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RESUMPTION OF OVARIAN ACTIVITY AFTER CALVING AND INFLUENCE ON REPRODUCTIVE PERFORMANCE IN DAIRY COWS (A REVIEW)*

IVAN STANČIĆ, DEJAN VUKOVIĆ, RATKO MIJATOVIĆ, BLAGOJE STANČIĆ, STOJA JOTANOVIĆ, IGOR APIĆ, MIHAJLO ERDELJAN[1]

SUMMARY: During the past few decades, continued genetic progress for milk production, coupled with new reproductive technologies performed in high-producing dairy cows, has led to significant decreasing of dairy cows fertility all over the world. Delayed anoestrus post partum is one of the major causes of fertility decreasing and economic losses in intensive milk production. The aim of these paper is to review the causes and possibility for reducing its impact on subsequent reproductive performance in dairy cows.

Key words: *ovarian aktivity, anestrus, post partum, dairy cow.*

INTRODUCTION

The duration of the interval between two successive calving (i.e. calving interval) is the main parameter of reproductive efficiency in dairy cow herds. This period should, optimally, last 12 to 13 months, because, in that situation, the maximum milk and calves production per cow per year can be achieve (Crowe, 2008). However, in the practical intensive production conditions, calving interval often lasting over 14 months. As the duration of pregnancy is biological constant, the duration of this period is significantly influence by the period from calving to successful conceptions establishment, i.e. service period duration (Stančić and Košarčić, 2007).

From the standpoint of reproduction, duration of service period is directly determined by the interval from calving to first ovulatory estrus resumption, and by the

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[1]Ivan Stančić, DVM, PhD, assistant professor, Blagoje Stančić, PhD, full professor and Mihajlo Erdeljan, DVM, assistant, University in Novi Sad, Faculty of Agriculture, Novi Sad, Serbia. Dejan Vuković, DVM, MS, Veterinary Ambulance, PKB, Beograd, Serbia. Ratko Mijatović, DVM, MS, Veterinary Ambulnce, Banja Luka, Republic of Serbska (Federation BiH). Stoja Jotanović, PhD, associate professor, University of Banja Luka, Faculty of Agriculture, Republic of Serbska (Federation BiH). Igor Apić, DVM, Veterinary Institute, Subotica, Serbia.
Corresponding author: Ivan Stančić, e-mail: dr.ivan.stancic@gmail.com; phone: + 381 21 485-3496.

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period from first to successful insemination (Bousquet et al., 2000). The first ovulation, in healthy cows, is usually occurs between 15 and 30 days post partum. However, at about 70% of cows, this ovulation is silent, i.e. ovulation without manifestation of external estrus signs (Stančić 1989; Crowe, 2008). For practice, it is very important to record the first ovulation after calving, in order to monitoring the following cyclical ovarian activity and estrus manifestations, which can be used for insemination. This is important because the cow should be fertile inseminated within 90 days post partum, in order to achieve optimum length of calving interval of 12 months. However, during the past few decades, numerous studies have reported the significant decrease in dairy cows reproductive performance, primarily as a result of delayed resumption of ovarian activity post partum (Thacher et al., 2006; Savović, 2010; Gautam et al., 2010; Gvozdić et al., 2011). The aim of this paper is to review the recent findings about post partum ovarian activity resumption in high milk producing dairy cows.

