

Review Article

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Postpartum Uterine Infections in Cows and Factors Affecting it– A Review

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ABSTRACT

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Uterine infections in postpartum phase are the most common and of greatest economic importance in dairy animals. Uterine function is often compromised in cattle by bacterial contamination of the uterine lumen after parturition; pathogenic bacteria frequently persist, causing uterine disease, a key cause of infertility. Certain risk factors resulting in an increase in chance of clinical disease are retained placenta, dystocia, twins and stillbirth calves. Although many cows eliminate these bacteria during the first 5 weeks after parturition, but in 10–17% of animals infection persists which causes uterine disease. The presence of pathogenic bacteria in the uterus causes inflammation, histological lesions of the endometrium and delays uterine involution. In addition, uterine bacterial infection, bacterial products or the associated inflammation, suppress pituitary LH secretion, and perturbs postpartum ovarian follicular growth and function, which disrupts ovulation in cattle. Thus, uterine disease is associated with lower conception rates, increased intervals from calving to first service or conception, and more cattle culled for failure to conceive.

Introduction

Postpartum reproductive health in dairy cattle is judged by complete uterine involution (return to its normal size and position), free from infection and for cows to have cyclic activities by the time they enter the breeding period (LeBlanc, 2002; Gautam *et al.*, 2009).

80 to 100% of cows will have bacterial contamination within the uterus after parturition. Cows with abnormal vaginal discharge are more likely to have an increased an ovulatory period or extended postpartum luteal phases. Cows diagnosed with endometritis have 20% lower conception rates and the average interval from calving to

conception is 30 days longer. Decrease in reproductive performance is seen even after cows are successfully treated for endometritis. Sub-clinical endometritis can persist after outward signs resolve which result in an increase in number of days open and more services per conception (Sheldon *et al.*, 2009).

Postpartum uterine infections can delay the regeneration of endometrium and disrupt the resumption of cyclic ovarian function which leads to the postponement of first insemination (AI), increase in number of inseminations per conception and thus calving interval is prolonged (Foldi *et al.*, 2006).

LeBlanc *et al.*, (2002) reported that conception rate was 20% lower in cows with endometritis, and calving to conception interval increases by 30 days and about 35% more animals were culled for failure to conceive.

Reduced fertility due to postpartum infection can increase the amount of hormones used for synchronization as well as multiple doses of semen due to increased services per conception. Milk production is reduced due to the reproductive tract infection. Also, treatment affects the individual due to high expenses and can reduce the amount of saleable milk due to milk-withdrawal periods. Culling rates also increase when the cow fails to conceive (Sheldon *et al.*, 2009).

Postpartum uterine infection

Postpartum period is defined as the period after parturition and lasts until reproductive function is restored so that another pregnancy can occur. There are four major events during this period which include: myometrial contractions and expulsion of secundus, endometrial repair, resumed ovarian function and elimination of bacterial contamination in the reproductive tract (Senger, 2012). Secundus begins three days postpartum, reaches its peak during second week and all the fluid is normally expelled by 18 days postpartum (Olson *et al.*, 1986). Viscous consistency of normal secundus changes to foul smelling watery and reddish brown exudates because atonic uterus is not able to expel its content during puerperal metritis (Smith and Risco, 2002) and increases the risk of bacterial complications (Sheldon and Dobson, 2004). Uterine involution consists of the reduction in uterine size, clearing bacterial contamination, sloughing of caruncles and regeneration of the endometrium (Sheldon *et al.*, 2008) and is completed by 28 days postpartum (Saut *et al.*, 2011). Resumption of

cyclicality also occurs during this interval, with the first ovulation occurring around days 40 to 45 postpartum (Cengic *et al.*, 2012). This interval can be affected by nutrition, body condition, parity and can be extended due to uterine disease (Sheldon *et al.*, 2002).

Bacterial contamination of uterine lumen after parturition often hinders the uterine function (Sheldon and Dobson, 2004). Bacteria can be cultured from samples collected from uterine lumen of dairy cattle in the first 2 weeks after parturition without appearance of any apparent clinical signs (Sheldon *et al.*, 2002).

Polat *et al.*, (2009) reported that 10-17% of cows have pathogenic bacteria two weeks post-calving while Sheldon (2007) found that intensively managed dairy cattle often have bacterial uterine contamination rates of 90 to 100% within the first two weeks postpartum. Prevalence of clinical and sub-clinical endometritis after parturition ranges between 5 to >30% and 11 to >70%, respectively (Galvao *et al.*, 2009).

Uterine infections can be classified as puerperal metritis, clinical endometritis, sub-clinical endometritis and pyometra (Sheldon, 2004; Sheldon *et al.*, 2008).

Puerperal metritis

Metritis is a severe inflammatory response that occurs within all the layers of the uterus including the endometrium, submucosa, myometrium and perimetrium. Puerperal metritis usually occurs within Day 10 postpartum and is defined as an acute systemic illness caused by an infection of the uterus (Sheldon *et al.*, 2006). Important characteristic of puerperal metritis is rectal temperature greater than 39.5°C within 21 days after calving. Retained placenta, fetal maceration or difficult calvings are predisposing factors for occurrence of

puerperal metritis (Foldi *et al.*, 2006; Chapwanya, 2008). Up to 40% animals develop metritis within the first fourteen days of calving and 10 to 15% of these animals have infection for at least another three weeks leading to a chronic uterine disease known as endometritis (Sheldon and Dobson, 2004).

