Comparative Study of Ultrasonographic Features of Abomasum in Cattle and Buffaloes Suffering from Various Gastrointestinal Tract Disorders

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ABSTRACT

The present study was conducted on 40 clinical cases of bovine (10 cattle, 30 buffaloes) to ultrasonographically evaluate the position of abomasum in relation to anatomical landmarks in cattle and buffaloes suffering from various gastrointestinal tract (GIT) affections. Animals were divided into five groups *viz*. foreign body syndrome (n=14), faecolith (n=6), caecal im7paction (n=5), reticular abscess (n=2) and diaphragmatic hernia (n=13) as per disease condition confirmed upon ultrasonography and surgical findings. Ultrasonographically, the distance from caudal most aspect of wither at dorsal spine to dorsal most aspect of abomasum, distance from xiphoid to cranial most aspect of abomasum, distance from mid of umblicus to caudal most aspect of abomasum and distance from ventral midline to ventral most aspect of abomasum was recorded to evaluate the size of abomasum. The ultrasonographic findings were correlated with intra-operative findings. It was concluded that the size of abomasum is significantly reduced in animals suffering from caecal impaction while the size of abomasum was significantly increased in animals suffering from faecolith and was comparable in animals suffering from diaphragmatic hernia, foreign body syndrome and reticular abscess. The location of pylorus was not significantly altered in any disease condition.

Key words: Abomasum, Buffalo, Cattle, Gastrointestinal affection, Position, Ultrasonography.

INTRODUCTION

Dairy sector is mainly dependent upon cattle and buffalo rearing in developing countries. The economy of farmers is primarily dependent upon agriculture and animal husbandry. Abomasal impaction is an infrequently diagnosed condition of adult cattle that is characterized by drier than normal abomasal contents and larger than normal abomasal volume and for making a diagnosis exploratory right/left flank laparotomy is necessary. Abomasal distension is difficult to diagnose due to non specific clinical signs such as anorexia, scanty faeces, often pasty or absence of defecation, abdominal distension, tympany and hyper- or hypo-motile rumen (Behl *et al.,* 1997). Rectal palpation of abomasum is difficult due to its anatomic location. Scanning of abomasum at the level of the right elbow in the 8, 9 and 10th intercostal space with omasum displaced dorsally along with positive liptek test under ultrasound guided abomasocentesis was found confirmatory for abomasal impaction / dilatation (Athar *et al.,* 2011). Diagnostic ultrasonography provides a window for non-invasive visualization of bovine thoraco-abdominal organs. It is coming up as an important diagnostic tool for the bovine thoraco-abdominal disorders including traumatic reticuloperitonitis, left and right displacement of abomasum, ileus of small intestine (Braun, 2003), vagal indigestion (Braun *et al.,* 2009), reticular diaphragmatic hernia (Mohindroo *et al.,* 2007, Saini *et al.,* 2007) and traumatic pericarditis (Braun *et al.,* 2008).

Although few studies are available on ultrasonography of abomasum but conclusive studies are not available regarding size, position in relation to anatomical landmarks and other features of the organ in animals suffering from various disease conditions. To the authors' knowledge no literature is available comparing the status of abomasum in various gastrointestinal (GIT) disorders. Therefore, the present study was carried out to evaluate the abomasum in various GIT disorders in bovine.

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MATERIALS AND METHODS

The present study was conducted on 40 clinical cases of bovine (10 cattle, 30 buffaloes) suffering from various abdominal disorders, referred to the Department of

Veterinary Surgery and Radiology. The study was conducted to record the ultrasonographic dimensions of the abomasum. The animals were divided into various groups according to the primary disease / disorder diagnosed *viz*. foreign body syndrome (n=14), faecolith (n=6), caecal impaction (n=5), reticular abscess (n=2) and diaphragmatic hernia (n=13). The topographic location of the abomasum was assessed ultrasonographically. Ultrasonography was carried out using Wipro GE Logiq 3 BT Expert ultrasound machine in real time B mode with a 2.0-5.0 megahertz (MHz) convex transducer. Ultrasonography was done in standing animal restrained in a crate without any sedation. The lateral and ventral aspect of abdominal wall (12^{th} to 4^{th} intercostals spaces (ICS)) on right side was shaved and washed. The transmission gel was applied and the animals were examined with a 2.0-5.0 MHz convex transducer. Abomasal wall was identified at each ICS. The dorsal, ventral, cranial and caudal borders of abomasum were marked at each ICS.

