Ultrasonographic assessment of change in omasal position during the last month of gestation and first month of lactation in buffaloes

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Summary

This study was aimed to determine the effect of advanced pregnancy on the topography and size of the omasum in 22 healthy Murrah buffaloes. The omasum was scanned 15–20 days before and after parturition, as per the standard procedure. The dorsal and ventral margins of the omasum were identified and marked at each intercostal space (ICS). The dorsal and ventral limits up to the dorsal midline were measured. The omasum was scanned in 6th to 11th ICS during advanced pregnancy and 7th to 11th ICS after the parturition. Irrespective of the pregnancy, the dorsal and ventral margins of the omasum were located farther dorsal and close to the spine in the 6th, 7th and 11th ICS. Except in one buffalo, the omasum was scanned in four consecutive ICS during the advanced pregnancy. After parturition the omasum was scanned in four and five consecutive ICS in 17 and five buffaloes, respectively. The mean dorsal and ventral limits of the omasum increased significantly (P < 0.05) in each ICS during post parturient period as compared to the advanced pregnancy. After parturition, the omasal size increased significantly (P < 0.05) in the 10th ICS only while the omasum was pushed dorsocranially during the advanced pregnancy. Irrespective of the pregnancy status, the omasal distance from the spine showed the least variation in the 8th and 9th ICS in all the buffaloes. In summary, we advocate the 8–9th ICS as the optimum location for the ultrasonographic evaluation of the omasum in healthy buffaloes. Although, the findings of the omasal size may or may not hold true for animals with different body weights, the present findings can be extrapolated to other bovine species and can be used as a reference for evaluating the effect of pregnancy on the omasum.

Key words: Buffalo, omasum, pregnancy, topographic anatomy, ultrasonography
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Introduction

The omasum is almost a spherical organ with slightly flattened sides and lies on the right floor of the intra-thoracic part of the abdominal cavity. The main function of the omasum is the absorption of water, dissolved minerals and short-chain fatty acids and anorexia due to any cause may reduce the size of the omasum. The primary diseases of the omasum, such as omasal impaction and omasitis, are documented to be rare. However, as compared to other parts of the world, the incidence of omasal impaction is higher in bovines of Punjab, India with higher incidence in buffaloes as compared to cattle.

The basic anatomy and physiology of gastrointestinal tract is similar for cattle and buffaloes except a few minor differences with respect to diaphragm, caecum and liver. The buffalo diaphragm is thinner than the diaphragm of cattle and hence diaphragmatic hernia occurs more frequently in buffaloes than cattle. In cattle, the blind end of the caecum is free, but in buffaloes mesentery is attached at this end and hence buffaloes are not predisposed to caecal torsion. In the buffalo, the liver is comparatively more round, large and thick.

Owing to almost similar gastrointestinal tract, the same protocol has been applied for the clinical examination of the digestive system and abdominocentesis in cattle and buffaloes in different studies. The reticular wall thickness (measured ultrasonographically) is reported to be similar for cattle and buffaloes, but the reticular motility pattern is reported to be slightly different between the two species. Also the ultrasonographic windows for the examination of liver and spleen were similar for cattle and buffaloes. However, the signs of pain and systemic reactions are more commonly observed in pericarditis affected cattle compared to that in buffaloes and it is difficult to induce pain response in buffaloes compared to the cattle.

The omasum is inaccessible for most methods of the clinical examination except deep palpation. So, ultrasonography has been applied as a non-invasive diagnostic aid for the evaluation of the omasum in cattle and buffaloes. Some reports describe ultrasonography as a useful tool for differentiating the healthy and impacted omasum while other reports suggest that ultrasonography cannot be reliably used to diagnose omasal impaction. However, the results of these studies cannot necessarily be applied to the pregnant animal because the size and topography of the omasum in the pregnant animal may be different to that of the non pregnant animal. During pregnancy, especially in the advanced stage, there is a change in location of various abdominal organs and the effect on size and topography of the abomasum and liver has been evaluated ultrasonographically. However, it is not known whether the advanced pregnancy can affect the size and location of the normal or impacted omasum in bovids, if so, these changes could be seen ultrasonographically. Further, the size and topography of the omasum has not been studied in healthy or diseased buffaloes. The aim of this study was to determine the size and topography of the omasum in healthy buffaloes, and to evaluate the effect of the advanced pregnancy on the size and location of the omasum. These results could then be applied to healthy and diseased buffaloes and other bovids.

