Original Paper

DOI: 10.22067/veterinary.v8i1.54780

Received: 04 January, 2016
Accepted after revision: 05 July, 2016
Published online: 10 April, 2017

Effect of early administration of equine chorionic gonadotropin and prostaglandin $F_{2\alpha}$ on reproductive performance of postpartum dairy cows

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Keywords

eCG; postpartum; $PGF_{2\alpha}$; reproductive performance

Abstract

The aim of this study was to evaluate the effect of eCG, $PGF_{2\alpha}$, and combination of eCG and $PGF_{2\alpha}$ early postpartum on reproductive performance in high producing dairy cows. Three hundred sixty eight postpartal Holstein dairy cows were divided in 4 groups. Cows in groups 1 and 2 received 500 IU eCG on day 8 ± 2 and cows in groups 3 and 4 received saline. Cows in groups 1 and 3 received injections of 500 µg cloprostenol twice 8 hours apart between days 20 to 25 postpartum, and cows in group 2 and 4 received saline. Presentation of a functional CL was assessed by ultrasonography of ovaries and serum progesterone concentration in groups 1 and 3. None of the treatments could improve fertility, and reproductive indices including 120 days in milk pregnancy rate, pregnancy loss, first service pregnancy rate and calving to conception interval was not different among the various different groups. Only days to first service in eCG treated cows was marginally lower than that of control cows. Treatment with eCG in cows in group 2 (eCG+saline) had no effect on the initiation of ovarian cyclical activity by day 30 ± 1 postpartum. Resumption of ovarian cyclical activity by day 30 ±1 postpartum did not affect reproductive performance in dairy cows. Additionally, treatment with eCG, $PGF_{2\alpha}$ and combination of eCG and $PGF_{2\alpha}$ had no effect on the prevalence of clinical endometritis, anovulatory anestrus, and follicular cyst. In conclusion, early treatment of high producing dairy cows after parturition with eCG and $PGF_{2\alpha}$ had no effect on reproductive performance of lactating dairy cows.

Abbreviations

eCG: Equine Chorionic Gonadotropin
$PGF_{2\alpha}$: Prostaglandin $F_{2\alpha}$
GnRH: Gonadotropin Releasing Hormone
DIM: Days In Milk
CL: Corpus Luteum
AI: Artificial Insemination
BCS: Body Condition Score

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OR: Odds Ratio
RFM: Retained Fetal Membranes
AD: Abomasal Displacement
FSCR: First Service Conception Rate
PR120: Pregnancy Rate At 120 Days In Milk
PRL: Pregnancy Loss
SD: Standard Deviation
DFS: Days To First Service
CCI: Calving To Conception Interval
IM: Intramuscular
TMR: Total Mixed Ration

Introduction

During the past few decades, continued genetic progress for milk production, coupled with nutritional management of high-producing dairy cows, has led to antagonism between high milk production and fertility (Lucy, 2001, Moore and Thatcher, 2006). To have a calving interval of 12 to 13 month, cows should become pregnant within 3 month after calving. To acquire normal fertility and acceptable calving intervals in dairy cattle, it is important that the cyclic ovarian activity is resumed early in the postpartum period (Stevenson and Pursley, 1994). Additionally, a good uterine involution status at the time of insemination is essential for achieving normal reproductive rates.

Numerous studies have reported that the reproductive performance of dairy cows was compromised primarily through delayed resumption of ovarian activity postpartum (Lamming and Darwash, 1998, Shrestha et al., 2004, Kawashima et al., 2006, Petersson et al., 2006). Minimizing the interval from calving to the first ovulation provides ample time for completion of multiple ovarian cycles (more luteal phases) prior to insemination, which in turn improves the conception rate (Butler and Smith, 1989). Reduced fertility in cows with delayed resumption of ovarian activity might be related to lower estradiol and progesterone concentrations due to lack of multiple cycles prior to insemination, and this may lead to suboptimal oviductal and uterine environments for supporting embryo survival and growth (Thatcher and Wilcox, 1973, Gautam et al., 2010). The early resumption of ovarian activity leading to the availability of circulating estradiol-17β may help to hasten uterine involution through a reduction in size, a marked increase in uterine tone and improve the uterine defense mechanisms (Rowson et al., 1953, Hussain, 1989). Equine chorionic gonadotropin (eCG) has FSH and LH-like activities in ruminants where both hormones are required for the periovulatory maturation of the follicles and parenteral administration of eCG stimulates follicular growth and ovulation in cattle (Gonzalez-Menico et al., 1978, Newcomb et al., 1979). Thus, eCG administration in dairy cows results in fewer atretic follicles, the recruitment of more small follicles showing an elevated growth rate, the sustained growth of medium and large follicles and improved development of the dominant and pre-ovulatory follicle (De Rensis and López-Gatius, 2014). Based on these characteristics, eCG treatment can be utilized during early postpartum to improve reproductive performance by acceleration of ovarian activity resumption.

Another treatment used widely in the early postpartum to improve reproductive performance is prostaglandin $F_{2α}$ ($PGF_{2α}$) which has been in many studies at various times postpartum. The proposed benefits of $PGF_{2α}$ would be from induction of estrus in cows having a responsive corpus luteum, causing evacuation of uterine contaminants or by improvement of uterine defenses by temporarily increasing estrogen and decreasing progesterone concentrations in plasma (Kasimanickam et al., 2005). In cows that do not have active corpora lutea $PGF_{2α}$ may enhance immune functions or increase uterine motility to help the uterus to resolve infections (Nakao et al., 1997, Hirsbrunner et al., 2003). According to an evidence-based medicine study, use of $PGF_{2α}$ as a standard treatment in postpartum period should be critically reconsidered, and despite the large number of studies that have been done in this area, still further research is required to assess and quantify the efficacy of this treatment (Haimerl et al., 2012).