Each intercostal space was scanned, beginning dorsally and progressing ventrally towards the ventral midline at the level of respective ICS, with the transducer held parallel to the ribs. The dorsal and ventral boundary of the abomasal wall was identified ultrasonographically, and marked with a chalk at each ICS on the body of the animal. The dorsal border of abomasum up to the spine and ventral border of abomasum up to the ventral midline were measured in centimeters (measurements of ventral border of abomasum placed right to the midline was taken as positive while measurements of abomasum placed left of midline was taken as neagitive). Each intercostal space was scanned again, beginning cranially and progressing caudally, with the transducer held perpendicular to the ribs. The cranial and caudal boundary of the abomasal wall was identified, ultrasonographically, and marked with a chalk at each ICS on the body of the animal. The cranial border up to the point of xiphoid and caudal border up to the center of umbilicus were measured in centimeters. The markings were then connected with a chalk to get an approximate shape of the organ, externally. After identifying the dorsal border of abomasum the transducer was held stationary for 3-5 min to record abomasal motility if any.

Recording of position of abomasum in relation to anatomical landmarks (Fig1) was done as follows:

A) Distance from caudal most aspect of wither at dorsal spine to dorsal most aspect of abomasum was recorded in centimeters (A).

B) Distance from xiphoid to cranial most part of abomasum was recorded in centimeters (B).

C) Distance from mid-point of umbilicus to caudal most part of abomasum (distance of caudal border of abomasum from mid-point of umbilicus towards the cranial side of mid-point of umbilicus was taken as positive and towards the caudal side was taken as negative) was recorded in centimeters (C).

D) Distance from ventral midline to ventral most part of abomasum (distance of ventral border of abomasum from ventral midline towards the right side of ventral midline was measured as positive and towards the left side of ventral mid line was measured as negative) was recorded in centimeters (D).

Visibility of folds was recorded as visible or not visible. Echogenicity of contents was recorded as anechoic with echogenic stippling or echogenic. Motility of abomasum was recorded as motile or non-motile. Location of pylorus was recorded by placing transducer at different inter coastal spaces and the ICS where pylorus could be seen completely was recorded.

The clinical and ultrasonographic findings were confirmed upon right/ left exploratory laparotomy in standing position under local anaesthesia. Following rumenotomy, two third of rumen contents were evacuated to palpate rumen, reticulum and abomasum. The presence of penetrating and non-penetrating foreign bodies was carefully checked in the rumen and reticulum. Abomasal health was determined by ascertaining the size, contents and consistency (doughy to hard) of the organs on palpation through rumen wall during rumenotomy. Before closing the rumen it was filled up to one third with water and 4 bolus of Yeasac, 100g of Liv. 52 were put inside the rumen except in cases of diaphragmatic hernia where rumen was evacuated completely. Laparotomy wound was closed in a routine manner.

The sick animals were divided into various groups depending upon the laparo-rumenotomy findings *viz*. foreign body syndrome, faecolith, caecal impaction, reticular abscess, diaphragmatic hernia. Intra-operatively the size of the abomasum was evaluated subjectively by the same person in the animals as: small/ normal/ distended. The consistency of abomasum was recorded as: hard/ doughy/ watery. Intraoperative findings were correlated with ultrasound findings to establish dimensions of abomasum in these disease conditions. The mean ± SE of the ultrasonographic measurements were worked out using SPSS 16.0 software. Table showing the statistical value is given at the end of text.

