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15-Ketodihydro-$PGF_{2\alpha}$, Progesterone and Cortisol Profiles in Heifers after Induction of Parturition by Injection of Dexamethasone

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Königsson K, Kask K, Gustafsson H, Kindahl H, Parvizi N: 15-Ketodihydro-$PGF_{2\alpha}$, progesterone and cortisol profiles in heifers after induction of parturition by injection of dexamethasone. Acta vet. scand. 2001, 42, 151-159. – In order to study rapid changes in 15-ketodihydro-$PGF_{2\alpha}$, cortisol and progesterone in the period preceding parturition in cattle, pre-term parturition was induced in 4 late pregnant heifers. Parturitions were induced by 2 intramuscular injections of 20 mg dexamethasone with a 24-h interval. The first injection was made on days 254, 258, 264 and 265 in gestation, respectively. Twenty-four h before the first injection an intravenous polyurethane cannula was inserted. Blood samples were collected at least every hour until 12 h after parturition and during the second stage of labour at least 6 times per hour. Plasma was analysed for 15-ketodihydro-$PGF_{2\alpha}$ and progesterone by radioimmunoassays, and for cortisol by an ELISA. The average time from injection to parturition was 7.7 (6.6-8.9) days (mean (range)). Two of the heifers had retained foetal membranes (RFM). At the start of the experiment the levels of $PGF_{2\alpha}$ metabolite were low (< 300 pmol/L) and increased slowly to levels between 1000 and 2000 pmol/L at one day before parturition. During the last day, however, the levels increased rapidly and the highest levels (>10000 pmol/L) were reached at the time of delivery. No pulsatile release was seen. Immediately after foetal expulsion the PG-metabolite levels decreased rapidly in all animals. In the 2 animals with RFM, however, this decline ceased within a few h. The PG-metabolite levels in these animals then started to increase and reached levels as high as during parturition. Luteolysis occurred between 1.6 and 0.4 days before parturition in all animals. The cortisol profile showed a distinct peak at the time of parturition in the RFM heifers. This peak was absent in the non-RFM heifers. This study shows that the $PGF_{2\alpha}$ release at prepartal luteolysis and parturition is not pulsatile in cattle and that cortisol profiles in heifers with retained foetal membranes might differ from the profiles in non-RFM heifers at the time of parturition.

dexamethasone; parturition; 15-ketodihydro-PGF_{2a}; progesterone; cortisol; luteolysis.

Introduction

The foetal pituitary-adrenal axis is the route by which parturition is initiated in cattle (*Flint et al.* 1979). In late gestation, ACTH from the foetal pituitary stimulates the foetal adrenals to produce increased amounts of cortisol. This increase induces synthesis of placental 17α-hydroxylase and aromatase and increases production of oestrogen at the expense of progesterone (*Anderson et al.* 1975). Other steroids, like the synthetic cortisol analogue dexamethasone, can

induce placental 17α-hydroxylase and aromatase in pregnant cattle in a similar way (*Lindell et al.* 1977, *Peters & Poole* 1992). The subsequent decrease in progesterone production together with increased levels of oestrogens and induction of endometrial cyclooxygenase-2 (COX-2) synthesis, prepare the uterus for parturition.

Prostaglandin $F_{2\alpha}$ has this far been shown to be the major luteolytic hormone produced by the bovine endometrium (for a review see *Mc Cracken et al.* 1999). The release of $PGF_{2\alpha}$ at luteolysis in the oestrous cycle has been studied (*Basu & Kindahl* 1987) and found to be released into the uterine veins in an "on-off" fashion (*Kindahl* 1994). Each pulse lasts about 4 h and is followed by a period of several h with only basal $PGF_{2\alpha}$ release. This pulsatile release continues during luteolysis as the progesterone falls to basal levels. After luteolysis, the $PGF_{2\alpha}$ pulsatility ceases. In cattle reaching the end of pregnancy progesterone is produced mainly by the corpus luteum and parturition does not occur until this progesterone production has ceased (*Lindell et al.* 1981, *Janszen et al.* 1990). The aim of this experiment was to study the profile of the $PGF_{2\alpha}$ metabolite, 15-keto-13,14-dihydro-$PGF_{2\alpha}$, and to relate this to cortisol and progesterone levels as well as clinical findings during the period after induction of parturition by dexamethasone in cattle.

