

Determination of Gestational Age in Shami Goats Based on Transabdominal Ultrasonographic Measurements of Placentomes and Uterine Diameter

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Abstract

The study was aimed to estimate the gestational age of Shami does by transabdominal ultrasonographic measurement of maternal parameters. Thirty-three Shami does aged 2-2.5 years with confirmed conception dates were used. The does were examined in a standing position using a transabdominal 3.5 MHz convex sector probe of real-time ultrasonography. The does were examined weekly starting from 21 days of pregnancy until parturition. Measurements of the maternal parameters that include; the uterine diameter, placental width, and placental height were obtained from the ultrasonographic images using the software Screen Calipers. Results showed that the gestational sac and embryos were observed early on 21 and 35 days of pregnancy. The litter size of Shami does was 2-3 kids. Uterine diameter ranged between 27 ± 1.4 and 136.9 ± 4.2 mm between 21-130 days, placentomes width was 17.6 ± 0.6 - 38.5 ± 2.1 mm, placentomes height was 9.5 ± 1.8 - 24.5 ± 1.4 mm on 51-150 days of gestation. The highest positive correlations were obtained between the gestational age and the measurements of uterine diameter ($r=0.943$). The least positive correlations were between the gestational age and the values of placenta width ($r=0.715$) and placentom height ($r=0.615$). In conclusion, transabdominal ultrasonography is a practical method for pregnancy diagnosis and monitoring of embryo in Shami goats. Also, it is reliable to estimate gestation age from 21 days of pregnancy. The uterine diameter was the best maternal parameter that can be used for the longest period for estimation of Shami goats gestational age.

Keywords: Shami goats, Transabdominal, Ultrasonography, Gestational age.

تقدير عمر الحمل في الماعز الشامي بالاعتماد على قياسات الامواج فوق الصوتية عبر جدار البطن للمشائم وقطر الرحم

الخلاصة

هدفت الدراسة الحالية الى تقدير عمر الحمل في الماعز الشامي من خلال قياس معايير الام باستخدام الفحص بالامواج فوق الصوتية عبر جدار البطن. تم استخدام 33 من اناث الماعز الشامي عمرها بين 2-2,5 سنة ولها تاريخ معروف لبدء الحمل. فحصت الحيوانات في وضع الوقوف باستخدام المجس المحدب ذو التردد 3.5 ميكا هرتز لجهاز التصوير بالامواج فوق الصوتية. فحصت اناث الماعز أسبوعياً ابتداءً من اليوم 21 من الحمل حتى الولادة. أخذت قياسات معايير الام التي شملت؛ قطر الرحم، عرض المشائم، وارتفاع المشائم من صور الامواج فوق الصوتية باستخدام برنامج Screen Calipers. أظهرت النتائج ملاحظة الكيس الجنيني والاجنة ابتداءً من اليوم 21 و 35 من الحمل، على التوالي. تراوح عدد الاجنة للاناث الحوامل بين 2-3 اجنة. تراوح قطر الرحم بين 27 ± 1.4 - 136.9 ± 4.2 ملم بعمر 21-130 يوم، وعرض المشائم 17.6 ± 0.6 - 38.5 ± 2.1 ملم بعمر، وارتفاع المشائم 9.5 ± 1.8 - 24.5 ± 1.4 ملم بعمر 51-150 يوم. سجل أعلى إرتباط إيجابي بين قطر الرحم وعمر الحمل ($r=0.943$)، كما سجل ارتباط اقل مع عمر الحمل لكل من عرض المشائم ($r=0.715$) وارتفاع المشائم ($r=0.615$). استنتج من الدراسة ان الفحص بالامواج فوق الصوتية عبر جدار البطن طريقة عملية لتشخيص الحمل ومراقبة الجنين في الماعز الشامي. أيضا هي طريقة عملية لتقدير عمر الحمل بدءاً من اليوم 21 من الحمل. لقد كان قطر الرحم أفضل معايير الام لتقدير عمر الحمل اذ يمكن استخدامه لمدة أطول في تقدير عمر الحمل لاناث الماعز الشامي.

