Early fetal sexing of Saanen goats
by use of transrectal ultrasonography to identify
the genital tubercle and external genitalia

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Objective—To define the optimum period for sexing of Saanen goat fetuses by use of transrectal ultrasonography.

Animals—82 Saanen goats pregnant with 124 fetuses.

Procedures—Fetal sexing was performed on the basis of the final location of the genital tubercle or identification of external genitalia. In experiment 1, fetuses (n = 78) were monitored every 48 hours from days 40 to 60 of gestation, whereas for experiment 2, 46 fetuses were examined only once between days 47 and 77 of gestation.

Results—For experiment 1, accuracy of fetal sexing was 20 of 20 (100%) for a single fetus, 39 of 42 (92.8%) for twin fetuses, and 10 of 16 (62.5%) for triplet fetuses. Diagnostic accuracy was significantly lower for triplet fetuses than that for single or twin fetuses. Final location of the genital tubercle was detected between 45 and 55 days of gestation (mean ± SEM, 48.9 ± 1.8 days). For experiment 2, accuracy of fetal sexing for a single fetus (24/24 [100%]) was significantly higher than the accuracy for twin fetuses (16/22 [72.7%]). Considering all fetuses that were born, accuracy of diagnosis was 69 of 78 (88.4%) for experiment 1 and 40 of 46 (86.9%) for experiment 2. Accuracy did not differ significantly between experiments.

Conclusions and Clinical Relevance—Real-time ultrasonography after day 55 of gestation is a suitable method for determination of sex of Saanen goat fetuses by observation of the genital tubercle or identification of external genitalia. (Am J Vet Res 2007;68:561–564)

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productive technologies will further increase the practical applications of ultrasonography.

The GT is an embryonic structure that differentiates into the external genitalia in males and females. During differentiation, the GT moves from its initial position between the hind limbs toward the umbilical cord in males and towards the tail in females. Few studies on fetal sex identification in sheep have been reported, and to our knowledge, there have been no reports on fetal sex identification by use of ultrasonography in dairy goats.

Therefore, the purpose of the study reported here was to determine fetal sex by use of transrectal ultrasonography in Saanen goats. The objective for the first experiment was to provide an early determination diagnosis of the sex of fetuses on the basis of the final position of the GT, as determined through serial examinations conducted between days 40 and 60 of gestation. The objective for the second experiment was to evaluate the accuracy of fetal sexing for a single examination conducted between days 47 and 77 of gestation.

Materials and Methods

Animals—Eighty-two Saanen goats pregnant with 124 fetuses were used in the study. Conduct of the study was approved by the Universidade Federal Rural de Pernambuco Animal Care and Use Committee.

Ultrasoundographic examination—Two experiments were conducted. There were 78 and 46 does included in experiments 1 and 2, respectively. Does were mated only once during estrus. Day of mating was considered day 0 of gestation.

Transrectal ultrasonography was performed by use of an ultrasound machine equipped with a linear transducer (6.0 and 8.0 MHz) coupled to an adapted device to facilitate manipulation within the rectum of each doe. A printer was also part of the ultrasound equipment.

All ultrasonographic examinations were performed by the same investigator (MHBS), with the goats restrained in a chute in a standing position. Briefly, the rectum of each doe was digitally evacuated before the start of each examination and whenever necessary during examination. Ultrasonographic coupling gel was applied to the transducer before insertion into the rectum.

Once the transducer was within the rectum, the fetus or fetuses were located and scanning for sex determination was initiated. Sex of each fetus was determined on the basis of identification of the GT and evaluation of its location relative to the location of the umbilical cord attachment and tail or on the basis of identification of external genital structures (prepuce, penis, and scrotum in male fetuses or nipples and vulva in female fetuses) in various scanning planes.

A fetus was recorded as a male when the GT was located immediately caudal to the umbilical cord and as a female when it was located near the tail. In experiment 1, 78 fetuses were monitored every 48 hours from days 40 to 60 of gestation, whereas for experiment 2, 46 fetuses were examined only once between 47 and 77 days of gestation. For experiment 2, sex of each fetus was determined on the basis of GT position or any anatomic structure indicative of the external genitalia.

Confirmation of sex of fetuses—During the last week of gestation, does were transferred to separate box stalls for parturition. Sex of fetuses was confirmed immediately after birth.

Statistical analysis—Data obtained were analyzed by use of a χ² test. Values of P < 0.05 were considered significant.

Results

In experiment 1, final location of the GT was detected between days 45 and 55 (mean ± SEM, 48.9 ± 1.8) of gestation (Figure 1). For 68 of 78 (87.2%) fetuses, the GT reached its final position between 45 and 50 days of gestation. For the other 10 (12.8%) fetuses, final position of the GT was observed at > 50 days of gestation.

Table 1—Accuracy of determination of the sex of fetuses in Saanen does examined by use of transrectal ultrasonography every 48 hours between days 40 and 60 of gestation.