Materials and methods

Animals

In this study 4 late pregnant heifers (3 of the Swedish red and white breed (A, B and C) and one of the Swedish black and white breed (D)) were used. The animals were divided into 2 groups (A and B in the first group and C and D in the second) according to expected date of calving. All heifers were examined clinically and found healthy. Rectal palpation was used for pregnancy diagnosis. At the clinic, the heifers were fed according to Swedish standards (*Spörndly* 1993).

The local ethical committee approved the study.

Induction of parturition

Twenty mg dexamethasone (Vorenvet® vet 1 mg/ml, BI-vet, Malmö, Sweden) was injected twice intramuscularly at a 24 h interval. The injections were made 3 to 4 weeks before expected calving (days 254-265).

The experimental period was divided into 4 phases, I to IV. Phase I started at the first dexamethasone injection and ended with either rupture or the first view of the foetal membranes. The subsequent phase II ended with the first sight of any part of the foetus and was followed by phase III. This phase ended at the final expulsion of the calf. Phase IV ended 12 h after parturition.

Blood sampling

Blood was collected via a polyurethane cannula (Cook central venous catheter, Cook, Brisbane, Australia) inserted 24 h before the first injection of dexamethasone. After cutaneous infiltration of local anaesthetics (Lidocain, Astra, Södertälje, Sweden) and a stab incision in the superficial skin, the catheter was inserted in the *V. jugularis externa.* Samples were collected once per hour from 2 h before the first injection of dexamethasone and until the start of parturition (phase I). During phase II, blood samples were collected at 10 min intervals. As soon as any part of the calf was visible from the outside, the sampling interval was changed to 5 minutes (phase III) and this sampling interval continued until at least 15 min after the calf was born. After parturition (phase IV), samples were collected once per hour for 12 h. The blood was transferred both to glass tubes containing Na-Heparin (Venoject, Terumo, Leuven, Belgium) and to glass tubes containing NaEDTA with addition of 2000 KIE of Aprotinin (Trasylol®