Introduction

Shami goats, also known as Damascus goats, is a native breed of Syria and other Near East countries. Shami goats are one of an important farm animal that bred primarily for milk and meat production. They are characterized by high milk production and high rate of twins (1).

The age of pregnancy in farm animals is estimated depending on the time of insemination which is considered to be the zero day of pregnancy, and this method is more accurate for determination the age of pregnancy. However, the method that adopted for bred of goats remains rudimentary in many countries, including Iraq, since it does not adopt the recording system and record the date of insemination. Therefore, determination of pregnancy age in such animals requires a reliable method to obtain accurate results (2).

A reliable pregnancy diagnosis will help to estimate the delivery date which enhance the flock growth planning and management, production of livestock, possible pre-partum diseases. It also allows rebreeding or culling of does. Early pregnancy diagnosis and determination of fetal numbers is very crucial in farm-bred goat, because when there is a lack of gestation in the does usually results in the loss of one production year. Additionally, accurate information on the stage of gestation would be useful to dry off the lactating does at an adequate period, and to monitor the does near birth (3). The

last 4-6 weeks of gestation is considered a critical period for does reproduction, at this period the majority of fetal growth is occurring, placing increasing nutritional demands on the does. Low nutrition of does at the mid and late period of gestation is one of the most important factors that reduce the fetal growth (4) and fetal birth weight (5). The fetus is developed rapidly during the late period of pregnancy leading to increased energy demands, and in combination with hormonal interactions (insulin and prolactin), having an effect on lipid and carbohydrate metabolism in pregnant animals, and predispose the animals at risk to develop pregnancy toxemia (6). Additionally, estimation of gestational age is important for vaccination programs. In goats and during the last trimester, 79% gained body weight and fetal development obtained (7).

Different methods for pregnancy diagnosis in goats were developed. The ultrasonography is one of the most appropriate methods that can be used for pregnancy diagnosis in does. The accuracy of transrectal and transabdominal approach of the method is about 100% on 25–30 day of pregnancy (8).

Several studies have been used the ultrasonography for predication of the gestational age in different breeds of goats. These measurements include; uterine diameter, crown rump length, fetal head diameter, trunk diameter, measurement the dimensions of the heart and diameter of the umbilical cord (9-15).

In Iraq, very limited studies were conducted

to determine the pregnancy age in local Iraqi goats (16,17), and only one study was carried to detect the single and multiple pregnancy according to ultrasonographic measurement of placentomes in Shami goats (18). While there is no study has been conducted to estimate the age of pregnancy in Shami goats.

The objective of the current study was predication of the gestational age of Shami does by transabdominal ultrasonographic measurement of maternal parameters that includes uterine diameter, placentomes width and height.

Materials and Methods

Animals

Thirty-three cyclic Shami does were used in this study. The age of does was 2-2.5 years and they have 1-2 previous parturition. The animals were in the same farm under the same management, environment and feeding system.

Estrus cycle of the does were synchronized using a vaginal sponge (Esponjivet[®], Laboratorios Hipra, S.A., Spain) for 14 days. After that, the sponges were drawn off, and a 500 IU of serum gonadotrophin (eCG) (Oviser[®], Laboratorios Hipra, S.A., Spain) was injected intramuscularly. The does appear the signs of estrus within 72 hours. All does were mated at least one time with fertile males. The first day of mating was designated as day 0 of gestation.

Ultrasonography

Transabdominal ultrasonography was applied according to the method was described previously in goats and sheep without fasting or shaving (12). The does were scanned in standing position using a 3.5 MHz convex array transducer of the real-time ultrasound scanner ECM-iMAGO (iMAGo, ECM, France). Ultrasound transmission gel was used as coupling medium. The probe was applied to the hairless area immediately cranial to the udder (19).

The ultrasonographic scanning of the does was weekly starting on 21 day of gestation until the parturition. A series of ultrasonographic images of the pregnant uterus were obtained and recorded for later analysis and measurement.

