Extending Melengestrol Acetate Treatment from Fourteen to Eighteen Days in Beef Heifers

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Summary with Implications

This study compared estrus synchronization, estrus response, and artificial insemination pregnancy rates of beef heifers fed melengestrol acetate the normal 14-day period or extended to an 18-day period using the melengestrol acetate—prostaglandin—heat detect and timed artificial insemination protocol. Therefore, the purpose of this study was to evaluate if extending melengestrol acetate feeding by 4 days increases the number of heifers ovulating, which would result in greater estrus response and pregnancy rate in the whole herd. Early estrus response following prostaglandin administration occurred in heifers who averaged an earlier estrus response after melengestrol acetate withdrawal but extending the melengestrol acetate feeding period did not increase herd estrus synchronization, estrus response, or pregnancy rate. When necessary, producers may consider extending melengestrol acetate feeding an alternative option without significant differences in pregnancy rate (i.e.: scheduling conflicts).

Introduction

There are two long-term progestin-based protocols for synchronization of estrus: the 14-day (d) controlled internal drug release (CIDR) protocol, and the 14-d melengestrol acetate (MGA) protocol. Synchrony of estrus and subsequent ovulation after administration of prostaglandin F_{2a} (PG) stems from the initial synchronized estrus that occurs following exogenous progestin exposure earlier in the treatment schedule. Long-term progestin-based protocols have gained wide acceptance in development programs for beef heifers due to their effectiveness among both pubertal and peripubertal heifers. Peripubertal heifers, who will ovulate for the first time after progestin withdrawal, often ovulate later following progestin withdrawal leading to decreased synchronization with the herd, estrus response after PG, and pregnancy rates. Pubertal heifers would not ovulate as long as progestin treatment continued.

A previous study comparing 18-d CIDR and 14-d CIDR protocols suggests there are no differences in estrus expression or pregnancy rate due to treatment. It remains conceivable that an extension of MGA feeding would be more impactful due to the differences in estrus response resulting from MGA and CIDR withdrawal. The objective was to determine if increasing the length of MGA treatment would alter the proportion of heifers that express estrus during the estrus detection period following administration of PG and result in increased conception rates to artificial insemination (AI).

Procedure

Black Angus, Black Angus x Simmental, and Red Angus x Simmental crossbred spring calving heifers from two separate herds were transported to a ranch near Sutherland, Nebraska for breeding. Treatments were initiated in April of 2020 (Year-1; 898 heifers) and 2021 (Year-2; 822 heifers). Heifers were separated by herd and allocated into feedlot pens at random containing an average of 111 ± 25 heifers. Each year, pens were assigned to one of two estrus synchronization protocols in an independent measures design for a total of 15 pens. The heifers assigned to the **E14** treatment were synchronized using the 14 d melengestrol acetate (MGA) protocol described in Figure 1 and served as the control group (n = 907). The heifers assigned to the **E18** treatment was similar except the MGA fed during the treatment phase started four days before the initial 14 d treatment period starting on Day -3 (n = 813). The E18 treatment served as the test group.

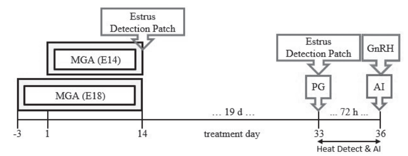

Figure 1. Melengesterol acetate (MGA)—prostaglandin F2α (PG)—gonadotropin releasing hormone (GnRH) protocol used for estrus synchronization in beef heifers. MGA is fed Day 1 to 14 (E14) or Day -3 to 14 (E18). An estrus detection patch is applied following MGA withdrawal in 2021. PG is injected on Day 33 and another estrus detection patch is applied. Heifers are heat detected and AI before Day 36 with the remaining heifers heat detected, AI, and GnRH on Day 36.

On Day 1 or -3 of the protocol, MGA was mixed into the total mixed ration as prescribed at 0.5 mg per heifer per day. On day 15, MGA was withdrawn from the diet. On Day 33, 2cc prostaglandin $F2_{\alpha}$ (PG, Lutalyse® HighCon) was intramuscularly injected, weights were recorded, and estrus detection patches (Estrotect™) were applied. Every 12 hours (h) after PG administration heifers with more than 50% patch removed were AI in the PM. On Day 36, all remaining heifers were AI, as part of the timed AI protocol, and patch scores were recorded (1 = < 25% removed, 2 = 25% to 50% removed, 3 = > 50% removed, 4 = patch missing). Heifers with a patch score of 1 or 2 were not considered to be in estrus, and patch scores of 3 or 4 were considered to be in estrus. Gonadotropin-releasing hormone (Factrel®, GnRH) was intramuscularly injected (2cc) to all heifers with a patch score of 1, 2, or 4. Intact bulls were introduced to both herds 3 days after AI at a heifer to bull ratio of 25:1 and remained with the herd for 30 d. After insemination, heifers grazed on pasture for the remainder of the study. A veterinarian diagnosed pregnancy via transrectal ultrasonography. Pregnancy diagnosis was recorded based on the age of the fetus using