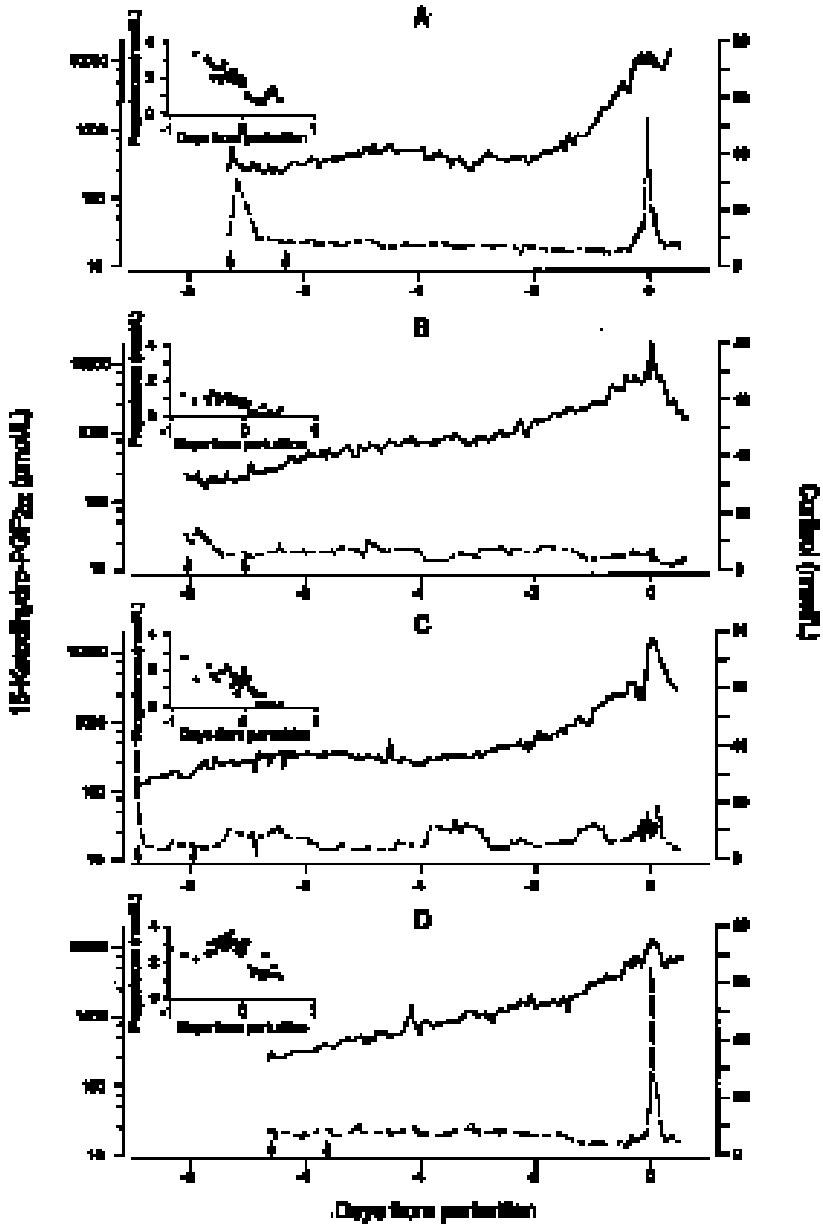

Figure 1. 15-Ketodihydro-$PGF_{2\alpha}$ (solid line), cortisol (dashed line) and progesterone (solid circles) profiles in four heifers after induction of parturition by intramuscular injections of dexamethasone in late pregnancy. Parturition takes place at day 0. Progesterone levels during parturition are shown in the small figure. Arrows indicate time for injection of dexamethasone. (Note – Logarithmic scale for the prostaglandin $F_{2\alpha}$ metabolite)

10000 KIE/ml, Bayer, Göteborg, Sweden). The tubes were agitated and centrifuged for 10 min at 1000 × g (3000 rpm). Plasma was stored at -20 °C until analysis.

Samples for analysis of progesterone were selected as follows: one sample every 8th hour until the day of luteolysis, then 1 sample every 4th h. From 12 h before parturition 1 sample every hour, and after parturition had started (phases II and III) 1 sample every 30th min. During phase IV, 1 sample per hour was selected.

Samples for cortisol analysis were selected as follows: a set of 5 consecutive samples, 1 per hour, were analysed. Twelve h after the first sample another set of five samples were analysed. This continued until 12 h before parturition. Then samples were selected once per h until the start of parturition. During phase II, samples were selected every 20th min and during phase III, one sample every 10th minute was selected. During phase IV, 1 sample per hour was selected.

Analytical methods

15-Ketodihydro-$PGF_{2\alpha}$ was analysed using a radioimmunoassay (*Granström & Kindahl* 1982). Heparin plasma was used for the analysis and all samples were analysed in duplicates. The sensitivity of the method was 30 pmol/L. The intra-assay coefficients of variation ranged between 6.6% and 11.7% for the different ranges of the standard curve and the inter-assay coefficient of variation was 14%.

Heparin plasma was used for analysis of progesterone. This was done by the use of a solid-phase radioimmunoassay technique (Coat-A-Count Progesterone, Diagnostic Products Corporation, Los Angeles, CA, U.S.A.). The sensitivity of the assay was 0.1 nmol/L. The intra-assay coefficients of variation for 3 control samples (2.6 nmol/L, 21.9 nmol/L and 53.1 nmol/L) assayed in duplicates in 20 assays were 11.9%, 5.8% and 7.0%, respectively. The inter-assay coefficients of variation were 12.6%, 12.1% and 13.3%, respectively.