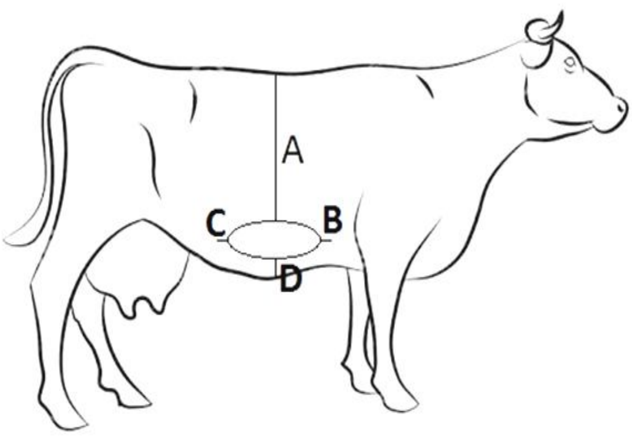

Fig 1: Sketch showing the measurements of abomasum in relation to anatomical landmarks.

RESULTS AND DISCUSSION

Ultrasonography was performed on all animals to assess the location of the abomasum in various affections using a 2.0-5.0 MHz convex transducer. This transducer was found suitable for ultrasonography of the organ. Ultrasonography was done in standing animal restrained in a crate without any sedation. Animals were found to be very cooperative so no need for sedation was felt during course of study. No difficulty was faced in scanning and borders of abomasum could be easily identified in majority of animals. Ultrasonography of abomasum was done in all the animals included in the study.

The ventral abdominal region caudal to xiphoid process was examined with 2.0-5.0 MHz convex transducer. The abomasum was always scanned at 9th intercostal space on the right side of the ventral midline with omasum placed dorsally. This was used as reference point for starting the ultrasonographic evaluation of abomasal wall in the animals with transducer held parallel to the ribs. The transducer was then moved ventrally at the level of same intercostal space till ventral border of abomasum was identified. The procedure was repeated on each cranial/caudal intercostal space. For identifying the cranial and caudal borders, transducer was held perpendicular to the ribs at the level of 9th intercostal space and moved in cranial/caudal direction to locate cranial and caudal wall of abomasum respectively. The abomasum was scanned mostly on the right side of the ventral midline but in caecal impaction abomasum could be scanned on left side of ventral midline also. This might be due to increase in size of caecum in caecal impaction that put pressure on the abomasum and displaced it to the left side of ventral midline. The abomasum could be clearly differentiated from other organs because of its thinner wall, moderately echogenic structure as compared to the reticulum (Streeter and Step, 2007) and its contents, which appeared heterogeneous due to presence of fluid, digested feed particles, gas bubbles with echogenic stippling (Braun *et al.,* 1997a). The ultrasonographic findings were confirmed upon laparo-rumenotomy.

The dorsal border of the abomasum was seen as a thin echogenic line with folds (Fig 2, Table 1). The dorsal border of the abomasum was seen closest to dorsal spine in animals suffering from diaphragmatic hernia (76.98±3.54cm) followed by animals suffering from foreign body syndrome (77.81±4.05 cm), reticular abscess (79.95±0.15 cm), faecolith (80.47±6.15 cm) and was seen farthest from dorsal spine in animals suffering from caecal impaction (85.02±2.012 cm). This suggested that dorsal border of the abomasum was placed more ventrally in animals suffering from caecal impaction than any other disease condition and more dorsally towards dorsal spine in animals suffering from diaphragmatic hernia.

Table 1: Table showing the statistical values.

Disorder	Mean ± SE of the distance from dorsal spine to dorsal most aspect of abomasum (cm)	Mean ± SE of the distance from xiphoid to cranial most part of abomasum (cm)	Mean ± SE of the distance from ventral midline to ventral most part of abomasum	Mean ± SE of the distance from umblicus to caudal most aspect of abomasum (cm)	Mean ± SE of the location of pylorus at different inter costal spaces
Foreign body syndrome (n=14)	77.81±4.05	4.16±0.62	3.65±1.00	7.39±1.39	9.86±0.09
Faecolith (n=6)	80.47±6.15	3.87±1.38	2.05±0.05	-1.52±5.04	10.00±0.00
Caecal impaction (n=5)	85.02±2.12	4.14±1.15	-1.55±3.85	13.76±2.17	9.60±0.24
Reticular abscess (n=2)	79.95±0.15	2.70±1.40	8.30±0.00	6.15±1.75	9.50±0.50
Diaphragmatic hernia (n=13)	76.98±3.54	2.97±0.96	3.81±1.96	5.41±2.87	9.42±0.19

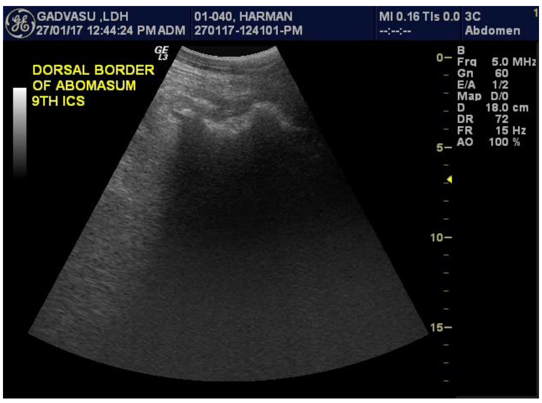

Fig 2: Ultrasonogram showing the dorsal border of abomasum at 9th ICS with folds.

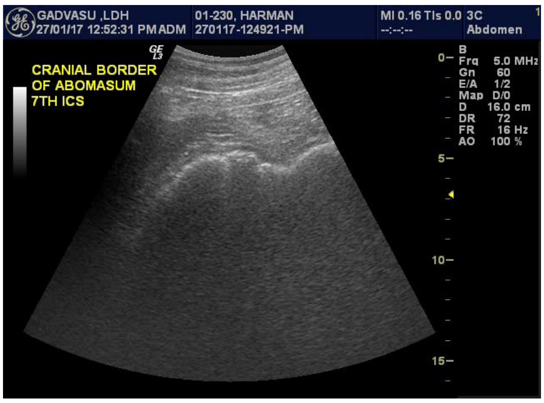

Fig 3: Ultrasonogram showing the cranial border of abomasum at 7th ICS.

The cranial border of the abomasum (Fig 3, Table 1) was seen closest to the xiphoid in reticular abscess (2.70±1.40 cm) followed by animals suffering from diaphragmatic hernia (2.97±0.96 cm), faecolith (3.87±1.38 cm), caecal impaction (4.14±1.15 cm) and was seen farthest from xiphoid in animals suffering from foreign body syndrome (4.16±0.62 cm). This suggested that cranial border of abomasum was placed more caudally in animals suffering from foreign body syndrome than any other disease condition and more cranially towards xiphoid in animals suffering from reticular abscess.

The ventral border of abomasum (Fig 4, Table 1) was seen only in 18 animals (foreign body syndrome=6, faecolith=2, caecal impaction=2, reticular abscess=1, diaphragmmatic hernia=7, this might be due to overlapping of abomasum by rumen. The ventral border of abomasum was seen closest to ventral midline towards right side in animals suffering from faecolith (2.05±0.05 cm) followed by animals suffering from foreign body syndrome (3.65±1.00 cm), diaphragmatic hernia (3.81±1.96 cm) and was seen farthest from ventral midline towards right side in animals suffering from reticular abscess (8.30±0.00 cm). In contrast, the ventral border of abomasum in animals suffering from caecal impaction (-1.55±3.85 cm) was seen on the left side of the midline. This showed that ventral border of the abomasum in animals suffering from reticular abscess was placed more towards the right of ventral midline and was located towards the left of ventral midline in animals suffering from caecal impaction.