Previously, several studies have evaluated reproductive performance after combined GnRH and $PGF_{2α}$ application in dairy cows after parturition (Etherington et al., 1984, Benmrad and Stevenson, 1986, Janowski et al., 2001, Tucker et al., 2011). GnRH and $PGF_{2α}$ affected postpartum ovarian function by causing precocious ovulation and premature regression of the first luteal structure (Benmrad and Stevenson, 1986). This manipulation of ovarian activity immediately after parturition may enhance fertility by increasing the ovulation frequency and occurrence of estrus before first service. Additionally, administration of $PGF_{2α}$ after parturition has beneficial effects on uterine health. Recently, Rostami et al. (2011) reported that eCG treatment early in post-partum could assist the early resumption of ovarian activity.

The aim of this study was to evaluate the effects of eCG and $PGF_{2α}$ administration alone or in combination in early postpartum period on reproductive performance of dairy cows in a commercial dairy farm.

Materials and Methods

Animals and study farm

The experiment was conducted between May and November 2014 in a commercial Holstein dairy farm in the Khorasan Razavi province, Neyshabur, Iran (latitude: 36° 10° 55° N; longitude: 58° 56° 37° E; altitude: 1415 m). The cows were nonseasonal year-round calvers milked thrice daily with herd average annual milk yield of 10370 kg per cow. Cows were housed in open shed barns and fed a total mixed ration (TMR) including corn silage, alfalfa and/or hay, cornmeal, barley, and protein supplement (NRC, 2001). The gynecological examinations were performed after parturition for detection of reproductive problems. The voluntary waiting period was 40 days, and cows detected in estrus were artificially inseminated. Heat detection was done by visual observation. Pregnancy diagnosis was performed between 30 to 35 days after insemination by transrectal ultrasonography via a 5 MHz linear array transducer (Easi-Scan, BCF technology, Livingston, Scotland) and again on days 80 to 85 for detection of pregnancy loss.

Study design

All cows after parturition were enrolled into the study except cows that had aborted or born a dead calf. The animals were divided randomly into four groups. In group 1 (n=90), cows received an intramuscular (im) injection of 500 IU eCG (Gonaser; Hipra, Spain) on day 8 ± 2 followed by twice intramuscular (im) injections of 500 µg cloprostenol (Estroplan; Parnell, Australia) 8 h apart between days 20 to 25 postpartum. In group 2 (n=90), cows received an intramuscular injection of eCG on day 8 ± 2 followed by twice intramuscular injections of sterile saline (5ml) 8 h apart between days 20 to 25 postpartum. In group 3 (n=91), cows received an intramuscular injection of saline on day 8 ± 2 followed by twice intramuscular injection of cloprostenol 8 h apart between days 20 to 25 postpartum. In group 4 (n=97) that served as the control group, cows received an intramuscular injection of saline on day 8 ± 2 followed by twice intramuscular injections of saline 8 h apart between days 20 to 25 postpartum. Before the first cloprostenol injections in groups 1 and 3, cows were examined by transrectal ultrasonography for corpus luteum (CL) detection and simultaneously blood samples were collected for determination of serum progesterone concentrations. Also in groups 2 and 4, two blood samples were collected 10-12 days apart on d 20±1 and d 30±1 postpartum.

Cows were scored for body condition in a 1–5 scale (1 = emaciated, 5 = obese) in the first week after calving as described by Ferguson et al. (1994). Recorded data included milk fever, abomasal displacement, dystocia, retained placenta, twining, uterine infections (metritis and clinical endometritis), anovulatory anestrus and follicular cyst. Milk fever and abomasal displacement were diagnosed based on typical clinical signs of diseases by farm veterinarian, paralysis, dullness, low body temperature, high heart rate, responsiveness to calcium injection for determination of milk fever and, systemic illness, anorexia, pinging noise from the abdomen for abomasal displacement. Dystocia was defined as animals requiring the assistance of at least two people for more than 10 min to deliver the calf. Retained placenta was defined as the failure to expel the fetal membranes within 24 h after parturition. Uterine diseases were diagnosed based on the definition by Sheldon et al. (2006). Anovulatory anestrus was defined as the lack of expression of estrus accompanied by minimal follicular development, anovulation and absence of a CL. Ovarian follicular cyst was defined as follicles that achieve a diameter of at least 17mm and that persist for more than 6 days in the absence of CL (Silvia et al., 2002).

Recorded reproductive variables were days to first artificial insemination (AI), first service conception rate, pregnancy by 120 days in milk (DIM), calving to conception interval and pregnancy loss by day 80 after last AI.

Blood sampling and progesterone assay

Blood was collected by coccygeal venipuncture using vaccutainer tubes that contained clot activator (16x100mm, 10 mL Vacuplast, Shandong, China). The samples were immediately placed in ice, and later centrifuged at 1800×g for 20 min for separation of serum. The determination of the serum progesterone was accomplished using the Progesterone Immunoenzymatic kit (DRG, Marburg, Germany) following the manufacturer's instructions, which provides the material support for the quantitative determination of progesterone in serum and plasma, for in vitro diagnosis.

Cows were classified as having initiated ovarian activity by day 30 postpartum if progesterone concentration was ≥1.0 ng/mL in one of the two samples, or noncyclic, when both sera samples were ≤1.0 ng/mL.