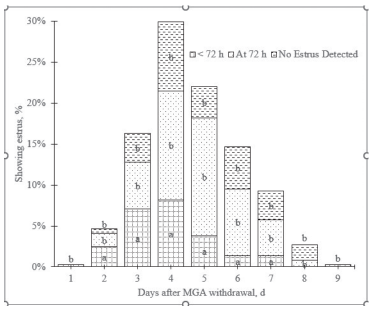

Figure 2. Timing of estrus expression after melengestrol acetate (MGA) withdrawal separated by timing of estrus expression after prostaglandin (PG) administration. '< 72 h' denotes estrus expression before 72 h after PG administration, 'At 72 h' denotes estrus expression 72 h after PG administration. [a,b] Different superscripts have different average timing of estrus after MGA withdrawal based on individual timing of estrus after PG administration

Table 1. Differences in estrus detection after melengestrol acetate (MGA) withdrawal and prostaglandin (PG) administration, conception rate, and weight gain with both years of treatment separated by herd, expressed as least square means and standard error of the mean.

		Treatments		
		E14[1]	E18[2]	P value
Herd 1, (n = 898)	Avg MGA Estrus Time[3], d	5.0 ± 0.24	4.5 ± 0.23	0.12
	Avg PG Estrus Time[4], h	68 ± 1.1	67 ± 1.1	0.31
	Exhibiting Estrus, %	67 ± 4.0	67 ± 4.0	0.96
	Pregnancy Rate, %	56 ± 2.4	57 ± 2.4	0.69
	Avg Daily Gain, lb	1.4 ± 0.37	1.4 ± 0.37	0.73
Herd 2, (n = 822)	Avg MGA Estrus Time[3], d	4.6 ± 0.11	4.6 ± 0.16	0.82
	Avg PG Estrus Time[4], h	61 ± 1.7	62 ± 1.7	0.15
	Exhibiting Estrus, %	75 ± 9.3	77 ± 9.5	0.65
	Pregnancy Rate, %	60 ± 4.5	58 ± 4.7	0.69
	Avg Daily Gain, lb	1.2 ± 0.22	1.3 ± 0.23	0.50
Both Herds (n= 1720)	Avg MGA Estrus Time[3], d	4.8 ± 0.13	4.5 ± 0.15	0.15
	Avg PG Estrus Time[4], h	64 ± 1.5	64 ± 1.6	0.98
	Exhibiting Estrus, %	71 ± 3.8	73 ± 4.0	0.84
	Pregnancy Rate, %	58 ± 2.3	58 ± 2.4	0.96
	Avg Daily Gain, lb	1.3 ± 0.14	1.4 ± 0.15	0.70

[1]E14 treatment: the normal 14 d MGA estrus synchronization protocol where estrus is exhibited following MGA withdrawal and again after PG administration

[2]E18 treatment: an extended 18 d MGA estrus synchronization protocol where estrus is exhibited following MGA withdrawal and again after PG administration

[3]Average time period between MGA withdrawal and the expression of estrus during Year-2 only

[4]Average time period between PG administration and the expression of estrus

a 7 d window to differentiate pregnancies resulting from AI and natural bull breeding. For the purposes of this study, only heifers that were recorded as artificially inseminated were considered pregnant and the remainder were considered open. A few heifers from each treatment may have been bull bred if fetal aging was indeterminable around the time of AI.

Protocol Changes in Year 2

On Day 15 (1 d following MGA withdrawal), estrus detection patches were applied, and twice daily reports of heifers with more than 50% patch removed were recorded. The following changes in the protocol were management decisions made by the producers in the second year of the experiment. After PG administration, heifers from both herds with more than 50% patch removed were recorded at 48 h and one pen from each treatment in herd 1 were recorded at 60 h. All heifers from herd 2 were administered GnRH regardless of patch score. No bulls were introduced to herd 1 after PG, which means all pregnant heifers from herd 1 were bred by AI in the second year of this study. Pregnancy diagnosis was confirmed 72 d after AI in herd 2 and 51 d after AI in herd 1.

