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CLINICAL AND ENDOCRINOLOGICAL STUDIES  
IN PRIMIPAROUS POST PARTUM SOWS  
EFFECTS OF LACTATION LENGTH AND LITTER SIZE

By

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KUNAVONGKRIT, A.: *Clinical and endocrinological studies in primiparous post partum sows. Effects of lactation length and litter size.* Acta vet. scand. 1984, 25, 260—279. — The object of this investigation was to determine the relationships between clinical findings and hormonal patterns in primiparous sows with different lactation length and litter size during lactation, weaning and to the first oestrus. Seven pairs of primiparous full sib sows were used to determine the effect of lactation length with normal litter size. One sow of each pair was assigned to nurse the piglets for 3 weeks (group A) while the other nursed for 5 weeks (group B). Another 8 primiparous sows (group C) were assigned to nurse 2—4 piglets during a 5-week lactation period. Oestrus detection was performed twice daily and laparoscopic examination every 2 weeks. If the sows did not come in oestrus within 3 weeks after weaning they were slaughtered. Peripheral plasma levels of progesterone, oestradiol-17 $\beta$  and LH were estimated by radioimmunoassays throughout the experimental period.

None of the sows belonging to groups A and B came in oestrus during lactation. One sow belonging to group C had ovulatory oestrus on day 19 of lactation. The means of the interval from weaning to oestrus in sows belonging to groups A, B and C were 11.4, 7.8 and 6.3 days, respectively. All sows in the 3 groups had low levels of plasma progesterone and oestradiol-17 $\beta$  during the lactation period. The plasma levels of LH were also low but a slight significant increase was found during the progressive weeks of lactation in all groups. The mean of the LH levels in group C sows was higher than in group B. No obvious differences in hormonal profiles were found between different groups of sows around weaning. The plasma levels of progesterone and oestradiol-17 $\beta$  were low throughout the post weaning period in anoestrous sows whereas the plasma level of LH showed a slight increase during the first week after weaning, thereafter being maintained approximately constant during the remaining part of the experimental period. The mean of plasma levels of LH obtained from daily samples 14 days after weaning in sows which had ovulatory oestrus during week 3 post weaning was higher than in the anoestrous sows, but the difference was not significant.

post weaning oestrus; progesterone; oestradiol-17 $\beta$ ; luteinizing hormone.

Lactation in the pig is a period which is usually associated with suppression of oestrus and ovulation. The physiological mechanisms underlying the lactational anoestrus in the sow are unclear. Most studies agree that lactation and suckling stimulus may be the most important causes of the suppression of the reproductive activity during the post partum period in sows (e.g. *Crichton & Lamming* 1969, *Cox & Britt* 1981). After a lactation period of 4 to 8 weeks, oestrus usually occurs within a week after weaning, but the interval from weaning to oestrus is longer in primiparous sows than in older sows (*Einarsson & Settergren* 1974, *Dubois et al.* 1980, *Benjaminsen & Karlberg* 1981). The interval from weaning to oestrus is increased as the duration of lactation is shortened (e.g. *Pay* 1973, *Varley & Cole* 1978). Lactational anoestrus and the interval from weaning to oestrus are therefore dependent upon, and intimately connected with the complex interrelationships of the endocrine events controlling lactation.

*Parvizi et al.* (1976) observed that more than one nursing piglet was necessary to suppress oestrus during lactation in miniature sows. Recently, some investigators have shown that a reduction in the litter size before weaning or limited nursing shortened the interval from weaning to oestrus (*Stevenson & Britt* 1981, *Thompson et al.* 1981, *Cox et al.* 1981, *Britt & Levis* 1982). These findings suggest that the suckling intensity may be involved in the synthesis and/or release of the gonadotrophic hormones.

The purpose of this study was to determine the relationships between clinical findings and hormonal patterns in primiparous sows with different lactation length and small versus normal litter size, respectively, during lactation, weaning, and to the first oestrus.

## MATERIALS AND METHODS

### *Experimental animals*

Twenty-two primiparous sows of Swedish Landrace, Swedish Yorkshire or crosses between these breeds were used. The animals were purchased from commercial herds and brought to the clinic 3—4 weeks before expected farrowing. They were housed in individual pens throughout the experimental period and were fed a commercial feed containing all necessary nutrient accord-

ing to the Swedish breeding stock standard. Oestrus detection was performed twice daily with the presence of a boar after parturition and throughout the experimental period.