Measurements of maternal parameters

The ultrasonographic images of the uterus were processed to obtain the measurements of parameters using the software Screen Calipers (Version 4.0, ©2006, Iconico, Inc., <http://www.iconico.com/caliper/>). The software was calibrated in millimeter using an image of the ultrasonic device with known distances (Figure 1). After that, the software was used to obtain the measurements of the uterus and their components in millimeter (20). The maternal parameters include; the uterine diameter, placentomes width, and placentomes height (Figure 2-4).



Figure 1: Calibration of the Screen Caliper software through an image of the ultrasonic device with known distances in millimeter.

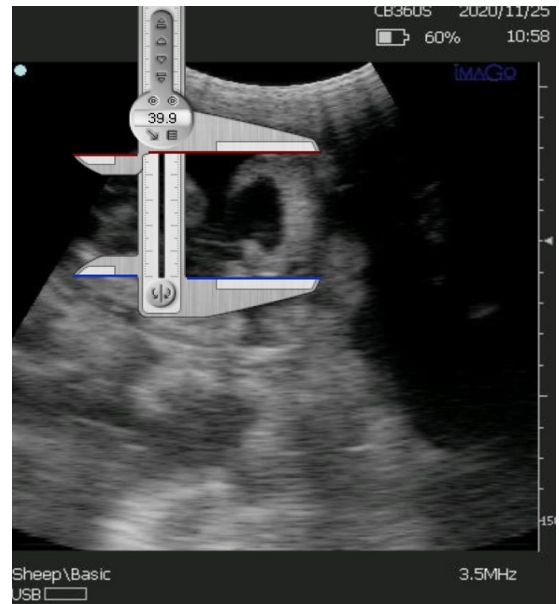


Figure 3: Measurements of the placentomes width in pregnant Shami doe using the Screen Caliper software.



Figure 2: Measurements of the uterine diameter in pregnant Shami doe using the Screen Caliper software.

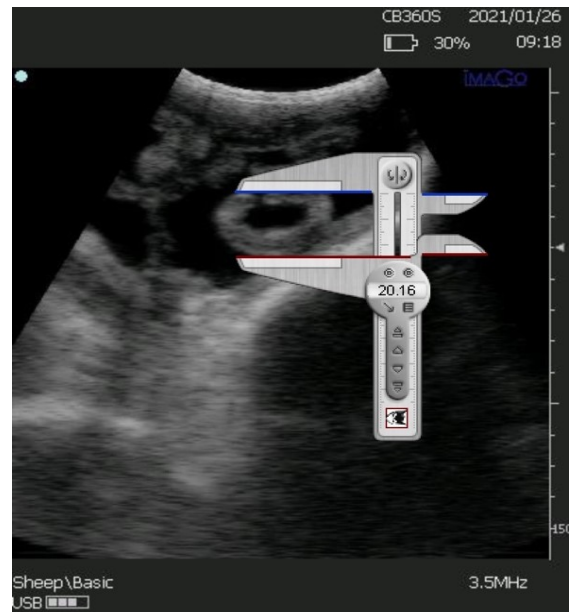


Figure 4: Measurements of the placentomes height in pregnant Shami doe using the Screen Caliper software.

Data analysis

The obtained data of the parameters were in millimeter (mm); they were presented as mean + SE. Data of the maternal parameters were plotted as X-Y scatter chart. Linear regression was added to the chart and straight line equations were obtained using the Microsoft Excel application (Microsoft Office Professional Plus 2016). The formula $y = ax + b$ was used for calculation of the gestational age, where $y =$ gestational age, $a =$ predictors (constant), $x =$ measured value, and $b =$ dependent variable. The values of correlation coefficient between the gestational age and the parameters were calculated using SigmaStat (Jandel scientific software V3.1). The results were considered significant if $P < 0.05$.