REPRODUCTIVE PERFORMANCE IN HIGH MILK PRODUCED HERDS

In recent decades, a permanent decline of reproductive performance is estimated in high milk producing dairy cows herds all over the world (Dobson et al., 2007). Reduction in reproductive efficiency is manifested by prolonged post partum anoestrus (Thacher et al., 2006), increasing the number of cows with silent estrus of irregular lasting, as a consequence of shortened luteal phases in the early cycles post partum (Lucy, 2007), reduced successful conception rate after first insemination (Lucy, 2001), increasing the number of cows with abnormal preimplantational embryos development, as well as increasing the various uterus diseases (Furchon et al., 2000, Bouchard and du Tremblay, 2003), which leads to increased embryonic and fetal mortality (Lucy, 2007). The substantial increase in the appearance of regular and irregular returns to estrus, and increasing the number of required successful insemination per conception (i.e. AI-index), is direct results of embryos and fetuses mortality (Sheldon and Dobson, 2003; Savović, 2010; Stančić et al., 2011). In the most developed European countries, successful conception rate after first postpartal insemination, decrease from 55% to 45%, in the period since 1990. to 2000. year (Bousquet et al., 2004). Increasing number of insemination per successful conception (i.e. AI-index) is the direct result of conception rate decrease. For example, Lucy (2001) states that past 20 years, AI-index decrease from average 1.75 insemination per successful conception, to over 3 insemination per conception. This parameter is very important for assessing the degree of fertility of cows, because it is inversely proportional to the successful conception rate and service period duration (Kossaibati and Esslemont, 2000). It has been suggested that in high-yielding dairy herds, there is marked incidence of prolonged anoestrus post partum increasing and that this is the main factor that reduce reproductive performance and economic looses in high-yielding dairy herds (Peter et al., 2009). Direct consequence of prolonged anoestrus after calving is increasing the service period duration. Therefore, the control of service period duration is the most important factor for increase the reproductive performance in dairy cow herds. This control include interaction of three basic factors: (1) normal resumption of cyclic ovarian activity post partum, (2) effective detection estruses post partum and (3) high successful conception rate after first insemination post partum (Iglesia et al., 1996; Crowe, 2008; Garcia et al., 2011).

Milk production in the contemporary high-yielding dairy herds are usually ranges

between 8,000 and over 10,000 kg per cow per year. This is the result of very intensive selection to the high milk yield, as well as advances in feeding and housing technology. Most research shows that the decline in reproductive efficiency of cows is directly related to high milk production, as well as a variety of stressful factors, resulting from the technology of housing cows in very cramped conditions (Rodriguez-Martinez et al., 2008). In addition, application of modern biotechnology for stimulation and control of certain reproductive functions, and treatment of reproductive disorders, also have a significant impact on the reduced reproductive performance of high- yielding dairy cows. This, in particular, relates to the use of hormonal drugs (gonadotropins, progestogens and luteolitics), used for the induction and synchronization of post partum oestrus (Grafenau et al., 1998; Grafenau et al., 1999; Stančić and Košarčić, 2007; Grafenau et al. , 2008; Gvozdić et al., 2011).

PHYSIOLOGOY OF OVARIAN ACTIVITY ESTABLISHMENT *POST PARTUM*

During the period of pregnancy, in the cows blood circulation dominate high concentrations of progesterone, originate from gestational corpus luteum and placenta. High concentrations of progesterone, via the hypothalamus, inhibit the release of gonadotropins (Follicle hormone - FSH and Luteinizing hormone - LH) from the pituitary, resulting in the absence of ovarian activity, in terms of follicular growth and ovulation (McDonald, 1989). Therefore, cow exhibit gestational anoestrus. However, about 20 days before normal term of parturition, blood progesterone concentrations rapidly decline, especially during the 2 to 3 days before parturition. This decrease in progesterone concentration is a consequence of GnRh-ACTH secretion (gonadotropin releasing hormone adrenocorticotropic hormone) from the fetal hypothalamus, which stimulate ACTH secretion from the fetal pituitary. ACTH stimulates the secretion of cortisol from the fetal adrenal cortex, which inhibits the synthesis of progesterone in the placenta and stimulates the synthesis of estrogen and $PGF_{2\alpha}$ in the placenta. Estrogen and $PGF_{2\alpha}$ stimulate the secretion of oxytocin from the mother neurohypophysis and inhibition of secretion of progesterone from the gestational corpus luteum. These events stimulate the myometrial contractions and beginning of parturition (Peters and Ball, 1987).

Resumption of cyclic ovarian activity (follicular growth and ovulation), under the influence of pituitary gonadotropins (FSH and LH) secretion, normally occurs within the first 2 to 4 weeks post partum (Webb et al., 2004). The growth of ovarian follicles begins usually 7 to 10 days post partum, as a result of pituitary FSH secretion increasing, about 3 to 5 days after calving. Tonic releasing of pituitary LH release (i.e. LH-surge), lead to final growth of dominant follicles and ovulation (Peters and., 1994; Stančić et al., 1995; Ginther et al., 996; Crowe et al. 1998). After the first ovulation post partum, cyclic corpus luteum formating and cyclic ovarian activity resume. Over 80% of cows normally resume cyclic ovarian activity within the first 35 days after calving (Reist et al., 2000). Generally, in normal cows, the first ovulation, on average, occurs 15 days, second 32 days and the third 53 days after calving (Wattiaux, 1996; Walker, 1997). However, it is normal that the first ovulation post partum is silent, with no external signs of estrus, in the about 76% of cows. Second estrus is visible in about 50%, and the third estrus after calving is visible in more than 90% of cows (Walker, 1997; Stančić and Košarčić, 2007; Crowe, 2008).