Seven pairs of the animals were full sibs and used for different lengths of lactation. The other 8 sows were used in the small-litter experiment. The breeds of sows were stratified across experiments. One sow from each pair of full sibs was assigned to nurse the piglets for 3 weeks (group A, nos. 1A—7A) while the other nursed for 5 weeks (group B, nos. 1B—7B). Eight sows (group C, 1C—8C) were assigned to have only 2—4 piglets suckled during a 5-week lactation period. Three sows (2A, 1C and 4C) developed hypogalactia after parturition and were treated with antibiotics and oxytoxin for 3—4 days, thereafter, they recovered and continued their lactation normally.

All sows were slaughtered after the first post-weaning oestrus or 3 weeks after weaning if they did not come in oestrus within that period. The reproductive organs were removed and examined macroscopically within 1 h after slaughter. Ovarian and uterine tissues were fixed, sectioned and stained according to the conventional histological methods.

#### *Blood collection and laparoscopic examination*

Blood samples were taken 3 times per day (8 a.m., 12 a.m. and 4 p.m.) from the day of parturition until slaughter. The collections were done via a silastic catheter which was inserted in the jugular vein 7 days before expected farrowing (Rodriguez & Kunavongkrit 1983). Once a week after parturition frequent collections were made from all sows at 15 min intervals for 4 h (from 8 a.m. to 12 a.m.). All blood samples were centrifuged and plasma was removed into plastic tubes and kept at  $-20^{\circ}\text{C}$  until assayed.

Laparoscopic examination modified from the technique described by Wildt *et al.* (1973) was used for inspection of genital organs. The examinations were carried out once every second week after parturition and throughout the experimental period.

#### *Hormonal analysis*

Daily samples (8 p.m.) were analysed for the peripheral plasma levels of progesterone (Bosu *et al.* 1976) and oestradiol-17 $\beta$  (Boilert *et al.* 1973) and all samples were used for analysis of

the peripheral plasma levels of LH (Stupnicki & Madej 1976) using radioimmunoassay systems. All these 3 radioimmunoassays have previously been validated in the porcine species (Kunavongkrit *et al.* 1983).

### *Statistical analysis*

Statistical analysis for LH levels was performed by analysis of variance using the General Linear Models procedure according to the SAS package (Helwig & Council 1979).

**D u r i n g l a c t a t i o n.** Data from sows belonging to groups A and B during the first 3 weeks after parturition were analysed by using 2 models and pre-planned comparisons were made.

**Model 1:** Daily samples were analysed according to a model including the effects of week, sampling day within week, full sib family, sow within full sib family and the interaction between full sib family and week. The number of classes for these effects were: week (3), day (21), family (7) and sow (14).

**Model 2:** Standard deviations of the weekly samples were analysed according to a model including the effects of week, full sib family and sow within full sib family. The number of classes for these effects were: week (3), family (7) and sow (14).

Data from sows belonging to groups B and C during the 5-week lactation period were analysed by using 3 models and pre-planned comparisons were made.

**Model 3:** Daily samples from groups B and C were analysed for each group according to a model including the effects of sow, week, sampling day within week, and the interaction between sow and week. The number of classes for these effects were: sow ( $B = C = 7$ ), week ( $B = C = 5$ ) and day ( $B = C = 35$ ).

**Model 4:** Daily samples from groups B and C were analysed for a comparison between groups B and C according to a model including the effects of group, sow within group, week, sampling day within week, and the interaction between group and week. The number of classes for these effects were: group (2), sow (14), week (5) and day (35).

**Model 5:** Standard deviations of weekly samples were analysed according to a model including the effects of group, sow within group, week and the interaction between group and week. The number of classes for these effects were: group (2), sow (14) and week (5).

**Around weaning.** Data from all groups of sows, pre- and post-weaning, were analysed by using two models and pre-planned comparisons were made. The pre-weaning period was defined as one day before weaning and the day of weaning. The post-weaning period was defined as days one and two after the day of weaning.

**Model 6:** Daily samples were analysed according to a model including the effects of group, sow within group, pre- or post-weaning, sampling day within pre- or post-weaning period. The number of classes for these effects were: group (3), sow (19), pre- or post-weaning (2) and day (4).

**Model 7:** Daily samples were analysed according to a model including the effects of "oestrus or anoestrus" (oestrus or anoestrus is classified according whether the sow had ovulatory oestrus within 3 weeks after weaning or not, regardless of which treatment group they belonged to), sow within "oestrus or anoestrus", pre- or post-weaning, and day within pre- or post-weaning period. The number of classes for these effects were "oestrus or anoestrus" (2), sow (19), pre- or post-weaning (2) and day (4).

**Post-weaning.** The statistical analysis was performed only for anoestrous sows (group X,  $n=4$ ) and for the sows which had ovulatory oestrus during week 3 after weaning (group Y,  $n=2$ ). The analyses were made according to 2 models and pre-planned comparisons were made.

**Model 8:** Daily samples from sows belonging to group X were analysed according to a model including the effects of sow, week post-weaning and sampling day within post-weaning week. The number of classes for these effects were: sow (4), week (3) and day (21).

**Model 9:** Daily sampling during the first 2 weeks after weaning of sows belonging to groups X and Y were analysed according to a model including the effects of week post-weaning, day within week post-weaning, group (X or Y), sow within group (X or Y) and the interaction between week and group (X or Y). The number of classes for these effects were: week post-weaning (2), day (14), group (2) and sow (6).

In all the above analyses the effects of sow and full sib family were regarded as random variables, whereas all other effects were regarded as fixed factors.

The degrees of significance are expressed as follows:

$P > 0.05$	not significant	NS
$0.05 > P > 0.01$	almost significant	*
$0.01 > P > 0.001$	significant	**
$P < 0.001$	highly significant	***

## RESULTS

### *Clinical and post mortem findings*

**Different lactation periods.** The clinical data and post mortem findings in sows belonging to groups A and B are presented in Table 1. The animals had an average of 9.0 and 9.6 live piglets (on day 1 post partum) and an average of 8.4 and 8.7 weaned piglets in groups A and B, respectively. According to oestrus detection and laparoscopic examination, none of the sows showed symptoms of heat or evidence of ovulation during lactation.

Table 1. Clinical and post mortem findings of primiparous sows nursing normal litter sizes during 3-week (group A) and 5-week (group B) lactation period.

Sow no.	No. of piglets		Ovulatory oestrus after weaning	Weaning to oestrus (days)	Weight (g)	
	nursed	weaned			ovaries	uterus
1A	7	7	Yes	5	26.1	765
1B	8	8	Yes	5	21.0	522
2A	10	9	Yes	21	12.5	412
2B	7	7	No	—	8.1	124
3A	9	9	No <sup>a</sup>	—	17.2	773
3B	12	10	Yes	9	6.0	310
4A	8	7	Yes	8	13.7	685
4B	10	10	No	—	3.0	208
5A	7	5	Yes	17	25.4	770
5B	9	8	Yes	8	15.0	687
6A	10	10	No	—	8.1	300
6B	12	11	Yes	6	9.6	433
7A	12	12	Yes	6	15.7	630
7B	9	7	Yes	10	19.0	858
Average						
A	9.0	8.4	5/7	11.4	16.9	619
B	9.6	8.7	5/7	7.8	11.7	449

<sup>a</sup> = silent oestrus but ovulated.

Five sows (1A, 2A, 4A, 5A and 7A) which had a 3-week lactation period had ovulatory oestrus at an average of 11.4 days (range 5—21 days) after weaning. One sow (3A) did not show any symptoms of heat but according to the laparoscopic examination, ovulation took place at around day 14 after weaning. Another sow (6A) did not come in heat or ovulate during the experimental period and only small follicles were found in the ovaries at slaughter.

Five sows (1B, 3B, 5B, 6B and 7B) which had a 5-week lactation period had ovulatory oestrus at an average of 7.8 days (range 5—10 days) after weaning. Two other sows (2B and 4B) did not come in heat or ovulate during the experimental period.

An average number of 18.3 and 16.0 corpora lutea were found at slaughter in the ovaries of the ovulatory oestrous sows belonging to groups A and B, respectively. The difference was not significant. In the anoestrous sows only small follicles (diameter < 5 mm) were found in the ovaries at slaughter.

**Small litter size.** The clinical data and post mortem findings in sows belonging to group C are shown in Table 2. The animals nursed an average of 3.3 piglets during a 5-week lactation period. One sow (1C) which nursed 2 piglets had ovulatory oestrus during lactation (day 19 post partum) and came in

Table 2. Clinical and post mortem findings of primiparous sows nursing small litter size (group C) during the 5-week lactation period.

Sow no.	No. of piglets			Ovulatory oestrus after weaning	Weaning to oestrus (days)	Weight (g)	
	born alive	nursed	weaned			ovaries	uterus
1C	3 <sup>a</sup>	2	2	Yes	—16,6 <sup>b</sup>	13.5	692
2C	9	4	4	No	—	8.5	257
3C	9	4	4	Yes	5	17.1	2500
4C	14	4	4	Yes	12	20.9	900
5C	12	3	3	Yes	4	14.8	842
6C	12	3	3	Yes	4	11.6	380
7C	5 <sup>a</sup>	3	3	c)	—	4.5	200
8C	10	3	3	c)	—	7.1	267
Mean		3.3	3.3	5/6	6.3	12.3	754

a = 5 and 2 stillborn piglets for sows 1C and 7C respectively.

b = Ovulatory oestrus, before (—) and after weaning (days).

c = Sows were slaughtered at weaning.

heat again after 22 days. At weaning, 2 sows (7C and 8C) were slaughtered because of leg weakness. Therefore only 5 sows were followed in the post weaning oestrus.