For the cortisol analysis, EDTA plasma was used with an addition of Trasylol. Cortisol concentrations were determined directly by a rapid EIA in 20μl plasma diluted 1:40 without prior extraction (Marc et al. 2000). The cross-reactivities for the method are as follows: cortisone 45%, corticosterone 15%, desoxycorticosterone 8%, progesterone 8% and testosterone 3%. Parallelism between standards and unknowns in plasma were demonstrated for the range between 8 and 44 nmol/L plasma. The intra- and interassay coefficients of variation were 8.9% and 12.6%, respectively.

Statistical methods

For determination of the cortisol baseline a method was used that calculated the mean value of the base line after removal of all high values. Cortisol levels were judged as elevated when they exceeded 2 standard deviations above this mean value. Mean values and standard deviations were calculated by use of Minitab for Windows 95, release 12 (Minitab inc. PA, U.S.A.). Initial levels of progesterone and $PGF_{2\alpha}$ metabolite are calculated as the mean and standard deviation of the first 5 and 10 samples, respectively. $PGF_{2\alpha}$ metabolite levels during luteolysis are calculated as mean and range of the values during the period when progesterone levels decline most rapidly. Start and end of luteolysis are defined as the last progesterone value before onset and the first progesterone value after the end of luteolysis.

Results

Clinical observations

Clinical results in individual animals are shown in table 1. Parturition took place 7.7 (6.6-8.9) days (mean (range)) after the first dexamethasone injection in the 4 heifers. The parturitions were uneventful in 3 (A, B and C) of the heif-

Table 1. Clinical data after induction of parturition by intramuscular injection of dexamethasone to four late pregnant heifers.

ID	First DX[a] inj. (day in pregnancy)	DX inj. to parturition (days)	Phase I (days)	Phase II (hours)	Phase III (hours)	Placental expulsion (hours post partum)
A[d]	258	7.2	6.9	4.2	3.2	RFM[d]
B	264	8.0	8.0	0.2	0.5	2.5
C	254	8.9	8.7	2.8	1.3	5.8
D[d]	265	6.6	6.2	6.7	2.3[c]	RFM[d]

[a] Dexamethasone, 20 mg, intramuscularly
[c] Assisted calving
[d] Retained foetal membranes

ers. In heifer D, gentle traction of the calf was applied during the last part of the second stage of labour. All 4 heifers delivered healthy calves of normal size. In 2 of the heifers (A and D), the foetal membranes were retained after parturition (RFM).

Prostaglandin metabolite

The levels of $PGF_{2\alpha}$ metabolite before first dexamethasone injection ranged from 150 to 300 pmol/L in all animals. After injection, the $PGF_{2\alpha}$ metabolite levels showed two different kinds of patterns. In heifers B and D (see Fig.), the $PGF_{2\alpha}$ metabolite levels continuously increased from the time of dexamethasone injection until parturition. In heifers A and C, however, the levels of $PGF_{2\alpha}$ metabolite started to increase initially as for heifers B and D, but after a few days the levels declined to levels similar to the pre-experimental levels. In heifers A and C, the $PGF_{2\alpha}$ metabolite levels then started to increase a second time and this increase continued until parturition. The nadir of this decrease appeared at three and four days before parturition in heifers A and C, respectively. Luteolysis occurred in all animals during the final increase of $PGF_{2\alpha}$. During this period the $PGF_{2\alpha}$ metabolite levels increased rapidly but showed no signs of a pulsatile release. Mean values of $PGF_{2\alpha}$ metabolite during luteolysis are shown in table 2. The high $PGF_{2\alpha}$ release during parturition was prolonged in heifers A

Table 2. Changes in $PGF_{2\alpha}$ metabolite and cortisol levels after induction of parturition by intramuscular injection of dexamethasone to 4 late pregnant heifers.