PROLONGED *POST PARTUM* ANESTRUS

In high producing dairy cows, described endocrine mechanisms of cyclic ovarian activity resumptin, may be delayed for shorter or longer period after calving, leading to increasing the period from calving to first ovulation. As a consequence, postpartum anoestrus period will be prolonged (Thacher et al., 2006). If ovulation does not occur within the first 35 days post partum, and if the first estrus is not manifest within the first 50 days post partum, the postpartum anoestrus is prolonged (Stančić, 1989; Walker, 1997). Also, if ovulation occurs within the first 35 days after parturition, and no luteal activity (increase in concentration of progesterone) $\geq$ 14 days after ovulation, it is also considered to be prolonged anoestrus post partum. Today, the prolonged postpartum estrus was defined as absence of increasing concentrations of progesterone in blood plasma or milk, within the first 50 days post partum (Gautam et al., 2010). According to some studies, between 20 and 48% of dairy cows manifested prolonged postpartum anestrus (Rhodes et al., 2003). In one of our research, performed on a large dairy farm in Vojvodina, within the first 60 days after calving, the first estrus was recorded in only 36% of cows that had no peripartal problems, while this value was about 10% lower in cows with disorders during and immediately after calving (Savović, 2010; Stančić et al., 2011). Some studies show that prolonged period for ovarian function resumption, occurs in about 75% of high milk production cows, which is usually a consequence of prolonged luteal phase or delayed first ovulation after calving (Shrestha et al., 2004).

The interval from calving to first ovulation, may be significantly prolonged, influenced by numerous zootechnological factors, such as inadequate nutrition, poor body condition, poor housing conditions, high milk production, calving parity and inadequate ambiental climate factors (Santos et al., 2009). Prolonged anoestrus post partum also can be the result of post partum disorders and diseases of infectious and non-infectious etiology (Peter et al., 2009). Basically, all these factors influence the prolonged inhibition of pituitary FSH and LH secretion, which delays the normal development and ovulation of dominant follicles. Although these factors do not affect the initial disturbance of ovarian follicles growth post partum, it was shown that they can significantly disrupt and/or prolong the ultimate growth, maturation and ovulation of dominant follicles (Peter et al., 2009).

The rapid weight losses, as a result of significant negative energy balance in the cows body, due to intensive increase in milk production during the first 2 to 3 months of lactation, is one of the most common causes of prolonged post partum anestrous (Crowe, 2008; Erdeljan et al., 2011). Negative energy balance is directly related to the inhibition of Gn-RH release from the hypothalamus, which results in reduced and/or delayed ovulatory LH surge release from pituitary (Mwaanga and Janowski, 2000). This inhibition is associated with a low content of IGF-I (insulin-like growth factor), in cows with a negative energy balance (Zulu et al., 2002).

Dystocia, retention of placenta and uterine infection are the most common pathologic causes of prolonged postpartum anestrous. These disorders is usually caused by prolonged duration of gestational corpus luteum (i.e. corpus luteum persistent), as a result of impaired synthesis of $PGF_{2\alpha}$ an luteolitic hormone in the inflamated endometrium (Stančić, 1995; Fourchon et al., 2000; Gröhn and Rajala-Schultz, 2000; Bell and Roberts, 2007; Savović, 2010; Stančić et al., 2011; Gvozdić et al. 2011).