Four sows (3C, 4C, 5C and 6C) had ovulatory oestrus at an average of 6.3 days (range 4—12 days) after weaning. One sow (2C) did not come in oestrus or ovulate and at slaughter only small follicles (diameter < 5 mm) were found in the ovaries. Sow 3C had a relatively big uterus but macroscopic and microscopic examination revealed a normal picture.

An average number of 17.6 corpora lutea were found at slaughter in the ovaries of the ovulatory oestrous sows belonging to group C.

### Endocrinological findings

One sow (1C) which had ovulatory oestrus during lactation showed a normal pattern of hormones compared to normal cycling animals (Fig. 1). This animal is therefore not included in the following presentation.

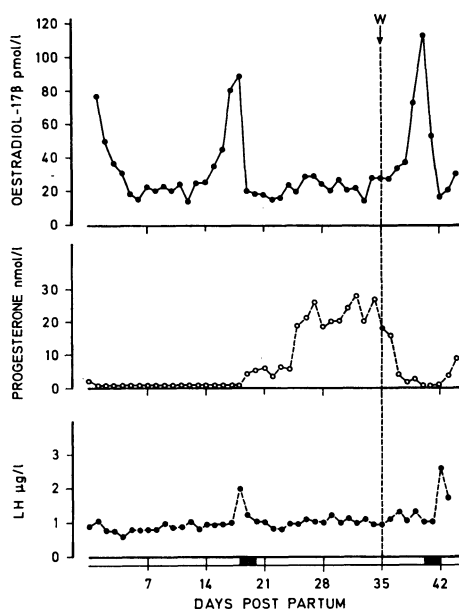


Figure 1. Peripheral plasma levels of progesterone, oestradiol-17 $\beta$  and LH in sow 1 C. W indicates weaning day. Horizontal black bars indicate ovulatory oestrus.



**Table 3.** The mean (X) and range (r) of peripheral plasma levels of progesterone (P<sub>4</sub>, nmol/l) and oestradiol-17β (E<sub>2</sub>, pmol/l) during lactation period in sows belonging to groups A, B and C.

Period	Group A (n=7)						Group B (n=7)						Group C (n=7)						
	P <sub>4</sub>		E <sub>2</sub>		X		P <sub>4</sub>		E <sub>2</sub>		X		P <sub>4</sub>		E <sub>2</sub>		X		
	X	r	X	r	X	r	X	r	X	r	X	r	X	r	X	r	X	r	
Lactation																			
Week 1	2.7	0.3-8.3	170.2	33-237	2.1	0.3-6.6	104.2	30-270	2.2	0.4-5.8	94.5	32-340							
d. 1-3																			
d. 4-7	0.6	0.1-1.6	23.4	11-52	0.5	0.0-0.9	22.6	7-37	0.6	0.1-1.0	23.6	7-44							
Week 2	0.3	0.0-1.0	17.5	7-35	0.4	0.1-0.9	19.7	9-37	0.4	0.0-0.9	18.1	12-47							
Week 3	0.2	0.0-0.6	17.7	8-34	0.3	0.0-0.7	17.7	7-37	0.3	0.0-0.7	16.8	4-43							
Week 4	—	—	—	—	0.3	0.0-0.6	17.6	4-35	0.3	0.0-0.6	16.8	8-34							
Week 5	—	—	—	—	0.4	0.0-1.1	14.6	5-34	0.3	0.0-0.6	15.8	8-38							

During lactation. Peripheral plasma levels of progesterone and oestradiol-17 $\beta$  decreased and reached the basal levels a few days after parturition. Thereafter the levels were maintained at levels around the detection limit during the whole lactation period. The mean and range of plasma progesterone and oestradiol-17 $\beta$  levels during lactation in groups A, B and C are presented in Table 3. No significant difference between these 3 groups can be established.

Peripheral plasma levels of LH during lactation were low, but a significant change of the basal LH levels during the progressive weeks of lactation was observed. From the first 3 weeks of lactation the LH levels in group A combined with group B showed no significant difference between weeks of lactation, either from the daily samples or from the standard deviation of weekly samples (Table 4), whereas there was a significant difference between weeks of lactation in sows belonging to group B or C ( $P < 0.05$ , Table 5).