The caudal border of the abomasum (Fig 5, Table 1) was seen closest to mid of umbilicus towards cranial side in animals suffering from diaphragmatic hernia (5.41±2.87 cm) followed by animals suffering from reticular abscess (6.15±1.7 cm), foreign body syndrome (7.39±1.39 cm) and was seen farthest from mid of umbilicus towards cranial side in animals suffering from caecal impaction (13.76±2.17 cm). In contrast the caudal border of the abomasum, in animals suffering from faecolith was placed towards the caudal side of mid of umbilicus (-1.52±5.04 cm). This suggested that caudal border of the abomasum in animals suffering from caecal impaction was placed more cranially than any other disease condition and in animals suffering from faecolith caudal border was placed caudal to umbilicus.

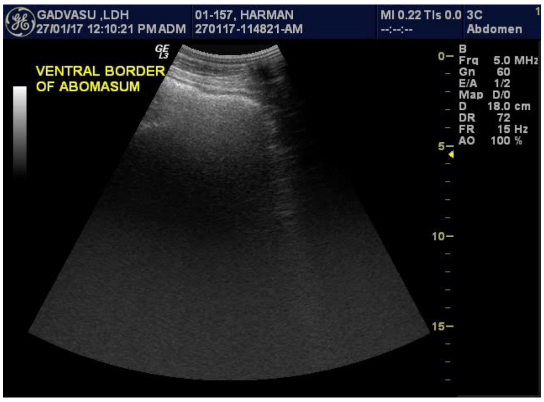

Fig 4: Ultrasonogram showing the ventral border of abomasum.

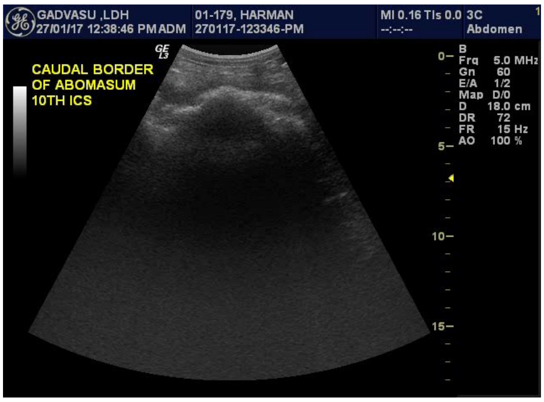

Fig 5: Ultrasonogram showing the caudal border of abomasum at 10th ICS.

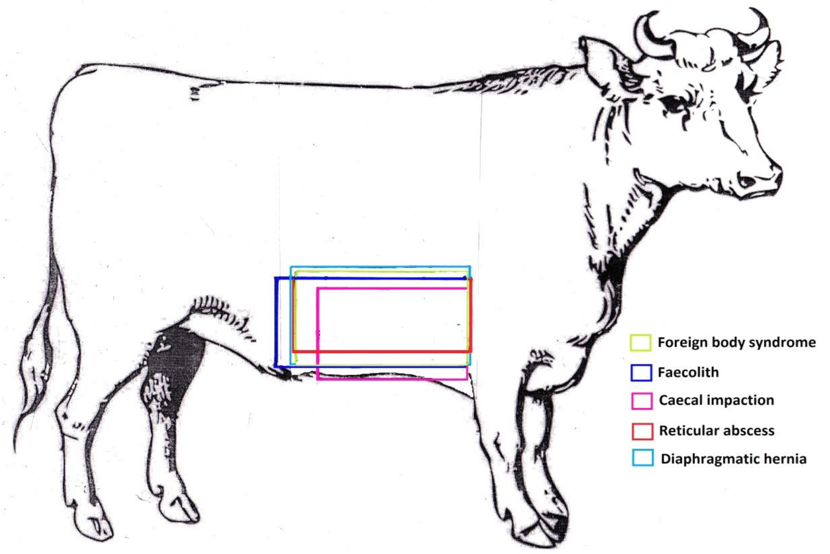

Fig 6: Approximate size of abomasum in animals suffering from various disorders.

