INFLUENCE OF BLOOD METABOLITES AND METABOLIC HORMONES ON POSTPARTUM OVARIAN ACTIVITY IN COWS*

SARFRAJ ALI[1], M. K. AWASTHI[2], J.R. KHAN[3] R.P. TIWARI[4] AND M.R. POYAM[5]

Veterinary Gynaecology & Obstetrics Department

College of Veterinary Science & Animal Husbandry, Anjora, Durg (C.G.) 491 001

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ABSTRACT

Present investigation was conducted to study the influence of blood metabolites and metabolic hormones on postpartum ovarian cyclic activity in Sahiwal cows. Selected experimental animals (n=18) had normal calving and subsequent normal genital health without apparent history of postpartum metritis and endometritis as assessed by gynaeco-clinical examination. Blood samples were collected from each experimental animal on days 50 and 60 postpartum; and blood glucose and serum concentrations of non-esterified fatty acid (NEFA), insulin, triiodothyronine (T_3), thyroxin (T_4) and progesterone (P_4) were determined. Animals were classified as cyclic (P_4 > 1 ng/ml) and acyclic (P_4 < 1 ng/ml) based on serum progesterone concentration on day 50 and /or day 60 postpartum. An increasing trend of serum progesterone concentration was observed in both cyclic and acyclic animals with increasing postpartum interval though extent of which was greater in cyclic animals. Non-significant differences were observed in blood glucose concentration, serum T_3 and T_4 concentrations between cyclic and acyclic animals on days 50 and 60 postpartum. Acyclic animals recorded significantly higher ($P<0.01$) serum NEFA concentration and significantly lower ($P<0.05$) serum insulin concentration on days 50 and 60 postpartum than in cyclic animals. From the present study it may be concluded that an increased concentration of serum NEFA and a decreased level of serum insulin probably resulted in delay in onset of postpartum ovarian activity in Sahiwal cows.

Keywords: Postpartum cows, Blood glucose, Insulin, Triiodothyronine, Thyroxin, Progesterone

INTRODUCTION

High-producing dairy cows inevitably go in to a more severe negative energy balance (NEB) during early postpartum period, which induces changes in biochemical, endocrinological and metabolic pathways that are responsible for reproductive performance of the post-parturient dairy cows. Lactating cows utilizes more glucose for milk production and fat gets mobilized for energy production resulting in higher serum NEFA concentration (Bowden, 1971). An increased blood NEFA concentration directly impairs ovarian function (Kendrick *et al.*, 1999) resulting in delay in first visible signs of estrus, a decrease in conception rate, and a prolonged calving interval (Opsomer *et al.*, 2000). Delay in postpartum cyclic activity is thought to because of suppression of ability of the hypothalamo-hypophyseal axis to execute the pulsatile release of luteinizing hormone (LH), required for fostering follicular development and ovulation. The physiological pathways

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[1]Post-graduate student, [2]Associate Professor,
[4] Professor& Head, [5]Assistatnt Professor
[3]Professor, Veterinary Physiology & Biochemistry Department, College of Veterinary Science & Animal Husbandry, Anjora, Durg (C.G.) 491 001
[2]Corresponding Author, Corresponding Addresses:
B-16, Adarsh Nagar, DURG (CG) 491 001;
Tel. ®0788-2211818, Mobile: 075871-69135,
Fax: 0788-2623326,
E-mail address: mkawasthidurg@indiatimes.com

by which, the hypothalamic-pituitary-ovarian axis is informed about the energy status of the animal are complex, and involve several metabolites and hormones, such as the growth hormone (GH), insulin-like growth factor-I (IGF-I) system, insulin, thyroid hormones etc. In perspective, present experiment was conducted to investigate the influence of blood metabolites viz. blood glucose and serum NEFA and metabolic hormones viz. serum insulin, 3,3,5-tri-iodothyronine (T_3) and thyroxin (T_4) on ovarian cyclic activity in postpartum Sahiwal cows.

MATERIALS AND METHODS

Suckled postpartum Sahiwal cows (n=18) maintained at Bull Mother Experimental Farm, College of Veterinary Science and Animal Husbandry, Anjora, Durg, in healthy state from first to sixth lactation were utilized for present study. They were fed with green fodder, hay, straw, compound concentrate mixture and a balanced mineral mixture as per standard feeding schedule followed in the farm. All these animals had normal calving and subsequent normal genital health as assessed by gynaeco-clinical examination. The selection of experimental animals was based on apparent absence of postpartum metritis and endometritis in these animals. Blood samples were collected from each experimental animal on days 50 and 60 postpartum for estimation of blood metabolites viz. concentrations of blood glucose and serum NEFA; and metabolic hormones viz. serum concentrations of insulin, 3,3,5-tri-iodothyronine (T_3), thyroxin (T_4) and serum progesterone (P_4). Blood glucose was analysed immediately after collection of blood by accu-check glucometer through strip method. Serum non-esterified fatty acid (NEFA) level was determined by modified soap extraction method (Shipe *et al.*, 1980). Serum concentrations of insulin, triiodothyronine, thyroxin and progesterone were determined using radioimmunoassay kits supplied by BRIT, BARC, Mumbai. Animals showing serum progesterone level >1 ng / ml either on day 50 and/or day 60 were classified as cyclic and animals with concentration of serum progesterone < 1 ng / ml on days 50 and 60 were classified as acyclic (Cartmill *et al.*, 2001). Differences of significance in variables were determined with the help of independent 't' test between two groups using SPSS computer programme version 10.0.