The formation of follicular cysts in the early post partum period, also signifi-

cantly prolonged interval from calving to first ovulation (Kesler and Garverick, 1982). Follicular cysts are defined as follicular structures with a diameter of at least 2.5 cm, which persist for at least 10 days in the ovary, in the absence of corpus luteum. They can be pure follicular cysts (i.e. enlarged unovulated follicle) or luteinizing follicular cyst (partial lutinization of follicle theca interna), in contrast to the corpus luteum cyst. The concentration of progesterone in blood plasma of cows with follicular cysts was low (<1.0 ng / ml), but was significantly increased in cows with luteal follicular cysts. Clinically, cows or heifers with follicular cysts, is usually anoestrual or nymphomanic, depending on the level of follicular wall luteinization (luteal follicular cysts) and the size and number of pure follicular cysts. Cows with cystic corpus luteum usually manifested a normal estrous cycle (Kesler and Garverick, 1982). Although many follicular cysts, formed in the early postpartum period, regresses spontaneously, their occurrence in 6 to 19% of animals, they represent a significant problem of reproduction in herds of dairy cows. Namely, it is often difficult to assess whether performed a more expensive treatment, or waiting for the cyst spontaneously regresses (Gossen and Hoedemaker, 2006). Occurrence of follicular cysts etiology is not understood, but it is known that all the factors that can disrupt the physiological mechanism for release of Gn-RH from the hypothalamus, may lead to follicular cyst. The relatively successful treatment of follicular cysts with Gn-Rh preparations supports this assumption. Cystic follicles are significantly more common in some breeds (Holstein Friesian and Jersey), and less in some others (Guernsey and Ayrshire). There is also considerable variation depending on the occurrence of cysts in some line of bulls within the same race (Coleman, 2008).

Some studies suggest that a prolonged interval from calving to first estrus is genetically determined in high milk producing breeds (Jamrozik et al., 2005). It was found that prolonged anestrous is more common in some breeds (genotypes), for example Holstein Friesian, but mechanism of action of genotype on this phenomenon is unknown (Mwaanga and Janowski, 2000). In the high producing dairy cows herds, a manifestation of external signs of estrus is not always clearly expressed, and this period is short, often as a result of metabolic imbalances due to high milk production or as a result of some pathological conditions, such as mastitis, endometritis, laminitis, etc. (Veselinović et al ., 2004; Van Eerdenburg et al., 2002; Diskin, 2008). Quite often it happens that signs of estrus are not registered, because of inadequate estrus detection technologies on the farm, or because the estrus signs are weak and/or short manifested (Garcia et al., 2011). Clearly expressed outward signs of estrus, particularly standing reflex, are a very good indicator of high reproductive efficiency of cows. In addition, estrus detection is significant for determine the optimal moment of insemination, which is one of the primary factors of high herd reproductive efficiency (Garcia et al., 2011).

CONCLUSION

Numerous studies clearly show a significant reduction in reproductive efficiency of high-yielding dairy cows herds worldwide. The main reasons are the increased occurrence of prolonged post partum anestrous and increased number of rebreedings (unsuccessful insemination), as a result of significantly increased of embryonic and fetal mortality rate. Direct result is the increasing of service period and intercalving interval duration. The ultimate result is significant reduction of milk and calf production per cow per year. The problem of prolonged post partum anestrous in herds of high

producing dairy cows is very complex, as a consequence of the interaction between multiple genetic and paragenetic factors. Therefore, it is not possible to defined a unique and practical useful method to solving this problem. However, the earlier records of prolonged postpartal cyclic ovarian activity resumption or prolonged absence of luteal activity after the first ovulation, which occurred within the normal (physiological) post partum period, is the crucial factors to significantly shorten the service period and, consequently, increase the reproductive efficiency in high-yielding dairy cows herds.

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REUSPOSTAVLJANJE OVARIJALNE AKTIVNOSTI POSLE TELENJA I UTICAJ NA REPRODUKTIVNU PERFORMANSU VISOKO MLEČNIH KRAVA (PREGLED)

IVAN STANČIĆ, RATKO MIJATOVIĆ, BLAGOJE STANČIĆ, STOJA JOTANOVIĆ, IGOR APIĆ, MIHAJLO ERDELJAN

Izvod

Tokom nekoliko zadnjih decenija, genetski napredak u proizvodnji mlek, povezan sa primenom novih reproduktivnih tehnologija, doveo je do značajnog smanjenja fertiliteta u zapatima krava visoke mlečnosti širom sveta. Produžen postpartalni anestrus je jedan od glavnih uzroka smanjenog fertiliteta i ekonomskih gubitaka u intenzivnoj proizvodnji mleka. Cilj ovog rada je da se prikažu uzroci i mogućnost smanjenja uticaja ovog faktora na sledeću reproduktivnu performansu visoko mlečnih krava.

Ključne reči: ovarijalna aktivnost, anestrus, post partum, muzna krava.

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