After using appropriate scaling, abomasum was sketched as a rectangle over a figure of bovine on a paper sheet in different disease conditions (Fig 6). It was found that size of abomasum was small in animals suffering from caecal impaction and seemed cranio-caudally compressed and the ventral border was towards left of ventral midline. This might be due to increase in size of caecum that might put pressure on the abomasum which in turn might have resulted in decrease in size of abomasum and resulted in placement of ventral border towards the left of ventral midline. In animals suffering from foreign body syndrome, reticular abscess and diaphragmatic hernia size of abomasum was similar. In animals suffering from faecolith size of abomasum was larger than the other groups. The caudal border of the abomasum was seen caudal to the umbilicus. This can be due to hindrance in the process of peristalsis because of the presence of faecolith in the intestines that led to accumulation of ingesta into the abomasum and consequently increase in the size of abomasum.

The abomasal folds were visible in 37 animals out of 40 animals (Fig 7). Abomasal folds were not visible in one animal each suffering from foreign body syndrome, faecolith and diaphragmatic hernia. This might be due to increase in size abomasum in these three animals that led to stretching of wall of abomasum and hence folds may have straightened. Slow movement of the feed in the abomasum was also often visualised. This type of movement was seen by earlier workers also (Braun *et al.,* 1997a). Motility of abomasum was present in 25 cases (foreign body syndrome=12, faecolith=3, caecal impaction=4, reticular abscess=1, diaphragmatic hernia=8) (Fig 8). Motility of abomasum was mostly absent in animals suffering from faecolith (n=3) and diaphragmatic hernia (n=5). The loss of motility in animals suffering from faecolith can be due to increase in size of abomasum and can also be due to accumulation of ingesta in the abomasum due to presence of faecolith. In animals suffering from diaphragmatic hernia, due to chronic nature of the disease motility of abomasum might have been absent.

Contents of abomasum appeared heterogeneous, moderately echogenic with echogenic stippling in majority of the animals (n=32, Fig 9). This type of echogenicity was seen by earlier workers also (Braun *et al.,* 1997a). In other animals (n=8) abomasal contents was somewhat echogenic. Pylorus was mostly placed between 9-10th intercostal space

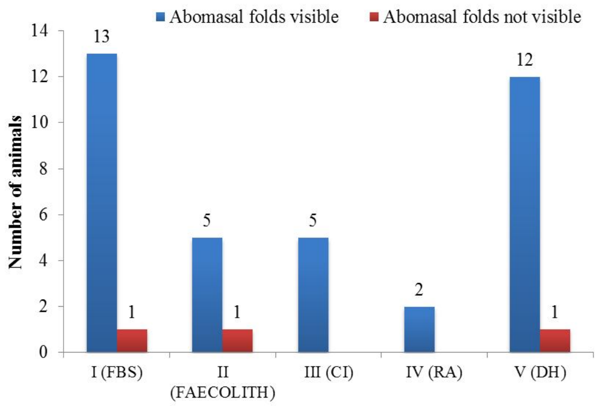

Fig 7: Visibility of abomasal folds in animals suffering from various disorders.

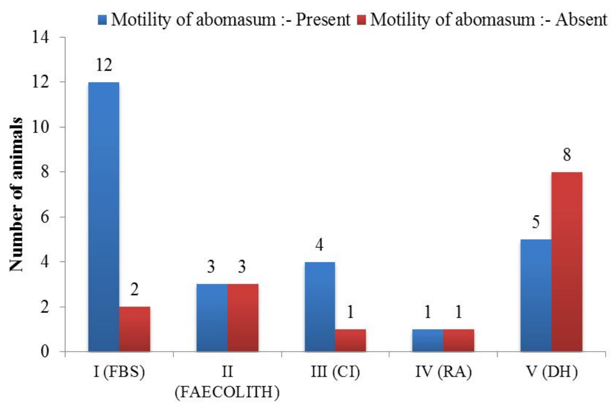

Fig 8: Motility of abomasum in animals suffering from various disorders.

