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Post-Partum Ovarian Activity in Finnhorse Mares with Special Reference to Seasonal Effects

By *Erkki Koskinen*

Agricultural Research Centre, Equine Research Station, Ypäjä, Finland.

Koskinen, E.: Post-partum ovarian activity in Finnhorse mares with special reference to seasonal effects. Acta vet. scand. 1991, 32, 313–318. – In a previous study, times from parturition to the first ovulation were followed in 55 Finnhorse mares on the basis of milk progesterone determinations. Ninety-six per cent of mares had ovulated by day 20 post-partum. If intervals of more than 19 days are excluded from the data, the time from parturition to 1st ovulation was 117 days. However, in cases of foaling before and after the beginning of June the times were 13.0 days and 8.8 days, respectively ($p < 0.001$). Long intervals (over 16 days) occurred mainly before 1st May (in 6 out of 7 cases).
In a 2nd study, 25 post-partum Finnhorse mares were examined by rectal palpation and ultrasonic scanning. Five and 7 days post partum, but not 2 days post partum there was a statistically significant difference between ovulatory ovaries and non-ovulatory ovaries regarding size of whole ovary and the largest follicle. Six to 8 days before the first post-partum ovulation, the size of the preovulatory follicle was greater in mares which had foaled before the middle of May (32 mm) than in those which had foaled after the middle of May (20 mm) ($p < 0.05$). Within 2 days before ovulation there was no statistical difference between the sizes (43 mm and 42 mm, respectively). The growth rate was therefore slower in cases of early foaling (1.8 mm/day) than in cases of late foaling (3.7 mm/day).

anoestrus; follicle; foal heat; ovulation; progesterone determination; horses; ultrasonography.

Introduction

The mare is a seasonal breeder. The physiological breeding season starts in late April or early May and peaks in late June or early July, in the northern hemisphere (*Kenney et al.* 1975). The modern practice in horse management of breeding mares as early as possible leads to foalings during late winter and spring, which is usually a time of sexual repose in mares. This causes problems and differences in ovarian activity in post-partum mares.

In a clinical study *Loy* (1980) showed that the time from parturition to first ovulation is influenced by the foaling month. Ninety-seven per cent of mares had ovulated by day 20 (mean 10.2 ± 2.4 days) but there was an apparent shift from longer intervals in January and February to shorter intervals in May. Intervals of more than 14 days occurred mainly from Januay to March (in 37 out of 40 cases).

The results of *Palmer & Driancourt* (1983) were broadly similar to those of *Loy* (1980) *Palmer & Driancourt* (1983) also found that the incidence of ovarian inactivity after the 1st post partum ovulation increased early in the breeding season. However, parturition was regarded as a powerful stimulus to ovulation in early foaling mares which would not otherwise have completed the cycle (*Loy* 1980, *Palmer & Driancourt* 1983). Thus,

mating during foal heat is of practical importance early in the year. However, the considerable variation in times between foaling and 1st ovulation can make the timing of mating difficult.

The preovulatory follicle becomes the largest follicle 1 week prior to ovulation and grows by 3–5 mm a day until ovulation takes place (*Hughes et al.* 1975, *Ginther* 1979, *Neely* 1983, *Pierson & Ginther* 1985, *Palmer* 1987).

The effect of season on the follicles on the day before ovulation has been studied in 102 non-foaling riding-type horse mares by *Ginther & Pierson* (1989). They found significant differences in mean diameters of preovulatory follicles in April (46 mm) and May (48 mm) as compared to July (40 mm) ($p < 0.01$).

The purpose of this study was to examine the following in the special Finnish climate at latitudes > 60° N, and with cold and dark winters:

- post-partum events in the Finnhorse breed,
- seasonal effects on ovarian and follicular growth during the post-partum period and
- the seasonal variations in intervals from parturition to the first ovulation.

