Introduction

During recent years, there has been increasing awareness in the need for early diagnosis of pregnancy in goats. Examination of goats for pregnancy may be done as part of a reproductive herd health program or may simply be requested by the pet goat owner who would like to know the pregnancy status of his or her doe. A reliable technique for early detection of pregnancy would allow early culling or rebreeding of barren does. Perhaps the most important reason for pregnancy diagnosis is detection of pseudopregnancy or hydrometra, which may occur in pet and commercial goats, especially in dairy herds where breeding is delayed to adjust milk supplies. Does pronounced open or pseudo pregnant are often culled or given prostaglandin to make them come in estrus. So there is great emphasis placed on a highly accurate pregnancy test.

A variety of examination methods have evolved over the years. Ultrasonography, hormone assay, and radiography have emerged as the most useful methods utilized today. Older described methods of laparotomy, cervical palpation, abdominal palpation or ballottement, and rectal-abdominal palpation with a rod have limited utility or have been abandoned. Although non-return to estrus following breeding is suggestive of pregnancy, pathologic conditions of the uterus and ovaries, physiologic anestrus late in the breeding season, and out of season breeding may cause postbreeding anestrus in nonpregnant does. Many does also exhibit estrous behavior during pregnancy, making this an unreliable means of pregnancy diagnosis. Choice of the above methods depends on availability of equipment, number of days postbreeding, number of animals to examine, desired accuracy, need for immediate results, cost to the client, and experience of the examiner.

Different Methods of Pregnancy Diagnosis in Goats

1. **Non-Return to Estrus**

2. **Progesterone Assay**

   **Blood**
   
   Ewes = 15 to 17 days  
   Does = 18 to 22 days  
   Plasma P4 > 1.0 ng/mL  
   Accuracy  
   = 75 - 86% pregnant  
   = 90 - 100% non-pregnant

   **Milk**
   
   RIA milk P4:  
   above 10 ng/mL = 86% pregnant  
   <10 ng/ml = 100% non-pregnant

Plasma concentrations of progesterone tend to be more predictable of the true endocrine status.
3. **Radiography**: 65-70 days

4. **Rectal - Abdominal Palpation**

   Hulet rod = 1.5 × 50 cm plastic rod

5. **Abdominal Palpation**: third trimester

   The gravid uterus or fetus can sometimes be palpated through the relaxed abdominal wall of the standing doe or ewe by placing a hand on either side of the abdomen and squeezing or lifting upward.

6. **Estrone Sulphate Test**

   Estrone sulphate is produced by the feto-placental unit and can be measured in the blood, milk, and urine by radio-immuno assay. >50 days post breeding this test is close to 100% accurate for the detection of pregnancy and non-pregnancy.

   - Milk = 82% accurate for pregnant
   - = 83% accurate for non-pregnant

7. **Ultrasonography**

   a. **A-mode ultrasonography**: Amplitude depth ultrasound for pregnancy diagnosis is detection of the fluid-filled uterus and is thus not pregnancy-specific. A-mode units emit ultrasonic waves from a hand held transducer placed externally against the skin of the abdomen and directed towards the uterus. Ultrasound waves are converted to electrical energy in the form of audible or visual signal. These units detect fluid-filled organs at a depth of 10-20 cm. The transducer is placed low in the right flank near the udder of the standing doe. Clipping a small area of hair in this region will allow optimal contact. A coupling agent such as commercial ultrasonic gel, K-Y jelly, carboxymethylcellulose lubricant, or vegetable oil should be applied to the transducer to eliminate air spaced between the skin and the transducer head. Some units emit a light or audible signal when a fluid-filled structure is detected. Units with an oscilloscope display reflections as peaks or blips on the screen. Nonpregnancy is suggested when the peaks are present only in the left half of the screen. When a fluid-filled structure is detected, peaks will also appear on the right half of the screen. Accuracy = 80-85% if performed between 60 to 120 days of gestation.

   b. **Doppler**: The principle of Doppler ultrasound for pregnancy diagnosis is the detection of movements - blood flow in the middle uterine artery, umbilical arteries, fetal heart beat, and fetal movements. Transducer emit ultrasound waves; sound reflected from motionless structures has the same frequency as the transmitted sound, whereas sound reflected from a moving organ or blood has a different frequency. The difference in frequency is converted to audible sound. Audible signals, which may be distinguished by the observer, include the fetal heartbeat, arterial blood flow in the middle uterine artery and umbilical arteries, fetal body movement, and maternal intestinal movement.

   The transducer can be applied externally to the skin of the abdomen or intrarectally
using a rectal probe. The transducer, coated with a coupling agent, is applied to the clipped skin low in the right flank in front of the udder and the abdomen systematically searched. In the intrarectal technique, a specially designed rectal probe is inserted in the rectum and slowly rotated. A positive diagnosis of pregnancy is made by listening for the rapid, pounding sound of the fetal heart beat; rapid, swishing sound of the fetal pulse, which is faster than the maternal pulse; sharp, short duration sounds of fetal movement; or the swishing sound of blood flow in the middle uterine artery, which is at the same rate as the maternal pulse.