Results and discussin

Estrus synchronization and pregnancy diagnosis:

After injection of eCG, all does exhibited estrus within 72 hours. All mated does were pregnant as confirmed at kidding. The first sign of pregnancy was the appearance of a gestational sac (Figure 5). Gestational sac was detected first on day 21 of gestation, it appears as a circular or an elongated anechoic area located in the uterus. The litter size of Shami does was 2-3 kids.

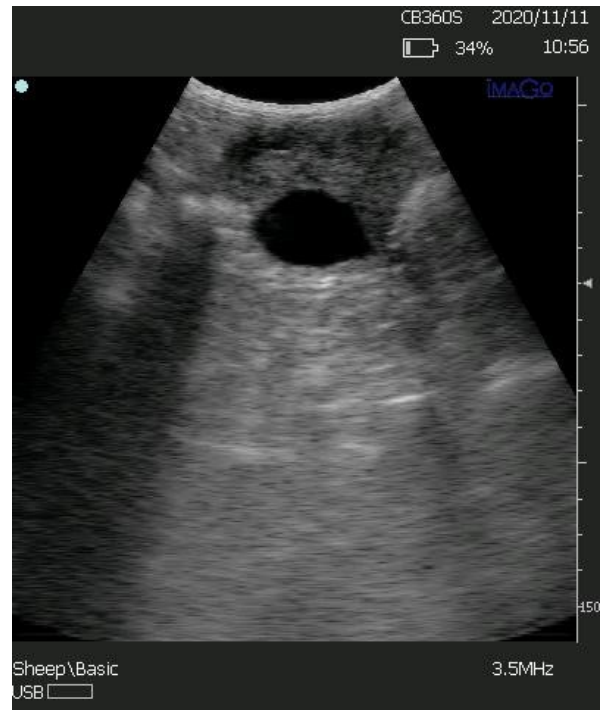


Figure 5: Ultrasonic image of pregnant Shami doe showing the gestational sac.

Maternal parameters:

Uterine diameter

Figure 6 shows the values of the uterine diameter. The uterine diameter was 27 ± 1.4 mm at 21-30 days of pregnancy. This distance was increased gradually to be 136.9 ± 4.2 mm at 121-130 days of pregnancy.

Placentomes width and height

Placentomes were visible as small nodules 4.6 mm in size on 42 day of gestation. As pregnancy progressed, placentomes increased in size and appeared as C-shaped or O-shaped gray. The placentomes width on 51-60 day of gestation

were 17.6 ± 0.6 mm, they were increased to reach 38.5 ± 2.1 mm on 141-150 day of gestation (Figure 7). At the same time, the measurements of the placentomes height were increased gradually from 9.5 ± 1.8 to 24.5 ± 1.4 mm. (Figure 8).

Estimation of gestational age

The relationship between the gestational age and the measurements of the maternal parameters were shown in Figure 9. The equations of the regression line, squares of the correlation coefficient and P values of these relationships were presented in Table 1. A highly significant ($P < 0.01$) positive correlation was observed between the gestational age and maternal parameters of pregnant Shami goats. The highest positive correlations were obtained between the gestational age and the measurements of uterine diameter ($r = 0.943$). The least positive correlations were shown between the gestational age and the values of placentomes width ($r = 0.715$) and placentomes height ($r = 0.615$).

According to the available references, this study considered to be the first of its kind in Iraq to estimate the gestation age in Shami goats using transabdominal ultrasonography. Only two studies were conducted previously in Shami goats; the first one was to detect the relationship between the fetal number and the placentomes size (18), while the second one was in Syria using linear array transducer to detect early pregnancy in Shami goats (21).