Materials and methods

Study 1

The study was conducted from 1981 to 1987 in the Equine Research Station in southern Finland, at a latitude of 61° N. The first records from 55 different foaling Finnhorse mares were analysed. The mean age of the mares was 10.0 years with SD = ± 4.7 years and ranging from 4 to 22 years. They had foaled 1–10 times, although 54.5 % of the mares were foaling for the first time. During the study there was no artificial induction of ovarian activity such as light treatment or hormone therapy. Lights were on in the stables for about 12 h a day, usually from 6.00–6.30 a.m. to 6.00–6.30 p.m. in the evening. There was one 60 W light bulb per box in the stable. Ovulation was followed on the basis of increased progesterone concentration in milk samples. Luteal activity was judged to have begun when progesterone concentration exceeded 2 nmol/l and remained high in subsequent samples. Progesterone was determined in whole milk using a direct radioimmunoassay (RIA) method specially developed for mare's milk[1]. A few millimetres of milk were collected 3 times a week (on Mondays, Wednesdays and Fridays). Because there is a one day delay resulting from 3 weekly samplings and a delay of about 20 h in the milk progesterone rise after ovulation (*Koskinen et al.* 1991), ovulation was estimated to have taken place 2 days before the detected milk progesterone rise.

Study 2

During spring 1985, 21 Finnhorse mares with mean age of 13.1 years and SD = ± 5.3 years and ranging from 4–23 years, were examined by rectal palpation and ultrasonic scanning[2] on the 2nd and 5th days post partum and then every other day post partum until 1st ovulation. The longest diameter of the ovaries was estimated by rectal palpation. The diameter of the largest follicle in each ovary was measured ultrasonically. The day between the existence of a follicle and its disappearance was regarded as the day of ovulation.

Statistical analysis of the data was performed by means of analysis of variance[3]. In the 1st study the dependent variables was

[1] Farmos Diagnostica, Turku, Finland.

[2] Aloka SSD-210 DX-scanner, 5 MHz.

[3] GLM procedure in SAS, SAS Institute Inc., SAS Circle, Box 8000, Cary, NC 27512-8000, U.S.A.

days post partum and the independent variable the foaling season (Model 1). In the 2nd study the dependent and independent variables in the models 2–5 were: size of ovary vs. ovulation in the ovary (Model 2), size of largest follicle vs. ovulation in the ovary (Model 3), size of preovulatory follicle vs. season of foaling (Model 4 and 5).

Results

Study 1

Interval from parturition to first ovulation. Ninety-six per cent (53/55) of the mares had ovulated by day 20 post partum. However, 90 % of the mares which had foaled after 1st June had had their first ovulation by day 11 post partum, whereas 90 % of the early foaling mares had ovulated as late as by day 17 post partum (Table 1).

If intervals over 19 days are excluded from the data the mean time from parturition to 1st ovulation was 11.7 days (SD ± 3.4 days, range 5–19 days, N = 53). However, in the mares foaling before June the mean time was 13.0 days (SD ± 3.1 days, range 5–19 days, N = 37). It was 8.8 days (SD ± 2.2 days, range 7–15 days, N = 16) for mares foaling after 1st June ($p < 0.001$, Model 1).

Table 1. Cumulative frequency of first ovulations on various days after foaling.

Days from foaling to 1st post partum ovulation	Foalings before June 1st N = 39	Foalings after June 1st N = 16	All observations N = 55
5	2.6	6.2	3.6
6	2.6	6.2	3.6
7	2.6	37.5	12.7
8	5.1	50.0	18.2
9	7.7	62.5	23.6
10	15.4	68.7	30.9
11	23.1	93.7	43.6
12	38.5	93.7	54.5
13	59.0	100.0	70.9
14	69.2	100.0	78.2
15	76.9	100.0	83.6
16	82.1	100.0	87.3
17	89.7	100.0	92.7
19	94.9	100.0	96.4
22	97.4	100.0	98.2
37	100.0	100.0	100.0

Long intervals (over 16 days and up to 37 days) occurred mainly before 1st May (in 6 out of 7 mares).

The time from parturition to 1st ovulation shortened markedly between the middle of May and the middle of June (Table 2).

Table 2. Time from parturition to first post-partum ovulation in foalings between May and June.