Statistical analysis

All analyses were performed using SAS software (Version 9.2; SAS Institute Inc., Cary, NC, USA). The association of treatment with categorical outcomes, including pregnancy by 120 days in milk (DIM), first service conception rate, resumption of cyclical activity by day 30±1 postpartum, serum progesterone level above 1ng/ml on day 20 postpartum, clinical endometritis, anovulatory anestrus, and follicular cyst, presence or absence of functional CL, and pregnancy loss were tested with Chi-square test (PROC FREQ). Additionally, the effect of presence or absence of functional CL, and resumption of ovarian cyclical activity by day 30±1 postpartum and clinical endometritis on pregnancy by 120 days in milk (DIM), first service conception rate were tested with chi-square test (PROC FREQ). The same covariates as described above were considered in the models. Thereafter data were analyzed by a multivariate logistic regression using the LOGISTIC procedure of SAS. Parity, body condition score (BCS), dystocia, retained placenta, metritis, abomasal displacement, and milk fever were considered as covariate in the models. Then, the variables were removed by manual backward stepwise elimination if the P> 0.2. Finally, interactions among variables were assessed using multivariable logistic regression (PROC LOGISTIC) modeling through a backward model-selection procedure. To determine the degree of association between the risk factors and outcome variables, odds ratio (OR) and 95% confidence intervals were calculated. For all statistical analyses, differences with P<0.05 were considered to be significant.

Observations of time to pregnancy were censored for open cows on the date of culling or at the end of the study. Kaplan-Meier (product limit) survival function estimates

Table 1
Descriptive statistics for treatment and control groups.

Variable	All cows, No.	eCG+PGF$_{2\alpha}$, No. (%)	eCG, No. (%)	PGF$_{2\alpha}$, No. (%)	Control, No. (%)	*p* value
Parity						
1	181	42 (23.2)	43 (23.8)	46 (25.4)	50 (27.6)	
2	78	19 (24.4)	20 (25.6)	19 (24.4)	20 (25.6)	0.99
≥3	109	29 (26.6)	27 (24.8)	26 (23.8)	27 (24.8)	
BCS [1]						
≤2.75	98	26 (26.5)	28 (28.6)	19 (19.4)	25 (25.5)	0.75
3-3.75	242	56 (23.1)	57 (23.6)	64 (26.4)	65 (26.9)	
≥4	28	8 (28.6)	5 (17.8)	8 (28.6)	7 (25)	
Dystocia						
Yes	177	44 (24.9)	42 (23.7)	44 (24.9)	47 (26.5)	0.99
No	191	46 (24.1)	48 (25.1)	47 (24.6)	50 (26.2)	
RFM [2]						
Yes	50	12 (24)	14 (28)	14 (28)	10 (20)	0.69
No	318	78 (24.5)	76 (23.9)	77 (24.2)	87 (27.4)	
Metritis						
Yes	36	8 (22.2)	7 (19.5)	9 (25)	12 (33.3)	0.96
No	332	82 (24.7)	83 (25)	82 (24.7)	85 (25.6)	
AD [3]						
Yes	15	4 (26.7)	2 (13.3)	3 (20)	6 (40)	0.55
No	353	86 (24.4)	88 (24.9)	88 (24.9)	91 (25.8)	
Milk fever						
Yes	40	10 (25)	11 (27.5)	9 (22.5)	10 (25)	0.96
No	328	80 (24.4)	79 (24.1)	82 (25)	87 (26.5)	

[1] BCS: Body condition scores
[2] RFM: Retained fetal membranes
[3] AD: Abomasal displacement

(the LIFETEST procedure in SAS) were used to calculate crude associations of treatment with median time to first breeding and pregnancy. The effects of treatment on time to first breeding and pregnancy were analyzed with multi-variable survival analysis using Cox's proportional hazards regression (the PHREG procedure in SAS). Both of these survival analysis procedures are nonparametric, so they do not depend on any specification of the underlying distribution of the data.

Results

Descriptive statistics are shown in Table 1. None of the variables (diseases that occurred within 2 weeks after parturition in addition to BCS and parity) were significantly different between the treatment and control cows.

Reproductive indices include 120 DIM pregnancy rate, and pregnancy loss were not significantly different between the control and treatment groups ($p > 0.05$) (Table 2). First service conception rate in group 3 (Saline + PGF$_{2\alpha}$) was higher than the other groups but this difference was not significant (20.88%, $p = 0.560$). Days to first service in eCG treated cows (eCG + PGF$_{2\alpha}$ and eCG + Saline) were lower than cows in the control group with marginal significance (p= 0.059). Based on survival analysis, calving to conception interval was not different between treatment and control groups (Table 3).

Overall, 60% of all cows in groups 2 and 4 (eCG + Saline and control) had resumed estrous cyclicity by 30 ± 1 days postpartum. Treatment with eCG did not affect cyclical ovarian activity resumption until day 30±1 after parturition in group 2 in comparison with control group (62.2% vs. 55.7%; $p \geq 0.05$) (Table 4). Also, on day 20 ± 1 after parturition number of cows with serum progesterone level above than 1ng/ml in eCG treated group were not significantly different from those in the control group (37.8% vs. 32%; $p \geq 0.05$). Additionally, initiation of ovarian cyclical activity by day 30 after parturition had no effect on the reproductive performance parameters (Table 5). Only, interval from parturition to first service was significantly shorter in cyclic cows than noncyclic cows ($p \leq 0.05$).

