PhD thesis

Effect of prostaglandin treatment on the corpus luteum, plasma progesterone concentration and the largest follicle in dairy cow

Attila Répási DVM
Szent István University, Faculty of Veterinary Science
Clinic for Large Animals

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Promotor: Professor Ottó Szenci DVM, PhD, DSc
Szent István University, Faculty of Veterinary Science
Clinic for Large Animals

Co-Promotor: Professor László Solti DVM, PhD, DSc
Szent István University, Faculty of Veterinary Science
Department and Clinic of Obstetrics and Reproduction

Co-Promotor: Professor Károly Vörös DVM, PhD, DSc
Szent István University, Faculty of Veterinary Science
Department and Clinic of Internal Medicine

The study described in this thesis was performed at the Clinic for Large Animals, Faculty of Veterinary Medicine, Szent István University, Üllő – Dóra major, Hungary

Contents

Frequently used abbreviations

AI	Artificial Insemination
CL	Corpus Luteum
NEB	Negative Energy Balance
PG	Prostaglandin
P4	Progesteron
RP	Rectal Palpation

Introduction

Reproductive efficiency is a critical component of a successful dairy herd management, whereas a reproductive inefficiency is one of the most costly problems facing the dairy industry today. Therefore the fertility of dairy cows is a growing concern. Calving interval is a major component which involves the days from calving to the initiation of the next pregnancy, usually referred as open days, and the fixed effect of gestation length. Open days depend on the days from calving to the first insemination or mating and fertilization, and associated with conception rate. "To be effective in any drug therapy that shortens the calving interval and to induce ovulation must go hand in hand with good reproductive management and excellent estrus detection". The synchronised ovulation regimes reduce the time required for estrus detection but about 60% of synchronized cows do not conceive at first service. The effectiveness of estrus detection, and the conception rate had a great impact on the calving interval. The detection of estrus was a problem in 30% of the herds studied with up to 46% of the cows inseminated when progesterone concentration in the milk was high. The latter results in low conception rates, and insemination of pregnant cows can induce embryonic or fetal mortality. Both events increase the calving interval.

The purpose of the thesis is to survey the lifespan of the CL during the estrus cycle, the changes of the P4 concentration, the diagnosis of ovarian structures by means of rectal palpation and ultrasonography, and to discuss the synchronization techniques of estrus by inducing luteolysis with prostaglandin treatments (effect of different doses and techniques, and application modes of PGF2α treatments, and failure of luteolysis).

The main objective of our examinations was to study particularly the effects of prostaglandin treatment on the corpus luteum, the largest follicle, the progesterone concentration, and

the time of detected oestrus and/or ovulation in dairy cow, using different doses (0 mg, 25 mg, vs. 35 mg), different types (natural vs. synthetic) and different number (once vs. twice 8 h apart) of prostaglandin treatments from the day of treatment (Day 0).

Further objective of our examinations was to negotiate the parameters (the area of CL, and the largest follicle, time of ovulation, pregnancy rate in relation to the time of ovulation) of treated (single dose) and non treated cows when the Day 0 was day of AI.

Chapter 1 (Review)

The review discusses the lifespan of the CL during the estrous cycle, the luteolytic mechanisms in the bovine corpus luteum, the changes of the P4 concentration, the diagnosis of ovarian structures by means of rectal palpation and ultrasonography, when concluded that comparing rectal palpation (RP) with P4 concentrations, there was a 77% to 79 % agreement between the diagnosis of a CL by an experienced palpator and P4 concentration The detection of a CL by ultrasonography proved 96% accurate, as judged by milk P4 concentration (> 5 ng/ml). The review show synchronization techniques of estrus by inducing luteolysis with prostaglandines. Synchronization with a single injection of PGF2α still did not control the time of AI, because estrus detection continued to be necessary. When timed AI after PGF2α in lactating dairy cows was examined pregnancy rates per AI was substantially lower than those for AI after a detected estrus. Much of the variation in time to ovulation was probably due to the variation in the stage of the growth of the preovulatory follicle at the time of PGF2α treatment. The methods of using various locations and doses for PGF2α treatments and failure of luteolysis were also discussed.