RESULTS AND DISCUSSION

Postpartum ovarian cyclic activity of experimental animals was assessed based on serum progesterone (P_4) concentration on days 50 and 60. Two animals were cyclic (P_4>1 ng/ml) by day 50; however, by day 60 postpartum, 12 animals became cyclic (Table) supporting the fact that with increasing postpartum intervals ovarian cyclical activity is increased. An increasing trend of serum progesterone concentration was observed in both cyclic as well as acyclic animals with increasing postpartum interval though extent of which was greater in cyclic animals (Table). The present finding approximates with the observation reported by Naidu *et al.* (2006), who documented similar trend of serum progesterone profile in cows during postpartum period.

Mean blood glucose concentration, mean serum concentrations of non-esterified fatty acid (NEFA), insulin, triiodothyronine (T_3) and thyroxin (T_4) in cyclic and acyclic animals on days 50 and 60 postpartum are presented in Table. Non-significant differences were observed in blood glucose concentration between cyclic and acyclic animals on days 50 and 60 postpartum suggesting that adequate blood glucose concentration was present in acylic animals and probably its level did not influence postpartum ovarian cyclicity in experimental animals. Acyclic animals had significantly higher ($P<0.01$) serum NEFA concentration on days 50 and 60 postpartum than in cyclic animals. Postpartum dairy cows use their reserves through lipolysis to survive and produce milk under negative energy balance (Adewuyi *et al.*, 2006). A more severe negative energy balance results in a greater serum concentration of non-esterified fatty acid (Block *et al.*, 2001). Although adequate blood glucose concentration was present in acylic animals in the present study, serum NEFA concentration was significantly greater than in cyclic animals suggesting greater extent of lipolysis in them. Negative energy balance associated with higher serum

NEFA concentration during early postpartum period affected follicular development resulting in increased interval to first ovulation (Butler and Smith, 1989). LH pulse frequency was negatively correlated with plasma concentration of NEFA and the size of the largest follicle was negatively correlated with NEFA concentration (Grimard *et al.*, 1995). Concentrations of NEFA in plasma and follicular fluid are closely related, and a negative relationship between follicular concentrations of NEFA and estradiol has been demonstrated (Comin *et al.* 2002).

Significant differences ($P < 0.05$) were observed in serum insulin concentration between cyclic and acyclic animals on days 50 and 60 postpartum. Insulin has been suggested as a metabolic signal that may influence LH secretion (Butler and Canfield, 1989). Serum insulin concentration is positively related to CL development and progesterone concentrations (Thatcher *et al.*, 1996), and follicular growth rate (Lucy *et al.*, 1992). Insulin controls the ovulation rate by increasing the follicular development (Webb *et al.*, 1994). Insulin infusion increased estradiol secretion by the dominant follicle of the first postpartum follicular wave in dairy cows, and this effect appears not to be mediated through changes in pulsatile LH release (**Butler *et al.*, 2004**).

There was non-significant difference in serum T_3 and T_4 concentrations between cyclic and acyclic animals on days 50 and 60 postpartum in the present study. However, an increasing trend of serum T_3 and T_4 levels was observed in cyclic animals with increasing postpartum interval in the present study. On the contrary, a decreasing trend in serum T_3 level was observed in acyclic animals as the postpartum interval advanced. However, acyclic animals had a static serum T_4 concentration on days 50 and 60 postpartum. An increasing trend in serum T_3 level has been reported after parturition in dairy cows (Nath *et al.*, 2005). Low thyroid hormone concentrations have been suggested to be associated with low reproductive performance in the postpartum cow (Huszenicza *et al.*, 2002). Present result approximates with observation of Kesler *et al.* (1981) who reported that mean concentrations of thyroxin remained low during the first estrous cycle and its level subsequently increased in next estrous cycle. Serum T_4 level was comparable between cyclic and acylic animals in the present study suggesting that serum T_4 concentration did not influence directly on cyclicity of experimental animals.

Based on present observation it may be suggested that high serum NEFA and low serum insulin concentrations may affect the postpartum ovarian cyclic activity, however, blood glucose, serum T_3 and T_4 concentrations probably did not have direct effect on postpartum ovarian cyclic activity in Sahiwal cows.

TABLE: MEAN ± SE OF PROGESTERONE, METABOLIC HORMONES AND BLOOD METABOLITES IN CYCLIC AND ACYCLIC SAHIWAL COWS ON DAYS 50 AND 60 POSTPARTUM

Parameters	Day 50		Day 60	
	Cyclic (n=2)	Acyclic (n=16)	Cyclic (n=12)	Acyclic (n=6)
Progesterone (ng/ml)	0.69 ± 0.13	0.39 ± 0.02	2.02 ± 0.18	0.64 ± 0.10**
Glucose (mg/dl)	48.66 ± 1.46	48.33 ± 1.14	48.66 ± 1.37	51.16 ± 1.68
NEFA (mMol/L)	0.066 ± 0.02	0.18 ± 0.02**	0.058 ± 0.018	0.20 ± 0.008**
Insulin (µU/ml)	13.16 ± 0.25	11.48 ± 0.82*	15.16 ± 0.44	13.03 ± 0.55*
T_3 (ng/ml)	1.77 ± 0.13	2.11 ± 0.34	2.15 ± 0.23	1.87 ± 0.21
T_4 (ng/ml)	107.0 ± 2.69	107.83 ± 1.64	110.0 ± 2.62	107.50 ± 2.3

**Significant ($P < 0.01$), *Significant ($P < 0.05$)

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