilatation was found to be accurate with ultrasound.

Ultrasonography, according to Tschuor and Clauss (2008), is a helpful tool for showing the stratification of rumino-reticular contents in live animals. He claimed that when imaging the dorsal portion of the rumen, it will frequently reveal the existence of a gas dome with reverberation lines and that it may be challenging to distinguish between the fiber mat and an underlying fluid phase ventrally.

To document the clinical and ultrasonographic differences between cattle and buffaloes with different sequelae of TRP and the significance of ultrasonography in detecting such sequelae, Abdelaal *et al*. (2009) examined 29 cows and 33 buffaloes with traumatic reticuloperitonitis (TRP). The precise information about the various TRP sequelae in both species was given by ultrasonography. Additionally, ultrasonography allowed for the precise determination of the lesions' location and size as well as the best spot for abdomino- and thoraco-centesis. Both livestock and buffaloes with pericarditis as well as four buffaloes with thoracic abscesses showed brisket edema and swollen jugular veins. Therefore, it was crucial to use ultrasonography for early TRP identification, particularly in buffaloes, and to distinguish between various sequelae that share the same symptoms.

With a 3.5 MHz linear transducer and 144 calves experiencing vagal indigestion, Braun *et al*. (2009) used ultrasonography to assess reticular motility. They measured the frequency, amplitude, duration, and speed of the reticular contractions per three minutes while the animals were standing and awake. In comparison to cattle with distal functional stenosis, those with proximal functional stenosis (reticulo-omasal stenosis) had substantially more contractions per three minutes at 4.6 (2.01) per minute.

In research by Athar *et al*. (2010) on 101 cattle with thoracoabdominal disorders, 27 animals (six buffalo and one cow) were found to have diaphragmatic hernias as determined by clinical signs, radiography, ultrasonography, and left flank laparotomy. In 23 instances (85.18%), ultrasonography was useful in confirming diaphragmatic hernia. All of the animals' reticular movement could be seen using ultrasound technology at the level of the fourth and the fifth intercostal spaces.

Six chronically ill Jersey/Red Sindhi cross-bred cows were identified with intestinal intussusception by Imran (2010) based on clinical, ultrasonographic, and surgical exams. The most noticeable ultrasonographic discovery, "Bull's eye lesion," was diagnostic of trans-abdominal or transrectal intussusception. Images of the lower flank and the 12th intercostal region on the right side revealed dilated intestinal loops larger than 3.1 cm in size. They recommended using ultrasonography to support and supplement transrectal results of bovine intestinal intussusception. When transrectal inspection of the cows revealed no suspected intestinal mass, ultrasonography was, however, of little use.

According to Kumar (2010), the reticulum was visible in healthy buffaloes at the 6th intercostal space and in cows at the 5th intercostal space with biphasic contractions. Diaphragmatic hernia in buffaloes is confirmed by the presence of the reticular wall and motility at the 4th ICS and by guiding the transducer cranially at the 5th ICS. It is possible to diagnose localized adhesions, diffused peritonitis, reticulitis, and reticular abscess using ultrasound. The right side normal bovine omasum with no visible motility was examined from the 7th to 11th ICs. In the majority of cases of omasal impaction or abomasal impaction/dilatation in cattle, scanning of the omasum over a larger region (6th -7th -12th ICS) with a caudo-dorsal displacement of the gall bladder up to 12th ICS was observed. According to Imran *et al*. (2011), the healthy omasum's mean dorso-ventral length varied from 10.7 cm to 13.13 cm. The disparity between the normal and affected omasums' mean dorso-ventral extents was statistically insignificant. These findings imply that omasal impaction in Indian cross-bred calves may not be detectable by ultrasonographic imaging.

To identify reticular diaphragmatic hernia in non-pregnant and pregnant cows and buffaloes, Kumar and Saini (2011) reported the accuracy of reticular wall detection and its motility using ultrasound at the fifth intercostal space. Additionally, the topographic position of the reticulum in healthy cows and buffaloes was highlighted. According to their findings, the reticulum of seemingly healthy non-pregnant cows can typically be seen at the elbow level on the right and left sides of the fifth intercostal area. However, the reticulum can be seen at the sixth intercostal region in seemingly healthy non-gestational buffaloes. This suggests that the reticulum is typically more cranially situated in cows than in buffaloes.