Results of our study showed that the gestational sac was detected firstly on day 21, while the embryos were detected at day 25 of gestation. These results are much similar to that was obtained by Medan et al. (22) who observed the gestational sac and embryo in Shiba goats firstly at 20.2 and 24.3 days of gestation, respectively. Also, our results agreed with results of Karadaev et al. (23) who measured the gestational sac firstly on 21 day of pregnancy in local Bulgarian goats. Other researchers needed more time (24-28 days) to detect the gestational sac in Boer (24), Egyptian Baladi (25), Saanen goats (26) and Assam hill goats (27), while Khand et al. (28) reported the first sign of pregnancy in Teddy goats (an elongated or somewhat circular anechoic area in uterus) on day 19 of gestation, and proper embryo with echoic structure within uterine fluid on day 21. Results of present study confirm the finding of Sayuti et al. (15) who observed the embryo of Kacang goats firstly at 24 days of pregnancy, and observation of Devi et al. (27) who measured the embryo of Assam hill goats first time on 24 day of pregnancy.

The measurement of uterine diameter that obtained in the current study on 21 day of gestation (27 mm) was higher than those observed in Teddy goats (21.55 mm) (28) and local Bulgarian goats (10.3 mm) (23).

In this study, the uterine diameter was easy to be identified by ultrasonography from days 21 to days 144 of gestation, and it was highly

correlated ($R^2 = 0.88$) with the gestational age. Similar high correlation ($R^2 = 0.89$) was found in Bulgarian local goats (13). On the other hand, much higher coefficient ($R^2 = 0.97$) was reported in Teddy goats (28).

Placentomes are easily recognized and measured throughout the pregnancy. They were detectable in this study as small echogenic nodules as early as in day 42 of pregnancy (4.6 mm). Similar observation was recorded in west African dwarf goats on day 34.4 day of gestation (29), and in local Bulgarian goats on 42 day of gestation (23). The observation of placentomes in the present study was too late in comparison to other studies that used the transrectal ultrasonography; Karen et al. (10) was detected the placentomes on 28 day of pregnancy in Egyptian native goats; Hussein (18) was measured the placentomes of Shami goats in Iraq on 30 day of gestation; and Medan et al. (22) was observed the placentomes on 35 day of pregnancy in Shiba goats. In the present study the placentomes diameter on 51-60 day of gestation was 17.6 mm and reach to 38.5 mm at the end of gestation, this record agreed with Hussein (18) who reported a value of 17.43 mm for the placentomes diameter in Shami goats on 51- 60 day, and observation of Rasheed (17) in Iraqi black goat who found 18.5 and 39.6 mm as a measurement of the placentomes on 56-65 and 126-135 day of pregnancy. Also, the value of placentomes diameter that recorded in the current study shown equals to that value that recorded in Abaza and Gurcu goats (18 and 19 mm on 60 day

of gestation) (14), while other studies were recorded fewer values for the placentomes diameter in Korean black goat (14.7 mm) (9), Kacang goat (12.4 mm) (15) and local Bulgarian goats (13.6 mm) (23) at the same period of gestation.

A significant positive correlation ($R^2 = 0.511$) was recorded in the present study between the placentomes measurements and gestational age of Shami goats. The value of the correlation coefficient that reported in the current study was lower than those which recorded in Abaza ($R^2 = 0.908$) and Gurcu ($R^2 = 0.899$) goats (14).

According to the above information, we find significant differences between the measurements of maternal parameters that recorded in the current study for Shami goats compared to those that presented in other studies of other goat breeds. This differences may be mainly due to different goat breeds, especially the difference in body size which reflected and influences the measurements of maternal parameters. The other reason of the above differences may be the ultrasonography approach. The transabdominal ultrasonography approach was depended in the current study for pregnancy diagnosis, observation of pregnancy and obtaining the measurements of maternal parameters, this approach considered safe and not harmful for animals during the examination. On the contrary, the transabdominal approach of ultrasonography gives more accurate results and at an earlier period of pregnancy.

