Pregnancy diagnosis in dromedary: comparison between transrectal and transabdominal ultrasonography

Ahmed Ali¹², Derar R Derar¹

¹Department of Veterinary Medicine, College of Agriculture and Veterinary Medicine, Qassim University, 51452 Buraydah, Saudi Arabia. ²Department of Theriogenology, Faculty of Veterinary Medicine, Assiut University, 71526 Assiut, Egypt.

Abstract

This study aimed to compare between transrectal and transabdominal ultrasonography for visualization of camel conceptus during different stages of gestation in dromedary. A group of six pregnant female dromedary camels was used in this study. Consecutive transrectal and transabdominal ultrasonography were performed once weekly between the second and 42nd weeks of pregnancy and every 2 weeks from the 42nd week until parturition. Six areas were selected for transabdominal ultrasound examination, namely caudal abdominal (CAA, right and left, above the base of the udder), middle abdominal (MIA, right and left, from the base of the udder to the umbilicus); and cranial abdominal (CRA, right and left, from the umbilicus to the xiphoid cartilage). On each examination, attempts were made to imagine the conceptus and to estimate the biparietal diameter (BPD), eyeball diameter (EBD), abdominal diameter (ABD) and ruminal diameter (RUD). The result revealed that between the 4th and 5th weeks, the conceptus could only be visualized by the transrectal approach (100%). Between the 6th and the 12th weeks, the conceptus was mostly observed through the left CAA (100%) and the transrectal (97.6%) approaches, but less repeatedly over the right CAA (66.7%) approach. From the 13th to the 27th weeks, the conceptus was mostly observed over the left CAA (100%), but less regularly through the right CAA (50%) and transrectal (31.8%) approaches. Between the 28th and 52nd weeks, the conceptus was chiefly detected via the left CRA approach (92.3%), but less often over right CRA (69.2%) and transrectal (60.3%) approaches. The EBD was the greatest accessible fetal parameter throughout transrectal and transabdominal examinations and the ABD was the slightest. It could be concluded that the transrectal, left CAA, and left CRA ultrasonography are the preeminent techniques for pregnancy diagnosis during early, mid-, and late gestation, respectively.

Key words:
Pregnancy diagnosis, dromedary camel, transrectal examination, transabdominal examination, fetal parameters.

1. Introduction
Pregnancy diagnosis is important camel management for maintaining a high level of reproductive efficiency [1,2]. Because camel is seasonal breeding, the diagnosis of early pregnancy is necessary to get them pregnant in the same season of parturition. Furthermore, most camel herds still implement unrestrained natural mating as a breeding policy, with the consequent deficiency of data around service date and gestational ages [3]. This delays the correct management of pregnant camels at the proper times.
Transrectal palpation is the greatest widely used technique for early pregnancy diagnosis in camels, however, the method does not afford adequate information about the viability of the conceptus during the earlier stages of gestation [4]. On the other hand, by ultrasonography, it became possible to study the development and growth of the camel fetal organs and parts without risking pregnancy [5,6].

Transrectal ultrasonography has provided trustworthy data on first times of intrauterine fluid accumulation, observation of embryo proper, organization of the embryo and onset of ossification. It also supplied accurate estimation for the fetal crown-rump length, biparietal diameter, abdominal diameter, ruminal length, eyeball diameter that could be used for prediction of gestational age and time of parturition [7].

Transabdominal ultrasound is a fast substitute to transrectal ultrasound or manual palpation of the reproductive tract. This technique does not necessitate the examiner to kneel behind the animal. Furthermore, some of the fetal parameters could not be detected by transrectal ultrasonography during mid- and late gestation as the gravid uterus had progressed down during the advancement of pregnancy [6,7].

To date, no literature has been available regarding the comparison of transrectal and transabdominal ultrasound for detection of the camel conceptus during different stages of fetal development. The aim of this study was, therefore, to compare between transrectal and transabdominal ultrasonography for monitoring dromedary camel conceptus during different stages of gestation.

2. Materials and Methods

2.1. Animals

A group of six pluriparous female dromedary camels was used in this study. They were aged 10 to 12 years, weighing from 392 to 438 kg with body condition scores from three to four via a scale from 1 to 5 [8]. The females were naturally mated to a known fertile male at normally occurring estrus. The last day of breeding was marked as day 0 of pregnancy. Transrectal ultrasonography was carried out 2 weeks after mating. Pregnancy was predicted via observation of non-echogenic fluid in the center of the uterine horn and by the existence of the corpus luteum on the ovary. These findings were ascertained later through detection of the embryo proper. The animals were kept at the Veterinary Teaching Hospital of Qassim University, Saudi Arabia.

2.2. Transrectal ultrasonography

Consecutive transrectal ultrasonography was performed once weekly between the second and 42nd weeks of pregnancy and every 2 weeks from the 42nd week until parturition. The examinations were carried out while the camels were in standing position in a special stanchion. The ultrasonography was performed by only one operator. Real-time, B-mode diagnostic ultrasound equipment (Aloka, SSD 500, Tokyo) with 5 MHz transrectal linear array transducers were used for examination. On each examination, attempts were made to imagine the conceptus and to estimate the following fetometric parameters: biparietal diameter (BPD; the broadest space between the outer limits of the cranium at an position of 90o to the falx cerebri), abdominal diameter (ABD, extreme diameter of the abdomen at the insert of the umbilical cord), ruminal diameter (RUD, the major intraluminal length of the rumen), and eyeball diameter (EBD, the lengthiest width of the vitreous body from medial to lateral sclera).

2.3. Transabdominal ultrasonography

The transabdominal ultrasonography was carried out at the same times of transrectal ultrasonography. It was performed while the animals were in standing position secured in a stanchion and by using a real-time, B-mode, diagnostic ultrasound (Aloka 500 SSD, Tokyo, Japan) attached with 3.5 MHz curve-linear array probes. Six areas were designated for transabdominal ultrasound examination (Fig. 1): caudal abdominal (CAA, right and left, directly above the base of the udder); middle abdominal (MIA, right and left, between the base of the udder and the umbilicus; and cranial abdominal (CRA, right and left, from the umbilicus to the xiphoid cartilage). The hair was clipped and ultrasound gel was applied to the area to be examined. The probe was then positioned and stirred perpendicularly on the skin of the pelvic and abdominal cavities. At each examination, efforts were made to detect the conceptus and its details and to measure the BPD, EBD, ABD, and RUD.

2.4. Statistical analysis

Chi-square test was used to evaluate the difference in percentages between the transrectal and transabdominal approaches in the frequency of detecting of the camel conceptus and its details.
during different stages of pregnancy. Statistical analysis was carried out using the SPSS program version 18, 2009. Level of significance was set at p < 0.05.

### 3. Results

Comparison between transrectal and transabdominal approaches in the frequency of detecting the camel conceptus during different stages of pregnancy is revealed in Table 1. Between the 4th and 5th weeks, the conceptus could only be imagined by the transrectal approach (100%). From the 6th to the 12th weeks, the conceptus was mostly observed through the left CAA (100%) and the transrectal (97.6%) approaches, but less frequently through the right CAA (66.7%) approach. Between the 13th and the 27th weeks, the conceptus was mainly observed through the left CAA (100%), but less frequently through the right CAA (50%) and transrectal (31.8%) approaches. Between the 28th and 52nd weeks, the conceptus was mainly detected through the left CRA approach (92.3%), but less frequently through right CRA (69.2%) and transrectal (60.3%) approaches.

![Figure 1. Changes in the location of the pregnant uterus during different gestational periods and the expected areas for transabdominal examination: (A) caudal abdominal approach used during early and late-gestation (B) middle abdominal approach used during mid-gestation (C) cranial abdominal approach used during late-gestation.](image)

![Figure 2. Using transrectal (upper row) and transabdominal (lower row) ultrasonography for estimation of the biparietal diameter (A, AA), eyeball diameter (B, BB) and abdominal and ruminal diameters (C, CC) of dromedary camel conceptus](image)

**Table 1.** Comparison between transrectal and transabdominal approaches in frequency of detecting the camel conceptus during different stages of pregnancy (n= 6 camels, examined for 198 times).

<table>
<thead>
<tr>
<th>Stage of pregnancy</th>
<th>Transrectal</th>
<th>Frequency of detection of the conceptus</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Transabdominal</td>
<td>caudal</td>
</tr>
<tr>
<td></td>
<td>-right</td>
<td>-left</td>
</tr>
<tr>
<td>4-5 weeks (n=12 examinations)</td>
<td>12/12 (100%)</td>
<td>0.0/12 (0.0%)</td>
</tr>
<tr>
<td>6-12 weeks (n=42 examinations)</td>
<td>41/42* (97.6%)</td>
<td>28/42 (66.7%)</td>
</tr>
<tr>
<td>13-26 weeks (n=66 examinations)</td>
<td>21/66 (31.8%)</td>
<td>0/66 (0.0%)</td>
</tr>
<tr>
<td>27-52 weeks (n=78 examinations)</td>
<td>47/78 (60.3%)</td>
<td>29/78 (37.2%)</td>
</tr>
<tr>
<td>Total (n=198 examinations)</td>
<td>121/198 (61.1%)</td>
<td>57/198 (28.8%)</td>
</tr>
</tbody>
</table>