The difference in clinical endometritis incidence was not significant among the groups ($p > 0.05$). Incidence of anovulatory anestrus and follicular cyst was not affected by treatment groups (Table 6). 24.05% of cows with functional CL and 31.68% of cows without functional CL before administration of PGF$_{2\alpha}$ in PGF$_{2\alpha}$ treated groups (eCG + PGF$_{2\alpha}$ and Saline + PGF$_{2\alpha}$) suffered from clinical endometritis and difference in incidence of clinical endometritis was not significant between cows with or without functional CL ($p \geq 0.05$). Presence or absence of functional CL before administration of PGF$_{2\alpha}$ in PGF$_{2\alpha}$ treated groups (eCG + PGF$_{2\alpha}$ and Saline + PGF$_{2\alpha}$) had no effect on first service

Table 2
Reproductive performance of dairy cows in different groups. Data are presented as mean ±SD and percentages.

Parameter	eCG+$PGF_{2\alpha}$	eCG	$PGF_{2\alpha}$	Control	*p* value
DFS [1] (day)	55.03 ± 12.14	54.54 ± 10.88	57.56 ± 14.79	60.18 ± 18.85	0.059
FSCR [2] (%)	15.56 (14/90)	13.33 (12/90)	20.88 (19/91)	16.49 (16/97)	0.560
PR120 [3] (%)	48.89 (44/90)	51.11 (46/90)	49.45 (45/91)	49.48 (48/97)	0.997
PRL [4] (%)	5.56 (5/90)	11.11(10/90)	10.99 (10/91)	8.25 (8/97)	0.569

[1] DFS: Days to first service
[2] FSCR: First service conception rate
[3] PR120: Pregnancy rate at 120 days in milk
[4] PRL: Pregnancy loss

conception rate, 120 DIM pregnancy rate, and calving to conception interval and the incidence of clinical endometritis ($p > 0.05$). Cows with clinical endometritis had lower first service conception rate and 120 DIM pregnancy rate, and longer calving to conception interval ($p < 0.05$).

Discussion

It is clarified that early resumption of ovarian activity after parturition improves fertility (Galvão et al., 2010) and ovulation of the first wave dominant follicle could decrease postpartum anestrus by 31 days (Beam and Butler, 1999). Thus one of the most important advantages of using ovulation inducing hormones in early postpartum period may be reduction of anovulatory anestrus incidence. In the last decades, many studies have tried to induce early resumption of ovarian activity with hormonal manipulation. Gonadotropin releasing hormone and its analogues are the mostly used hormones in this field (Beckett and Lean, 1997). In this study, we evaluated the effect of early administration of eCG on resumption of ovarian cyclical activity by day 30 ± 1 after parturition in high producing dairy cows. Resumption of ovarian cyclical activity by day 30 ± 1 postpartum did not significantly differ between the eCG treated and control groups in this study and eCG administration had no effect on the prevalence of anovulatory anestrus. Sheldon and Dubson (2000) showed that administration of eCG during the post-partum period increases follicular growth overcoming the negative influence exerted by the previously gravid uterine horn on folliculogenesis. In another recent study, Rostami et al. (2011) showed all primiparous cows that received one injection of 500 IU eCG on day 6 postpartum resumed ovarian cyclical activity by day 20 after parturition. Their study was conducted on a limited number of healthy primiparous cows without metabolic and reproductive diseases after parturition. Different farm conditions and inclusion criteria for the animal enrollment and greater number of the cows in the treatment and control groups in the present study may be the reason for the different results.

The effect of early administration of eCG on reproductive performance of high producing Holstein dairy cows was also evaluated in this study and calving to conception interval, pregnancy by 120 days in milk, first service conception rate, and pregnancy loss were not significantly different between the control group and the eCG treated cows and only days to first service in eCG treated cows was lower than control cows with marginal significance (p=0.0560).

Table 3
Calving to conception interval in dairy cows in treatment and control groups [1].

Calving to conception interval				
Treatment	n	Median, d	Hazard ratio	*p*
eCG+$PGF_{2\alpha}$	90	125	0.930	0.727
eCG	90	120	0.960	0.842
$PGF_{2\alpha}$	91	130	0.961	0.849
Control	97	122		Referent

[1] Cows were followed for 5 months and the data were analyzed using Kaplan-Meier and Cox proportional hazards survival analyses, accounting for the effects of parity, BCS and clinical diseases.

Table 4
Percent (No.) of cows within treatment and control groups that had a progesterone concentration >1 ng/ml

Cows	eCG	Control	P-value
% of cows with progesterone >1 ng/ml on day 20 ± 1 postpartum	37.8 (34/90)	32 (31/97)	0.404
% of cows with progesterone>1 ng/ml on day 30±1 postpartum	64.7 (57/88) [2]	55.7 (54/97)	0.208
% of cyclic cows[1] until day 30 postpartum	64.7 (57/88)	55.7 (54/97)	0.208

Differences with $p \leq 0.05$ were considered significant.
[1] Cows that had a progesterone concentration above 1ng/ml on day 20±1 or day 30±1 or both.
[2] Two cows were not assayed for serum progesterone level at day 30±1.

Sheldon and Dobson (2000) reported that intrauterine administration of eCG on day 14 after parturition increased follicular growth but did not able to shorten calving to conception interval, and service per conception. Recently, Vojgani et al. (2013) showed that treatment with eCG on day 6 after parturition reduced calving to conception interval in comparison with the control group but had no effect on first service conception rate, service per conception, and prevalence of repeat breeder cows. They also reported that days to first service were significantly advanced about 10 days in the eCG treated cows. In their study, only healthy cows with no puerperal diseases were included. Kawashima et al. (2006) showed that cows ovulating within 3 weeks postpartum had shorter days to first service than anovular cows. Likewise, enhancement of the initiation of postpartum luteal activity shortened the interval from calving to first service (Darwash et al., 2001).