Table 4. Results of the statistical analysis of LH levels from the first three weeks of lactation in sows belonging to groups A and B.

Effects	Level of significance	
	Daily (3 times/day) (model 1)	Weekly (15 min, 4 h) (model 2)
Week	NS.	NS.
Day (weeks)	*	—
Family	NS.	*
Sow (family)	***	NS.
Family $\times$ week	***	—

Table 5. Results of the statistical analysis of LH levels in sows belonging to groups B and C.

Effects	Level of significance			
	Daily (3 times/day) Model 3		Model 4	Weekly (15 min, 4 h) Model 5
	Group B	Group C	B vs. C	B vs. C
Sow	***	***	—	—
Sow (group)	—	—	***	***
Group	—	—	NS.	NS.
Week	*	*	***	NS.
Day (week)	NS.	NS.	NS.	—
Group $\times$ week	—	—	***	NS.
Sow $\times$ week	***	***	—	—

In group B sows the average of LH levels increased significantly from week 1 to week 5 of lactation (Fig. 2), average from 0.7 to 1.1  $\mu\text{g/l}$ ). In group C sows the average of LH levels also increased significantly during the first three weeks of lactation, thereafter a slight decrease was observed (Fig. 2), average 1.1, 1.3 and 1.5  $\mu\text{g/l}$  for the first 3 weeks and 1.2 and 1.0  $\mu\text{g/l}$  for the fourth and fifth week of lactation). Significances at various levels were found between weeks of lactation when comparing groups B and C, except that there was no significant difference in the fifth week.

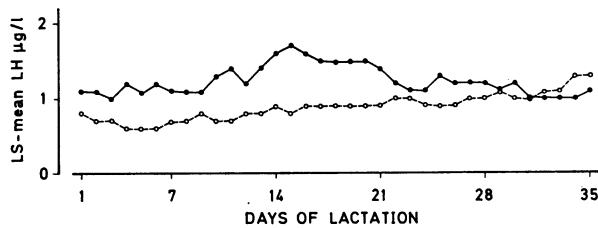


Figure 2. Least-squares means of the peripheral plasma levels of LH during lactation in sows belonging to group B (O-----O) and group C (●——●).

The daily LH levels did not differ within each week of lactation in group B or C but was significantly different ( $P < 0.05$ ) during the first 3 weeks of lactation when the results were obtained from both groups A and B.

There was no difference in daily LH levels but a significant difference in the standard deviation of weekly LH levels between the different full sib families.

The individual variation of the animals LH levels was highly significant in all groups even between sows within a family. But there was no significant difference in the standard deviation of the weekly LH levels between sows within a family.

The overall mean of peripheral plasma levels of LH was higher in sows belonging to group C than to group B (1.2  $\mu\text{g/l}$  for C, 0.9  $\mu\text{g/l}$  for B), but the difference was not significant. The standard deviation of weekly LH levels was not significantly different between groups B and C or between weeks of lactation (Table 5).

**Around weaning.** The peripheral plasma levels of progesterone and oestradiol- $17\beta$  were low around weaning in all groups. The patterns (mean  $\pm$  s.e.m.) of peripheral plasma levels

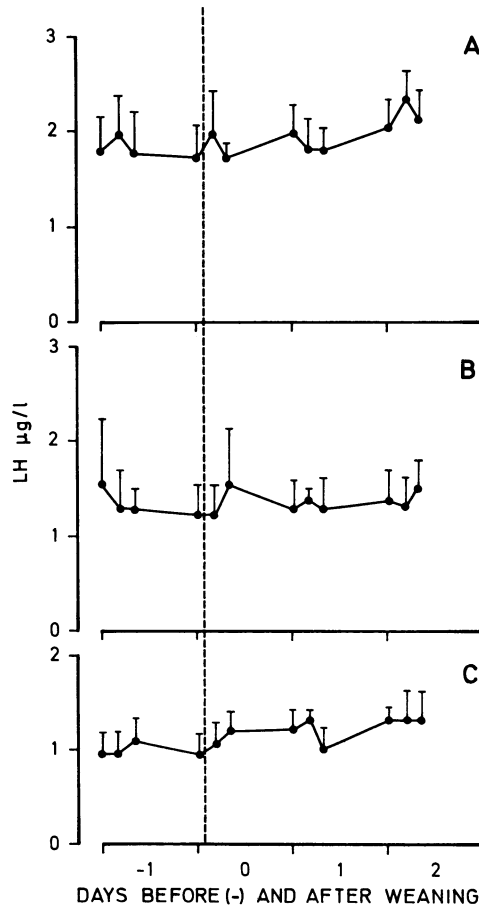


Figure 3. Mean  $\pm$  s.e.m. of the peripheral plasma levels of LH around weaning in groups A, B and C.

