IMPACT OF OXYTETRACYCLINE AND PROSTAGLANDIN F2α DURING PUERPERIUM PERIOD ON UTERINE RECOVERY AND POST-PARTURIENT REPRODUCTIVE CHARACTERISTICS IN BALADI COWS

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SUMMARY

This study aims to determine the influence of oxytetracycline and prostaglandin F2α during the puerperium period, on uterine recovery and post-parturient reproductive characteristics in Baladi cows. Twenty Baladi cows were used immediately after birth and were divided into two groups of 10 cows per group. The first group (n=10 cows) was treated with 20 ml intrauterine infusion of oxytetracycline hydrochloride solution for three consecutive days during the puerperium period and 5ml intramuscular prostaglandin F2α injection once after three hours from calving, while the second group (n=10 cows) was used as a control group. The present findings demonstrated the interval from parturition to uterine involution in Baladi cows was significantly (P<0.05) lower, (28.4 ± 4.5, days) in treated cows compared to 45.7 ± 3.5, days in control group cows. However, the period from calving to the resumption of estrus activity postpartum was significantly (P<0.05) higher, 60% in treated cows compared to 30% in control cows. Meanwhile, the time from calving to conceived was significantly (P<0.05) less (96.5±12.3, days) in treated cows than (155.3±15.2, days) in controlled cows. In addition, the conception rate from first mating was significantly (P<0.05) higher, 60% in treated cows compared to 30% in control cows. In conclusion, the current study demonstrated improvement in post-partum reproductive performance in cows which treated with oxytetracycline and prostaglandin F2α during the puerperium period. So, the study recommends that small breeders should treat their cows during the puerperium period.

Keywords: Oxytetracycline, prostaglandin F2α, uterine recovery, reproductive characteristics, Baladi cows

