SYNCHRONIZATION OF ESTRUS AND OVULATION IN SUPEROVULATED GILTS 1, 2

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Summary

A TOTAL of 103 crossbred gilts were group fed methallibure (100 mg in 1.8 kg feed/gilt/day) for 20 days. Twenty-three gilts were designated as controls (Group I). Gilts in Group II (n=23) and Group III (n=57) received 1,500 IU of PMS 24 hr. after the last feeding of methallibure. Group III gilts received 500 IU of HCG 80 hr. after the PMS to synchronize ovulation. The gilts were inseminated 12 and 24 hr. after either the onset of estrus (Groups I and II) or after an injection of HCG (Group III) and were slaughtered 23 to 29 days later.

The administration of PMS:HCG following the suppression of estrus with methallibure provided an improved method of synchronization of gilts. Seventy-four percent of the control gilts exhibited estrus on days 5 and 6 after the last feeding of methallibure, while 95% and 93% of the gilts of Groups II and III, respectively, exhibited estrus on days 4 and 5. That successful synchronization of ovulation was achieved by HCG administration during proestrus is indicated by the similar pregnancy rates for gilts of Group III mated at a precise time after HCG and those of Groups I and II inseminated according to the onset of estrus. Ovulation rate, total number of embryos and number of normal embryos were significantly (P<.01) increased in both groups of gilts receiving gonadotropin treatment as compared to control gilts.

The present study demonstrates a successful modification in existing techniques to permit the use of superovulation in conjunction with the precise control of ovulation so that matings at a predetermined time can be made.

Introduction

A practical method of controlling estrus in swine by the oral administration of 1α-methyl allythiocarbamoyl-2-methylthiocarbamoyl-hydrazine (Aimax, ICI 33828 or methallibure) has been demonstrated (Polge, 1965; Gerrits and Johnson, 1965; Stratman and First, 1965). The reports of Pope, Vincent and Thrasher (1968), Day and Longenecker (1968) and Baker, Shaw and Dodds (1970) have shown that administration of 1,000 to 1,500 IU of pregnant mare serum (PMS) after methallibure withdrawal improves the synchronization of estrus, induces superovulation, significantly increases embryo numbers at 30 days of gestation and increases litter size at farrowing. Polge, Day and Groves (1968) successfully used a sequential treatment of methallibure, 500 to 1,000 IU of PMS, and human chorionic gonadotropin (HCG) to control the time of ovulation in gilts which were artificially inseminated at a predetermined time.

The primary objective of the present experiment was to determine the reproductive performance of artificially inseminated gilts following synchronization of ovulation using methallibure, a level of PMS sufficient to induce superovulation, and HCG to control precisely the time of ovulation. The effect of superovulation on embryo numbers at 25 days of gestation was also determined.

Experimental Procedure

A total of 103 crossbred gilts ranging in age from 7 to 9 months were assigned to one of four replications of this experiment between July, 1968 and September, 1969. All animals
SYNCHRONIZATION OF ESTRUS IN GILTS

103 gilts received 100 mg Methallibure per gilt per day for 20 days

Group I

No PMS

No HCG

A.I. 12 and 24 hr. after onset of estrus

Group II

PMS day 21

No HCG

A.I. 12 and 24 hr. after onset of estrus

Group III

PMS day 21

HCG 80 hr. after PMS

A.I. 12 and 24 hr. after HCG

All gilts slaughtered on days 23 to 29 of gestation

Figure 1. Experimental design.

had exhibited at least one normal estrous cycle prior to being assigned to the experiment. The experimental design is shown in figure 1. Estrous control was accomplished by group feeding methallibure at the rate of 100 mg in 1.8 kg of a corn-soybean meal diet per gilt daily for 20 days. After the last feeding of methallibure, the gilts were checked for estrus twice daily using a mature boar.

Twenty-three gilts in Group I received only the methallibure treatment and were artificially inseminated 12 and 24 hr. after the onset of estrus. Twenty-three and 57 gilts in Groups II and III, respectively, were injected subcutaneously with 1,500 IU of PMS 4 24 hr. after the last feeding of methallibure. Group II gilts were inseminated 12 and 24 hr. after the onset of estrus. Group III gilts were injected intramuscularly with 500 IU of HCG, 80 hr. after the PMS injection and were inseminated 12 and 24 hr. after HCG regardless of when or if estrus was expressed. All gilts were inseminated with 100 ml of fresh diluted semen from boars of known fertility. One part semen was diluted with approximately four parts of an egg yolk, glucose and sodium bicarbonate diluter (Dziuk, 1958). Gilts were slaughtered on days 23 to 29 of pregnancy and the reproductive tracts were examined for number and condition of embryos and the number of corpora lutea were counted.

Estrus and slaughter data were subjected to analyses of variance. Significant differences among group means were examined by Duncan's multiple-range test as outlined by Steel and Torrie (1960).

Results

The occurrence of estrus was highly synchronized among gilts following the sequential

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treatment of methallibure:PMS and methallibure:PMS:HCG (table 1). Ninety-five percent and 93% of the gilts assigned to Groups II and III, respectively, exhibited estrus on days 4 and 5 after the last feeding of methallibure and 74% of the control gilts exhibited estrus on days 5 and 6.

As shown in table 2 the average interval between last feeding of methallibure and the onset of estrus was reduced (P<.01) by gonadotropin treatment (4.7 and 4.8 days vs. 5.9 days). The duration of estrus was significantly (P<.05) longer for gilts receiving PMS alone (Group II) as compared to gilts of Groups I and III (2.6 days vs. 2.3 and 2.2 days, respectively). One gilt of Group I not showing estrus until approximately one estrous cycle after methallibure withdrawal was excluded from further consideration in this study. While two gilts of Group III, which did not exhibit estrus, remained in the study because the fixed mating procedure allowed insemination 24 hr. after HCG. One of the two gilts was pregnant at slaughter.

Pregnancy rates at slaughter were similar for the three treatment groups (table 3), however, there was a significant replicate X treatment interaction (P<.05).

The effectiveness of PMS and PMS:HCG in stimulating superovulation in synchronized gilts is shown in table 3. Ovulation rate was significantly (P<.01) increased in both groups of gilts receiving gonadotropin treatment as compared to control gilts (25.5 and 28.3 vs. 13.2 corpora lutea, respectively).

The total number of embryos and number of normal embryos at slaughter were significantly (P<.01) greater in gilts receiving PMS (table 3). The average number of normal embryos was 10.6 for gilts in Group I as compared to 17.0 and 15.0 for gilts in Groups II and III, respectively.

Discussion

The administration of PMS and HCG following the suppression of estrus with methallibure provides an improved method of estrous synchronization in gilts. Polge et al. (1968) demonstrated the effectiveness of the sequential treatment of methallibure and 500 to 1,000 IU of PMS whereas the present study

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**TABLE 1. NUMBER OF GILTS EXHIBITING ESTRUS AFTER METHALLIBURE TREATMENT**

<table>
<thead>
<tr>
<th>Treatment group</th>
<th>No. of animals</th>
<th>Days after the last feeding of methallibure</th>
<th>Not in estrus</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Group I Controls</td>
<td>23</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>Group II PMS</td>
<td>23</td>
<td>↑</td>
<td>...</td>
</tr>
<tr>
<td>Group III PMS:HCG</td>
<td>57*</td>
<td>↑</td>
<td>...</td>
</tr>
</tbody>
</table>

* Gilts were inseminated twice on day 5.

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**TABLE 2. EFFECT OF PMS AND PMS:HCG ON ESTRUS IN GILTS SYNCHRONIZED WITH METHALLIBURE**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Group I Controls</th>
<th>Group II PMS</th>
<th>Group III PMS:HCG</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean S.D.</td>
<td>Mean S.D.</td>
<td>Mean S.D.</td>
</tr>
<tr>
<td>No. of animals</td>
<td>22</td>
<td>23</td>
<td>55</td>
</tr>
<tr>
<td>Interval of methallibure withdrawal to onset of estrus, days</td>
<td>5.9(^b) 1.18</td>
<td>4.7 0.49</td>
<td>4.8 0.49</td>
</tr>
<tr>
<td>Length of estrus, days</td>
<td>2.3 0.57</td>
<td>2.6(^c) 0.66</td>
<td>2.2 0.34</td>
</tr>
</tbody>
</table>

* Excluded one gilt of Group I and two gilts of Group III that did not exhibit estrus.

\(^b\) Significantly different from the PMS treated groups (P<0.01).

\(^c\) Significantly different from Groups I and III (P<0.05).
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TABLE 3. PREGNANCY RATE, NUMBER OF CORPORA LUTEA (CL) AND AVERAGE NUMBER OF EMBRYOS IN PMS AND PMS:HCG TREATED GILTS SLAUGHTERED ON DAYS 23 TO 29 OF GESTATION

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Group I Controls</th>
<th>Group II PMS</th>
<th>Group III PMS:HCG</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of animals</td>
<td>Mean S.D.</td>
<td>Mean S.D.</td>
<td>Mean S.D.</td>
</tr>
<tr>
<td>No. of pregnant animals</td>
<td>22</td>
<td>23</td>
<td>57</td>
</tr>
<tr>
<td>Pregnancy rate, %</td>
<td>81.8</td>
<td>69.6</td>
<td>80.7</td>
</tr>
<tr>
<td>No. of CL</td>
<td>13.2*</td>
<td>25.5</td>
<td>28.3</td>
</tr>
<tr>
<td>Total no. of embryos</td>
<td>10.9*</td>
<td>18.0</td>
<td>17.4</td>
</tr>
<tr>
<td>No. of normal embryos</td>
<td>10.6*</td>
<td>17.0</td>
<td>15.0</td>
</tr>
</tbody>
</table>

* Significantly different from the PMS treated groups (P<0.01).

extends these findings to include a suggested procedure for obtaining superovulation in conjunction with precise control of the time of ovulation.

The administration of PMS influenced the time of onset of estrus in gilts after methallibure treatment. The interval from methallibure withdrawal to the first expression of estrous behavior was approximately one day longer for control gilts as compared to gilts receiving 1,500 IU of PMS. Polge et al. (1968) reported a similar difference between control gilts and gilts treated with PMS and HCG.

When HCG administration is at a fixed time after PMS, the level of PMS markedly affects the number of gilts expressing estrus. Only two of 57 (3.5%) gilts of Group II receiving 1,500 IU of PMS followed in 80 hr. by 500 IU of HCG, failed to show estrus. Polge et al. (1968) reported that 5, 30 and 42% of the gilts receiving 1,000, 750, and 500 IU of PMS, respectively, followed in 96 hr. by 500 IU of HCG, failed to show estrus. The accurate establishment of the interval from a particular PMS treatment to proestrus is of major importance in determining the optimum time to administer HCG so that synchronization of ovulation can be obtained without a reduction in fertility level.

Estrous behavior was expressed during a 2-day period in 95% and 93% of the gilts of Groups II and III, respectively, which reflects the high degree of synchronization of follicular development achieved by PMS treatment. The successful synchronization of ovulation achieved through HCG administration during proestrus is indicated by similar pregnancy rates for gilts of Group III (mated at a fixed interval after HCG) and those inseminated 12 and 24 hr. after the onset of estrus.

Ovulation rate, as measured by the number of corpora lutea at slaughter, was significantly increased by the administration of 1,500 IU of PMS. The same dosage of PMS followed in 80 hr. by 500 IU of HCG slightly increased the ovulation rate. The ovulation rates reported here are consistently greater than those reported by previous investigators (Polge et al., 1968; Webel, Peters and Anderson, 1970) using lower doses of PMS or PMS:HCG but similar to the results found by Day and Longenecker (1968) and Webel et al. (1970) when the same dose of PMS was injected.

In association with the increased ovulation rate, gilts receiving PMS had significantly (P<.01) more embryos at 25 days of pregnancy. In comparison with the control gilts, PMS treatment resulted in an average increase of 4.9 normal embryos per gilt. There was no evidence that the injection of HCG in addition to PMS had an influence on embryo numbers or that inseminations made according to estrus rather than at a fixed time affected the number of embryos in superovulated gilts.

That a marked increase in the average number of normal embryos present at 25 days of gestation can be obtained by superovulation has been clearly demonstrated in the present study and this conclusion is in agreement with the previous reports by Day and Longenecker (1968), Longenecker and Day (1968) and Pope et al. (1968). The results also support the conclusions of Dziuk (1968) and Pope et al. (1972) that litter size at 25 to 30 days of pregnancy is improved when the number of fertilized eggs of recipient gilts is increased by egg transfer and that uterine crowding is not a major limiting factor of litter size during early pregnancy.

In conclusion, the present study demonstrates a successful modification in existing techniques for controlling ovulation to permit
the use of superovulation in conjunction with a regime designed to control more precisely the time of ovulation. Furthermore, the results extend previous findings on the application of a sequential treatment of metallibure and gonadotropins in controlling the time of ovulation in gilts and the effectiveness of superovulation as a means of increasing the number of normal embryos.

**Literature Cited**