	PGF2α metabolite			Cortisol	
ID	Initial levels pmol/L mean ± SD of the first 10 samples	Levels during luteolysis pmol/L mean (range)	Max values at parturition pmol/L	Basal levels nmol/L mean ± SD	Levels at parturition nmol/L
A[d]	322 ± 90	1878 (1134-2689)	13347	7.4 ± 1.4	33.6
B	209 ± 34	2157 (1863-2575)	21206	5.6 ± 1.7	7.8
C	147 ± 13	1323 (883-1856)	16587	7.5 ± 3.0	13.2
D[d]	256 ± 18	1762 (1155-2091)	13699	6.3 ± 1.7	65.5

[d] Retained foetal membranes

and D relatively to B and C, and this prolongation corresponded to an increased length of phases II and III. The peak value of $PGF_{2\alpha}$ metabolite at parturition was lower in heifers A and D than in heifers B and C. Immediately after foetal expulsion, the levels of $PGF_{2\alpha}$ metabolite declined rapidly in all heifers. In A and D (RFM heifers), however, the quick decline soon was interrupted by a new period of increasing $PGF_{2\alpha}$ metabolite levels. The post-partal levels in these animals were as high as during parturition. The post-partal increase was absent in heifers B and C (non-RFM heifers).

Progesterone

Progesterone levels at the time of dexamethasone injection were 12-18 nmol/L in all heifers. Luteolysis occurred during a period of time starting at 1.3 ± 0.3 and ending at 0.6 ± 0.1 days (mean ± SD) before parturition. After luteolysis, the progesterone levels remained elevated (1-2 nmol/L) until parturition. The progesterone profile around parturition is shown in the figure (inserted panels). After parturition, progesterone levels remained slightly elevated throughout the experiment in A and D (RFM). In B and C (non-RFM), the levels declined to levels below the sensitivity of the assay after the expulsion of the placenta.

Cortisol

Cortisol showed a basal level of 5.6-7.5 nmol/L in all heifers (Fig. 1 and Table 2) during the initial part of the experiment. In heifers A, B and D the variation of the cortisol levels was low during the period preceding luteolysis. In heifer C, the cortisol levels during this period were undulating with an interval between the peaks of about three days. The levels increased markedly immediately before and peaked during parturition in heifers A and D (RFM). Also in heifer C, there was a slight increase in cortisol levels but this was more pronounced immediately after parturition than during parturition. In heifer B, no such elevations could be seen. The cortisol increase started at 6.5 h and 4.3 h before parturition in heifers A and D, respectively. After parturition the levels declined rapidly in all animals.

Discussion

Studies of parturition should ideally be performed on late pregnant females without pharmacological intervention. However, the exact time of parturition is difficult to predict in cattle and a model where parturition is induced in a physiological manner can offer an alternative. Induction of parturition with dexamethasone gives a defined start of the initiation of parturition and thereby facilitates the intensive blood sampling that is necessary for the investigation of the rapid hormonal changes around parturition.

The main finding of this study was that there were no signs of pulsatile $PGF_{2\alpha}$ release leading to prepartal luteolysis. This is in agreement with studies by *Aiumlamai et al.* (1992) in cows, and by *Ford et al.* (1999) in goats, but unlike the situation in the bovine oestrous cycle (*Kindahl* 1994). In contrast to the pulsatile pattern observed in the oestrous cycle, the $PGF_{2\alpha}$ metabolite levels increased in a continuous way, showing a completely different profile. However, even though luteolysis is essential both in the oestrous cycle and before parturition the prerequisites are different at the two occasions. The prerequisite for luteolysis in the oestrous cycle includes 2 options: luteolysis in the case of non-pregnancy and non-luteolysis in case of pregnancy. Prepartal luteolysis, however, only includes one option, luteolysis without exceptions. The 2 kinds of release patterns possibly reflect this difference.