Endometritis

In postpartum cows, endometritis continues to be a major cause of poor fertility and delayed conceptions (Couto *et al.*, 2013). Two important types of endometritis have been recently recognized as the clinical and sub-clinical endometritis (Barlund *et al.*, 2008). Such cows do not show any signs of systemic illness (Sheldon, 2004).

Clinical endometritis is defined as a purulent or mucopurulent discharge or a cervical diameter >7.5 cm after 20 days in milk (DIM) or mucopurulent discharge after 26 DIM (LeBlanc *et al.*, 2002). Cows with endometritis have deeper uterine tissue involvement, higher degrees of bacterial contamination (Foldi *et al.*, 2006). Endometritis is defined as inflammation of mucus membrane of uterus and presence of mucopurulent to purulent discharge in uterus after three weeks of parturition or later (Turk *et al.*, 2011). Clinical findings by rectal palpation of the uterus are asymmetric uterine horns, thickened uterine wall and palpable presence of fluid during clinical endometritis (Lewis, 1997).

Sub-clinical endometritis is characterized by scanty exudates accumulated in uterus resulting in complete lack of cervical discharge with pathognomic property (Kasimanickam *et al.*, 2004; Gilbert *et al.*, 2005) and can be diagnosed by endometrial cytology if purulent discharge is absent in the vagina (Gilbert *et al.*, 1998). Sub-clinical endometritis can be defined by greater than

18% neutrophils in uterine cytology samples at 20-33 days or greater than 10% neutrophils at 34-47 days postpartum (Sheldon *et al.*, 2006).

Pyometra

Pyometra is defined as accumulation of purulent exudate of variable amount in the uterine lumen. Cows having first postpartum ovulation, before bacterial contamination of the uterus has been eliminated, are most likely to develop pyometra (Foldi *et al.*, 2006; Chapwanya, 2008). Pyometra is characterized by the presence of corpus luteum on ovary and accumulation of fluid of mixed echodensity in the uterine lumen and distention of the uterus on ultrasonographic examination (Manns *et al.*, 1985). There is functional closure of the cervix but the lumen is not always completely closed and some pus may discharge through the cervix into the vaginal lumen (Sheldon *et al.*, 2006). Prolongation of the luteal phase may be attributed to increased concentrations of luteotrophic prostaglandin PGE₂ associated with endometrial bacterial infection. Pyometra can occur if ovulation occurs too early in the postpartum period and corpus luteum is formed during uterine infection (Sheldon *et al.*, 2008).

Return of ovarian cyclic activity postpartum depends on the uterine immune response. High concentration of progesterone during luteal phase suppresses the immune response of the uterus and makes the uterus more susceptible to bacterial infection (Lewis, 2003). Negative effects of corpus luteum on the early postpartum uterus can be attributed to progesterone. Myometrium relaxation occurs due to effect of progesterone and hinders the clearing of bacterial contamination of uterus (Bonafos *et al.*, 1995). Also, increase in plasma progesterone concentration leads to decreased phagocytic

activity of both uterine and peripheral blood neutrophils (Dhaliwal *et al.*, 2001).

Factors affecting postpartum reproductive function

Condition of the postpartum reproductive tract is related to many attributes. Various factors such as puerperal condition, parity, season of calving, age of dam, level of feeding, suckling have influence on postpartum fertility of cattle (Zain *et al.*, 1995).

Parity

Rekwot *et al.*, (2000) concluded that uterine involution is rapid in pluriparous cows after examining cows for first 20 days postpartum. Onset of postpartum ovarian activity may take longer interval in primiparous cows (Lucy *et al.*, 1992). Days from calving to ovulation (first and second) and the number of follicular waves to first ovulation are more in primiparous cows than in multiparous cows. Parity, postpartum uterine involution and resumption of ovarian activity are negatively related to each other (Zhang *et al.*, 2010).

Uterine infections develop in cows having parity greater than 3 due to delayed involution of uterus and chances of endometritis after 3 weeks of parturition are more. Heifers and cows having parity less than three tend to develop puerperal metritis because of uterine tissue damage during dystocia (Bruun *et al.*, 2002). Uterine infections just after parturition affect the reproductive function of cow (Kim and Kang, 2003). Primiparous cows are at higher risk of clinical endometritis compared to second-parity cows (Aghamiri *et al.*, 2014).

Season

Calving season also affects postpartum reproductive function. Early involution occurs

in dry season than in rainy season (Rekwot *et al.*, 2000). Elmetwally *et al.*, (2016) recorded that ovarian cyclicity resumes much earlier in spring season as compared to winter season. Campo *et al.*, (2002) found no significant effect on uterine involution period due to calving season.