Different doses of eCG have different effects on the induction of ovulation. Generally, a greater ovarian response is observed with a higher dose (Newcomb et al. 1979). It is accepted that the 'standard' doses of eCG required to promote single ovulation should range between 200 and 1000 IU (De Rensis and López-Gatius, 2014). Because of the high metabolism rate of high producing dairy cows especially during early postpartum, maybe a higher dose of eCG is needed for effective follicular growth and consequently improvement in reproductive performance.

Very conflicting data with different results exists regarding the benefit of $PGF_{2α}$ administration postpartum for improving uterine health and reproductive performance (Young and Anderson, 1986, McClary et al., 1989, Archbald et al., 1990, Glanvill and Dobson, 1991, Burton and Lean, 1995, Melendez et al., 2004, Hendricks et al., 2006, LeBlanc, 2008, Galvao et al., 2009). In the present study, two doses of $PGF_{2α}$ that were administered at 8 h interval in cows in group 3 (saline+ $PGF_{2α}$) between days 20 to 25 after parturition had no effect on reproductive indices of dairy cows in comparison with control cows. Hendricks et al. (2006) showed that repeated administration of $PGF_{2α}$ in the early postpartum period had no effect on days to first service and the probability of pregnancy at first insemination. Salasel and Mokhtari (2011) reported that treatment of cows with calving and puerperal disease twice with a luteolytic dose of $PGF_{2α}$ 8 h apart on Day 20 postpartum improved reproductive performance. Archbald et al. (1994) showed that treatment with $PGF_{2α}$ for cows with abnormal puerperium was more effective than cows with normal puerperium. However, the results of a meta-analysis (Burton and Lean, 1995) showed that treatment with $PGF_{2α}$ during early postpartum period had no significant effect on the first service pregnancy rate of cows with a normal or abnormal puerperium. In this study, cows with or without puerperal problems were randomly divided between the control and $PGF_{2α}$ treated groups. Melendez et al. (2004) reported that only within primiparous cows, treatment with $PGF_{2α}$ can increase conception at first service. Cows from different parity were included in this study but there was no difference between primiparous and multiparous cows in terms of reproductive performance as a result of treatment with $PGF_{2α}$. In cows with a functional CL, administration of $PGF_{2α}$ decreases plasma progesterone and increases plasma estrogen concentrations. This removes the suppressive effect of progesterone on the immune system and allows for maximal resistance of the uterus to bacterial infection (Dhaliwal et al., 2001). It was also reported that exogenous $PGF_{2α}$ may enhance immune functions or increase uterine motility to help the uterus to resolve infections in animals that do not have active corpora lutea (Salasel and Mokhtari, 2011). In this study, we did not find any improvement in fertility after administration of $PGF_{2α}$ both in cows with or without functional corpus luteum. Other studies that showed reproductive improvement after $PGF_{2α}$ administration had found that the positive effect of $PGF_{2α}$ was independent of the presence of active corpus luteum (Salasel and Mokhtari, 2011). Even Gay and Upham (1994) reported that administration of $PGF_{2α}$ at approximately 25 DIM to clinically normal cows with a palpable CL significantly reduced first service pregnancy risk. Ultimately, an analysis of the data for the number of days open showed that a significant percentage of the treated cows with normal or abnormal puerperium had fewer days open than the untreated cows. However, calculations indicated that it would require only a few studies with a negative response to $PGF_{2α}$ to negate this finding (Burton and Lean, 1995).

It had been demonstrated that increased frequency of estrus and ovulation during the first 60 days postpartum leads to improvement in fertility (Benmrad and Stevenson, 1986). We used a combined eCG and $PGF_{2α}$ treatment early after parturition because it had been hypothesized that eCG through induction of precocious ovulation and $PGF_{2α}$ through induction of luteolysis of CL formed after induced ovulation can increase frequency of estrus cycles before insemination and ultimately lead to improvement in fertility. To the best of our knowledge, there is no study to evaluate the effects of eCG and $PGF_{2α}$ combination on the reproductive performance of cows. The combination of two treatments could not alter fertility traits in cows in comparison with cows in the control group.

Treatment with eCG, $PGF_{2α}$ and combination of eCG and $PGF_{2α}$ had no effect on the incidence of clinical endometritis, anovulatory anestrus, and follicular cysts in the present study. Hendricks et al. (2006) found that repeated injections of $PGF_{2α}$ early after parturition had no effect on the prevalence of clinical endometritis at either day 22 or 58 postpartum. Similarly, Dubuc et al. (2011) reported that administration of $PGF_{2α}$ at 35 and 49 DIM in a low and high-risk group of cows for uterine disease with clinical endometritis had no effect on clinical cure rate. In the present study, the presence of a functional CL before administration of $PGF_{2α}$ did not affect the incidence of clinical endometritis. Leblanc et al. (2002) reported that treatment of endometritis in cows without CL with $PGF_{2α}$ could not affect the time to pregnancy. Previous works have suggested that the therapeutic effects of $PGF_{2α}$ were independent of the presence or absence of a corpus luteum at the time of treatment (Young et al., 1984, Pepper and Dobson, 1987, McClary et al., 1989).

Table 5
Reproductive performance of cyclic or non-cyclic dairy cows on day 30 ± 1 postpartum. Data were presented as mean ± SD and percentages.

