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Radiologycal and ultrasonographical diagnosis of pregnancy in sheep

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Abstract

For pregnancy diagnosis in sheep have been used various methods (clinical, radiologic, ultrasonographic and hormonal). Both pregnancy and fetal numbers are accurately diagnosed by using radiography after day 70 of gestation. A-mode and Doppler ultrasonic techniques accurately detect pregnancy during the second half of gestation. Fetal numbers cannot be determined by A-mode ultrasound, while the Doppler technique needs experience to achieve high accuracy. Transrectal B-mode, realtime ultrasonography identifies the embryonic vesicles as early as d 12.8 days after mating, but the sensitivity of the technique for pregnancy is very low (12%) earlier than 25 days after mating. Transabdominal B-mode ultrasonography achieved high accuracy for pregnancy diagnosis (94% to 100%) and the determination of fetal numbers (92% to 99%) on day 29 to 106 of gestation. Realtime, B-mode ultrasonography appears to be the most practical and accurate method for diagnosing pregnancy and determining fetal numbers in sheep.

Keywords: Ultrasonography; radiology; diagnosis; sheep; pregnancy.

Review of literature

Nonpregnant ewes could be sold, reducing feed expenses, while non-pregnant lambs could be marketed at higher price than they would bring as mature ewes [14]. For sheep industry, early detection of pregnancy is of considerable economic value. Separation of the sheep herd into pregnant and non-pregnant ewes might reducere productive and production losses in form of abortions, stillbirths and production of weak lambs [32]. The accurate information on the stage of gestation would be useful to dry off lactating females at adequate period and to monitor the females near term [8]. In addition, predictions of the number of fetuses would allow appropriate nutritional management of the ewes in late gestation that will prevent pregnancy toxemia [9], minimize prelambing feeding costs, optimize birth weight, weaning weight and survivability of lambs and reduce the incidence of dystocia [14]. Ford et al. (1963) examined 322 ewes by radiography and reported 100% and 90% accuracy for diagnosing pregnancy and determination of the fetal number, respectively, after 70 days of gestation [9]. Grace et al. (1989) reported 94 to 100% accuracy of radiography for determining fetal numbers in 13 sheep flocks [16]. Besides the accuracy,the technique is quick; 400 to 600 ewes can be tested per day under farm conditions. The cost of the equipment and the potential health hazard to the operator may limit its use in the field [34] and [1]. In the past 20 years, three types of ultrasonographic systems were used for pregnancy diagnosis in small ruminants. A-mode ultrasound (Amplitude-depth or echo-pulse). In this system, the transducer containing one crystal emits ultrasound waves which penetrate the tissues under the skin and reflect when meet a high acoustic impedance interfaces (pregnant uterus or fluid-filled structures). The transducer receives the reflected echoes and converts them into peaks on oscilloscope with horizontal scale representing the depth of the reflecting structure or into audible signal. Meredith and Madani (1980) used

the reflection of ultrasound at depth 9 cm or greater as a positive sign of pregnancy in ewe and reported 96 % sensitivity and 87.5 % specificity in the period from 61 to 151 days after mating [23]. However, by the same approach, lowr sensitivity (86.7%) and specifity (69%) were reported in the ewe lambs at Days 73 to 103 postmating [22]. By using echo-pulse detectors, the accuracy for detecting pregnant ewes averaged 91% from Days 69 to 112 of gestation [30]. However, Watt et al. (1984) reported 97 % accuracy for diagnosing pregnancy from Day 51 of gestation to lambing[33] . A-mode ultrasound is a quick, convenient and simple technique, but it cannot predict the fetal number and the viability of the fetus [1]. Doppler devices utilize the Doppler shift principle to detect the fetal heart beats and flow of blood in uterine and fetal vessels. Lindahl (1971) reported that the intrarectal Doppler technique could be used for diagnosing pregnancy at the beginning of the second third with an accuracy of 90% or better [20]. According to the work reported by Deas (1977) the accuracy of intrarectal Doppler transducer for diagnosing pregnancy and non-pregnancy was 82% and 91%, respectively, from Days 41 to 60 of gestation [7]. After Day 71, the accuracy diagnosing pregnancy and non-pregnancy ranged between 85 % and 94 %, respectively [33]. In contrast, Trapp and Slyter (1983) reported 68 % and 84% accuracy for diagnosing pregnancy and non-pregnancy from Days 60 to 96 of gestation [30].The use of an external Doppler transducer gave almost 100 % accuracy for diagnosing pregnancy after Day 111 of gestation [33]. Concerning the predictions of fetal numbers, the external Doppler technique, when used by skilled operator gave 83 % and 93 % accuracy for diagnosing single and multiple fetuses at Days 80 to 95 of gestation, respectively [11]. However, Fukuietal.(1984) reported 74% and 89% accuracy for ewes carrying single and multiples, respectively from Days 60 to 120 of gestation [11]. Doppler devices have not been used successfully for estimating ovine gestational age [24] and [1]. Real-time B-mode ultrasonic scanning of the uterus in sheep appears to offer an accurate, rapid, safe and practical means for diagnosing pregnancy, determination off numbers and estimation of gestational age [1]. By using transrectal ultrasonography (7.5 MHz), embryonic vesicle of the pregnant Manchega dairy ewe was identified at Day 12.8 after mating, while the first visualization of the embryo was at Day 19 [15] or Day 20 [26]. By using 5 MHz transrectal probe, the first signs of pregnancy in form of circular and elongated anaechoic images located in utero cranial to bladder were observe dinewe on Days 17 to 19 [13] and [8], while embryo could be detected on Day 25 after mating [4]. The specificity of 7.5 MHz transrectal ultrasonography for diagnosing non-pregnancy was low during the first two months of gestation [26] and [1]. The false positive diagnoses were attributed to embryonic or fetal death. The sensitivity of 5 MHz transrectal ultrasonography for detecting pregnant ewes was very low (12%) at less than Day 25 of gestation [14]. There after, the sensitivity increased with progressing the pregnancy and ranged between 65 % and 87 % at Days 25 to 50, depending on the breed, age and parity of the ewes and the technique of the examination [1] and [4] and [13] and [14]. By using transrectal ultrasonography (7.5 MHz), single and multiple pregnancies in sheep were accurately (15 of 17 ewes) detected on Day 25 [26]. However, the accuracy of a 5 MHz transrectal ultrasonography for detecting ewe scarrying two fetuses or more was disappointing [14]. By using transabdominal ultrasonography, the accuracy of experienced operator for determination both single and multiple-bearing ewes was 99% from Days 46 to 93 of gestation [34]. A similar accuracy for ewes carrying single fetus was reported by Fowlerand Wilkins (1984), Davey (1986) and Gearhart et al. (1988),

