COMPARISON BETWEEN ULTRASONIC BIPARIETAL DIAMETER AND BODY DIAMETER AS CLOSE DETERMINANT OF GESTATIONAL AGE INDICATED BY THE OWNERS IN DOGS

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The use of ultrasonography gives almost accurate date of gestation. To get the accurate gestational age the present study used real-time B-mode ultrasonography after day 40 of pregnancy and to compare between BPD and BD of the foetus and also estimated the closeness to the data of the owners. The mean gestational age based on mean BPD (20.32±1.405mm) was 50.48±2.1. On the same day of measurement of BPD the mean gestational age based on mean BD (32.21±2.36mm) was 50.64±1.78. Use of BPD is the most accurate measurement tool for determining the GA, closer to the date of mating in the study.

Keywords: Biparietal diameter, Body diameter, Gestational age, Ultrasonography.

The early determination of pregnancy and the gestational age (GA) are important for reproductive management in small animal practices. Intervening when the pregnancy is full term can reduce losses of offspring from bitches having obstructions of the pelvis or vagina, histories of primary or secondary uterine inertia, or prolonged parturition with resultant puppy mortality. It has been demonstrated that from the ovulation day, the average gestation length is 63±1day (Holst and Phemister, 1971). It is important to stress that ovulation does not coincide with conception that may occur approximately 2 days later. The day of ovulation can be detected on the basis of other correlated events such as the luteinizing hormone (LH) surge, the associated initial rise in progesterone or the onset of diestrus. Ovulation is caused by a surge of LH concentration and it occurs approximately 2 days after this peak, thus, gestation length in the bitch is 65 ± 1 day with very little variation when timed from the preovulatory LH surge in peripheral blood (Concannon et al., 1983). Assessment of gestational age ultrasonographically based on foetal mean biparietal diameter (BPD) and/or mean body diameter (BD) is thus defined in relation to days after the LH peak. In the absence of LH surge determination; this paper aims to correlate the gestational age information from the owner with biparietal diameter and body diameter.

Materials and Methods:

The study was conducted in 19 bitches aged between 18months to 5years. Bitches were apparently healthy with no history of illness or injury during previous delivery. The pregnancy diagnosis was done using real-time B-mode ultrasonography after day 40 of pregnancy as indicated by the owner. The bitches were prepared for sonography by clipping hairs on the ventral abdomen and were preferably kept with full bladder as it can be used as an acoustic imaging window to locate the uterus. All the bitches were examined in dorsal, left and right lateral recumbency. An ultrasound coupling gel was applied on the abdomen to increase the conductivity and ultrason was started from caudal end and probe moved cranially to scan entire abdomen. The images on the monitor were frozen, different measurements were recorded and the images were stored on the computer. The gestational age using biparietal diameter and body diameter were recorded using the formula; GA = (15 x BPD) + 20 and GA = (7 x BD) + 29 which were fed as
default formulae in the machine. The biparietal diameter (BPD) is measured as the distance between parietal bones (Fig 1). Body diameter (BD) is measured taking the two diameters made at 90° angles in the transverse plane at the level of foetal liver and stomach (Fig 2).

The data collected from the owner, biparietal diameter and body diameter by ultrasonography were subjected to correlation coefficient and regression analysis.

Fig-1: Biparietal diameter (BPD) of the foetus for gestational age assessment

Fig-2: Body diameter (BD) of the foetus for gestational age assessment

Results

The 19 bitches were examined ultrasonographically after 40 days of pregnancy. The biparietal diameter and the body diameter of the foetuses were measured and the gestational age was recorded. The mean gestational age based on mean BPD (20.32±1.405mm) was 50.48±2.1. On the same day of measurement of BPD the mean gestational age based on mean BD (32.21±2.36mm) was 50.64±1.78. Although mean values between BPD and BD shows a very narrow margin, individually a wide range of difference was observed between BPD and BD, which was 0.17days to 6.89days. Similarly a difference of 0.49days to 2.86days was seen between GA of BPD and that of last date of mating, and a variation ranging from 0.45days to 8.56days was observed in GA of BD and that of last date of mating, indicating that BPD was much closer to last date of mating as indicated by the owner’s.

The results of the regression analysis indicating the relationship between gestational age based on biparietal diameter, body diameter, according to ultrasonography and according to owner are presented in the tables. The regression of GA based on BPD was significant compared to GA based on BD. The GA according to last date of mating is more related to GA based on BPD than GA based on BD. So the GA based on BPD is more closer to last date of mating when compared to GA based on BD.

Relationship between foetal measurements (BPD and BD) and the Gestational Age based on ultrasound measurement are depicted in Table-1, Fig-3 and Fig-4. Relationship between GA as per ultrasound measurements and the GA as per Owners are depicted in Table-2, Fig-5 and Fig-6.