INTRODUCTION

The puerperium period in cows is one of one of the most harmful periods in the life of the animal, as cows are exposed to infection by some pathogenic microbes inside the uterus that affect their reproductive performance after calving. Most of the cow breeders under the traditional and, bed, stalls system, especially in Upper Egypt, villages, would intervene to help their cows during parturition, thus exposing the cows to microbial pollution infection. Management factors and complications at parturition such as calving assistance can increase the incidence of uterine disease and have been identified as risk factors for clinical and subclinical endometritis (Wagener et al., 2014). The calving environment, dystocia, retention of the placenta, twins, and diet are considered the plausible risk factors for uterine infection (Sheldon et al., 2008). We must understand that there is an interactive relationship between the environment and uterine infection, immunity, and reproduction so that we can make strategies to counteract the fertility decline in cattle (Sheldon et al., 2008). Bacterial contamination of the uterine lumen is common in cattle during calving which leads to infection and uterine disease (Sheldon et al., 2008). One of the costliest issues facing the dairy industry is a uterine disease. Eicosanoids have the potential to directly affect uterine immunity, and exogenous PGF2α is possibly an effective treatment for uterine diseases (Lewis and Wulster-Radcliffe, 2006). Infertility conjugated with the uterine diseases causes harm to the endometrium and disruption of ovarian activity. Bacteria causes fluctuation in endometrial prostaglandin secretion and perturb ovarian follicle growth and function (Sheldon et al., 2008). Subclinical endometritis declines conception rates (Kasimanickam et al., 2004 and Gilbert et al., 2005). The primary goal of postpartum reproductive health in cows is the full involution of the uterus, the defense against infection, and the resumption of normal estrous cycle activity (LeBlanc et al., 2002 and Gautam et al., 2009). The uterine size declines during the puerperal cycle as the endometrium regenerates, a bacterial infection is removed and ovarian cyclicity in a phase known as uterine involution resumes, a condition for effective reproduction afterward (Heppelmann et al., 2013). A uterine bacterial infection occurs shortly after calving in many cows (Sheldon et al., 2009a and Molina-Coto and Lucy, 2018). Prunner et al. (2014) showed that the rate of uterine bacterial growth increased during the 15 days post-partum. Sheldon et al. (2006) and Földi et al. (2006) observed that uterine...
infections at or after calving are considered common, with 80-100% of animals possessing uterine lumen bacteria in the first 2 weeks, after birth. Subclinical endometritis is characterized as endometrial inflammation without systemic symptoms (Maduz et al., 2014 and Mariño et al., 2017). Subclinical endometritis is characterized as endometrial inflammation with a lack of purulent vaginal discharge, (Sheldon et al., 2019 and Tobolski et al., 2021). Subclinical endometritis is a uterine disease with no clinical symptoms that cannot be reliably identified at a farm site (Ricci et al., 2015). Cows with uterine inflammation have poor reproductive efficiency, resulting in lower conception rates, more open days, and more losses in pregnancy (Galvão et al., 2009 and Vieira-Neto et al., 2014). Changes in the immune and endocrine systems are associated with increased sensitivity of cows to infections during the periparturient period (Cai et al., 1994). Pothmann et al. (2015) found that more than 90% of the subclinical endometritis diagnosed have been found in multiparous cows. Alterations of a prostaglandin E2 and F2α synthesis pattern were associated with infected cows with subclinical endometritis (Gabler et al., 2009 and Baranski et al., 2013). Estradiol and progesterone impair the production of PGE and PGF in response to lipopolysaccharides (LPS), indicating the role of steroid hormones in interaction with bacterial contamination (Herath et al., 2006). The production of dairy cows is adversely affected by clinical, and subclinical endometritis, and economic losses are attributed to delays in resumption of ovarian activity, increased number of services per conception, and reduced milk yield (LeBlanc, 2008 and Cheong et al., 2011). The percentage of incidence rate of subclinical endometritis in normal parturition was 36.47% compared with 85.5% in abnormal parturition (Moges, 2015). Reduced activity of the dominant ovarian follicle was correlated with bacterial infection of the endometrium (Sheldon et al., 2002 and Williams et al., 2007). One of the best protocols for the treatment of postpartum endometritis in dairy cows is an intrauterine antibiotic infusion (Drillich et al., 2005). Intrauterine administration is helpful, especially in cows' treatment and prophylaxis of postpartum endometritis (Malinowsk et al., 2004). Kasimanickam et al. (2005) and Denis-Robichaud and Dubuc (2015) reported the importance of using antimicrobials and prostaglandin F2α in treatments of dairy cows with subclinical endometritis. Oxytetracycline is one of the broad-spectrum antibiotics used to treat postpartum endometritis in dairy cows (Sheldon et al., 2004). Noakes and England (2009) reported that oxytetracycline administration can be used as a prophylactic intrauterine antibiotic post-assisted parturition. For the treatment and prevention of endometritis, two major methods are commonly used: the use of antibiotics (intrauterine or systemic) or prostaglandins (PGF2α) (Lefebvre and Stock, 2012). PGF2α seems to be beneficial for clinical endometritis therapy (Salasel and Mokhtary, 2011). Intrauterine treatment with chlortetracycline was better than no treatment in dairy cows (Goshen and Shpigel, 2006). This study aims to determine the influence of oxytetracycline and prostaglandin F2α during the puerperium period in Baladi cows, which need simple assistance in parturition on uterine recovery and post-parturient reproductive characteristics.

MATERIALS AND METHODS

Farm and environment conditions:

The study was performed on a traditional farm in the Kom Ombou region (32° 31’ 23” east and 22° 28’ 09” north), in the Aswan governorate. In traditional farm conditions, the cows were raised and housed in semi-shaded sheds and tied. Table (1) illustrates ambient temperature (°C), relative humidity (RH %), and temperature humidity index (THI) during the study. Table (2) clarifies the classification of zones based on THI values in cattle with THI model proposed by (Samal, 2013). The study extended from November to April. Estimated temperature humidity index (THI) according to the formula suggested by Mader et al. (2006):

\[ \text{THI} = 0.8 \times T_{\text{max}} \text{db} + \left\{ \left[ \text{RH} / 100 \right] \times \left( T_{\text{max}} \text{db} - 14.4 \right) \right\} \times 46.4 \]

Temperature-humidity index (THI) = 0.8 x ambient temperature + [(% relative humidity) x (ambient temperature -14.4)] + 46.4

Table 1. Ambient temperature (°C), relative humidity (RH %), and temperature humidity index (THI) during the experimental period