of LH in sows belonging to groups A, B and C are presented in Fig. 3. The statistical analyses results of plasma LH levels around weaning in all 3 groups and the sows which had ovulatory oestrus or anoestrus are shown in Table 6. No obvious changes of the plasma levels of LH in pre- and post-weaning period were found in any of the three groups. There was no significant difference between groups (average LH levels 1.9, 1.4, 1.0  $\mu\text{g/l}$  in groups A, B and C, respectively), between pre- and post-weaning (average LH levels during pre- and post-weaning period were 1.4 and 1.5  $\mu\text{g/l}$ , respectively), or between day (average LH levels on day before, at and 2 days after weaning were 1.4, 1.4, 1.4 and 1.6

$\mu\text{g/l}$ , respectively). Nor was there any significant difference between pre- and post-weaning periods in each group of sows.

Peripheral plasma levels of LH around weaning were also compared in sows which had ovulatory oestrus or anoestrus after weaning (Table 6). No significant difference was seen between these 2 groups of sows.

Table 6. Results of the statistical analysis of LH levels around weaning in sows belonging to groups A, B and C in sows which had ovulatory oestrus or anoestrus.

Effects	Level of significance	
	Model 6	Model 7
Group	NS.	—
Sow (group)	***	—
Pre- and post-weaning	NS.	NS.
Day	NS.	NS.
Pre- and post-weaning $\times$ group	NS.	—
Oestrus and anoestrus	—	NS.
Sow (oestrus or anoestrus)	—	***

**Post-weaning.** The peripheral plasma levels of oestradiol- $17\beta$  were low until pro-oestrus in sows which had ovulatory oestrus, but the levels were low throughout the experimental period in anoestrous sows (Fig. 4). The peripheral plasma levels of progesterone were low in ovulatory oestrous sows until the ovulations occurred and thereafter, increased. In anoestrous sows the progesterone levels were low throughout the experimental period.

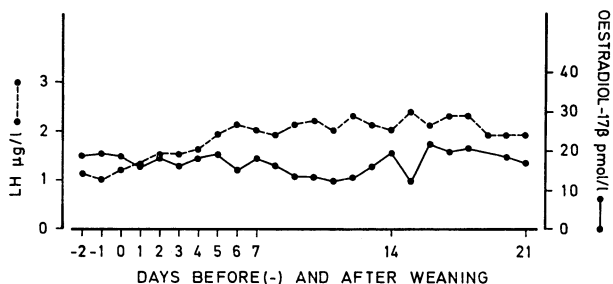


Figure 4. Least-squares means of the peripheral plasma levels of LH (●-----●) and oestradiol- $17\beta$  (●——●) in anoestrous sows two days before and after weaning.

The peripheral plasma levels of oestradiol-17 $\beta$  in the three pairs of full sib sows belonging to groups A and B during the first pro-oestrus after weaning were compared and the results are presented in Fig. 5. A tendency to higher mean values of plasma oestradiol-17 $\beta$  was found in group A than in group B, but the difference was not significant.

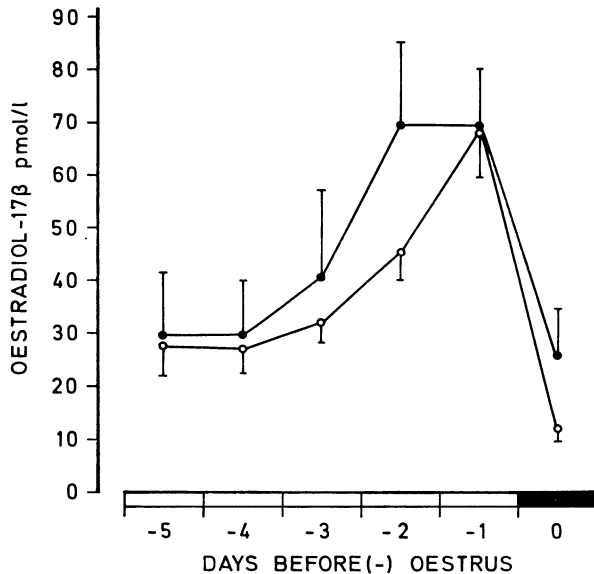


Figure 5. Comparison of the peripheral plasma levels of oestradiol-17 $\beta$  (mean  $\pm$  s.e.m.) during pro-oestrus in the three pairs of full sib sows belonging to group A (●—●) and group B (○—○).