<table>
<thead>
<tr>
<th>Table-1: Relationship between foetal measurements (BPD and BD) and the Gestational Age based on ultrasound measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement</td>
</tr>
<tr>
<td>----------------------</td>
</tr>
<tr>
<td>Biparietal diameter</td>
</tr>
<tr>
<td>Body diameter</td>
</tr>
</tbody>
</table>
Fig-3: Relationship between BPD of foetus and gestational age based on ultrasound measurement (regression analysis).

\[ Y = (20.06) + (1.497)X; r^2 = 0.990 \]

where, \( y = \text{GA based on BPD, } x = \text{BPD} \)

Fig-4: Relationship between BD of foetus and gestational age based on ultrasound measurement (regression analysis).

\[ Y = (28.72) + (0.6497)X; r^2 = 0.7472 \]

where, \( y = \text{GA based on BD, } x = \text{BD} \)

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Intercept (a)</th>
<th>Regression coefficient</th>
<th>( R^2 ) value</th>
<th>N</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>GA BR – BPD GA</td>
<td>6.269</td>
<td>0.8808</td>
<td>0.968</td>
<td>19</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>GA BR – BD GA</td>
<td>2.399</td>
<td>0.9545</td>
<td>0.8118</td>
<td>19</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>

Fig-5: Relationship between GA (BPD) as per ultrasound measurements and the GA as per Owner’s

\[ Y = (6.269) + (0.8808)X; r^2 = 0.9680 \]

where, \( y = \text{GA based on owner’s, } x = \text{GA based on BPD} \)

Fig-6: Relationship between GA (BD) as per ultrasound measurements and the GA as per Owner’s

\[ Y = (2.399) + (0.9545)X; r^2 = 0.8118 \]

where, \( y = \text{GA based on owner’s, } x = \text{GA based on BD} \)

Discussion

The duration of canine gestation, as timed from the preovulatory serum LH peak, is 65 ± 1 d. However full-term gestation, calculated from insemination, has ranged from 57 to 72d. The difference between these
measurements was attributed to the potential 6-day viability of sperm in the female reproductive tract and the long period of receptivity in the bitch. Gestation length as measured from the first day of diestrus based on vaginal cytology, has a large range (51–60 d). Based on other studies, the key to timing the duration of canine gestation was neither insemination date nor estrus onset, but rather the preovulatory LH surge and concomitant increase in serum progesterone concentrations. It is in agreement to the reports of Kutzler et al. (2003a) and, Kutzler et al. (2003b), both measurement of preovulatory serum progesterone concentrations (progesterone method), or fetal measurements made with transabdominal ultrasonography (ultrasound method), provided a more accurate estimate (65±2 d, prediction accuracy 90 and 87%, respectively) than other methods. Some studies also recommend the use of serial preovulatory serum progesterone measurements to estimate the day of the LH peak (Day 0), followed by transabdominal ultrasonography for confirmation. If preovulatory progesterone measurements are not available, the ultrasound method provided an accurate estimate of parturition date if the examination was performed by Day 39 and the gestational age was corrected for the nonpregnant body weight of the dam. However, the most accurate prediction was obtained when the ultrasound examination was conducted at Day 30 as also reported by Kutzler et al (2003b).

Most of the authors agree that the chorionic cavity diameter (gestational sac diameter; GSD) was a good indicator for the evaluation of embryonic development in early pregnancy and the most accurate predictor of gestational age between days 20 and 37 in the dog. From days 38 to 60, fetal head diameter was the most accurate predictor of gestational age, but foetal crown-rump length (CRL) and body diameter (BD) were also significant.

The BPD is visualized on a longitudinal scan of a foetal head. The distance is recorded when the parietal bones are parallel in order to standardize the measurement. Measurement of BPD is highly accurate (±1 day) within the first 6 weeks of pregnancy; afterwards a gradual decrease of the accuracy is observed, thus maintaining a good accuracy at ±2 days until week 8 as also reported by Luvoni (2013).

Use of BPD is the most accurate measurement tool for determining the GA, closer to the date of mating in the study. Biparietal diameter is more accurate than body diameter in the bitch after Day 37. Combining the use of BD and BPD will increase the accuracy relative to using BD alone as also mentioned by Lopate (2008). In the cases studied also the BPD of foetus was found to be significantly correlating (r=0.9995) with the GA. BD of the foetus was also found to be significantly correlating (r=0.8644) with the GA. Even though both BPD and BD are significantly correlating with the GA, BPD is more closer to the dates of mating given by the owner and is found to be a better prediction of GA than BD. Average head diameter (HD) ranged between 1.5 to 2.4 cm with mean 1.92 ± 0.06 cm and gestational age (GA) ranged between 42.5 to 56 days with mean 48.87 ± 1.0 days as also recorded by Javeid (2013). In accordance with other study the mean gestational age and mean BPD was 50.48±2.1 and 20.32±1.405mm, respectively and ranged between 39.14-67.56 days and 12.76-31.68mm, respectively.

Body diameter depends on number of the foetus, nutritional status of the dam and management of the animal. When the dam is well fed and given with nutritious food the foetus will also get good nutrition from dam through placenta so the foetus will grow well under proper nutrition so gives the higher body diameter compared to dam that are malnourished. BD will be more in case of single foetus when compared to multiple foetus because of distribution of nutrients of all the foetus in case of multiple foetus and in case of single puppy condition the supply of nutrients will be limited to that foetus so the foetus grows well and gives higher body diameter. Accuracy with the use of BPD measurements within 1 d of actual parturition was 64–75% in small breeds and 65% in medium breeds; and within 2 d this increased.
to 85–88 and 81–86% respectively. In cases of singletons or very small litters, BPD may be less accurate than in bitches with normal size litters as also reported by Son et al. (2001); Beccaglia and Luvoni (2006). It may be concluded that biparietal diameter correlates better with the gestational age as informed by the owner, than the body diameter of the foetus.

References