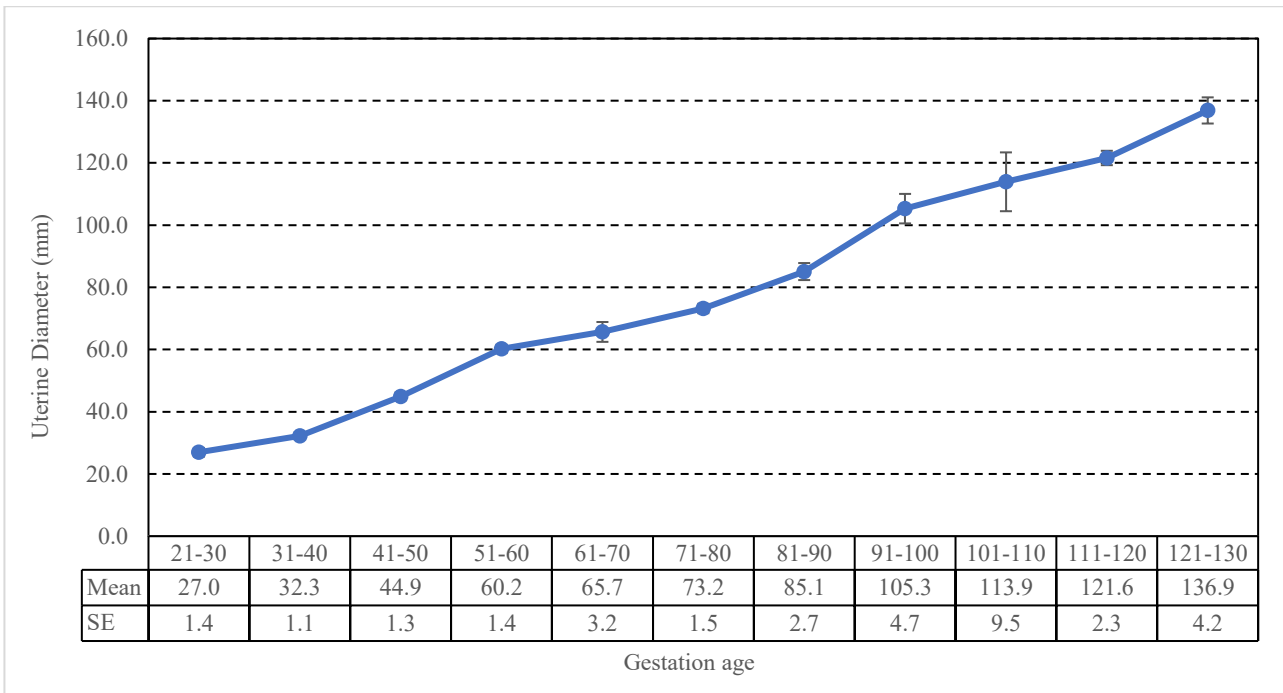


Figure 6: Measurements in mm (Mean ± SE) of the uterine diameter that obtained by transabdominal ultrasonography during the gestation period of Shami goats.

