

Transrectal Ultrasound Scanning for Detecting the Early Pregnancy in Korean Black Goats

H. G. Shin, Y. S. Choi, S. K. Jang, H. S. Yang, O. K. Lee, D. S. Lee, J. K. Cho and S. T. Shin*

College of Veterinary Medicine, Chungnam National University, Daejeon 305-764, Korea

ABSTRACT

This study was performed to establish the early pregnancy diagnosis with evaluation of size of embryonic vesicles and change of crown-rump length (CRL) by transrectal ultrasonography in the Korean black goats. Early pregnancy diagnosis was performed in the 114 goats from 19 to 35 days after coitus by transrectal 5.0 MHz transducer. Embryonic vesicles and CRL in the 142 goats from 19 to 42 days was measured to establish the correlation between gestational age and these parameters. The early pregnancy diagnosis achieved 80% accuracy after days 25 and 100% accuracy after days 28 after breeding. Diameters of embryonic vesicle and CRL were significantly increased with the gestational age. In these facts, early pregnancy diagnosis is possible on Days 25 after breeding and measurement of embryonic vesicles and CRL were useful to predict the gestational age in Korean black goat.

(Key words : Korean black goat, pregnancy diagnosis, transrectal ultrasonography)

INTRODUCTION

Early pregnancy diagnosis and determination of fetal age are of considerable economic value in farm animal reproductive management. A lot of methods developed for pregnancy diagnosis in small ruminants but most methods have not satisfied the desired criteria of sensitivity, accuracy, speed, safety, simplicity, and, low cost (George, 1990). The first article on pregnancy diagnosis in the goats by means of B-mode ultrasonography appeared in 1983 (Tainturier *et al.*, 1983). Both reliability and the practicality of pregnancy diagnosis by sonographic examination of small ruminants under field condition have improved (Buckrell *et al.*, 1986; Lavoit and Taverne, 1989). Nowadays, one of the most recent techniques for early pregnancy diagnosis in sheep, goat and cattle on the farm is B-mode ultrasonography.

In goats, there are not so many reports for early pregnancy diagnosis (Wani, 1981; Gonzalez *et al.*, 1999). In the previous study for evaluation of the early pregnancy diagnosis with 5 MHz linear array transrectal transducer in Anglo-Nubian goats, non-echogenic area allowed significantly difference between pregnant and non-pregnant on Day 18 and fetal crown-rump length was first detected as about 4 mm on Day 19 of gestation (Martinez *et al.*, 1998).

Recently, the demands of Korean black goat as experimental animals have been increasing. Because, they have short ge-

neration time and relatively low costs to raise than other ruminants. However, many researchers have been reported using the Korean black goat, there are few researches on evaluation of early pregnancy diagnosis and assessment of fetal age by means of the ultrasonic scanning.

The objectives of this study were 1) to determine the earlier date for pregnancy diagnosis, 2) to predict the fetal age from the proven parameters, such as, diameter of embryonic vesicle (DEV) and crown-rump length (CRL), to fetal growth in Korean black goats.

MATERIALS AND METHODS

1. Animals

Total 254 Korean black goats (*Capra hircus aegagrus*) were used in this study, 114 goats were used in early pregnancy diagnosis and 142 goats used in measurement of DEV and CRL. The does of body weight from 12 to 25 kg were fed alfalfa/grass hay and commercial ration with free access to water and trace-mineralized salt. Estrus was induced by the insertion of intravaginal progesterone devices CIDR[®] sheep & goat (InterAg, New Zealand) for 2 weeks. Goats became estrus were mated naturally.

2. Early Pregnancy Diagnosis

Transrectal ultrasonographic examination with a 5 MHz li-

* Correspondence : E-mail : stshin@cnu.ac.kr

near array transducer (Sonoace 600[®], Medison Co., Korea) were performed in 114 female Korean black goats between Days 19 to 35 post mating (breeding=Day 0). The animals were restrained in lateral recumbency during examination. The rectum was cleared of feces when it was necessary for reducing damage of rectal wall, and some lubricant was infused into the rectum. The transducer was introduced into the rectum until the bladder was displayed on the screen. The uterine horns were observed cranial or caudal to the bladder depends on the position of probe markers, and the transducer was rotated 90° clockwise and then 180° counterclockwise to image the entire reproductive tract. All transrectal imaging were conducted by the same operator. Images consistent with pregnancy include multiple fluid-filled uterus, embryo proper and fetal heartbeat. Pregnancy was confirmed by transabdominal ultrasound 8 weeks after breeding.