<table>
<thead>
<tr>
<th>Months of calving</th>
<th>Average Temperature (°C)</th>
<th>Average Relative humidity (RH %)</th>
<th>THI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Min.</td>
<td>Max.</td>
<td></td>
</tr>
<tr>
<td>November</td>
<td>20.4</td>
<td>30.2</td>
<td>19</td>
</tr>
<tr>
<td>December</td>
<td>16.1</td>
<td>29.5</td>
<td>20</td>
</tr>
<tr>
<td>January</td>
<td>13.2</td>
<td>20.5</td>
<td>23</td>
</tr>
<tr>
<td>February</td>
<td>14.3</td>
<td>23.4</td>
<td>22</td>
</tr>
<tr>
<td>March</td>
<td>19.3</td>
<td>31.3</td>
<td>19</td>
</tr>
<tr>
<td>April</td>
<td>21.4</td>
<td>35.0</td>
<td>17</td>
</tr>
</tbody>
</table>
Table 2. Classification of zones based on THI values in cattle with THI model according to (Samal, 2013)

<table>
<thead>
<tr>
<th>THI</th>
<th>Stress level</th>
<th>Response of cattle</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;72</td>
<td>None</td>
<td>Non-noticeable</td>
</tr>
<tr>
<td>72-79</td>
<td>Mild</td>
<td>Dairy cows will adjust by seeking shade, increasing respiration rate and dilatation of the blood vessels. The effect on milk production will be minimal.</td>
</tr>
<tr>
<td>80-89</td>
<td>Moderate</td>
<td>Both salivaproduction and respiration rate will increase. Feed intake may be depressed and water consumption will increase. There will be an increase in body temperature. Milk production and reproduction will be decreased.</td>
</tr>
<tr>
<td>90-98</td>
<td>Severe</td>
<td>Cows will become very much uncomfortable due to high body temperature, rapid respiration (panting) and excessive saliva production. Milk production and reproduction will be remarkably decreased.</td>
</tr>
<tr>
<td>&gt;98</td>
<td>Danger</td>
<td>Potential cow death scan occur.</td>
</tr>
</tbody>
</table>

**Trial animals and feeding:**

Twenty Baladi cows were included in the current study. The cow parity ranged from 3rd to 6th and the live body weight varied from 330 to 350 kg at calving. During the experiment, bran, wheat hay and concentrate feed mixture (16% protein) alongside Barseem Higaze (Alfa-alfa) as a green fodder was given to animals. Both cows were kept in the same environmental and administrative conditions according to a work routine.

**Designing the trial:**

Cows number was divided into two equal groups (n= 10 cows per group). The first group was treated with oxytetracycline and prostaglandin F2α, while the second group was served as a control. As recommended by the producer, the cows were treated with a 20ml intrauterine infusion of oxytetracycline sterile solution (Pan-Terramycin oxytetracycline hydrochloride solution 3g. Pfizer, Egypt) for three consecutive days during the puerperium period and 5ml equivalent 25 mg Dinoprost Trometamine (Lutalyse™, Zoetis, 5mg/ml) intramuscular prostaglandin F2α injection once after three hours from calving.

**Postpartum reproductive parameters evaluation:**

The uterine condition score (UCS) was measured and categorized as proposed by (Okawa et al., 2017): UCS1 = the uterus was completely palpable, with uterine horn symmetry and evidence of typical uterine conditions. UCS2 = the uterus was not completely noticeable, but with uterine horn asymmetry and incomplete involution. UCS3 = the uterus was not completely palpable and was located outside the pelvic cavity

**Uterine involution:** When both uterine horns return to their normal position and sit in the pelvic region at the same or almost equal non-gravid scale, their regular tone and quality are called full according to the uterine involution in accordance with Elmetwally et al. (2016) and Gohar et al. (2018).

**Assisted calving:** Those cows that need little help just pull the front legs during the delivery of the fetus.

**Conception rate:** The percentage of cows that are pregnant from the first postpartum mating, and calculated as:

\[
\text{Number pregnant cows} \times 100 \\
\text{Number served cows}
\]

**Identification of estrus and the diagnosis of pregnancy:**

Daily regular visual monitoring of cows was performed. Cows were considered in the estrus period once one of the estrus symptoms was exhibited like, mucus discharge and standing behavior. Post-sixty days (without any estrus symptoms) after service, the pregnancy was diagnosed by rectal palpation method.

**Analysis of hormones:**

Blood samples (10 ml) were collected from cows at estrus, 7th, 15th and 21st days post-service from the jugular vein in heparinized tubes. For plasma processing, samples were centrifuged for 20 minutes at 3000 rpm, plasma was separated, and stored at -18 °C until assay time. The Immunotech (France) radioimmunoassay package was used to test the hormones progesterone (P4) and estradiol-17β (E2). The susceptibility values of progesterone and estradiol-17β were 0.03 ng/ml and 4.0 pg/ml, respectively, according to the manufacturer's information. For progesterone (P4) and estradiol-17β (E2), the intra-assay variance coefficient was 6.4% and 12.1%, respectively.