<table>
<thead>
<tr>
<th>Fetuses/pregnancy</th>
<th>Sex determined</th>
<th>Sex not determined*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male fetuses</td>
<td>Female fetuses</td>
</tr>
<tr>
<td>Single</td>
<td>12</td>
<td>8</td>
</tr>
<tr>
<td>Twins</td>
<td>19</td>
<td>20</td>
</tr>
<tr>
<td>Triplets</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>38</td>
<td>31</td>
</tr>
</tbody>
</table>

*The GT or structures indicative of the external genitalia could not be detected during ultrasonography.
†Values represent number of fetuses in which sex was correctly identified/all fetuses examined (percentage).
‡Values with different superscript letters differ significantly (P < 0.05).
In experiment 1, there were no misdiagnoses regarding determination of the number or sex of fetuses; however, it was not possible to observe the GT in 9 fetuses. Accuracy of fetal sexing was significantly lower for triplet fetuses, compared with the accuracy for single and twin fetuses (Table 1). No significant difference in accuracy of fetal sexing was observed between single and twin fetuses.

In experiment 2, 24 does were pregnant with a single fetus and 22 were pregnant with twins. A significant difference was evident in the accuracy of fetal sexing between single and twin fetuses (Table 2).

Considering all fetuses that were born, accuracy of diagnosis was 69 of 78 (88.5%) for experiment 1 and 40 of 46 (86.9%) for experiment 2. Accuracy did not differ significantly between experiments.

Discussion

The greatest challenge of fetal sexing in small ruminants continues to be the determination of the earliest time at which ultrasonography can be used to determine the final position of the GT, which allows greatest accuracy for fetal sexing. The diagnosis of sex in fetuses of Santa Inês sheep that resulted from natural matings can be performed after day 30 of gestation by use of the final location of the GT, which is achieved between days 37 and 46 of gestation. However, in fetuses of Anglo-Nubian goats, the GT does not reach its final location until between days 44 to 49 of gestation, and determination of fetal sex on the basis of the final position of the GT should be performed after day 55 of gestation to avoid mistakes resulting from possible variations among animals and breeds.

In the study reported here, final position of the GT was detected > 50 days after mating in 10 of 78 (12.8%) fetuses in experiment 1, which supports the recommendation to determine sex of goat fetuses at ≥ 55 days of gestation to reduce the number of errors, especially with regard to the determination of female fetuses. An unsuitable position of the fetus that causes obstruction of the view of anatomic structures used for sex determination is a problem that impairs ultrasonographic examination, especially in does pregnant with multiple fetuses. Incorrect quantification of the number of fetuses and determination of fetal sex associated with fetal interposition in females pregnant with multiple fetuses have also been reported by other investigators.

An unexpected result was that ultrasonographic examinations performed at short time intervals (every 2 days) did not enhance determination of the number or sex of fetuses in triplets. In addition, examinations performed at short time intervals, such as the 2-day intervals used in our study, are limited in field conditions because the need to return to a farm or ranch would increase the cost of this procedure. In animals pregnant with multiple fetuses, it is not always possible to quantify or identify the sex of each fetus. The need for sophisticated equipment and qualified operators as well as the period of gestation during which ultrasonographic examinations are conducted, especially in dams with multiple fetuses, limit the ability to determine fetal sex in field conditions.

Results obtained for experiment 2 were considered satisfactory, taking into account that only 1 examination was performed between days 47 and 77 of gestation in field conditions. It would be prudent, when possible, to repeat the examination at least once. In agreement with another author, who pointed out that it was possible to observe differences in the position of the GT (ie, migration of the GT) only after day 40 of gestation, results of the study reported here suggested that GT migration toward the umbilical region is detectable only after day 45 of gestation in Saanen goats.

The rates we obtained for sex determination in pregnancies that consisted of a single fetus were higher than those reported by other investigators. On the other hand, errors associated with multiple fetuses were not attributable to our inability to determine the number of fetuses. This finding indicates that transrectal ultrasonography with a linear transducer is a suitable method for sexing goat fetuses between days 47 and 77 of gestation, regardless of whether the pregnancy consists of single or multiple fetuses.

Experience of the operator and quality of the ultrasound equipment are fundamental to the success of fetal sexing during any period of gestation. In the study reported here, we used a linear transducer with 2 frequencies. We assumed that the equipment contributed to the results, which were higher than those reported by other authors. The dual frequency of the linear transducer enabled us to remove any doubt about anatomic structures. In addition, we could enlarge images and retrieve images generated during the preceding 30 seconds of an examination. We also could freeze the ultrasonographic image on the screen to enable a more detailed analysis. All of these factors were important to our success in fetal sexing.

We believe that identification of the GT and structures related to the external genitalia by use of real-time ultrasonography is a suitable method for determining fetal sex in Saanen goats. Ultrasonographic examinations should be performed during the appropriate gestational period.

Table 2—Accuracy of determination of sex of fetuses in Saanen does examined once by use of transrectal ultrasonography between days 47 and 77 of gestation.

<table>
<thead>
<tr>
<th>Fetuses/pregnancy</th>
<th>Sex determined</th>
<th>Sex not determined*</th>
<th>No. of live-born kids</th>
<th>Accuracy of diagnosis†</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male fetuses</td>
<td>Female fetuses</td>
<td>Male fetuses</td>
<td>Female fetuses</td>
</tr>
<tr>
<td>Single</td>
<td>15</td>
<td>9</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Twins</td>
<td>8</td>
<td>8</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>23</td>
<td>17</td>
<td>2</td>
<td>4</td>
</tr>
</tbody>
</table>

See Table 1 for key.
References