The results of the early pregnancy ultrasonographic examinations were arranged as: correct positive diagnoses (a); incorrect positive diagnoses (b); correct negative diagnoses (c) and incorrect negative diagnoses (d). The ultrasound pregnancy test was calculated as described by Szenci *et al.* (Kutty, 1999);

Sensitivity (accuracy of a diagnosis of pregnant)

$$= (a/a+d) \times 100$$

Specificity (accuracy of a diagnosis of non-pregnant)

$$= (c/c+b) \times 100$$

Positive predictive value = $(a/a+b) \times 100$

Negative predictive value = $(c/c+d) \times 100$

Overall accuracy = $(a+b/a+b+c+d) \times 100$

3. Measurement of Embryonic Vesicle and Crown-rump Length

To study of the assessment of early stage pregnancy, DEV and CRL were measured by 5 MHz transrectal linear array transducer (Sonoace 600[®], Medison Co., Korea) in 142 (average sample size=10) Korean black goats between Days 19 to 42 after breeding, respectively.

When a vesicle was detected, it was frozen at its maximal size, and the vertical and horizontal diameters were measured with integral electronic calipers and then mean embryonic vesicle diameters were computed for each fetus. The embryo proper was first detected as an echogenic spot in the embryonic vesicle, thereafter, the crown-rump length was measured.

4. Statistical Analysis

Data of this study were fitted to their optimal regression lines ($p < 0.05$), and described by the equation as well as the

Table 1. Results of pregnancy diagnosis in a group of 114 goats. Portable ultrasonic scanner equipped with a 5 MHz linear array transrectal transducer was used for pregnancy diagnosis

Grouping and evaluation	Test performed during days after mating			
	19 to 21	22 to 24	25 to 27	28 to 35
No. of does	34	30	15	35
Diagnosis pregnant correct	14	9	7	16
Diagnosis pregnant incorrect	9	6	3	0
Diagnosis not pregnant correct	10	14	5	19
Diagnosis not pregnant incorrect	1	1	0	0
Sensitivity (%)	93.3	90.0	100.0	100.0
Specificity (%)	52.6	70.0	62.5	100.0
Positive predictive value (%)	60.7	60.0	70.0	100.0
Negative predictive value (%)	90.9	93.3	100.0	100.0
Overall accuracy (%)	70.6	76.7	80.0	100.0

coefficient of determination was calculated.

RESULTS

1. Accuracy of Early Pregnancy Diagnosis

The results of the early pregnancy diagnoses are presented in Table 1. Diagnoses made by transrectal ultrasound scanning of the uterus were highly accurate from 28 days after mating. The overall accuracy between Days 19 to 21, between Days 22 to 24, between Days 25 to 27 and between Days 28 to 35 were 70.6%, 76.7%, 80.0% and 100%, respectively. Accuracy of the transrectal early pregnancy diagnosis tended to increase consistently with the advancement of pregnancy.

2. Diameter of Embryonic Vesicle (DEV)

The DEV was shown on Fig. 1. DEV were significantly increased with the fetal age. The equation and the coefficient value were described as follows;

$$\text{Gestational Age (GA=day)} = 16.81 + 0.54 \times \text{DEV (mm)}$$

$$\text{Coefficient value (r}^2\text{)} = 0.76$$

3. Crown-rump Length (CRL)

Scatter plots and regression lines of CRL were depicted in

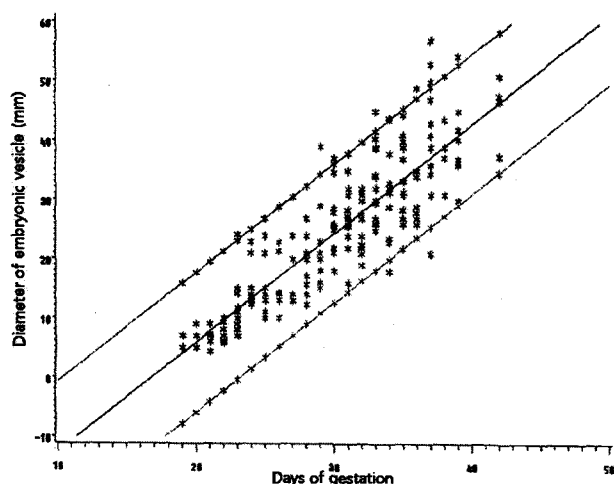


Fig. 1. Diameter of embryonic vesicle and regression line from Days 19 to 42 of gestation for 142 Korean black goats. The mid line showed the regression lines and the area between upper and lower lines signify the value of their 0.95 confidence limits.

Fig. 2. CRL was significantly increased with the fetal age. The equation and the coefficient value were described as follows;

$$\text{Gestational Age (GA=day)} = 20.82 + 0.76 \times \text{CRL (mm)}$$

$$\text{Coefficient value (r}^2\text{)} = 0.76$$

DISCUSSION

Early pregnancy diagnosis and detecting the fetal ages are important aspect of the reproductive management. Early detection of pregnancy would allow early culling or rebreeding of barrens and detecting of the fetal ages can provide predicting parturition days. The need for methods of pregnancy diagnosis is especially important in goats because the goats are a seasonal breeder, and failure to return to estrus as the goats pass into anoestrus (Smith, 1986).