**Statistical analysis:**

One factor (treatment effect) on uterine involution and postpartum reproductive characteristics was included in the statistical design. Chi Squire was done to test the significance of percentage values. The statistical analysis was carried out using software (SAS, 2002). The following statistical model was used:

\[
Y_{ij} = \mu + T_i + e_{ij}
\]

Where:

- \(Y_{ij}\) = the observation trait,
- \(\mu\) = overall mean,
- \(T_i\) = the fixed effect of \(i\)th treatment (\(i=1,2\) where 1=treated and 2=untreated)
Effect of treatment with oxytetracycline and prostaglandin F2α during the puerperium period on uterine involution in Baladi cows:

Table (3) shows that the period from parturition to uterine involution in Baladi cows was significantly (P<0.05) lower, 28.4±4.5 days in treated cows compared to 45.7±3.5 days in the control group cows. The return of the uterus to its normal non-pregnant size and postpartum role is called uterine involution, which relies on the rate of myometrial contractions, bacterial infection clearance, and endometrium histological regeneration (Elmetwally et al., 2016 and Elmetwally and Bollwein, 2017). During the normal uterine involution process after parturition, a variety of aerobic and anaerobic bacteria grow in the uterine lumen (Sheldon et al., 2008). Epithelial regeneration occurs approximately 25 days after parturition, while full histological regression occurs approximately 6-8 weeks postpartum (Sheldon et al., 2008). The time taken for complete uterine involution was recorded to range from 26 to 52 days in dairy cattle (Noakeset al. 2001). The present findings agreed with those reported by Swelum (2013) who proposed that the intrauterine treatment of dairy cows and camels with oxytetracycline in the puerperium period contributes to uterine tissue regeneration. Sheldon et al. (2004) stated that oxytetracycline is a broad-spectrum antibiotic used to reduce developing uterine bacteria. Beagley et al. (2010) found that intrauterine antibiotics in cattle have an adverse effect on local bacterial development. Malinowski et al. (2004) reported that intrauterine therapy has been found effective in the prevention and prophylaxis of postpartum uterine diseases in cows. In the current research, the beneficial impact of PGF2α therapy on the shortened time from calving to uterine involution was shown to indicate these results in line with those reported by Tobolski et al. (2021). Procedures involving uterine involution involve contractions and peristalsis, so conditions that lower blood calcium content or uterine production of PGF2α can decrease uterine involution and prolong intrauterine infection (Roberts, 1986). There is a positive association between the concentration of PGF2α in puerperal circulation and the uterine horn diameter (Sheldon et al., 2003). Hanzen et al. (2003) reported that repeated administration of PGF2α, 3-13 days after calving accelerates uterine involution by facilitating the removal of the contents of the uterus. To help the uterus overcome infections, exogenous PGF2α can improve immune functions or boost uterine motility (Hirsbrunner et al., 2003). Elsheikh and Ahmed (2005) observed that PGF2α injection within the first week resulted in rapid involution of the uterus in dairy cows. Melendez et al. (2004) reported that at 8 d postpartum, two doses of PGF2α 8 h apart in primiparous Holstein cows diminished the diameter of the uterine horns. Masouni et al. (2018) observed that 25mg PGF2α injection led to uterotonics effects, which may aid accelerate uterine involution in puerperal dairy cows. PGF2α is commonly used during early postpartum to facilitate uterine involution in dairy cows (Salasal and Mokhtari, 2011 and Jeremejeva et al., 2012). A certain amount of PGF2α is assumed to be a prerequisite for the uterine involution process, primarily to induce uterine smooth muscle shrinkage to enhance lochia discharge and uterine morphological and functional recovery (Williams, 2013). Ingawale and Bakshi (2016) suggested that injection of PGF2α on day 14 postcalving led to lowering the time needed for involution of the uterus from 31.5 days to 27.4 days in control and treated buffaloes groups respectively. During 30 days postpartum, dairy cows that received an injection of PGF2α on the day of calving, nearly 60% of cows had their uterus involution, compared to 30% of control dairy cows (Zidane et al., 2011). In cows with subclinical endometritis, PGF concentrations are lower than PGE in the fourth week postpartum, and the ratio of PGE to PGF production may be one of the causes of delayed involution or endometrial regeneration (Baranski et al. 2013).