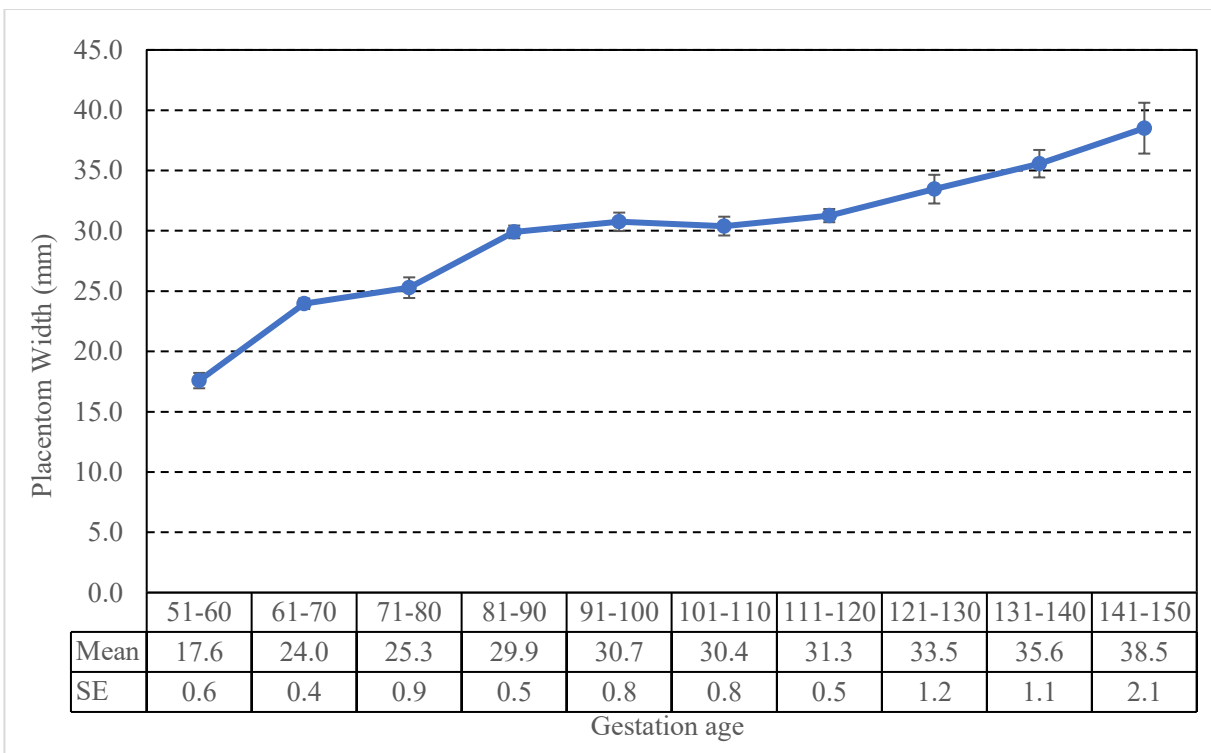


Figure 7: Measurements mm (Mean ± SE) of the placental width that obtained by transabdominal ultrasonography during the gestation period of Shami goats.

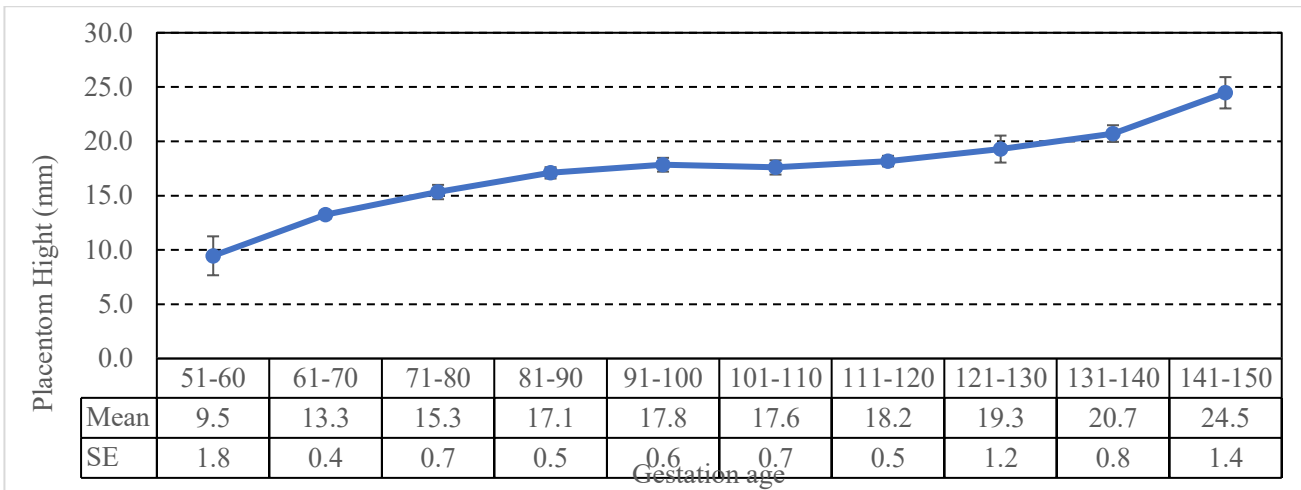


Figure 8: Measurements mm (Mean ± SE) of the placentom hight that obtained by transabdominal ultrasonography during the gestation period of Shami goats.