Cows	Cyclic	Non-cyclic	P-value
DFS [1] (day)	54.35 ± 13.66	62.31 ± 17.56	0.0007
FSCR [2] (%)	15.3 (17/111)	14.9 (11/74)	0.332
PR120 [3] (%)	52.25 (58/111)	45.95 (34/74)	0.401
PRL [4] (%)	11.71(13/111)	6.76 (5/74)	0.266
CCI [5] (day)	124.98 ± 60.63	135.25 ± 56.63	0.332

Differences with $p \leq 0.05$ were considered significant.
[1] DFS: Days to first service
[2] FSCR: First service conception rate
[3] PR120: Pregnancy rate at 120 days in milk
[4] PRL: Pregnancy loss
[5] CCI: Calving to conception interval

Table 6
Effect of treatment and control groups on some reproductive diseases. Data are presented in percent (absolute value)

Parameter	eCG+$PGF_{2α}$	eCG	$PGF_{2α}$	Control	P-value
Clinical endometritis	26.67 (24/90)	28.89 (26/90)	30.77 (28/91)	30.93 (30/97)	0.491
Anovulatory anestrus	15.56 (14/90)	13.33 (12/90)	17.58 (16/91)	20.62 (20/97)	0.258
Follicular cysts	8.89 (8/90)	6.67 (6/90)	6.59 (6/91)	6.19 (6/97)	0.495

Differences with $p \leq 0.05$ were considered significant.

Conclusions

Nutritional and genetic improvements in the last decade could not prevent the decrease in reproductive performance of dairy cows. After defining the postpartum reproductive physiology it is suggested that hormonal intervention early after parturition may be an ideal method for increasing fertility and this matter has been the focus of attention since around 1980. In this study, combined and individual treatment with eCG and $PGF_{2α}$ did not improve reproductive performance traits in high producing dairy cows. Only interval from calving to first insemination was reduced in eCG treated cows in comparison with control cows with marginal significance. Cows that received eCG on day 8±2 had the same rate of resumption of ovarian cyclicity on day 30±1 after parturition as cows in control group and resumption of ovarian cyclical activity by day 30±1 postpartum had no effect on reproductive performance of dairy cows. Based on the results of this study, use of eCG and $PGF_{2α}$ treatment in early postpartum period did not improve the reproductive performance of high producing dairy cows.

Acknowledgements

This study was supported by a research fund of the Ferdowsi University of Mashhad (Project No.: 3/30473). The authors wish to thank the manager, Mr. Dabiri and all employees of the Dasht Institute of Agro-Industry, especially

Mr. Khoramaki, Mr. Hosseini and Mr. Sadeghi for their sincere efforts.

References

Archbald, L.F., Tran, T., Thomas, P.G.A., Lyle, S.K. (1990) Apparent failure of prostaglandin F2 alpha to improve the reproductive efficiency of postpartum dairy cows that had experienced dystocia and/or retained fetal membranes. Theriogenology 34, 1025–1034.

Archbald, L.F., Constant, S., Tran, T., Risco, C., Klapstein, E., Elliot, J. (1994) Effect of sequential treatment with prostaglandin F2 alpha and/or oxytocin on estrus and pregnancy rate of lactating dairy cows. Theriogenology 42, 773–780.

Beam, S.W., Butler, W.R. (1999) Effects of energy balance on follicular development and first ovulation in post-partum dairy cows. Journal of Reproduction and Fertility 54, 411–424.

Beckett, S.D., Lean, I.J. (1997) GnRH in postpartum dairy cattle: a meta analysis of effects on reproductive efficiency. Animal Reproduction Science 48, 93-112.

Benmrad, M., Stevenson, S. (1986) Gonadotropin-releasing hormone and prostaglandin F2 for postpartum dairy cows: estrous, ovulation, and fertility traits. Journal of Dairy Science 69, 800-811.

Burton, N.R., Lean, I.J. (1995) Investigation by meta-analysis of the effect of prostaglandin F2 alpha administered postpartum on the reproductive performance of dairy cattle. Veterinary Record 136, 90–94.

Butler, W.R., Smith, R.D. (1989) Interrelationship between energy balance and postpartum reproductive function in dairy cattle. Journal of Dairy Science 72, 767–783.

Darwash, A.O., Lamming, G.E., Royal, M.D. (2001) A protocol for initiating oestrus and ovulation early postpartum in dairy cows. Animal Science 72, 539–546.

De Rensis, F., López-Gatius, F. (2014) Use of equine chorionic gonadotropin to control reproduction of the dairy cow: a review. Reproduction in Domestic Animal 49, 177-182.

Dhaliwal, G.S., Murray, R.D., Woldehiwet, Z. (2001) Some aspects of immunology of the bovine uterus related to treatments for endometritis. Animal Reproduction Science 67, 135-152.

Dubuc, J., Duffield, T.F., Leslie, K.E., Walton, J.S., Leblanc, S.J. (2011) Randomized clinical trial of antibiotic and prostaglandin treatments for uterine health and reproductive performance in dairy cows. Journal of Dairy Science 94, 1325–1338.

Etherington, W.G., Bosu, W.T.K., Martin, S.W., Cote, J.F., Doig, P.A., Leslie, K.E. (1984) Reproductive performance in dairy cows following postpartum treatment with gonadotrophin releasing hormone and/ or prostaglandin: a field trial. The Canadian Journal of Comparative Medicine 48, 245-250.

Ferguson, J.D., Galligan, D.T., Thomsen, N. (1994) Principal descriptors of body condition score in Holstein cows. Journal of Dairy Science 77, 2695–2703.

Galvão, K.N., Frajblat, M., Brittin, S.B., Butler, W.R., Guard, C.L., Gilbert, R.O. (2009) Effect of prostaglandin $F_{2\alpha}$ on subclinical endometritis and fertility in dairy cow. Journal of Dairy Science 92, 4906–4913.

Galvão, K.N., Fraiblat, M., Butler, W.R., Brittin, S.B., Guard, C.L., Gilbert, R.O. (2010) Effect of early postpartum ovulation on fertility in dairy cows. Reproduction in Domestic Animal 45, 207–211.