Effect of treatment with oxytetracycline and prostaglandin F2α during the puerperium period on resuming estrus cyclicity in Baladi cows:

Table (3) illustrates that the time from parturition to 1st postpartum estrus was significantly (P<0.05) below 45.2±9.1, days in treated cows compared to 68.2±6.2, days in control cows. The current results agreed with those reported by Schofield et al. (1999) who found that treatment of dairy cows with prostaglandin F2α, 21 days after calving shortened the first estrus period by around 10 days.Etherington et al. (1985) and Young et al. (1986) suggested that the use of PGF2α between 14 and 28 days postpartum resulted in reduced the period to the postpartum first estrus in dairy cows. Ingawaleand Bakshi (2016) stated that on day 14 postpartum, PGF2α injection resulted in a short interval from calving to the first postpartum estrus of 47.6 days relative to 67.1 days in control buffaloes. Intrauterine treatment with oxytetracycline twice weekly for 2 weeks prevented the negative effects of uterine disease on fertility in multiparous dairy cows (Goshen and Shpigel, 2006). Intrauterine therapy is a helpful medication, especially for the treatment and prophylaxis of postpartum uterine diseases in cows (Malinowsk et al. 2004). Beagley et al. (2010) reported that intrauterine antibiotics have a detrimental and effective impact on local bacterial growth in cattle. Usage of uterine oxytetracycline infusion provided better reproductive performance than the intramuscular method in the first 21st postpartum in cows diagnosed with uterine diseases (Armengol and Fraile, 2015). Intrauterine oxytetracycline can cause inflammatory responses and uterine defense reactions and stimulate uterine
leukocyte cells. It can also contribute to uterine tissue regeneration (Noakes and England (2009) and Swelum, 2013). The interval between parturition and the incidence of first ovulation was positively associated with the time needed to complete uterine involution (Madej et al., 1984). Gundling et al. (2012) found that treatment with PGF2α in cattle shows a positive effect on uterine involution. Uterine inflammation prevents the release of PGF2α by the endometrium and extends the luteal phase of the estrous cycle (Pepper and Dobson, 1987 and Bondurant, 1999). A single administration of PGF2α accelerates uterine involution and hastens a return to fertile estrous cyclicity in the early post-partum period (Lindell and Kindahl, 1983 and Kindahl et al., 1984). Archbald et al. (1993) suggested that during the early postpartum period, the use of PGF2α led to increasing fertility in dairy cattle. Cows with subclinical endometritis recorded a delayed return to postpartum calving ovarian activity (Salehi et al., 2017). In healthy cows, the number of ovarian follicles has been found to be higher and less incidence of cystic follicles than in cows with uterine disease (Maquvivaret et al., 2015). Anovulation is associated in Holstein Friesian cows with subclinical endometritis (Tsousiset et al. (2009). Galvaøet al. (2010) suggested that cows that started to cycle by 21 days postpartum had fewer incidences of subclinical endometritis postpartum and a greater pregnancy rate than an anovulatory cow. Dubucet al. (2012) observed that cows with subclinical endometritis had a delayed restart of ovarian activity postpartum. Opsomer et al. (2000) stated that the first postpartum ovulation is deferred in cows with uterine infections. Kudlac (1991) increased the duration of uterine involution resulting in an extended period of resumption of ovarian activity in the postpartum period in cows. Infected cows with subclinical endometritis early postpartum were less likely to ovulate than healthy cows (Burke et al., 2010). Bacteria modulate the secretion of endometrial prostaglandin and disrupt the development and activity of ovarian follicles (Sheldon et al., 2008). Uterine disease is associated with an increased incidence of anestrus and ovarian cystic (Peter, 2004). McDougall et al. (2007) and Senosy et al. (2009) showed a delayed resumption of dairy cattle to normal postpartum cycles in cows with uterine inflammation.