Figure 1: Diagram representing the left thoracic and abdominal wall for the topographic location of the omasum during the last month of pregnancy (blue circle) and within one month of parturition (Green circle) in Murrah buffaloes. The numerals represent the intercostal spaces. The omasal size in each intercostal space = length of the black arrow on animal body - length of the orange arrow on animal body.
Material and Methods

The study was conducted on Murrah buffaloes at dairy farm of Guru Angad Dev Veterinary and Animal Science University, Punjab, India. All the animals were maintained under similar environmental conditions and managemental practices. Initially 30 buffaloes of the same age group (5–6,5 years) were included in the study with an expected parturition within 15–20 days. On the basis of the clinical evaluation and metabolic profile testing, eight buffaloes were excluded from the study as they were suffering from subclinical or clinical ketosis (n=5) and fat cow syndrome (n=3). The study protocol was approved by the Institutional Animal Ethics Committee of the Guru Angad Dev Veterinary and Animal Science University, Punjab, India.

Ultrasonography of the Omasum

The omasum in each buffalo was scanned during the last month of the pregnancy (15–20 days before parturition) and 15–20 days after parturition. Ultrasonography was carried out by a portable ultrasound (SonoSite M-turbo) using a 2–5 MHz convex transducer. Ultrasonography was done in standing animals, restrained in a cattle crate without any sedation. The lateral aspect of the thoraco-abdominal wall [4 th to 12 th intercostal space (ICS)] on the right side was shaved (whenever necessary) and washed with water. Acoustic coupling gel was applied liberally for optimal transmission of the ultrasound waves. The liver was frequently scanned lateral to the costal part of the right abdominal wall. The wall of the omasum appeared as a crescent shaped thick echogenic area, while the gall bladder was seen at the dorso-lateral border of the omasum. In some animals, the attachments of the omasal laminae were visible as short echogenic cone-shaped structures at the dorso-lateral border of the omasum.

Table 1: Distances of the omasal margins (in cm) from the dorsal midline measured ultrasonographically in different intercostal spaces in healthy buffaloes

<table>
<thead>
<tr>
<th>ICS</th>
<th>Osmal Margin</th>
<th>During the last month of gestation</th>
<th>During the first month of lactation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>Mean ± S.D.</td>
<td>N</td>
</tr>
<tr>
<td>11”</td>
<td>Dorsal</td>
<td>3</td>
<td>46,93 ± 2,23</td>
</tr>
<tr>
<td></td>
<td>Ventral</td>
<td>3</td>
<td>75,3 ± 2,76</td>
</tr>
<tr>
<td>10”</td>
<td>Dorsal</td>
<td>18</td>
<td>38,17 ± 2,89</td>
</tr>
<tr>
<td></td>
<td>Ventral</td>
<td>18</td>
<td>84,92 ± 4,20</td>
</tr>
<tr>
<td>9”</td>
<td>Dorsal</td>
<td>22</td>
<td>37,4 ± 3,22</td>
</tr>
<tr>
<td></td>
<td>Ventral</td>
<td>22</td>
<td>91,12 ± 3,61</td>
</tr>
<tr>
<td>8”</td>
<td>Dorsal</td>
<td>22</td>
<td>45,86 ± 3,44</td>
</tr>
<tr>
<td></td>
<td>Ventral</td>
<td>22</td>
<td>84,38 ± 3,38</td>
</tr>
<tr>
<td>7”</td>
<td>Dorsal</td>
<td>18</td>
<td>49,36 ± 4,85</td>
</tr>
<tr>
<td></td>
<td>Ventral</td>
<td>18</td>
<td>70,26 ± 3,76</td>
</tr>
<tr>
<td>6”</td>
<td>Dorsal</td>
<td>4</td>
<td>49,25 ± 0,99</td>
</tr>
<tr>
<td></td>
<td>Ventral</td>
<td>4</td>
<td>66,12 ± 2,33</td>
</tr>
</tbody>
</table>