however, a lesser accuracy for ewes carrying multiples was reported by others[1] and [6] and [10] and [14]. By using transrectal ultrasonography (7.5 MHz), Schrick and Inskeep (1993) measured the crown-rump length of the ovine fetus from Days 20 to 40 of gestation and described the relationship between the crown-rump length (x) and the gestational age (y) by the following equation, Y = 14.05 + 1.16x - 0.012x2 [26]. By using the same approach,Gonzalez et al. (1998) reported a high (r = 0.94) correlation between the crown-rump length and the gestational age from Days 19 to 48 of gestation [15]. Fetal head diameters including the biparietal diameter, the occipito-nasal length and the diameter of the orbit were used to predict the stage of gestation in sheep. Regarding to the biparietal diameter (BPD), Gonzalez et al. (1998) used the transrectal ultrasonography to measure the BPD of Manchega sheep from Days 32 to 90 and found a high correaltion (r = 0.96) between the measured diameters and the gestional age [15]. Similar correlation was found by using transabdominal approach in Suffolk and Finn sheep from Days 40 to 95 (Haibel and Perkins 1989), in Booroola x South Australian Merino sheep from Days 49 to 109 (Sergeev et al. 1990, A. Karen et al 2001) and in Swedish pelt sheep from 10 weeks before lambing to birth [1] and [2] and [18] and [27]. Kelly and Newnham (1989) found the occipito-nasal length to be more accurate than BPD, showing a linear increase till Day 80 [19]. However, Sergeev et al. (1990) reported that the occipito-nasal length was more difficult to be measured than BPD and had the same accuracy for predicting fetal age [27]. Gonzalez et al. (1998) found a high correlation (r=0.95) between the fetal occipito-nasal length and the gestational age from Days 38 to 91 of gestation [15]. Regarding the diameter of the fetal orbit, Gonzalez et al. (1998) reported that the ovine fetal orbit increased in diameter from 2 mm at Day 36 to 17 mm at Day 90 of gestation and it gave a high correlation (r = 0.92) with the fetal age [15]. Ultrasonographic measurements of the ovine fetal thoracic diameter showed high correlation with the fetal age from Days 49 to 109 and from Days 23 to 90 of gestation [1] and [15] and [27]. By using 7.5 MHz transrectal ultrasonography, the rhythmic pulsations within the ovine embryonic vesicle were first on day 18 or 19 after mating, while by using 5 MHz transrectal ultrasonography, they were first observed from Days 21-23 after mating [13] and [26]. Aiumlamai et al. (1992) measured the ovine fetal heart rate during the second half of pregnancy by using transabdominal ultrasonography and reported that the fetal heart rate reached aplateau at 7 weeks before lambing (167 ± 1.5 bpm) then decreased at 3 weeks before lambing (139.0±15.7bpm) and reached 117.0 ± 9.2 bpm at birth [2]. In addition, a significant correlation was found between fetal heart rate and gestational age [1]. Placentomes could be detected by transrectal ultrasonography (5MHz) on Day 30 and on Day 32 of gestation [4] and [8]. At this period the placentomes appeared as echogenic areas on the surface of endometrium. On Day 42, the ovine placentomes presented cup-shaped forms and reached the maximum size by Day 74 [8]. There was a poor correlation between placentome size and ovine gestational age due to great variation in the size of placentome in the same observations [8] an [15]. In contrast, Kelly et al. (1987) found a significant quadratic relationship between ultrasonographic cotyledon diameter and square root transformation of day of pregnancy [19]. There was a high correlation (r = 0.96) between the width of three ovine fetal coccygeal vertebrae and gestional age. At the same time, somewhat lower correlation was found for umbilical cord diameter (r = 0.72) and fetal femur length (r = 0.78) [1] and [15]. Depending on the location of the genital tubercle of the ovine fetus, the accuracy of the transrectal ultrasonography (5 MHz) for detecting male and

female fetuses was 100% and 76% respectively from days 60 to 69 of gestation [1] and [5].

Conclusions

Early detection of pregnancy and determination of the fetal numbers have economical benefits to sheep producers. The method used for pregnancy diagnosis should be simple, accurate, rapid, inexpensive, practical and safe for both operators and animals. Accurate pregnancy diagnosis can be achieved by clinical, hormonal and imaging methods. Doppler technique requires great skill to achieve high accuracy for prediction of fetal numbers. Radiography and transabdominal B-mode ultrasonography accurately diagnose both pregnancy and fetal numbers, but the second technique is cheaper than thw first one and has the advantages of being safe and able to detect the fetal viability. The optimum time for using transabdominal or transrectal ultrasonography in sheep ranges from 25 to100 days of gestation.

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