Statistical Analysis

Statistical analyses were performed using SAS 9.4 (SAS Institute Inc.) via the LSMEANS in the GLIMMIX procedure. Estrus timing and responses after MGA withdrawal and PG administration, pregnancy status, and average daily gain (ADG) from AI to pregnancy diagnosis were analyzed as responses to treatment as a fixed affect. Timing of estrus after MGA withdrawal was further analyzed as a response to timing of PG administration induced estrus. Estrus timing and responses after MGA withdrawal and PG administration, pregnancy status, and ADG from AI to pregnancy diagnosis were analyzed as a response to herd. The experimental unit was 'pen' by 'year'.

Results

Estrus detection after MGA withdrawal precedes estrus response after PG administration but was only documented in Year-2 of the study. Melengestrol acetate induced estrus was detected in 50% of E14 and 46% of E18 with a normal distribution over a 9-d period but was not different between treatments (P = 0.60). The timing of estrus detection after MGA withdrawal was not different between treatments (P = 0.15, Table 1). Heifers who demonstrated behavioral estrus earlier after MGA withdrawal also exhibited estrus earlier (48 h or 60 h) after PG administration with differences between early behavioral estrus and estrus or non-estrus exhibiting heifers at timed-AI (P < 0.01, Figure 2). The timing of estrus after MGA withdrawal averaged 0.55 d earlier for heifers who displayed estrus after PG administration (P < 0.01) and 0.98 d earlier for heifers who displayed early estrus after PG administration but was not different by treatment (Table 1). As such, heifers that exhibited estrus after MGA withdrawal were more likely to exhibit estrus again after PG administration (P < 0.01) but were not different by treatment (P = 0.63). These differences suggest the timing of estrus after MGA withdrawal is paralleled with estrus after PG administration but extending the MGA treatment period from 14 d to 18 d did not impact when and if heifers exhibit estrus in the final stages of the synchronization and insemination process. The natural variance of cyclicity in individual heifers makes predicting estrus timing difficult, but parallel behavior among group averages suggest similar timing of estrus after MGA withdrawal and PG administration for this protocol.

In Year-1, the timing of PG-induced estrus averaged 64 ± 2.4 h for E14 and 63 ± 2.4 h for E18. In Year-2, the timing of PG-induced estrus averaged 65 ± 1.6 h for E14 and 67 ± 1.8 h for E18. The Year-1 records of PG-induced estrus are a more accurate representation of estrus timing, but neither Year-1, Year-2, or both years combined show differences by treatment ($P \geq 0.47$, Table 1). As such, PG induced estrus expression was not different by treatment ($P = 0.84$, Table 1). There was a greater percentage of heifers in estrus from each treatment in 2020 (E14 = 77.0% and E18 = 72.0%) compared to 2021 (E14 = 65.6% and E18 = 73.0%). Although the percentage of heifers in estrus tended to be different by treatment in 2021 ($P = 0.09$), all these values are within the normal range when compared to previous studies, which suggests the small differences found in this study were not an effect of treatment.

Similar to estrus response, a greater percentage of heifers from both treatments became pregnant in 2020 (E14 = 61.5% and E18 = 58.0%) compared to 2021 (E14 = 53.9% and E18 = 58.2%), but these values are within the normal range of pregnancy rate for AI. In both years combined, treatment did not affect AI pregnancy rate ($P = 0.96$, Table 1). Average daily gain between AI and pregnancy diagnosis were not affected by treatment (Table 1).

While management practices of both herds were the same, some differences in heifer development are expected due to environment, resulting in different rates of puberty, estrus, and pregnancy. These differences did not have an impact on the results of this study, however (Table 1).

Conclusion

Increasing the number of days that MGA was fed to heifers did not affect estrus expression or pregnancy rates resulting from AI but could be an alternative treatment period when necessary (i.e.: scheduling conflicts). The timing of estrus following MGA withdrawal appears to be an indicator of timing of estrus after PG administration, which could be inherent to the normal cyclicity of estrous in cattle using the MGA-AI protocol. More research with pubertal and peripubertal heifers may be required to track timing of estrus after MGA withdrawal and connect it to timing of estrus after PG administration. Further research to investigate synchronization of pubertal and peripubertal individuals is warranted, but the effect of extended progestin treatment on herd synchrony of estrus and pregnancy rate is negligible.

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