Due to the differences in reproductive performance after weaning and limited number of sows in each group, no comparison could be made of peripheral plasma levels of LH between groups.

The statistical analysis was performed for the anoestrous sows (4 sows) and also between the anoestrous sows and the sows which had ovulatory oestrus during the third week after weaning regardless of the groups they belonged to. The results are shown in Table 7. The mean values of peripheral plasma levels of LH in anoestrous sows after weaning are presented in Fig. 4. A gradual significant increase of the plasma levels of LH was observed during the first week after weaning in the anoestrous sows. The levels were thereafter maintained approximately

Table 7. Results of the statistical analysis of LH levels after weaning in anoestrous sows (model 8) and a comparison between sows which had ovulatory oestrus at week 3 post-weaning (group X, n=2) and anoestrous sows (group Y, n=4) (model 9).

Effects	Level of significance	
	Model 8	Model 9
Sow	***	—
Week	***	***
Day (week)	NS.	***
Group X and group Y	—	NS.
Sow (groups X and Y)	—	***
Week (groups X and Y)	—	N.S

constant during the second and third weeks. The mean values during weeks 1, 2 and 3 were 1.7, 2.1 and 2.1  $\mu\text{g/l}$ , respectively, the difference between weeks 1 and 2 being significant.

The mean of plasma LH levels obtained from daily samples 14 days after weaning in sows which had ovulatory oestrus during week 3 post-weaning was higher than in the anoestrous sows (2.2 vs. 1.9  $\mu\text{g/l}$ ) but the difference was not significant. The plasma levels of LH were significantly higher during the second than during the first week after weaning in both groups of sows.

## DISCUSSION

None of the sows belonging to groups A and B showed oestrus or developed corpora lutea during the lactation period. This indicates that oestrus and ovulation are suppressed during lactation in sows nursing normal number of piglets and is in agreement with previous reports (e.g. *Stevenson et al.* 1981, *Kunavongkrit et al.* 1982).

One sow belonging to group C, which only nursed two piglets, had ovulatory oestrus during lactation and developed corpora lutea. This observation accords with *Einarsson et al.* (1982), who reported that corpora lutea were presented a weaning in some sows which nursed few piglets. There was also a tendency to shorter intervals from weaning to oestrus in sows belonging to group C than to group A or B. This finding confirms the previous reports that reduction of litter size can shorten the interval from weaning to oestrus (*Stevenson & Britt* 1981, *Cox et al.* 1981, *Thompson et al.* 1981). Suckling intensity, reflected by the num-

ber of piglets per litter, might to some extent be related to the occurrence of oestrus during lactation.

The mean interval from weaning to the first oestrus was longer in sows belonging to group A than group B. This result is in agreement with earlier studies (e.g. *Pay* 1973, *Varley & Cole* 1978), indicating that the shorter lactation period resulted in a longer interval from weaning to oestrus.

Out of 19 sows followed during the 3 weeks post weaning, 14 came in oestrus and ovulated, while 1 ovulated without external signs of oestrus and 4 were anoestrous. This result is in close accordance with the findings of *Benjaminsen & Karlberg* (1981) who reported that approximately 73 % of primiparous sows had their first ovulatory oestrus within 3 weeks after weaning.

Both the peripheral plasma levels of progesterone and the oestradiol-17 $\beta$  levels were low throughout the lactation period in all groups of sows. This accords with the findings from some earlier studies (e.g. *Ash & Heap* 1975, *Stevenson et al.* 1981). *Kunavongkrit et al.* (1982) reported, however, a gradual increase of follicular size and number of normal follicles (diameter from 1 to 5 mm) in sows during late lactation. The relationships between follicular growth and production of steroids from the ovaries might be an object for further investigation, as hormone levels only were measured in the peripheral blood plasma in the present study.

The peripheral plasma levels of LH were low during lactation. This accords with previous reports (*Parvizi et al.* 1976, *Stevenson et al.* 1981). A significant gradual increase of the peripheral plasma basal levels of LH from the first to the fifth weeks of lactation was, however, observed. This is in agreement with *Stevenson & Britt* (1980) who reported that the LH synthesis and/or release was suppressed during early lactation (day 7) and thereafter gradually increased. Also *Kirkwood et al.* (1984) found a significantly higher LH level at day 34 of lactation than at day 9. *Edwards & Foxcroft* (1983) showed, in contrast to *Booman & van de Weil* (1980), that the basal LH secretion is not significantly depressed during lactation.