The absolute levels of $PGF_{2\alpha}$ metabolite at the time of prepartal luteolysis (1.6-0.4 days antepartum) are comparable to those observed dur-

ing the luteolytic pulses in the oestrous cycle (*Basu & Kindahl* 1987), but the levels observed after progesterone decline differ between pre-partal and preovulatory luteolysis. After pre-partal luteolysis, in this experiment, the $PGF_{2\alpha}$ metabolite levels continue to increase (5-10 times) until the end of calving while after luteolysis in the oestrous cycle the pulsatility ceases and $PGF_{2\alpha}$ metabolite levels decrease to basal levels. However, in a study by *Kornmatitsuk et al.* (2000), parturition in heifers was induced with $PGF_{2\alpha}$. In that study, the $PGF_{2\alpha}$ metabolite levels at the time of foetal expulsion (which was uneventful and occurred approx. 2 days post injection) were found to be around 10 times lower than what was observed in our experiment. The discrepancy between the results suggests that although the peripheral $PGF_{2\alpha}$ metabolite levels are several times higher during parturition after dexamethasone injections than during parturition after $PGF_{2\alpha}$ injections, this difference did not affect the clinical outcome of the birth process.

$PGF_{2\alpha}$ metabolite profile immediately after calving differed between RFM and non-RFM heifers. In both groups, the levels of the $PGF_{2\alpha}$ metabolite were high at the time of calving and there was an immediate decrease after the foetal expulsion. But, unlike the non-RFM heifers, the post-partal decline was soon interrupted by a new period of increasing $PGF_{2\alpha}$ metabolite levels in the RFM heifers. *Wimsatt et al.* (1993) showed that, in sheep, COX-2 expression in cotelydonary tissue increased and was the enzyme predominantly responsible for prostaglandin synthesis in late gestation. Thus, a separation of the foetal and maternal placentas as seen when the foetal membranes are shed immediately after calving resulted in an abrupt removal of the source of $PGF_{2\alpha}$ and, consequently, to a quick decline in $PGF_{2\alpha}$ metabolite levels. In RFM heifers, on the other hand, the non-shed placenta might have stimulated continuous $PGF_{2\alpha}$ synthesis also after calving. In this study, the experiment ended only 12 h after calving but other studies have shown that post-partal $PGF_{2\alpha}$ metabolite levels in RFM cows are as high as during parturition, or even higher (*Kornmatitsuk et al.* 2000). In a study by *Kask et al.* (1999) it was shown that during the first 2 weeks post partum, cows with retained foetal membranes have levels of $PGF_{2\alpha}$ metabolite that clearly exceed the levels seen in cows, where the placenta was shed immediately after parturition.

An interesting feature of the RFM heifers in this study was the distinct peak of cortisol at calving. The cortisol response might reflect stress due to a prolonged or difficult parturition as suggested by Hydbring et al. (1999) but might also be an effect of the retained foetal membranes *per se*. There are, however, studies that show a positive correlation between $PGF_{2\alpha}$ metabolite levels and cortisol release. This has been shown, after massive intravenous injection of a synthetic ACTH-analogue (tetracosactide) to pigs (*Mwanza et al.* 2000) and after intravenous endotoxin injections to cattle (*Odensvik & Magnusson* 1996). Cortisol and $PGF_{2\alpha}$ metabolite levels also increase simultaneously after starvation. The link between these 2 parameters remains unknown. But since only the 2 RFM heifers had cortisol peaks at parturition, although the levels of $PGF_{2\alpha}$ metabolite were as high as in the non-RFM heifers, the mechanism for this correlation must differ from the one that can be explained by the high levels of $PGF_{2\alpha}$.