Gautam, G., Nakao, T., Yamada, K., Yoshida, C. (2010) Defining delayed resumption of ovarian activity postpartum and its impact on subsequent reproductive performance in Holstein cows. Theriogenology 73, 180–189.

Gay, J.M., Upham, G.L. (1994) Effect of exogenous prostaglandin $F_{2\alpha}$ in clinically normal postparturient dairy cows with a palpable corpus luteum. Journal of American Veterinary Medical Association 205, 870–873.

Gonzalez-Menico, F., Manns, J., Murphy, B.D. (1978) FSH and LH activity of PMSG from mares at different stages of gestation. Animal Reproduction Science 1, 137–144.

Glanvill, S.F., Dobson, H. (1991) Effect of prostaglandin treatment on the fertility of problem cows. Veterinary Record 128, 374–376.

Haimerl, P., Arlt, S., Heuwieser, W. (2012) Evidence based medicine: quality and comparability of clinical trials investigating the efficacy of prostaglandin $F_{2\alpha}$ for the treatment of bovine endometritis. Journal of Dairy Research 79, 287–296.

Hendricks, K.E., Bartolome, J.A., Melendez, P., Risco, C., Archbald, L.F. (2006) Effect of repeated administration of PGF2alpha in the early post partum period on the prevalence of clinical endometritis and probability of pregnancy at first insemination in lactating dairy cows. Theriogenology 65, 1454–1464.

Hirsbrunner, G., Knutti, B., Küpfer, U., Burkhardt, H., Steiner, A. (2003) Effect of prostaglandin E2, DL-cloprostenol, and prostaglandin E2 in combination with D-cloprostenol on uterine motility during diestrus in experimental cows. Animal Reproduction Science 79, 17–32.

Hussain, A.M. (1989) Bovine uterine defence mechanisms: a review. Journal of Veterinary Medicine 36, 641–651.

Janowski, T., Zdunczyk, S.,Mwaanga, E.S. (2001) Combined GnRH and PGF2a application in cows with endometritis puerperalis treated with antibiotics. Reproduction in Domestic Animal 36, 244-246.

Kasimanickam, R., Duffield, T.F., Foster, R.A., Gartley, C.J., Leslie, K.E., Walton, J.S., Johnson, W.H. (2005) The effect of a single administration of cephapirin or cloprostenol on the reproductive performance of dairy cows with subclinical endometritis. Theriogenology 63, 818–830.

Kawashima, C., Kaneko, E., Montoya, C.A., Matsui, M., Yamagishi, N., Matsunaga, N., Ishii, M., Kida, K., Miyake, Y., Miyamoto, A. (2006) Relationship between the first ovulation within three weeks postpartum and subsequent ovarian cycles and fertility in high producing dairy cows. Journal of Reproduction and Development 52, 479–486.

Lamming. G.E., Darwash, A.O. (1998) The use of milk progesterone profiles to characterize components of subfertility in milked dairy cows. Animal Reproduction Science 52, 175–90.

LeBlanc, S.J. (2008) Postpartum uterine disease and dairy herd reproductive performance: A review. The Veterinary Journal 176, 102–114.

LeBlanc, S.J., Duffield, T.F., Leslie, K.E., Bateman, K.G., Keefe, G.P., Walton, J.S., Johnson, W.H. (2002) The effect of treatment of clinical endometritis on reproductive performance in dairy cows. Journal of Dairy Science 85, 2237–2249.

Lucy, M.C. (2001) Reproductive loss in high-producing dairy cattle: where will it end? Journal of Dairy Science 84, 1277–1293.

McClary, D.G., Putnam, M.R., Wright, J.C., Sartin J.L. (1989) Effect of early postpartum treatment with prostaglandin F2alpha on subsequent fertility in the dairy cow. Theriogenology 31, 565–570.

Melendez, P., McHale, J., Bartolome, J., Archbald, L.F., Donovan, G.A. (2004) Uterine involution and fertility of Holstein cows subsequent to early postpartum PGF2 alpha treatment for acute puerperal metritis. Journal of Dairy Science 87, 3238–3246.

Moore, K., Thatcher, W.W. (2006) Major advances associated with reproduction in dairy cattle. Journal of Dairy Science 89, 1254–1266.

Nakao, T., Gamal, A., Osawa, T., Nakada, K., Moriyoshi, M., Kawata, K. (1997) Postpartum plasma PGF metabolite profile in cows with dystocia and/or retained placenta, and effect of fenprostalene on uterine involution and reproductive performance. Journal of Veterinary Medical Science 59, 791–794.

Newcomb, R., Christie, W.B., Rowson, L.E.A., Walters, D.E., Bousfield, W.E.D. (1979) Influence of dose, repeated treatment and batch of hormone on ovarian response in heifers treated with PMSG. Journal of Reproduction and Fertility 56, 113–118.

N.R.C., 2001: Nutrient Requirements of Dairy Cattle, seventh ed. National Academy Press, Washington D.C., USA.

Pepper, R.T., Dobson, H. (1987) Preliminary results of treatment and endocrinology of chronic endometritis in the dairy cow. Veterinary Record 120, 53-56.

Petersson, K.J., Gustafsson, H., Strandberg, E., Berglund, B. (2006) Atypical progesterone profiles and fertility in Swedish dairy cows. Journal of Dairy Science 89, 2529–2538.

Rostami, B., Niasari-Naslaji, A., Vojgani, M., Nikjou, D., Amanlou, H., Gerami, A. (2011) Effect of eCG on early resumption of ovarian activity in postpartum dairy cows. Animal Reproduction Science 128, 100–106.

Rowson, L.E.A., Lamming, G.E., Fry, R.M. (1953) The relationship between ovarian hormones and uterine infection. Veterinary Record 65, 335–341.