ICS-intercostal space; N indicate the number of animals in which omasal wall was visible in the corresponding intercostal space

*Corresponding mean values in a row differ significantly

Statistical Analysis

The normal distribution was tested by Shapiro-Wilk test. All data was normally distributed and is presented as mean ± standard deviation (S. D). The mean values of different omasal parameters in the advanced pregnancy and after parturition were compared by paired t-test. For all statistical procedures a value of P<0,05 was considered significant, assuming the conventional alpha level of 0,05.

Results

The dorsal and ventral ultrasonographic margins of the omasal wall in each ICS were identified and marked with a chalk on the body of the animal. Distances between the spine, and the dorsal and ventral margins in each ICS were measured in centimetres with the help of a measuring tape (Fig. 1). The size of the omasum in each ICS was calculated as the difference between the ventral and dorsal limits from the spine.
protruding from the inner wall of the omasum (Fig. 3). The omasal motility was not recorded in this study.

The frequency with which the omasum was visible in the different intercostal spaces did not differ significantly between the peri-parturient and the post parturient period (Table 1). Irrespective of the pregnancy the omasum was visualized in the 8th and 9th ICS in all the buffaloes. During the peri-parturient period the omasum was scanned in four consecutive ICS in 21/22 buffaloes and the omasum was scanned in three consecutive ICS in one buffalo only (8th to 10th ICS). The omasum was scanned in the 7th to 10th ICS in 14/21 buffaloes, in the 6th to 9th ICS in four and in the 8th to 11th ICS in three buffaloes. After the parturition the omasum was scanned in four consecutive intercostal spaces in 17/22 animals (13/17; 7th to 10th ICS; 4/17; 8th to 11th ICS) while in five buffaloes the omasum was scanned in five consecutive ICS (7th to 11th ICS). Irrespective of the pregnancy, the dorsal limit of the omasum was visible as a semicircle running from cranial to caudal and was located farther from the spine in the 6th, 7th and 11th intercostal spaces. The ventral limit appeared as the lower half of the circle running from cranial to caudal, so the distance between the ventral limit of the omasum and spine was shortest in 6th, 7th and 11th intercostal spaces. After parturition, both the dorsal and ventral limits of the omasum from the spine increased significantly (p<0.05) as compared to the advanced stage of the pregnancy in each ICS (Table 1).

During the advanced pregnancy the mean omasal size ranged from 16.87±1.51 cm (in 6th ICS) to 53.72±2.85 cm (in 9th ICS) while in post parturient period its mean size ranged from 20.71±5.40 cm (in 7th ICS) to 53.26±2.76 cm (in 9th ICS) (Table 2). Irrespective of the pregnancy the omasum appeared largest in the 9th ICS and decreased in size both cranially and caudally. After parturition, the omasum became significantly (p<0.05) larger in the 10th ICS only (Table 2).

Discussion

The ultrasonographic examination of the omasum has been standardized in cattle but not in buffaloes. To the authors’ best knowledge, this is the first study to determine the topographic location and the size of the omasum in healthy buffaloes, irrespective of the breed. Scanning of the omasum has been carried out in healthy buffaloes of the same region as our study. This study had some limitations: First, the number of the subjects in that study was limited to two animals. Second, the omasum was scanned in the 8th and 9th intercostal spaces only, although the omasum could have been scanned in the other intercostal spaces also, as was observed in the present study. Similar to the present study the omasum has been scanned in 6th to 11th ICS in healthy cattle and 5th to 11th ICS in cattle with different gastrointestinal disorders. Third, the population of the diseased buffaloes was not uniform and exact measurements, such as the distance of the omasal margins from the spine and the omasal size, were not evaluated. Due to these limitations, the results cannot be extrapolated to the general population of buffaloes. We report the ultrasonographic features of the omasum and the influence of the advanced pregnancy on the topography of the omasum in healthy buffaloes.