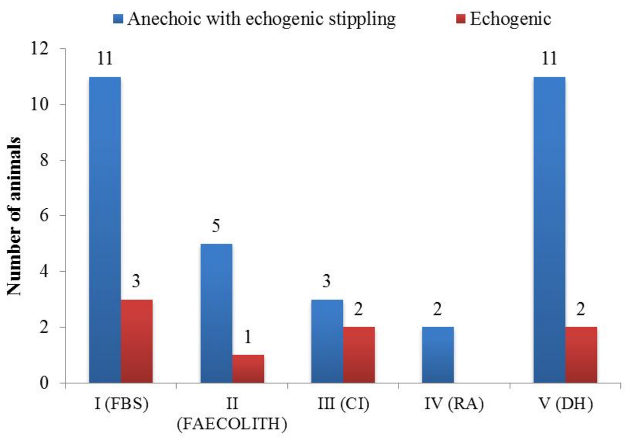

Fig 9: Echogenicity of contents of abomasum in animals suffering from various disorders.

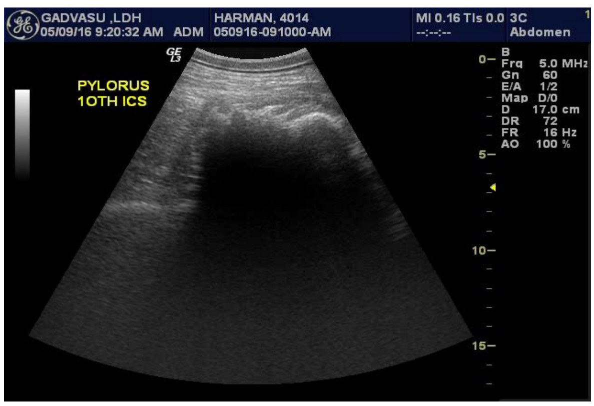

Fig 10: Ultrasonogram of pylorus at the 10th ICS in animals suffering from various disorders.

irrespective of group (Fig 10, Table 1). However, in animals suffering from faecolith, pylorus was more caudally placed (10 ICS), which might be attributed to large size of abomasum that led to more caudal placement of pylorus.

In all the animals that were diagnosed for foreign body syndrome, faecolith, reticular abscess and diaphragmatic hernia left flank laparo-rumenotomy was performed and in animals that were diagnosed for caecal impaction, right flank laprotomy was performed. The size and consistency of the abomasum were recorded intra-operatively. In all the animals the abomasal dimensions were subjectively similar to that assessed on ultrasonography.

Intra-operatively the size of abomasum in animals suffering from faecolith was subjectively larger as compared to other four groups. The size of abomasum in animals suffering from reticular abscess, foreign body syndrome and diaphragmatic hernia was subjectively similar. Size of abomasum in animals suffering from caecal impaction was subjectively smaller as compared to other four groups.

Intra-operatively in 2 animals suffering from foreign body syndrome the abomasum was doughy on palpation and in other 12 animals it was watery. In 4 animals suffering from faecolith the abomasum was doughy on palpation whereas in other 2 it was watery. In one animal suffering from reticular abscess the abomasum was doughy on palpation and in other it was watery. In 3 animals suffering from diaphragmatic hernia the abomasum was doughy on palpation whereas in other 10 animals it was watery. In 4 animals suffering from caecal impaction the abomasum was doughy on palpation and in one animal it was watery.

CONCLUSION

The size of abomasum is significantly reduced in animals suffering from caecal impaction and increased in animals with fecoliths. The size of abomasum was comparable in animals suffering from diaphragmatic hernia, foreign body syndrome and reticular abscess. The location of pylorus is not significantly altered in any disease condition. Ultrasonographic evaluation of abomasum in relation to anatomical landmarks was found reliable in assessing size of the organs in various disease conditions.

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