Salasel, B., Mokhtari, A. (2011) Effect of early postpartum $PGF_{2\alpha}$ treatment on reproductive performance in dairy cows with calving and puerperal traits. Theriogenology 76, 1723–1729.

Sheldon, I.M., Dubson, H. (2000) Effect of administration of eCG to postpartum cows on folliculogenesis in the ovary ipsilateral to the previously gravid uterine horn and uterine involution. Journal of Reproduction and Fertility 119, 157–163.

Sheldon, I.M., Lewis, G.S., LeBlanc, S.J., Gilbert, R.O. (2006) Defining postpartum uterine disease in cattle. Theriogenology 65, 1516–1530.

Shrestha, H.K., Nakao, T., Suzuki, T., Higaki, T., Akita, M. (2004) Effects of abnormal ovarian cycles during pre-service period postpartum on subsequent reproductive performance of high-producing Holstein cows. Theriogenology 61, 1559–1571.

Silvia, W.J., Hatler, T.B., Nugent, A.M., Da Fonseca, L.F.L. (2002) Ovarian follicular cysts in dairy cows: an abnormality in folliculogenesis. Domestic Animal Endocrinology 23, 167–177.

Stevenson, J.S., Pursley, J.R. (1994) Resumption of follicular activity and interval to postpartum ovulation after exogenous progestins. Journal of Dairy Science 77, 725-734.

Thatcher, W.W., Wilcox, C.J. (1973) Postpartum estrus as an indicator of reproductive status in dairy cow. Journal of Dairy Science 56, 608–610.

Tucker, A.L., Sanchez, H.L., Tucker, W.B., Williams, A., Fuquay, J.W., Willard, S.T., Ryan, P.L. (2011) Effects of early postpartum GnRH and prostaglandin $F_{2\alpha}$ administration on reproductive activity and ovulation synchronization in lactating dairy cows. Journal of Animal and Veterinary Advances 10, 900-908.

Vojgani, M., Akbarinejad, V., Niasari-Naslaji, A. (2013) Administration of eCG on Day 6 postpartum could enhance reproductive performance of Holstein dairy cows. Animal Reproduction Science 138, 159– 162.

Young, I.M., Anderson, D.B., Plenderleith, R.W. (1984) Increased conception rate in dairy cows cows treated with dinoprost tromethamine soon after calving. Theriogenology 26, 199–208.

Abstract (in Persian)

DOI: 10.22067/veterinary.v8i1.54780

تأثیر تجویز زودهنگام گنادوتروپین کوریونیک اسبی و پروستاگلاندین F2α بر روی عملکرد تولیدمثلی گاوهای شیری در دوره‌ی پس از زایش

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دریافت مقاله : ۱۳۹۴/۱۰/۱۴ پذیرش نهایی: ۱۳۹۵/۰۴/۱۵

چکیده

هدف از این مطالعه ارزیابی تأثیر تجویز گنادوتروپین کوریونیک اسبی(eCG)، پروستاگلاندین F2α و نیز ترکیب این دو هورمون بر روی عملکرد تولیدمثلی گاوهای شیری پرتولید در دوره‌ی پس از زایش بود. تعداد ۳۶۸ گاو تازه‌زای نژاد هلشتاین در ۴ گروه مطالعاتی تقسیم شدند. در روز ۲ ± ۸ پس از زایش، در گاوهای گروه ۱ و ۲، ۵۰۰ واحد بین المللی eCG تزریق شد و گاوهای گروه ۳ و ۴ سالین دریافت کردند. همچنین دو تزریق ۵۰۰ میکروگرمی کلوپروستنول به فاصله‌ی ۸ ساعت در فاصله‌ی بین روزهای ۲۰ تا ۲۵ پس از زایش در گاوهای گروه ۱ و ۳ انجام شد و گاوهای گروه ۲ و۴ در همین بازه‌ی زمانی ۲ تزریق سالین به فاصله ۸ ساعت دریافت کردند. حضور جسم زرد فعال در گروه های ۱و ۳ توسط معاینه‌ی اولتراسونوگرافی تخمدان ها و نیز ارزیابی غلظت پروژسترون در سرم خون ارزیابی شد. هیچکدام از درمان‌های انجام شده منجر به بهبود باروری نشد و شاخص های تولید مثلی اعم از میزان آبستنی در روز ۱۲۰ شیرواری، از دست رفتن آبستنی، میزان آبستنی در اولین تلقیح و روزهای باز بین گروه های مختلف تفاوت معنی داری نداشت. تنها فاصله‌ی زایش تا اولین تلقیح بعد از زایمان در گاوهای درمان شده با eCG به صورت مرزی کمتر از گاوهای گروه کنترل بود. در گاوهای گروه ۲ درمان با eCG تأثیری بر شروع فعالیت های چرخه‌ای تخمدان تا روز ۱ ± ۳۰ پس از زایش نداشت. بازگشت فعالیت چرخه‌ای تخمدان تا روز ۱±۳۰ پس از زایش، عملکرد تولیدمثلی گاوها را تحت تأثیر قرار نداد. علاوه بر این درمان با eCG، پروستاگلاندین F2α و ترکیب این دو هورمون تأثیری بر شیوع اندومتریت بالینی، آنستروس و کیست تخمدانی نداشت. در نتیجه درمان با eCG و پروستاگلاندین F2α دراوایل دوره‌ی پس از زایش تأثیری در عملکرد تولیدمثلی گاوهای شیری پرتولید نداشت.

واژگان کلیدی : eCG، دوره پس از زایش، هلشتاین، پروستاگلاندین F2α، عملکرد تولیدمثلی