In conclusion, the release of $PGF_{2\alpha}$ after induction of parturition by injection of dexamethasone in the bovine does not show a pulsatile release as it does during luteolysis in the oestrous cycle. Instead, the pre-partal profile of $PGF_{2\alpha}$ metabolite in the cow is characterised by an ever-increasing release initiated by the dexamethasone injection and terminated by the parturition. The $PGF_{2\alpha}$ metabolite levels then de-

crease immediately after the parturition. In heifers with retention of the foetal membranes, however, this decrease is soon interrupted by a new increase with $PGF_{2\alpha}$ metabolite levels as high as during the parturition. Furthermore in this study, heifers with retained foetal membranes had higher levels of cortisol at parturition than heifers where the placenta was shed immediately post partum.

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References

Aiumlamai S, Kindahl H, Fredriksson G, Edqvist L-E: Interrelationship of prostaglandin $F_{2\alpha}$, progesterone and oestrone sulphate in the immediate peripartal period in the bovine species. Proceedings and Poster 12th International Congress on Animal Reproduction, The Hague, The Netherlands August 23-27, 1992. Vol. 2, no. 246, pp. 831-833.

Anderson ABM, Flint APF, Turnbull AC: Mechanism of action of glucocorticoids in induction of ovine parturition: effect on placental steroid metabolism. J. Endocr. 1975, *66,* 61-70.

Basu S, Kindahl H: Development of a continuous blood collection technique and a detailed study of prostaglandin $F_{2\alpha}$ release during luteolysis and early pregnancy in heifers. J. Vet. Med. A 1987, *34,* 487-500.

Flint APF, Rickets AP, Craig VA: The control of placental steroid synthesis at parturition in domestic animals. Anim. Reprod. Sci. 1979, *2,* 239-251.

Ford MM, Young IR, Caddy DJ, Thorburn GD: Pulsatile output of prostaglandin $F_{2\alpha}$ does not increase at the time of luteolysis in the pregnant goat. Biol. Reprod. 1999, *61,* 411-415.

Granström E, Kindahl H: Radioimmunoassay of the major plasma metabolite of $PGF_{2\alpha}$, 15-keto-13,14-dihydro-$PGF_{2\alpha}$. Methods Enzymol. 1982, *86,* 320-339.

Hydbring E, Madej A, MacDonald E, Drugge-Boholm D, Berglund B, Olsson K: Hormonal changes during parturition in heifers and goats are related to phases and severity of labour. J. Endocrinol. 1999, *160,* 75-85

Janszen BPM. Bevers MM, Dieleman SJ van der Weijden GC, Taverne MAM: Synchronised calvings after withdrawal of norgestomet inplants from cows treated near term with prostaglandin. Vet. Rec. 1990, *127,* 405-407

Kask K, Gustafsson H, Gunnarsson A, Kindahl H: Induction of parturition with prostaglandin $F_{2\alpha}$ as a possible model to study impaired reproductive performance in the dairy cow. Anim. Rep. Sci. 1999, *59,* 129-139

Kindahl H: Maternal recognition of pregnancy in ruminants: an "on-off-mechanism" of prostaglandin release. Proceedings XIV Pan American Congress on Veterinary Sciences, Acapulco, México, 9 to 15 October 1994, pp. 586-589.

Kornmatitsuk B, Königsson K, Kindahl H, Gustafsson H, Forsberg M, Madej A: Clinical Signs and Hormonal Changes in Dairy Heifers after Induction of Parturition with $PGF_{2\alpha}$. J. Vet. Med. 2000, *47,* 395-410.

Lindell J.-O, Edqvist L.-E, Gustafsson B: Oophorectomy during different stages of pregnancy in the cow. Acta vet. scand. 1981, *22,* 553-565.

Lindell J-O, Kindahl H, Edqvist L-E: Prostaglandin release at dexamethasone induced parturitions in cows. Acta vet. scand. 1977, *18,* 257-265.

Marc M, Parvizi N, Ellendorff F, Kallweit E, Elsaesser F: Plasma cortisol and ACTH concentrations in the warmblood horse in response to a standardized treadmill exercise test as physiological markers for evaluation of the training status. J. Anim. Sci. 2000, *78,* 1936-1946.