On the ultrasonograms, the wall of the omasum appeared similar to that of the rumen. However, the rumen wall is normally imagined from the left side of the abdomen and extends to the right side only in vagal indigestion. Also, the omasum does not contract while rumen contracts at regular intervals. Non-visualization of the medial omasal wall may be attributed to gas within the omasum and the large distance between the medial wall and the body surface. The omasum-liver interrelationship was similar on the ultrasonograms to previously described findings.

The distance of the dorsal and ventral margins from the spine and the overall size of the omasum in each ICS

<table>
<thead>
<tr>
<th>ICS</th>
<th>During the last month of gestation</th>
<th>During the first month of lactation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>Mean ± S. D</td>
</tr>
<tr>
<td>11th</td>
<td>3</td>
<td>28.37±1.58</td>
</tr>
<tr>
<td>10th</td>
<td>18</td>
<td>46.75±3.25</td>
</tr>
<tr>
<td>9th</td>
<td>22</td>
<td>53.72±2.85</td>
</tr>
<tr>
<td>8th</td>
<td>22</td>
<td>38.52±2.99</td>
</tr>
<tr>
<td>7th</td>
<td>18</td>
<td>20.89±5.02</td>
</tr>
<tr>
<td>6th</td>
<td>4</td>
<td>16.87±1.51</td>
</tr>
</tbody>
</table>

ICS-intercostal space; N indicate the number of animals in which omosal wall was visible in the corresponding intercostal space

*corresponding mean values in a row differ significantly
was lower than reported for healthy Swiss Braunvieh cows and other cattle breeds with various gastrointestinal disorders. However, the size was larger than that reported for Indian Red Sendhi cows. Three findings of the present study indicated that the omasum was lifted dorsally and pushed cranially during the advanced pregnancy: 1) by the statistically significant difference of the dorsal and ventral limits of the omasum in each intercostal space during advanced pregnancy and the post parturient stage, 2) by the visualization of the omasum in the 6th intercostal space during advanced pregnancy only and, 3) by the localization of the omasum in five consecutive ICS in five buffaloes only after the parturition. The change in position of the omasum may be attributed to the change in position of the abomasum during advanced pregnancy or possible cranial push by the gravid uterus. The omasum is joined to the abomasum by the omaso-abomasal opening and change in the position of the abomasum could change the position of the omasum. Although the omasum was pushed dorsally and cranially, the overall size differed significantly in the 10th ICS only.

In the present study, the appearance of the dorsal and ventral limits of the omasum was similar to the previously reported for the non-pregnant cattle. The findings of the pregnant stage could not be compared to other studies due to lack of available literature on ultrasonography of the omasum in the pregnant animals.

Irrespective of the pregnancy status, the omasum was scanned in four consecutive ICS in majority of the buffaloes, the common location being 7th to 10th ICS. The size of the omasum and the distance of the omasal margins from the dorsal midline showed least variation in 8–9th ICS, revealed by lower standard error. Further, the omasum was visible in all the buffaloes in these two intercostal spaces only. In summary, we advocate these intercostal spaces as the optimum location for the ultrasonographic evaluation of the omasum in healthy buffaloes. Similar to present findings, the 8th and 9th ICS have been reported to be optimal locations for scanning of the omasum in cattle.

The buffaloes are mainly found in South Asia but that does not limit the scope of this manuscript to transfer the knowledge/findings from the buffaloes to other bovids. The extrapolation of the present findings to other bovids can be justified by some statements and facts. First, the digestive system of cattle and buffaloes is similar and the same protocol for the clinical examination of the omasum and other digestive organs has been employed for both cattle and buffaloes. Furthermore, in some previous studies, the same protocol has been used for the ultrasonographic evaluation of the omasum, reticulum and other digestive organs in both cattle and...

Figure 2: Ultrasonogram showing omasum and liver in 9th ICS in a Murrah buffalo: The omasal wall appears as a curved echogenic line and the liver is situated dorsolateral to the omasum.

