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COMMUNICATION

The Utility of Controlled-Release Norgestomet Implants in Synchronizing Estrus and Diagnosing Pregnancy in Ewes, and Factors Affecting the Diffusion Rate of Norgestomet from Silicone Implants

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ABSTRACT

One hundred Suffolk and cross-bred ewes were implanted with norgestomet/silicone implants to assess efficacy and utility, and to determine factors affecting norgestomet diffusion. The overall estrus and lambing responses were 90% and 67%, respectively. Administration of the implant for 14 days during pregnancy, in conjunction with progesterone determination on the 14th day, permitted the diagnosis of pregnancy status with 100% accuracy. Norgestomet implantation had no adverse effects on established pregnancy. Implants that were movable in situ on the 14th day had less connective tissue encapsulation and a higher ($p < 0.05$) norgestomet diffusion rate than implants that had rigid subcutaneous placement and more connective tissue encapsulation.

INTRODUCTION

Producers have sought a simple and effective means of synchronizing estrus in sheep for some time. Although a number of procedures have been developed and some have been approved for use outside of the United States, no procedure has gained approval from the United States Food and Drug Administration. Two procedures developed involve the use of 40 mg of synthetic progestins [fluorogestone acetate (FGA) and medroxyprogesterone acetate (MAP)] in vaginal sponges (1,2). Other reserachers have fed MAP (50 mg per day

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for 14 days; 700 mg total) while others have used large (9 mm in diameter and 5.0 cm long) silicone implants containing 375 mg progesterone (3–5). Although all of these procedures are generally effective (28% to 71% pregnancy rates), they require large dosing and are generally awkward to use. Additional technology needed by the sheep producers include the need to diagnose pregnancy and the ability to synchronize estrus a second time in the ewes not conceiving to the first synchronized estrus (6,7). The objectives of these studies were as follows:

1. To determine the efficacy of a controlled-release norgestomet implant in synchronizing estrus in ewes during various reproductive states.
2. To determine if the norgestomet/silicone implants could be used to synchronize a second estrus in ewes not pregnant to the first insemination without adversely effecting established pregnancy.
3. To determine if norgestomet/silicone implants used in conjunction with progesterone concentrations could be used to determine pregnancy status.
4. To determine the quantity of norgestomet diffused from the silicone implants and to identify factors affecting diffusion of norgestomet from silicone implants.

METHODS AND MATERIALS

One hundred Suffolk and cross-bed ewes from the University of Illinois Sheep Unit (Urbana, IL) were implanted with norgestomet/silicone implants at various times over a period of a year. The implants were matrix-type implants contained 3.66 mg of norgestomet and were 2.0 cm long. The implants were subcutaneously implanted on the dorsal side of the ear. Each ewe received one implant and the implants were left in situ for 14 days. Group 1 included 49 ewes implanted in early summer, the nonbreeding season. Groups 2 and 3 included 17 and 25 ewes, respectively, implanted during the fall, the breeding season. Group 4 included 9 ewes 30 to 40 days after parturition that were implanted in late winter, the transition period between the breeding and nonbreeding seasons. At implant removal ewes were intramuscularly administered 500 IU of pregnant mare serum gonadotropin (PMSG). Fertile rams were placed with the ewes after implant removal and pregnancy was determined 5 months later at lambing. For groups 1 and 4, rams included with the ewes were equipped with marking harnesses to facilitate the detection of estrus. Ewes with paint marks on the rump were considered to have been in estrus.

Ewes in group 3 were implanted with another norgestomet/silicone implant 40 days after removal of the first implant. Implants were left in situ for 14 days. At implant removal the ewes were bled via jugular venipucture and serum harvested via centrifugation at 2000 $\times$ g (8) was assayed for progesterone concentrations with a validated progesterone enzyme immunoassay (9). Rams with marking harnesses were placed with the ewes after removal of the second implant. Ewes with paint marks on the rump were considered to have been in estrus.

At the time of implant removal, implants were classified as being easily movable in situ or not movable in situ. Previous data (unpublished data) have demonstrated that implants not easily movable in situ have more connective tissue encapsulation than implants that are easily movable in situ. After implant removal, implants used in vivo and new implants were assayed for norgestomet content as described by Kesler et al. (10). Content assays were conducted immediately after removal and for each group of used implants assayed, 6 new implants were also assayed. Norgestomet content was analyzed by analysis of variance with three factors included in the analysis: group implanted, breed, and implant/tissue effect (11).

RESULTS

Combined, 90% of the ewes were detected in estrus after implant removal (Table 1). Further, 67% of the ewes that were exposed to fertile rams lambed within a 12-day period. The estrus and lambing responses were similar ($p > 0.25$) for all groups (Table 1).

For the 23 that maintained their implants and were bled for progesterone concentrations, 19 had elevated progesterone concentrations and 4 had low progesterone concentrations. Progesterone concentrations were either greater than 2.8 ng/ml or less than 0.2 ng/ml. All ewes with high progesterone concentrations lambed to the first synchronized insemination and all ewes with low progesterone concentrations did not lamb to the first synchronized insemination. Rams included with the ewes marked 8 of the 23 ewes, suggesting that these 8 were in estrus and not pregnant. Lambing results demonstrated that only 3 of the 8 were not pregnant at that

Table 1

Estrus and Lambing Responses of Ewes Implanted with Norgestomet/Silicone Implants for Estrus Synchronization

Group	Reproductive Status[a]	Estrus Response	Lambing Response
1	Anestrus	43/49 (88%)	29/49 (60%)
2	Cyclic	—	13/17 (77%)
3	Cyclic	—	19/25 (76%)
4	Postpartum	9/9 (100%)	6/9 (67%)
Combined		52/58 (90%)	67/100[b] (67%)

[a]The ewes were treated during the nonbreeding (anestrus) or breeding (cyclic) seasons. All ewes were mature ewes. Postpartum ewes were 30 to 40 days after parturition and were suckling one or more lambs.

[b]The lambing response was similar ($p > 0.25$) among groups.

time. Therefore, progesterone concentrations were 100% correct in diagnosing pregnancy status whereas estrus response, as diagnosed by ram markings, was 74% correct. The poorer ($p < 0.01$) pregnancy diagnosis by the ram markings may be partially due to observed matings of nonestrus ewes during feeding. Even then, one nonpregnant ewe did not display estrus, therefore giving pregnancy diagnosis by progesterone concentrations another advantage.

The administration of the norgestomet during established pregnancy did not appear to effect established pregnancy as lambing rates for ewes implanted during pregnancy (group 3) had a pregnancy rate (76%) similar ($p > 0.25$) to ewes treated similarly and during the same season of the year but not implanted during pregnancy (77%; group 2). Similar results were reported for heifers and cows administered norgestomet during pregnancy (6,7).

The mean amount of norgestomet released over the 14 days for the synchronized ewes averaged 2.699 mg. Of the three factors (group implanted, breed, and implant/tissue effect) included in the analysis, two (breed and implant/tissue effect) were significant at the 0.05 level. More ($p < 0.05$) norgestomet was secreted from the implants implanted in the Suffolk ewes (2.764 mg) than from the implants implanted in the cross-bred ewes (2.452 mg). Implants that were more movable in situ, those with less connective tissue encapsulation, liberated more ($p < 0.05$) norgestomet (2.908 mg) than implants that were less movable (2.589 mg), those with more connective tissue encapsulation. These data would suggest that connective tissue encapsulation suppressed hormone diffusion from silicone implants.

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