Own experiments:

Chapter 2

Lactating dairy cows have poor reproductive efficiency because of low fertility and low rates of estrus detection. The present experiment was carried out in two dairy farms under the same conditions. Lactating dairy cows with a mature corpus luteum determined by ultrasonography and having a follicle with a diameter of ≥ 10 mm (n=49) were randomly assigned to three groups. The first group was treated with a single dose (25 mg, n=20) of exogenous prostaglandin (PGF2α), while the second group was treated with 35 mg (n=19) on Day 0, and the third group was served as untreated (n=10). Blood samples were collected daily for analyzing progesterone concentrations. In Group 1 the incidence of estrus and A.I. in 10 days after treatment was 95 % (19/20). The conception rate was 31.6 %, and the average time to estrus after treatment was 3.7 day. In Group 2 the incidence of estrus and A.I. was 84.2 % (16/19). The conception rate was 31.2%, and the average time to estrus after treatment was 2.8 day. In the untreated group only two cows (20%) showed estrus during the examined period and none of them became pregnant. In Group 2 the percentage changes relative to the corpus luteum area decreased, and the percentage changes relative to the largest follicle area increased faster, and even the oestrus started sooner than in those cows treated with 25 mg PGF2α. However, these differences between groups were not statistically significant. At the same time, the decrease in the percentage changes relative to the area of corpora lutea and to the concentrations of P4 was statistically significant in both groups.

Chapter 3

Lactating dairy cows (n=72) with a mature corpus luteum (CL) (diameter of ≥ 17 mm determined by ultrasonography and having a follicle with a diameter of ≥ 10 mm were randomly

assigned to four groups. Cows were treated with cloprostenol i.m. once or twice, or with dinoprost i.m. once or twice with an 8-h apart. The ovaries of each cow were scanned daily by transrectal ultrasonography to measure the changes in the areas of corpus luteum and the largest follicle and to determine the occurrence of ovulation. Oestrus was detected twice daily. In addition, blood samples were withdrawn from each cow daily for measuring the progesterone (P4) concentrations. Significant decreases in the percentage changes relative to areas of CL and P4 concentrations and increases in the percentage changes in the area of the largest follicle on day 0 were detected in each group during the experiment**.** However, the type of the drug and the number of the treatments had no significant effect on those parameters.

Cows ovulated with or without showing oestrus (Group A) and cows having no oestrus and ovulation (Group B) were also evaluated. In contrast with the mean area of the CL and the mean concentration of P4 on Day 0, the mean area of the largest follicles between the two groups on Day 0 differed significantly. Significant decreases in the percentage changes relative to the area of the CL and P4 concentration and increases in the percentage changes relative to the area of the largest follicle during the experiment were detected in both groups however there were no group differences.

Treatment of dairy cows with two injections of prostaglandins (cloprostenol or dinoprost) at an 8-h interval resulted in more cows being observed in oestrus within 5 d after treatment and having significantly higher pregnancy rate than those treated with a single prostaglandin injection.

Chapter 4

Primiparous and multiparous lactating dairy crossbred cows (after Day 40 post partum) with a mature corpus luteum (CL) (diameter of $\geq$ 17 mm determined by ultrasonography) and

having a follicle with a diameter of $\geq$ 10 mm were treated with prostaglandin (n=80) and if they showed estrus were inseminated (Group 1: n=39). Cows (Group 2: n=41) after detected estrus were inseminated and served as control. The ovaries of each cow were scanned daily by transrectal ultrasonography from the day of detected estrus (Day –1) until ovulation, to measure the changes in the areas of corpus luteum and the largest follicle and to determine the occurrence of ovulation.
There were no significant differences between the treated and untreated cows in terms of reduction in the area of CL and of an increase in the area of the dominant follicles, however, the average area of the follicles in Group 2 was greater than in Group 1.
The highest pregnancy rate was achieved if A.I. was done on the same day as ovulation occurred in both groups (pregnancy rate in treated group was: 62,5%, in untreated group: 66,6%). In Group 1 54,5% pregnancy rates were achieved if ovulation occurred on Day 1, or 50% on Day 2 after A.I, and 53,3% and 44,4% in Group 2, respectively. The pregnancy rate for cows ovulated before A.I. in the second group was 25%. No ovulation occurred in 7 cows until Day 2 after AI and none of them became pregnant.