Month	Week of year	Mean days from foaling to 1st post partum ovulation	No. of mares	SD (days)
may	18	16.7	6	3.7
May	19	14.0	7	1.7
May	20	13.5	6	2.2
May	21	12.5	4	1.7
May	22	12.0	1	–
June	23	9.0	5	2.8
June	24	8.5	4	1.9
June	25	7.5	2	0.7

Study 2

Ovaries. Two days post partum, follicles larger than 1 cm in diameter were found in 18/21 (86 %) of left ovaries and 12/21 (57 %) of right ovaries. Five days post partum they were found in 21/21 (100 %) of left ovaries and in 20/21 (95 %) of right ovaries. The first post-partum ovulation occurred in the left ovary in 13/21 (62 %) of cases.

Five and 7 days but not 2 days post partum the ovulatory ovary and its largest follicle were statistically significantly larger than the ovary and follicle on the non-ovulatory side (Tables 3 and 4, Models 2 and 3).

Follicles. Within 6 to 8 days before the first post-partum ovulation the size of the

Table 3. Sizes of the ovulatory and the non-ovulatory ovary after foaling.

Days post partum	Ovulatory ovary			Non-ovulatory ovary			Significance
	Mean mm	SD mm	N	Mean mm	SD mm	N	
2	46	14	18	42	12	19	N.S.
5	59	11	20	41	8	21	**
7	76	13	5	42	5	5	**

**: $p < 0.01$.

Table 4. Size of largest follicle in ovulatory and non-ovulatory ovaries after 21 foalings.

Days post partum	Largest follicle in ovulatory ovary		Largest follicle in non-ovulatory ovary		Significance
	Mean mm	SD mm	Mean mm	SD mm	
2	15	11	11	9	N.S.
5	28	9	15	8	**
7	35	8	13	7	**

**: $p < 0.01$.
N.S.: Non significant difference.

preovulatory follicle was statistically significantly greater in mares which had foaled before 15 May (mean 32 mm, SD ± 4.5 mm, N = 5) than in those which had foaled after 15th May (mean 20 mm, SD ± 9.4 mm, N = 10, $p < 0.05$, Model 4). Within 2 days before ovulation there was no statistically significant difference, the mean sizes being 43 mm (SD ± 4.9 mm, N = 7) and 42 mm (SD ± 4.4 mm, N = 13, Model 5). Thus growth rate was slower in early foalings (1.8 mm/day) than in late foalings (3.7 mm/day). The mean size of 37 mm of the preovulatory follicle was reached on average three days before ovulation. The overall growth rate was 2.7 mm/day (range 2.5–3.0 mm/day) (Table 5).

Table 5. Size of the preovulatory follicle before first post-partum ovulation.

Days before ovulation	Mean diameter mm	SD	N	Growth rate per day (mm)
7	26	7.5	14	–
5	31	6.0	17	2.5
3	37	5.7	20	3.0
1	42	4.4	20	2.5

Discussion

In the study reported here, 96 % of mares had ovulated by day 20 post partum. *Loy* (1980) reported a similar result (97 %).

The mean time from parturition to first ovulation (11.7 days, SD ± 3.4 days) is slightly longer than that found by *Loy* (10.2 days, SD ± 2.4 days). Contributory factors to the difference may be light, nutrition and breed. In our study, the interval was longer and the variation greater in mares which foaled before June (mean 13.0 days, SD ± 3.1 days)

than in mares which foaled later in summer (8.8 days, SD ± 2.2 days). *Loy* also discovered a shift to shorter intervals from parturition to 1st ovulation as the season advanced. In Finland, the shortening was most marked between mid May and mid June.

Long intervals > 16 days occurred in the early part of our breeding season. This finding is in agreement with the finding of *Loy* (1980), who observed long intervals mainly from January to March.

According to *Palmer et al.* (1982) ovarian stimulation was observed when light treatment reduced the dark period to less than 9 to 10 h per 24 h. Ovulation begins after 1 to 2 months of such a stimulatory light/dark ratio. The critical limit of 9–10 h of darkness is reached naturally somewhere around the spring equinox in Finland. It should be borne in mind that in countries distant from the equator dawn and dusk are gradual. Total darkness therefore lasts for less than 12 h during the spring equinox because of the long twilight. Under natural illumination, an increase in ovarial activity of mares would normally be expected in May. This expectation is supported by the results of the study reported here.