Table 1: The regression line equations, squares of the correlation coefficient and P values of the relationship between gestational age and the maternal parameters that obtained by transabdominal ultrasonography during the gestation period of Shami goats.

Parameters	Regression line equation	R ²	P value
Placentomes width	Y=3.1164x+7.7101	0.512	<0.001
Placentomes height	Y=3.6902x+35.66	0.378	<0.001
Uterine diameter	Y=0.9454x+3.5295	0.889	<0.001

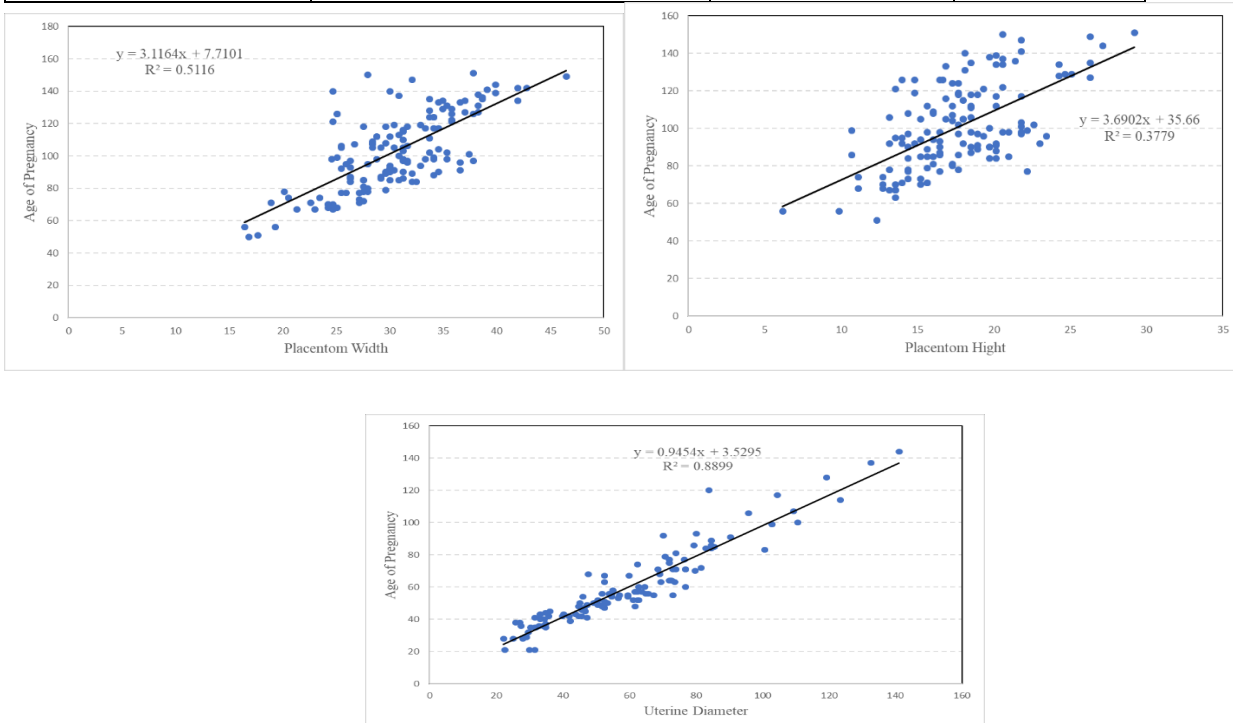


Figure 9: The relationship between the gestational age and the measurements of the maternal parameters of pregnant Shami does.

Conclusions

In conclusion, is a practical method for pregnancy diagnosis and monitoring of embryo in Shami goats. Also, it is reliable to estimate gestation age starting on 21 day of pregnancy. Uterine diameter was the best maternal parameter which can be used for longest period for estimation of Shami goats gestational age.

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Conflict of interest

No conflicts regarding publication of this manuscript.

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