Buckley *et al.*, (2010) reported a positive association between retention of foetal membranes with a seasonal pattern on the incidence of uterine infections. Reduced feed intake during winter season resulting in negative energy balance leads to metritis. Also, immunosuppression and decreased leukocyte activity during winter increases the risk of uterine infection (Onyango, 2014). Winter months and stabling mean lack of grazing, increased energy expenditure for maintenance, different feed, overcrowding, reduced exercise and less access to sunlight increases the risk of postpartum uterine disease (Cady, 2010).

Age of dam

Gunduz *et al.*, (2010) found that age was highly significant in the presentation of uterine infections. Brunn *et al.*, (2002) found high incidence of uterine infection at an early age. Lowest incidence of postpartum metritis occurred in cows between 2 and 4 years of age and was highest in cows older than 7 years (Smith and Risco, 2002). Young cows are prone to uterine injuries during assisted calving and thus predisposing them to uterine infections (Konyves *et al.*, 2009; Tsousis *et al.*, 2009). Cows aged between 2-4 years have a small pelvis compared to older cows and thus greater degree of uterine damage leads to uterine infection (Potter *et al.*, 2010).

Tsousis *et al.*, (2009) found out that cows in their first parity had persistent purulent discharge compared to older cows which could have been as a result of calving

assistance leading to uterine lesions. Endometritis was more prevalent in mature cows where cows in their third or higher lactation had a prevalence of 21% compared to 13% for cows in first and second lactation (LeBlanc *et al.*, 2002).

Dystocia

Dystocia is defined as complications developed during calving which often results in postpartum uterine infections (Foldi *et al.*, 2006; Tsousis *et al.*, 2009). Dystocia results in injury to uterine tissue which can easily be invaded by pathogens and leads to uterine infection (Kim and Kang, 2003). Oversized or malpresented calf can cause injuries to the genital tract during traction and repulsion and thus create septic conditions which may result in infections (Zaborski *et al.*, 2009). Dystocia delays the process of complete parturition by disturbing the hormonal events resulting in placenta retention and predisposing cows to uterine infection (Smith and Risco, 2002).

Multiple births increased the odds for dystocia which was also involved in the aetiology of post-parturient infections (Hossein-Zadeh, 2010). Trauma during dystocia and caesarean section leads to release of heparin (at the site of injury) which inhibits collagenases and can also delay uterine involution and contribute to retention of foetal membranes (Beagley *et al.*, 2010).

Retention of Foetal Membranes (RFM)

Retention of foetal membranes in cattle can lead to adverse health effects that ultimately affect reproductive performance. In cattle, failure to expel foetal membranes within 12 to 24 hours is termed as RFM (Drillich *et al.*, 2003). Decrease in the antioxidant enzyme capacity of the placenta during pregnancy can also contribute to the etiology of RFM. Lower parturition levels of placental superoxide

dismutase and plasma estrogen were found in cows which subsequently developed RFM (Gupta *et al.*, 2005). Normal detachment of the bovine placenta involves separation of the finger-like cotyledon villi from the caruncle crypts. Dystocia and uterine trauma have been associated with uterine atony that could inhibit expulsion of membranes and lead to secondary retention (Au *et al.*, 1992; Eiler and Fecteau, 2007). Vitamin E and selenium can increase chemotaxis and leukocyte numbers at the fetomaternal junction, thus contributing to the normal expulsion of fetal membranes (Bourne *et al.*, 2007).

Opsomer and Kruif (2009) stated that contamination of the uterus by pathogens which had RFMs and dystocia can affect fertility due to the disruption of the normal endocrine control of ovarian activity, disrupted follicular development, have tendency to prevent the establishment of pregnancy by the presence of pathogenic organisms in the uterine lumen and have two times higher risk of metritis with a subsequent effect on fertility. Infections generally gain entry during calving and frequently associated with difficult birth (dystocia) and Retention of Fetal Membranes (RFM).

Under normal condition the microorganisms are eliminated from the uterus during uterine involution by the normal Uterine Defense Mechanism (UDM). However, when the UDM is compromised due to various factors the clinical symptoms of metritis sets in and sometimes leads to the death of the animal (Deori and Phookan, 2015).

Negative sequel to RFM include delayed uterine involution, longer time to 1st service, increased services per conception, decreased pregnancy rates and increased days open. RFM also have been associated with increased risk for endometritis, metritis, ketosis, and mastitis (McDougall, 2001; Bruun *et al.*, 2002).

In conclusion, postpartum uterine infection is the most important cause of infertility in dairy animals. Various predisposing factors like dystocia, RFM, still birth, caesarean section play an important role in establishment of the uterine infections. Extent of uterine infection depends on the immune response of the cow as well as the species and number (load or challenge) of bacteria. The infectious agents colonize and penetrate the mucosal epithelium and/or release bacterial toxins that lead to establishment of uterine infection. As uterine infections affect the cyclicity of animal, intrauterine transport of sperm and embryo implantation thus leading to delayed calving to first service interval and reduced conception rates posing huge economic losses to the farmers, therefore, proper nutrition during pregnancy, hygienic conditions during calving and immediate veterinary care in case of dystocia is required to limit the postpartum uterine infections.

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