* Values at the same row differ significantly at p < 0.05.
Comparison between transrectal and transabdominal approaches in the frequency of detecting different fetal parameters during different stages of pregnancy is presented in table 2. The EBD was the furthermost accessible fetal parameter throughout transrectal and transabdominal examinations and the ABD was the least.

Table 2. Comparison between transrectal (TR) and transabdominal (TA) approaches in the frequency of detecting of different camel parameters during different stages of pregnancy (n=6 camels, examined for 198 times).

<table>
<thead>
<tr>
<th>Stage of pregnancy</th>
<th>Frequency of detection of fetal parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>EBD</td>
</tr>
<tr>
<td>4-5 weeks (n=12 examinations)</td>
<td>TR 0.0/12</td>
</tr>
<tr>
<td></td>
<td>(0.0%)</td>
</tr>
<tr>
<td>6-12 weeks (n=42 examinations)</td>
<td>TR 17/42</td>
</tr>
<tr>
<td></td>
<td>(40.5%)</td>
</tr>
<tr>
<td>13-26 weeks (n=66 examinations)</td>
<td>TR 21/66</td>
</tr>
<tr>
<td></td>
<td>(31.8%)</td>
</tr>
<tr>
<td>27-52 weeks (n=78 examinations)</td>
<td>TR 47/78*</td>
</tr>
<tr>
<td></td>
<td>(60.3%)</td>
</tr>
<tr>
<td>Total (n=198 examinations)</td>
<td>TR 85/198</td>
</tr>
<tr>
<td></td>
<td>(42.9%)</td>
</tr>
</tbody>
</table>

* Values at the same row differ significantly at p <0.05.

4. Discussion

Based on the current data, visualization of the camel conceptus depended on the stage of gestation and changes occurring in size and location of the pregnant uterus. The gestational changes in the uterus of dromedary camels have been described [9,10]. The uterus grows into cranial and ventral after the third month of pregnancy. By the fourth month, the uterus is in anterior of the pelvic brim, but most of it can be touched. By 5 months of gestation, the uterus is totally in the abdomen and the fetus is not regularly palpable. The fetus comes to be palpable again after the sixth month of pregnancy. The head and limbs become palpable by the seventh to eighth month as the fetus begins its ascent. By 11 months, the fetal limbs can be easily detected in the pelvic cavity.

The transrectal approach was superior for the early pregnancy diagnosis. This may be due to the low frequency used during the transabdominal approach (3.5 MHz) related to that used through transrectal examination (5 MHz). Essentially, higher frequencies have a congruently shorter wavelength and can be used to make sonograms with better details. However, the weakening of the sound wave is increased at greater frequencies. Therefore, to have improved penetration of deeper tissues, a minor frequency (3 to 5 MHz) is used [11].

According to the present data, transabdominal ultrasonography has some advantages including (1) the camel conceptus and fetal parameters could be detected throughout the gestation period beginning from the sixth week onwards, (2) this technique does not require the sonographer to kneel behind the animal, (3) in advanced pregnancy it gives some fetal details that could not be noticed by transrectal ultrasonography [6].

Data revealed that the left side approach was more favorable for imagining of the conceptus than the right side. This may be recognized to the fact that all the observed pregnancies were found in the left horn. In dairy cattle, transabdominal ultrasound in the right flank has not been commended as an exact method for early pregnancy diagnosis [12].

The accessibility of the different fetal parameters detected in this study related to the stage of pregnancy and the area of examination. The EBD was the most accessible fetal parameter due to the head and eye could be detected in most stages of gestation. The RUD and ABD were the tiniest accessible organs because, with the progress of gestation, it became too long to be presented efficiently on the screen.

5. Conclusion

In dromedary camels, the transrectal, left CAA, and left CRA ultrasonography are the best approaches for pregnancy diagnosis during early, mid-, and late gestation, respectively.

Author contribution
Ahmed Ali: Supervision; Investigation;
Methodology; Data curation; Formal analysis; Writing - review & editing.

Derar R Derar: Investigation; Methodology.

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Conflict of interest
Authors declare that there are no conflicts of interest.

References