New scientific results:

1. The PGF2α treatment caused a statistically significant decrease in the percentage changes relative to the area (mm^2) of the luteal tissue on Day 0, and the plasma concentration (ng/ml) of progesterone (P4) in the cow treated with different doses, different types and different numbers of prostaglandin treatments during the experiment. Similar changes were detected in cows with standing and silent estrus or ovulation

without any sign of estrus, and in cows having no estrus and no ovulation.

2. The PGF2α treatment caused a statistically significant increase in the percentage changes relative to the area (mm^2) of the largest follicles on Day 0, in the cow treated with different types and different numbers of prostaglandin treatments during the experiment. Similar changes were detected in cows with standing and silent estrus or ovulation without any sign of ostrus, and in cows having no estrus, and no ovulation.

3. The mean area of the largest follicles of the cows detected with standing and silent oestrus or ovulated without any sign of estrus on Day 0 (163,3±66,1 mm^2) was significantly (P=0,016) greater than that of the cows having no estrus, and no ovulation (125,2±53,0 mm^2).

4. The area of CL on Day 0 (cows treated with different doses) correlated significantly to plasma P4 level (P=0,0099), but similar significant differences could not be found between Days 1 to 4 after treatment.
With the exception of Day 3 after treatment (P=0,181), the area of CL (cow treated with different types and different numbers) correlated significantly (Day 0: P=0,02, Day 1: P=0,05, Day 2: P=0,008, Day 4: P<0,001) to the plasma P4 level during the experiment.

5. Treatment of dairy cows with 2 luteolytic dosages of PGF2α or its synthetic analogue at an 8-h interval resulted in significantly (P=0,0309) higher conception rate (27,8% vs. 66,6%) than those, with 1 dosage.
6. Cows ovulated too early or too late in relation to the time of AI the conception rate was significantly lower. Therefore

determination of optimal time for AI is of great practical importance.

Publication list

Répási A., Beckers JF, Sulon J, Perényi Zs, Reiczigel J and Szenci O (2003): Effect of Different Doses of Prostaglandin on the Area of Corpus Luteum, and the Largest Follicle and Progesterone Concentration in Dairy Cow**.** Reproduction in Domestic Animals. **38,** 423-428.

Répási A, Beckers JF, Sulon J, Karen A, Reiczigel J and Szenci O (2005) Effect of the Type and Number of Prostaglandin Treatments on Corpus Luteum, the Largest Follicle and Progesterone Concentration in Dairy Cows. Reproduction in Domestic Animals. **40**, 1-7.

Abstracts

Répási A, Beckers JF, Sulon J, Perényi Zs, Reiczigel J and Szenci O: Különböző dózisú prosztaglandin készítmények hatása a sárgatest luteolízisére és a vemhesülésre. (Effect of Different Doses of Prostaglandin on the luteolysis and the pregnancy). XII Magyar Buiatrikus Kongresszus, October 12-14, 2001, Balatonfüred, Hungary, Proceedings, pp. 74-76.

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Répási A, Beckers JF, Sulon J, Karen A, Reiczigel J and Szenci O: Prosztaglandin kezelések hatása az ovuláció bekövetkeztére szarvasmarhában. (Effects of prostaglandin treatments on the occurrence of ovulation in dairy cows). XIV. Magyar Buiatrikus Kongresszus, October 9-11, 2003, Keszthely, Hungary, Proceedings, pp.160-161.

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