Suckling stimulus might be a factor in suppressing the release of gonadotrophin-releasing hormone in pigs (*Cox & Britt* 1981) resulting in low basal levels of LH especially during the early lactation period. Due to the large variation among sows in the



present study, there was no significant difference in the basal levels of LH during lactation between sows with normal litter size and sows with small litter size. However, there was a clear tendency to higher basal LH levels in the sows belonging to the small litter group compared to other groups. This may imply that suckling intensity to some extent is involved in the synthesis and/or release of gonadotrophic hormone.

The peripheral plasma levels of LH before weaning were not significantly different from the levels after weaning in all groups in the present study. This is in agreement with the results from some other studies (*Stevenson & Britt 1980, Kirkwood et al. 1984*). *Crighton & Lamming (1969)* and *Edwards & Foxcroft (1983)* on the other hand found significantly increased levels of LH after weaning. One reason for the different results might be the different parity of sows in the latter studies and also a great variation among animals.

The mean levels of the peripheral plasma levels of oestradiol- $17\beta$  during the first pro-oestrus after weaning did not differ significantly between 3 pairs of full sib sows nursing 3 and 5 weeks, respectively. These results are in agreement with 2 earlier studies (*Edwards & Foxcroft 1983, Kirkwood et al. 1984*). Due to the infrequent blood sampling during the first oestrus after weaning it is not possible to compare the sizes of LH surges in the different treatment groups. However, the peripheral plasma levels of LH had a tendency to increase during the first week after weaning in the sows which came in oestrus and ovulated in the third week, as well as in anoestrous sows. A tendency was also revealed to higher plasma levels of LH during the first 14 days after weaning in the oestrous sows compared to the anoestrous sows.

In conclusion, this study has demonstrated that no obvious difference in progesterone or oestradiol- $17\beta$  secretion occurred between sows with different lactation length or litter size. Although plasma levels of LH were low during lactation, there was a significantly higher basal level during the later stage than during the early stage of lactation. There was also a tendency to higher LH basal levels in sows nursing small than normal litters. No obvious difference in the peripheral plasma levels of LH in the pre- and post-weaning periods was found between treatment groups.

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#### SAMMANFATTNING

*Kliniska och endokrinologiska studier av digivande ungsuggor:  
Inverkan av diperiodens längd och kullstorlek.*

Ändamålet med föreliggande undersökning var att fastställa sambandet mellan kliniska observationer och hormonella mönstret hos ungsuggor, med olika diperiod och kullstorlek, under diperioden, avvänjningen och efter avvänjningen till första brunsten. Sju helsysterpar med normal kullstorlek användes för att studera effektken av diperiodens längd. En sugga per par hade en diperiod av 3 veckor (grupp A) och den andra suggan en diperiod av 5 veckor (grupp B). Åtta ungsuggor (grupp C) diade 2—4 smågrisar under 5 veckor. Brunstkontrollen utfördes 2 gånger dagligen och inspektion av äggstockarna med hjälp av laparoskopiiinstrument varannan vecka. Suggor som inte visat brunst inom 3 veckor efter avvänjningen slaktades. Perifera blodplasmanivåerna av östradiol-17 $\beta$ , progesteron och LH bestämdes under hela försöksperioden.

Ingen av suggorna i grupperna A och B visade brunst under diperioden. En av suggorna i grupp C visade brunst och ovulerade dag 19 under diperioden. Intervallet mellan avvänjning och brunst för de suggor som visade brunst efter avvänjningen var i medeltal 11,7, 7,8 och 6,3 dagar i grupperna A, B respektive C. Blodplasmanivåerna av progesteron, östradiol-17 $\beta$  och LH var låga under diperioden hos suggorna i samtliga grupper. En svag stegring observerades emellertid av LH-nivån. Medelnivån av LH var något högre hos suggorna i grupp C än i grupp B. Inga skillnader påvisades i hormonmönstret under avvänjningen mellan de olika grupperna. Blodplasmanivåerna av progesteron och östradiol-17 $\beta$  var låga under hela perioden efter avvänjningen hos de suggor som inte ovulerade. LH-nivån steg något under första veckan efter avvänjningen och låg sedan på oförändrad nivå. Blodplasmanivåerna av LH under de första 14 dagarna efter avvänjningen var högre hos de suggor som visade brunst och ovulerade under vecka 3 jämfört med de anöstrala suggorna. Skillnaden var emellertid inte statistiskt säker.

Sammanfattningsvis påvisade denna studie inga påtagliga skillnader i perifera blodplasmanivåerna av progesteron, östradiol-17 $\beta$  och LH mellan suggor med 3 och 5 veckors diperiod och med liten eller normal kullstorlek under diperioden.

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