Using the transrectal route, Buckrell *et al.* (1986) observed uterine fluid in pregnant ewes, sometimes as early as between days 16 and 20, but regularly between days 20 and 23; a fetus was visible in all cases from day 30. But Martinez *et al.* (1998) reported that the embryo could be observed on Day 20.7±0.5. The others reported that amniotic vesicle is visualized on Day 20 and the embryo is determined by heartbeat from Day 24 to 26 of gestation (Ott *et al.*, 1981), and embryo observed on Day 20 to 25 after breeding in sheep and goats (Montigny *et al.*, 1982; Dionysius, 1991; Szenci *et al.*, 1997). In this study, the most early fluid-filled uterine observed on Day 16, but

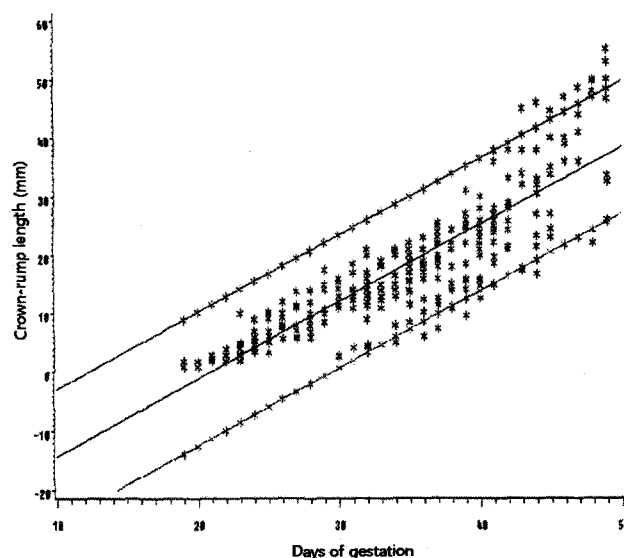


Fig. 2. Crown-rump length and regression line from Days 19 to 49 of gestation for 142 Korean black goats. The mid line showed the regression lines and the area between upper and lower lines signify the value of their 0.95 confidence limits.

usually after Day 19 after breeding and embryo proper detected Days 19 to 20 after breeding. In these works, it was difficult to distinguish embryonic vesicles at these periods because goat uterus normally has an intra-uterine fluid correlated with estrus cycle (Kastelic *et al.*, 1991). As well as Hanzen *et al.* reported that almost all (125 of 126) false positive diagnoses by ultrasound were caused by embryonic mortality in cattle and embryonic mortality in goats and ewes has been reported to range from 6 to 40% (Schrack and Inkeep, 1993; Kuty, 1999).

The overall accuracy between Days 28 to 35 was 70.6%, 76.7%, 80.0% and 100%, respectively. From these results, early pregnancy diagnosis were valuable from 25 days after breeding and ultrasound scanning was a reliable method for diagnosing early pregnancy in Korean black goats.

Because embryonic vesicle diameter was different their size with same method in the same does, determination of have some difficulties. For this reason, we measured several times and used means of the vertical and horizontal value at their maximal size, but the coefficient of determination was relatively low ($r^2=0.76$, $p<0.05$). It may be need to more study for measurement of diameter of embryonic vesicle.

Crown-rump length was significantly increased from the first detection of the embryo to the end of the study and a reliable

parameter for tracing embryonic growth (Martinez *et al.*, 1998). In this study, our *R*-square value ($r^2=0.76$) of crown-rump length between Days 19 to 49 in Korean black goat was lower than others; Martinez *et al.* (1998) ($r^2=0.94$) in Anglo-Nubian goat, White *et al.* (1985) ($r^2=0.82$) in cattle and Meira *et al.* (1998) ($r^2=0.95$) in jennies. In our experiences, fetal movement was more active after about 35 days of gestation, and may be fetal movements also affect to determination of crown-rump length. From Day 19 to 38, the pattern of embryonic growth could be described by a linear regression equation allowing for the predicting of gestational age by measuring crown-rump length (Martinez *et al.*, 1998). In heifers, embryonic growth corresponded to the quadratic regression equation, with an increased growth rate was observed after approximately Day 50 of pregnancy (Kahn, 1989; Kastelic *et al.*, 1991). In ewes, Schrick and Inskip (1993) also found a quadratic relationship between time and growth up to Day 40. The reason of low correlation coefficient in this study may be on Days 38 or 39, growth rate increased and it was no longer possible to describe embryonic growth using the same linear regression equation. Consequently, appropriate regression model could be used for describing the conceptus growth after the Day 38 of pregnancy.

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