Figure 3: Ultrasonogram showing omasum with short omasal laminae in 10 ICS in a Murrah buffalo: 1. Omasal wall, 2. Liver, 3. Hepatic vessel, Ds: dorsal, Vt: ventral
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Feeding could have affected the size and location of the omasum in this study. In order to minimize this variation all the buffaloes were examined at least 2 hours after the morning feeding. The animals were of the same breed and similar age group in order to minimize the variation affecting the location of the omasum.

Most of the studies have limitations, which may be known to authors at the time of study or become apparent with better understanding and advancement in the technology. Our study had limitations. First, the distance between the omasum and the peritoneum of the lateral body wall was not determined for any of the intercostal spaces. This parameter could be also affected by the advanced pregnancy and needs to be evaluated in further studies. Second, it was difficult to estimate the exact time before parturition because of the inability to predict the exact date of the parturition. So, all the buffaloes were not truly evaluated at the same time before parturition. The reliability of the results may be further evaluated by repeated examinations of the buffaloes, two-three consecutive times for each animal within one month before and after the parturition. In this study, the repeated examinations were not undertaken; as this was a preliminary study to evaluate the effect of pregnancy on the size and topography of the omasum. We wanted to establish whether there is any effect of pregnancy on the size and topography of the omasum or not. Moreover, interassay coefficient of variation should be calculated for each measurement. As previously mentioned by Braun and Jacquat, the repeated examination provides accurate result only when the animals are examined under the same conditions. The omasal size would be correlated to body weight of animals. So, another limitation is that currently we do not know whether the findings of omasal size will hold true for animals with different body weights or not, especially in calves. However, we believe that the established effect of the pregnancy on the omasal location and size will be true for cattle also and can be confirmed in future studies.

Conclusion

The size of the omasum did not change significantly with the advanced pregnancy except in the 10th intercostal space. The omasum was pushed dorsally and cranially during the advanced pregnancy. The result of this study could be used as a reference for the omasal examination in the healthy buffaloes, changes in the organ’s size or position as a result of illness, and for the evaluation of effect of the pregnancy on the size and topography of the omasum in cattle and buffaloes. However, the size of the omasum may not be similar in animals of the different age groups due to difference in the body weight and size. The present findings can be extrapolated to other bovid species for evaluating the effect of pregnancy on the omasum.

Acknowledgements

This work is a part of Ph.D. dissertation of first author and was funded by Guru Angad Dev Veterinary and Animal Sciences University.

Conflict of interest: None.
posto a ecografia dal 6° all’11° ICS durante la gravidanza avanzata e dal 7° all’11° ICS dopo il parto. Indipendentemente dalla gravidanza, i margini dorsali e ventrali dell’omaso sono stati localizzati più verso il dorso e vicini alla spina dorsale nel 6°, 7° e 11° ICS. L’omaso è stato scansionato in quattro ICS consecutivi durante la gravidanza avanzata eccetto per un bufalo. Dopo il parto, l’omaso è stato sottoposto a ecografia in quattro e cinque ICS consecutivi in 17 ris. 5 bufali. I limiti medi dorsali e ventrali dell’omaso sono aumentati in modo significativo (P<0,05) per ogni ICS durante il periodo post partum rispetto alla gravidanza avanzata. Dopo il parto le dimensioni dell’omaso sono aumentate significativamente (P<0,05) solo nel 10° ICA mentre l’omaso è stato spinto in posizione dorso-craniale durante la gravidanza avanzata. Indipendentemente dallo stato della gravidanza, la distanza dell’omaso dalla spina dorsale ha mostrato le minori variazioni nell’8° e 9° ICS in tutti i bufali. Per concludere noi riteniamo che la posizione migliore per una valutazione ecografica dell’omaso nei bufali sani si situa tra l’8° e il 10° ICS. Anche se i risultati delle dimensioni dell’omaso possono o non possono essere concluenti per gli animali di peso corporeo differente, i presenti risultati possono essere estrapolati per altre specie bovine e possono essere utilizzati come riferimento per una valutazione dell’effetto della gravidanza sull’omaso.

Parole chiave: Bufalo, omaso, gravidanza, anatomia topografica, ecografia

References


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