McCracken JA, Custer EE, Lamsa JC: Luteolysis – a neuroendocrine-mediated event, Physiol. Rev. 1999, *79,* 263-323.

Mwanza AM, Madej A, Kindahl H, Lundeheim N, Einarsson S: Plasma levels of cortisol, progesterone, oestradiol-17b and prostaglandin $F_{2\alpha}$ metabolite after ACTH (Synacthen Depot®) administration in ovarieectomized gilts. J. Vet. Med. 2000, *47,* 193-200.

Odensvik K, Magnusson U: Effect of oral administration of flunixin on the inflammatory response to endotoxin in heifers. Am. J. Vet. Res. 1996, *57,* 201-204.

Peters AR, Poole DA: Induction of parturtion in dairy

cows with dexamethasone. Vet. Rec. 1992, *131,* 576-578.

Spörndly R (ed): Fodertabeller för idisslare (Nutrition requirement for ruminants), Speciella skrifter HUV, SLU 1993, *52.* (in Swedish)

Wimsatt J, Nathannielsz PW, Sirois J: Induction of prostaglandin endoperoxide synthase isoform-2 in ovine cotelydonary tissues during late gestation. Endocrinology 1993, *133,* 1068-1073.

Sammanfattning

15-Ketodihydro-$PGF_{2\alpha}$ progesteron och kortisol profiler hos kvigor efter förlossningsinduktion med dexametason.

För att studerat frisättningen av $PGF_{2\alpha}$, progesteron och kortisol under perioden föregående kalvning hos nötkreatur inducerades förlossning hos 4 kvigor. Induktionen gjordes genom att 20 mg dexamethason injicerades intramuskulärt 2 gånger med 24 timmars mellanrum. Första injektion gjordes dag 254, 258, 264 och 265 i dräktigheten hos respektive kviga. Tjugofyra timmar före första injektionen sattes en intravenös polyuretankateter i *v. jugularis externa* och blodprov samlades därifrån minst 1 gång i timmen till och med tolv timmar efter kalvning. Under kalvningens utdrivningsfas togs blodprov minst sex gånger i timmen. Plasma analyserades med avseende på 15-ketodihydro-$PGF_{2\alpha}$ (PG-metabolit) och progesteron med RIA, och med avseende på kortisol med en ELISA. Tiden från första injektion till kalvning var 7,7 (6,6-8,9) dagar (medelvärde (spridning)). Två av kvigorna fick kvarbliven efterbörd. Vid experimentets början var nivåerna av PG-metabolit låga (<300 pmol/l) men de steg till mellan 1000 och 2000 pmol/l en dag före förlossning. Under den sista dagen steg nivåerna snabbt och de högsta halterna (>10000 pmol/l) nåddes under utdrivningsfasens slutskede. Ingen pulsatil frisättning kunde upptäckas. Omedelbart efter utdrivningsfasen sjönk PG-metabolitnivåerna snabbt hos alla kvigor. Hos de två kvigor som fick kvarbliven efterbörd avbröts dock denna sänkning. Hos dessa kvigor började i stället PG-metabolitnivåerna återigen att stiga och nivåer lika höga som under utdrivningsfasens slutskede kunde uppmätas. Luteolysen inträffade mellan 1,6 och 0,4 dagar före kalvning hos alla kvigor. Kvigor som efter kalvning fick kvarbliven efterbörd hade förhöjda kortisol värden i samband med utdrivningsfasen. Denna förhöjning saknades hos kvigor där efterbörden avgick normalt. Studien indikerar att $PGF_{2\alpha}$ frisättningen vid den prepartala luteolysen inte är pulsatil och att kortisolfrisättningen hos kor som får kvarbliven efterbörd kan skilja sig från den man ser hos kor där efterbörden avgår normalt.

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