Sharma *et al*. (2015) reported that between April and October, during the summer and rainy seasons (90%), forestomach disorders are common in cattle and buffaloes, accounting for a large percentage of diseased cows and buffaloes (138/1840) at the hospital. Different forestomach disorders and their prevalence was: Diaphragmatic hernia (DH) 17%, traumatic reticuloperitonitis (TRP) 14%, idiopathic motility disorder or vagus indigestion (VI) 22%, adhesive peritonitis (AP) 13%, frank exudative peritonitis (FEP) 12%, reticular abscess (RA) 8%, ruminal and omasal impaction (RI) 5%, and abomaso duodenal ulceration (ADU) 9%. DH and RA were considerably more prevalent in buffaloes than in cattle. Impactions were also more common in buffaloes, but the frequency was very low (5%). ADU was found in buffalo just as frequently as it was in cows.

Burgstaller *et al*. (2017) reviewed the experimental methods used to measure abomasal emptying in the calf including those that would be appropriate for use under field conditions. Among these methods, the use of ultrasonography and different absorption tests (d-xylose, acetaminophen) as tools to measure abomasal emptying.

Braun *et al*. (2019) looked at the clinical, laboratory, ultrasonographic, and pathological findings in 87 cows with type-4 abomasal ulcers aged 2 to 10 years (4.5 1.5 years). In decreas-

ing order, the most common clinical findings were compromised health status accompanied by partial or complete anorexia (100%), abdominal guarding (81%), congested scleral vessels (77%), ruminal atony (73%), tachycardia (68%), tachypnoea (65%), positive foreign body tests (58%), decreased skin surface temperature (53%), fever (49%), reduction in negative intraabdominal pressure (39%), poorly subdivided plant fragments in feces Ultrasonographic evidence of local or generalized peritonitis was found in 65 (87%) of the 75 cows investigated. Postmortem investigation revealed that all of the cows had type-4 abomasal ulcers and generalized peritonitis. The same authors mentioned that abdominal ulcers of type 4 (U4) are perforated ulcers that cause widespread peritonitis. The clinical, laboratory and ultrasonographic findings in 38 calves with U4 are described in this retrospective analysis. The medical reports of 38 calves with U4 ranging in age from three days to 20 weeks were examined. Poor overall health (95%), reduced skin elasticity (95%), rumen atony (91%), abdominal guarding (76%), and positive percussion and/or swinging auscultation on the right side of the abdomen (75%). Increased numbers of segmented neutrophils (87%), eosinopenia (87%), acidosis (84%), azotemia (79%), and hyponatremia (79%) were the most common laboratory results. Intestinal atony (68%), fluid (67%), and fibrin deposits (58%) were the most common abdominal ultrasonographic observations (Braun *et al*., 2021).

A comparison of the clinical, laboratory, and ultrasonographic findings of these kinds of abomasal displacements has not been done, even though left and right displacements of the abomasum and abomasal volvulus are well-known disorders of cattle. The goal of this research was to contrast these circumstances in a sizable herd of cows. The outcomes of clinical, laboratory, and ultrasonographic assessments were looked up in the medical records of 1982 dairy cows with left displaced abomasum (LDA, n. = 1341), right displaced abomasum (RDA, n. = 338), and abomasal volvulus (AV, n. = 303). Braun *et al*. (2022) mentioned that the three major clinical findings were decreased intestinal motility in 61.1% of the cows, reduced rumen motility in 89.7% of the cows, and an abnormal demeanor in 48.2% of the cows. In 96.9% of the cows with LDA, percussion and simultaneous auscultation, as well as balloting and simultaneous auscultation, were all positive. In 98.5% of the cows with RDA and 99.3% of the cows with AV, the same was true on the right. For the diagnosis of LDA in 97.9% of the cows and RDA/AV in 90.2% of the cows, ultrasonography was helpful. The severity of the abomasal reflux syndrome-related laboratory findings differed among the cows; 83% of them had hypokalemia, 67% had elevated rumen chloride concentrations, 67% had elevated base excesses, and 50% had hemoconcentration. Using the clinical indicators, a conclusive determination was made. A conclusive diagnosis was reached in 75.0% of the cows with LDA and in 22.5% of the cows with RDA/AV based on the clinical signs. Another 22.0% of the cows with LDA and 53.0% of the cows with RDA/AV needed an ultrasound to receive a conclusive diagnosis. Reliable differentiation of RDA and AV needed laparotomy or postmortem examination.

CONCLUSION

This review highlights the importance of the use of ultrasonography as a significant laboratory tool for the accurate diagnosis of digestive disorders in the bovine sector.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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