Although many mares experience foal heat 1 week after foaling in early spring, mating would be in vain in the case of the many mares which are acyclic for several weeks before regular cycles start. Only foalings in June or later are suitable for traditional foal heat breeding 8 or 9 days after parturition without further ovulation control. *Kenney et al.* (1975) have stated that it is only during summer that the oestrus cycle of the mare is so short and regular that mating on the 3rd day of oestrus is successful if no signs other than extrinsic signs of oestrus are used for ovulation control.

The greater activity of the left ovary after foaling observed in our study reported here was also observed in findings relating to a large slaughter-house material in Australia (*Osborne* 1966).

Two days after foaling it was not possible to predict on which side ovulation would occur but by the 5th day post partum, or 6–8 days before ovulation, the preovulatory follicle was significantly larger than the largest follicle on the non-ovulatory side.

The size of the preovulatory follicle shortly before the 1st post partum ovulation (43 mm) and its size 3 days before ovulation (37 mm) are similar to the sizes found in other oestrus cycles in non-foaling Finnhorse mares (43 mm and 36 mm), respectively (*Koskinen et al.* 1989). This indicates that the same criteria apply to both foaling and non-foaling mares as regards, e.g. deciding the time of mating on the basis of diameter of the ovulatory follicle.

Interestingly, 1 week before ovulation, the largest follicle in the ovulatory ovary was larger in mares which had foaled before 15th May than in mares foaling after this date. Unlike *Ginther & Pierson* (1989), we found no difference in the size of the preovulatory follicle just before ovulation in early as opposed to late season foalings. However, *Ginther* (1979) found a small size of preovulatory follicle in July. Our material included only 1 mare foaling after June.

The observed growth of the preovulatory follicle by 2.7 mm/day during the last week before ovulation is in agreement with the findings of *Pierson & Ginther* (1985), and *Palmer* (1987). The difference between growth rates in relation to early foalings (1.8 mm/day) and late foalings (3.7 mm/day) indicates that follicles develop slowly during the early season. This is worth remembering when predicting times of ovulation on the basis of size of the preovulatory follicle.

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Sammanfattning

Ovariefunktionen hos finnhästston efter fölning med speciell hänsyn till årstidsvariationen.

I den första delen av undersökningen uppföljdes tiden mellan fölning och den första ovulationen postpartum hos 55 finnhästston genom mätning av progesteronhalten i mjölk. Nittiosex procent av stona hade ovulerat senast 20 dygn postpartum. Om man utesluter de fall där ovulationen skedde senare än 19 dagar postpartum, var genomsnittstiden till den första ovulationen 11.7 dygn. Det förelåg en signifikant skillnad i detta intervall mellan de ston som fölade före den 1. juni jämfört med dem som fölade senare (13.0 vs. 8.8 dygn, $p < 0.001$). Intervall på mer än 16 dygn påträffades främst bland de ston som fölade före den 1 maj (6 av 7).

I den andra delen av studien undersöktes 25 finnhästston postpartum genom rektal palpering och sonografi. Fem och 7 dygn postpartum var det ovulerande ovariet signifikant större än det icke-ovulerande ovariet, vilket också gällde storleken av den största follikeln; denna skillnad kunde inte påvisas 2 dygn postpartum. Sex till 8 dygn före den första postpartum ovulationen var storleken av den preovulatoriska follikeln större hos de ston som hade fölat före mitten av maj (32 mm) jämfört med dem som hade fölat senare (20 mm); skillnaden var statistisk signifikant ($p < 0.05$). Däremot förelåg ingen skillnad i detta avseende om follikelstorleken mättes 2 dygn före ovulationen (43 mm respektive 42 mm). Follikeltillväxten var sålunda långsammare hos tidigt fölande ston (1.8 mm per dygn) än hos ston som fölade sent (3.7 mm per dygn).

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Reprints may be requested from: Erkki Koskinen, Equine Research Station, SF-32100 Ypäjä, Finland.