The external Doppler technique for detection of pregnancy approaches an accuracy of 100% during the last half of gestation but is not as effective in the 50 to 75 day range or earlier. The intrarectal Doppler technique was superior to the external technique when attempted at the beginning of the second trimester and may achieve an accuracy of 90% or better. The intrarectal technique may be attempted as early as 25 to 30 days postbreeding, but false negatives are a problem; it is preferable to wait until day 35 to 40. False negatives may also occur when soft feces around the rectal probe interfere with sound wave transmission; this can be minimized by feeding dry feed 2 to 3 days prior to examination. False positives are unlikely with the Doppler technique when fetal sounds are used as the criteria for pregnancy diagnosis. Hydrometra can cause increased maternal blood flow in the middle uterine arteries, but no fetal sounds will be heard. Doppler units with a frequency of 2.25 MHz may be superior in near term pregnancies, whereas a 5 MHz frequency seems better for detecting earlier pregnancies.

c. **B-Mode Ultrasonography:** Real-time B-mode produces a 2 dimensional image on the screen. For pregnancy examination, it produces a moving image of the uterus, fetal fluids, fetus fetal heartbeat, and placentomes. Ideal time for trans-abdominal scanning is between 40 to 75 days. Prior to 40-45 days the transducer may have to be placed higher in the inguinal region. 25-30 days is best done transrectally.

**Diagnosis**

Positive diagnosis of pregnancy is assured by imaging the embryo/fetus or placentomes surrounded by fluid.

1. Fetus and fetal heart beat: Intrarectally > 25 days; Transabdominally > 35 days

2. Placentomes: > 40 days (transabdominal)

3. Estimating the fetal age: 40 to 100 days measuring the width of the fetal head or biparietal diameter. A positive diagnosis of pregnancy is assured by imaging the embryo/fetus or placentomes surrounded by fluid. A presumptive diagnosis of pregnancy or Hydrometra can be made by imaging multiple anechoic (fluid-filled) sections of uterine lumen cranial to the bladder from 25 to 40 days of gestation using a transabdominal or transrectal approach. A false positive pregnancy diagnosis during this period may be caused by Hydrometra. This condition occurs commonly enough in goats to advise caution against making a positive diagnosis of pregnancy until the embryo/fetus can be seen. The urinary bladder should not be confused with a fluid-filled uterus. The bladder can be identified transrectally by viewing the characteristic triangular-shaped neck as the transducer is directed causally.
The bladder wall can usually be seen as an echogenic white line separating the anechoic lumen of the bladder from the anechoic uterine luminal sections. The fetus and fetal heart can be seen after day 25. The fetus appears as an echogenic mass within the uterine lumen. Visualizing fetal movement or beating of the fetal heart during real-time imaging can assess fetal viability. As a pregnancy advances to the late second and third trimesters, only portions of the fetus such as the thorax and skull and be imaged on the screen at one time. Placentomes can be seen by 35-40 days, appearing as echogenic densities in the uterine wall. They become cup-shaped or C-shaped by 45-50 days when viewed in cross section with the concave surface directed toward the uterine lumen.

The ability to identify multiple fetuses with real-time ultrasonography is a clear advantage over other ultra-sound techniques. Feeding management can be adjusted for does carrying multiple fetuses or single fetuses. The optimal time for counting a fetal numbers is probably somewhere between 40-70 days. At 70 days and beyond, additional fetuses may lie beyond the depth of a 5 MHz linear-array transducer. Twins can be more accurately diagnosed than triplets and fetal numbers are frequently underestimated. Estimating fetal numbers prolongs the time of examination and the reader should be aware of its limitations. Another advantage of real-time ultrasonography is the ability to distinguish a viable pregnancy from a hydrometra, pyometra, and fetal mummification.

Real-time ultrasonography can also be used to estimate fetal age in the goat at 40 to 100 days of gestation by measuring the width of the fetal head (biparietal diameter). A symmetrical image of the fetal head showing the greatest head width is frozen on the screen and the distance between the uppermost edge of the superficial and deep parietal bone images is measured in millimeters with electronic calipers. Image symmetry is crucial to accurate measurements and can be afforded by viewing both fetal orbits in the same image. Table 1 shows the derived equations from several studies for computing the gestational age in various goat breeds based on biparietal diameter measurement. This technique required practice to fully master but should be helpful in predicting parturition dates when actual breeding dates are unknown.

<table>
<thead>
<tr>
<th>Breed</th>
<th>GA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toggenburg</td>
<td>27.9 + 1.64 BPD</td>
</tr>
<tr>
<td>Nubian</td>
<td>26.8 + 1.74 BPD</td>
</tr>
<tr>
<td>Angora</td>
<td>28.6 + 1.77 BPD</td>
</tr>
<tr>
<td>Pygmy</td>
<td>23.2 + 2.08 BPD</td>
</tr>
<tr>
<td>Suffolk</td>
<td>22.5 + 1.81 BPD</td>
</tr>
<tr>
<td>Finn</td>
<td>21.4 + 1.85 BPD</td>
</tr>
</tbody>
</table>

*Adapted from Haibel, G. K. et.al.: Real-time ultrasonic measurement of fetal biparietal diameter (BPD) for the prediction of gestational age (GA) in small domestic ungulates. Society for Theriogenology Newsletter Vol. 13, No. 5 (1990).
The proper citation for this article is: