The effect of Gonadotrophins on estrus induction and fertility in prepubertal gilts

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SUMMARY

The aim of our study was to investigate the efficacy of exogenous gonadotrophin to induce puberty and pregnancy in prepubertal gilts which had reach the weight of fully grown pigs. The animals used in the study included 195 crossbreed German Landrace gilts aged between 150-180 days old, weighing between 75-90 kg and 24 crossbreed German Landrace adult male pigs. The prepubertal gilts of Group I (n = 65) and Group II (n = 65) were first administered with single IM dose of 1500 IU PMSG. At the same time, animals from the Group III (n = 65), which formed the control group, received 2 ml of a placebo. Seventy two hours after the PMSG administration, animals from the Group I received IM 500 IU hCG while 8 µg of GnRH was given to the Group II. Animals from the control group were administered at the same time with a placebo. Twenty four hours after hCG, GnRH placebo administrations, the gilts were exposed to the male pigs during 72 hours. Pregnancy diagnosis was performed by ultrasonic techniques between 35-45 days after mating. Estrus symptoms were recorded in 56 animals (86.2 %) from the Group I, 4.2 ± 0.4 days after the last administration the estrus was detected in 55 animals (84.6 %) from the Group II, 4.3 ± 0.5 days after the end of the treatment. In the control group, 61 animals exhibited estrus behaviour spontaneously 48 ± 10 days after the last placebo administration. Pregnancy was diagnosed in 53 animals of the Group I (81.5 %), 51 of the Group II (78.5 %) and 57 of the control group (87.7 %). The size of the first litter was a 7.8 ± 1.3 in Group I, 7.6 ± 1.4 in Group II and 10.2 ± 1.1 in the control group. It has been concluded that, a fertile estrus can be induced using exogenous gonadotrophins (PMSG and hCG) or a treatment associating PMSG with GnRH in prepubertal gilts and that these treatments improve lifetime reproductive performance.

KEY-WORDS : gilt - Gonadotrophin - puberty - fertility - pregnancy rate.

RÉSUMÉ


Cette étude avait pour objectif d’étudier l’effet d’un traitement à base de gonadotropines sur l’induction de l’œstrus et la fertilité de truies prépubères. Cent quatre vingt quinze truies prépubères âgées de 150-180 jours et pesant entre 75 et 90 kg, de race Landrace Allemand et 24 verrats adultes ont été utilisées. Une dose unique de PMSG a été administrée par voie intramusculaire (500 U.I) à chaque truie des groupes 1 (n = 65) et 2 (n = 65). Une administration d’un volume de 2ml de placebo a été simultanément réalisée aux truies du groupe III (n = 65) qui constitue le groupe de contrôle. Soixante douze heures après l’administration de PMSG, les truies du groupe 1 ont reçu une administration de hCG à la dose de 500 U.I alors que les truies du groupe 2 recevaient une administration de GnRH à la dose de 8 µg et que les truies du groupe 3 recevaient une administration de placebo. Vingt quatre heures après les administrations de GnRH, hCG ou de placebo, les truies ont été mises en présence des verrats pendant 72 heures. Le diagnostic de gestation a été réalisé par examen échographique aux stades 35-45 jours. Les signes d’œstrus ont été détectés chez 56 individus du groupe I , 4.2 ± 0.4 après la dernière administration, chez 55 truies du groupe II, 4.3 ± 0.5 après la dernière administration et soixante et une truies du groupe contrôle ont présenté des signes d’œstrus spontané, 48 ± 10 jours après la dernière administration de placebo.Cinquante trois truies issues du groupe I (81.5 %) ont été diagnostiquées gestantes contre cinquante et une truies (78.5 %) du groupe 2 et cinquante sept (87,7 %) du groupe 3. La taille moyenne de la portée a été de 7.8 ± 9.3 dans le groupe 1, 7.6 ± 1.4 dans le groupe 2 et 10.2 ± 1.0 dans le groupe contrôle. Ce travail montre que l’œstrus peut être induit chez les truies prépubères avec un traitement combiné des gonadotropines du GnRH et que ces traitements permettent d’augmenter les performances de reproduction des animaux.

**Introduction**

The insemination and ovulation time has to be well coordinated in order to obtain maximum fertility in pigs. The estrus period, which is longer than that of cows, and the varying ovulation time makes it more difficult to determine the optimal insemination time in sows [12, 30].

The age of puberty in sows is approximately 200 days and while varying between 18-24 days, the sexual cycle lasts for approximately 21 days. The start of estrus in sows is characterized by changes in behavior: mounting other animals and swelling of the vulva. However, stressful conditions and make it harder to determine these symptoms. Estrus lasts for approximately 48 hours in sows [30, 35]. Ovulation occurs about 2 days after the start of estrus and the duration of ovulation is varied from about 1 to 6 h [8, 9, 29].

DZUIK [9] has reported that the optimal insemination time in sows varied between 6 to 18 hours after the start of estrus. In his study, DZUIK [9] has reported that optimal fertility can be achieved in sows with inseminations at 6 to 18 hours intervals, 12 hours before ovulation. Other researchers [22, 31, 33] have suggested that optimal fertility rate can be achieved with inseminations done at 0-24 hours before ovulation.

Estrus in prepubertal gilts can be induced with exogenous gonadotrophins (PMSG, hCG) or GnRH [4, 27].

Exogenous gonadotrophins can induce follicle development in 3-4 month-old sows [11]. Estrus and ovulation in sows occurred when a 1000 IU was combined with a 500-1000 IU administration of hCG. However, the litter size was limited by the small size of the uterus [11]. The most convenient age for cycle induction in sows appeared to be 5-6 months. Because 6 months of age is the time when the uterus has reached its adult size, it is suggested to be the convenient time for the initiation of the treatment [26]. Using this protocol, it was shown that ovulation occurred approximately 39-44 hours after hCG administration and about 35-41 hours after GnRH administration [2, 19, 25, 29].

In our study, we aimed to investigate the effect of exogenous gonadotrophins to induce estrus and pregnancy in gilts, which have not yet reached pubertal maturation but have reached the body weight of adult sows.

**Material and method**

The study was performed in 195 crossbreed German Landrace prepubertal gilts aged between 150-180 days, weighing between 75-90 kg, and 24 crossbreed German Landrace adult male pigs. The prepubertal gilts were randomly distributed between 3 groups of 65 and separated from the males. Estrus detections were made with the male pigs and the gilts, which hadn’t estrus behaviors, decided as prepubertal gilts. Body weights were 83.95 ± 4.01 kg (group I, n = 65), 84.23 ± 3.56 kg (group II, n = 65) and 84.12 ± 4.03 kg (group control, n = 65) and aged were 161.75 ± 8.92 days, 160.70 ± 8.52 days and 160.10 ± 7.46 days respectively in the groups. All the pigs were at the similar nutrition and management conditions. The pigs were fed twice daily and were given unlimited water.

The prepubertal gilts in Group I (n = 65) and Group II (n = 65) received a single intramuscular (IM) dose of 1500 IU PMSG (Synchroject®, Vetifarm, Turkey) [21, 24, 34]. Simultaneously, 2 ml placebo (2 ml of saline solution) was administered to gilts from the Group III (n = 65). Seventy two hours after the PMSG administration, 500 IU of hCG (Pregnyl®), Organon, Turkey) [18] was intramuscularly administered to the animals of the Group I, while gilts from the group II received a intramuscular dose of 8 µg GnRH (Receptal®, Intervet, Turkey) [23]. At the same time, placebo was administered to animals from the control group. Twenty four hours after the hCG, GnRH or placebo administration, prepubertal gilts were exposed to boars during 72 hours. Estrus signs were recorded under the supervision of the farm personnel. Prepubertal gilts which had mated with male pigs at least once were recorded. Male pigs were kept until 60 days with gilts of the control group and estrus behavior was examined every day. Pregnancy was diagnosed via ultrasonographic examination between days 35-45 after mating.

Estrus time and litter size of prepubertal gilts from groups I, II and the control group were statistically compared using the Student t test whereas estrus, mating behavior and pregnancy rates were statistically compared using the Chi-square test. The results were reported as mean ± SD.

**Results**

In the examinations done for a total of 130 prepubertal gilts in Groups I and II, estrus symptoms were detected in 56 gilts (86.2 %) in Group I (n = 65) and 55 gilts (84.6 %) in Group II (n = 65) ; and 56 animals in Group I (n = 65) and 55 animals in Group II (n = 65) had mated with the male pigs. Estrus symptoms appeared 4.2 ± 0.4 days after the last administration in Group I and 4.3 ± 0.5 days after the last administration in Group II. No estrus symptoms were observed in sows from the control group (n = 65) in the period immediately following exposure to the male pigs. Estrus appeared spontaneously in 61 (93.8 %) of the animals of the control group 48 ± 10.4 days after the last placebo administration (Table I, Figure 1).

Pregnancy was diagnosed in 53 (81.5 %) animals of the Group I and 51 (78.5 %) of the Group II. In the control group, pregnancy was diagnosed in 57 animals (87.7 %) when mated following spontaneous estrus 48 ± 10.4 days after the last placebo administration. The total size of the litter was 414 with a mean value of 7.8 ± 1.3 in Group I and reach 388 with a mean of 7.6 ± 1.4 in Group II. In the control group, the total number of offspring was 582, with a mean of 10.2±1.1 (Table II, Figure 2).

There was no statistically significant difference between Group I and II with respect to estrus, mating, pregnancy rates and number of offspring. The pregnancy rate and number of offspring from the groups I and II were significantly greater than that of gilts from the control group (Table II).
THE EFFECT OF GONADOTROPHINS ON ESTRUS INDUCTION AND FERTILITY IN PREPUBERTAL GILTS

**Figure 1.** — Estrus and mating rates and estrus times obtained from the groups.

<table>
<thead>
<tr>
<th></th>
<th>Estrus rate</th>
<th>Mating rate</th>
<th>Estrus times (day)</th>
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<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td><strong>Group I (n=65)</strong></td>
<td>56</td>
<td>86.2&lt;sup&gt;a&lt;/sup&gt;</td>
<td>56</td>
</tr>
<tr>
<td><strong>Group II (n=65)</strong></td>
<td>55</td>
<td>84.6&lt;sup&gt;a&lt;/sup&gt;</td>
<td>55</td>
</tr>
<tr>
<td><strong>Group control (n=65)</strong></td>
<td>61</td>
<td>93.8&lt;sup&gt;b&lt;/sup&gt;</td>
<td>61</td>
</tr>
</tbody>
</table>

[*] The control group showed estrus spontaneously approximately 48 ± 10.4 days after placebo administration.

<sup>a, b</sup> Longitudinal columns with different letters have significant differences between them (p < 0.01)

Chi-square (estrus rate and mating rate) Student τ test (estrus time)

**TABLE I.** — Estrus and mating rates and estrus times obtained from the groups.
TABLE II. — Pregnancy rates and number of offspring in groups I, II and control.

<table>
<thead>
<tr>
<th></th>
<th>Pregnancy rate</th>
<th>Number of offspring (n)</th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>Total</td>
<td>Live</td>
</tr>
<tr>
<td>Group I (n=65)</td>
<td>53</td>
<td>81.5*</td>
<td>7.8±1.3*</td>
<td>7.3±1.1</td>
</tr>
<tr>
<td>Group II (n=65)</td>
<td>51</td>
<td>78.5*</td>
<td>7.6±1.4*</td>
<td>7.4±1.1</td>
</tr>
<tr>
<td>Control group (n=65)*</td>
<td>57</td>
<td>87.7*</td>
<td>10.2±1.1*</td>
<td>9.3±0.7</td>
</tr>
</tbody>
</table>

\* Longitudinal columns with different letters have significant differences between them (p < 0.01)

Chi-square (pregnancy rate) Student τ test (number of offspring)

The control group showed spontaneous estrus approximately 48 ± 10.4 days after placebo administration and inseminated.

Table II. — Pregnancy rates and number of offspring in groups I, II and control.
Discussion

Researchers have reported that estrus stimulation can be done with exogenous gonadotrophins in prepubertal aged 100 days-old and that the most convenient age for stimulation is after 140 days (7,20). In our study, 150-180 days old gilts were used. Although all treated and control groups were kept in a similar husbandry and management conditions, in the control group, the estrus was not observed between 24-72 hours after the placebo administration. These results indicated that the boars did not induce the estrus sign during this period. While SIGNORET [28] indicate that the boar can stimulate the estrus signs in the gilts at puberty. Fertility in pigs is known to vary with season, being lower in the summer months. During the summer, both the farrowing rate and litter size were shown to be lower than in the other seasons [20]. Our study was performed at the end of the summer season.

In our study, the estrus rates obtained from prepubertal gilts treated with gonadotrophins and/or GnRH (86.2 % and 84.6 %), were higher than the estrus rates of 75 % found by DZUIK and DHINDSA [10] and 76 % by LANGENDIJK et al [19] who used PMSG and hCG and lower than the estrus rate of 91 % reported by LANGENDIJK et al [19] who used PMSG and GnRH.

Researchers [2, 19, 25, 29] have reported that, treatments of combining exogenous gonadotrophins PMSG and hCG or combining PMSG with GnRH can both achieve cycle stimulation and that ovulation occurs 39-44 hours after hCG administration and 35-41 hours after GnRH administration. Similarly in our study, while there was no statistically significant difference between the parameters of Groups I and II, the mean mating and pregnancy rates and the mean number of offspring, of the gonadotrophins treated group were lower than that of the control group. However, the animals of the control group showed estrus approximately 48 ± 10.4 days after the animals of the treated group showing that PMSG and hCG administrations has the advantage to advance pregnancy in prepubertal gilts. In the present study, the results have shown that the gilts responded to exogenous gonadotrophins about 44 days before they reach the natural puberty. This finding is important since the pregnancy is initiated earlier. The lag time between the last administration and estrus signs was about 4 days as previously reported by HURTGEN et al. [15].

The 81.5 % pregnancy rate achieved in the PMSG and hCG treated group was higher than the 78.5 % rate found by BRITT et al [3], who carried out the same protocol, and the 67 % rate found by DZUIK and DHINDSA [10], who administered a lower dose of PMSG (500 IU PMSG). The 78.5 % pregnancy rate of the PMSG and GnRH treated group was lower than the 85.4 % pregnancy rate found by PETERS et al [23], who administered GnRH before insemination. In our study the litter size of the control gilts was higher than that of gonadotrophins treated gilts. This might be due to the lower uterine length. Other investigators have also indicated that the uterus length and farrowing at younger ages affect the litter size of gilts [6, 11, 13, 14, 36]. The litter size obtained from gonadotrophins treated gilts in our study 8 was of the same order of magnitude than that reported by HOLTZ et al [14] and by BRITH et al [3]. The 10 litter size achieved in the control group was comparable to that of 8 found by HOLTZ et al [14] and of 11 by PETERS et al [23].

It has been reported by researchers that ovulation and estrus can be synchronised using gonadotrophins, that the time of estrus and insemination can be determined and that hCG or GnRH can be used successfully in the stimulation of ovulation [1, 5, 16, 17, 32]. When the number of offspring obtained in our study, in which estrus was stimulated with PMSG combined with either hCG or GnRH in prepubertal gilts is considered, it can be concluded that these administrations produce fertile estrus. This fact is also supported by other researchers [7, 15, 19, 23, 24, 34].

It has been concluded that estrus can be induced in a fertile way using exogenous gonadotrophins in 150-180 days old prepubertal gilts, that GnRH administrations following PMSG administration instead of hCG does not improve reproductive performance.

References

29. — SOEDE N.M. and KEMP B. : In synchronized pigs, the duration of ovulation is not affected by insemination and is not a determinant for early embryonic diversity. Theriogenology, 1993, 39, 1043-1053.