**Effect of treatment with oxytetracycline and prostaglandin F2α during the puerperium period on days open in Baladi cows:**

Table (3) indicates that the interval from calving to conceived (Days open) was significantly (P<0.05) less, 96.5±12.3, days in treated cows compared with 155.3±15.2, days in controlled cows. The present findings align with those reported by Kasimanickam et al. (2005), who observed that in dairy cows treated with a single PGF2α and antibiotics dose, the period from calving to conception was less than 101, 103 days compared to 119 days in control cows, respectively. Similar findings reported by Risco et al. (1994) showed that routine postpartum application of PGF2α decreases the time from calving to pregnancy in dairy cows. Goshen and Shpigel (2006) suggested that usage of intrauterine antibiotics in normal, treated, and untreated dairy cows with clinical metritis resulted in 140.5, 136.2, and 165.5 days of open days, respectively. Mcclary et al. (1989) treatment of dairy cows with PGF2α during early postpartum resulted in a decline in days open 98.6 days compared to 118.8, days for untreated cows. There were fewer days open for dairy cows treated with prostaglandin F2α (Folman et al., 1990). The dairy cows treated with PGF2α on day 8 postpartum recorded lower days open (White and Dobson 1990). Lopez-Gatius (2003) observed a drop in days open after administration of PGF2α during the early postpartum phase relative to the control group in dairy cattle. Cows with uterine disease (endometritis) recorded a longer interval (151 days) from calving to conception than unaffected dairy cows (119 days) (LeBlanc et al., 2002). Galvaø et al. (2009) showed that PGF2α treatment in dairy cows with subclinical endometritis declines the time from parturition to conception. Bicalho et al. (2016) reported that cows with subclinical endometritis had longer 42 days open compared to healthy cows. Kasimanickam et al. (2004) stated that in cows with subclinical endometritis the days open was longer 141 days compared to 112 days in healthy cows. Similar findings were reported by Gilbert et al. (2005) who found that in cows with subclinical endometritis the time from calving to pregnancy was longer 206 days compared to 118 days in healthy cows. Madoz et al. (2013) observed that cows with subclinical endometritis had an increase in the interval from parturition to conception compared with normal cows 133 and 93, days respectively. Galvaø et al. (2009) reported that treatment with PGF2α in dairy cows with subclinical endometritis led to a decrease in the time from calving to pregnancy. Ricci et al. (2015) proposed that there was a 40-day delay to conception in beef cows with subclinical endometritis relative to normal cows. Vieira-Neto et al. (2014) proposed that cows with subclinical endometritis recorded a longer number of days open compared to healthy cows. Uterine disease results in an increase in the time from calving to pregnancy in multiparous cows (Toni et al., 2015). The time from calving to pregnancy (DO) extended in cows with postpartum uterine disorders such as subclinical endometritis (Barański et al., 2012). Barrio et al. (2015) found that the time from calving to conception (DO) was longer 154 days in cows suffering from subclinical endometritis compared with 119 days in healthy cows.
Effect of treatment with oxytetracycline and prostaglandin F2α during the puerperium period on conception rate in Baladi cows:

Figure (1) shows that the conception rate from the first service was significantly (P<0.05) higher, 60% in treated cows compared with 30% in control cows. One of the safest and most effective protocols for the treatment of postpartum endometritis in dairy cows is an intrauterine infusion of antibiotics (Drillich et al., 2005). The present findings correspond with those stated by Armengol and Fraile (2015) reported that intrauterine infusion of oxytetracycline produce improve reproductive performance in cows during the first 21 days postpartum and increases conception rate from the first service. Ahmadi et al. (2005) found that the pregnancy rate of oxytetracycline-treated cows was 66.7%, compared with 33% of cows receiving only PGF2α. McDougall (2002) stated that intrauterine antibiotic therapy has increased the reproductive efficiency of dairy cattle. Sheldon and Noakes (1998) reported that the pregnancy rate from the first service was 48.7% when treating the cows with tetracycline intrauterine infusion but was 52.5% when PGF2α was used. Goshen and Shpigel (2006) in normal, treated, and untreated clinical metritis (CM) cows after intrauterine antibiotics, conception rates after the first insemination were 38.3%, 42.5%, and 18%, respectively. A lower conception rate from the first service was recorded in dairy cows with uterine infection (endometritis) (29.8%) than in unaffected (37.9%) (LeBlanc et al., 2002). A single dose of antibiotics or PGF2α increases the reproductive efficiency of dairy cows with subclinical endometritis (Kasimanickam et al. 2005). Ribeiro et al. (2015) reported that the occurrence of disease in dairy cows is 42%, from calving to service and these diseases are responsible for the decline in fertility and conceptus development. Bicalho et al. (2016) found that pregnancy rates were 27% lower in cows with subclinical endometritis than in healthy cows. Barlund et al. (2008) reported that cows with subclinical endometritis had a significantly lower first-service conception rate than healthy cows. Embryonic viability is likely to be impaired in a contaminated uterus owing to a decline in uterine milk quantity and the harmful effects of bacterial compounds (McDougall, 2001). The postpartum uterine disease may affect sperm transfer, embryonic attachment failure, and poor placental development (Sheldon et al., 2009a). Early postpartum subclinical endometritis in dairy cows reduces the pregnancy rate by 29%, relative to 45%, in normal cows (Madoz et al. 2013). Vieira-Neto et al. (2014) suggested that cows with subclinical endometritis have a lower conception rate compared to healthy cows. Salasel et al. (2010) and Janowski et al. (2013) reported that 50% of repeat breeder dairy cows suffer from subclinical endometritis. Kasimanickam et al. (2004) suggested that during the postpartum period, the first service pregnancy rate in dairy cows with subclinical endometritis was 18% compared to 32% in healthy cows. Gilbert et al. (2005) showed that the pregnancy rate from the first service was 11% in cows with the uterine disease compared to 36% for healthy cows. Treatment of dairy cows in early postpartum with two doses PGF2α 8 h apart led to an increased first service conception rate (47.1%) in treated cows compared to (27.6%) in the control group (Salasel and Mokhtari, 2011). After the first artificial insemination, the pregnancy rate was zero percent in control cows, but 25.0% in dairy cows who administered PGF2α (Okawa et al., 2021). Melendez et al. (2004) demonstrated that when Holstein cows were administered two doses of PGF2α 8 h apart at 8 d postpartum, the treatment led to an improved pregnancy rate at first service by 17%. Jeremejeva et al. (2012) showed that injections of prostaglandin F2α plus anti-inflammatory drug at periods of 8 h after 8 days postpartum led to a rise in the pregnancy rate by 50% in treated cows compared to 37% in the control group in dairy cows after the first services. Herath et al. (2009) observed that in cows with E. coli infection evidence for raising production of PGE relative to PGF2α. Single PGF2α administration 14 to 28 days post-partum resulted in a 68% increase in first-service conception rate compared to 43% in control cows (Young et al. 1984). McClary et al. (1989) reported that treatment of the dairy cow in early postpartum with prostaglandin F2α led to an improvement of first service pregnancy rates (41.3%) in the treated cows and (35.7%) in the control group. PGF2α has a local influence on the hypothalamic-pituitary axis and an elevated frequency of LH pulses (Peters et al., 1989). Guilbault et al. (1987) stated that higher concentrations of PGF2α early in the postpartum period are associated with the early resumption of ovarian activity. Ingawale and Bakshi (2016) suggested that PGF2α injection resulted in an improvement in the rate of first-service pregnancy (33.33%) in treated buffaloes on day 14 postpartum, compared to (16%) in untreated buffaloes. Galvao et al. (2009) stated that PGF2α treatment in cows with subclinical endometritis improves the first-service conception rate.

Table 3. Effect of treatment with oxytetracycline and prostaglandin F2α during the puerperium period on uterine involution and post-parturient reproductive aspects in Baladi cows

<table>
<thead>
<tr>
<th>Items</th>
<th>Treated cows (10 cows)</th>
<th>Untreated cows (10 cows)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uterine involution period (days)</td>
<td>28.4 ± 4.5</td>
<td>45.7 ± 3.5</td>
</tr>
<tr>
<td>The interval from parturition to 1st postpartum estrus (days)</td>
<td>45.2±9.1</td>
<td>68.2±6.2</td>
</tr>
<tr>
<td>The interval from parturition to conceived (days open)</td>
<td>96.5±12.3</td>
<td>155.3±15.2</td>
</tr>
</tbody>
</table>

a, b: values within the same row having different superscripts are significantly different at P <0.05.
Concentrations of progesterone (ng/ml) and estradiol-17β (pg/ml) during the estrous cycle in treated and untreated Baladi cows

As shown in table (4), concentrations of progesterone and estradiol-17β at estrus were significantly (P < 0.05) higher in pregnant cows than in non-pregnant cows. Atypical progesterone profiles that indicate delayed ovulation, cystic ovarian disease, or prolonged luteal phases are frequently caused by uterine diseases, such as retained placenta and uterine infection (Opsomer et al. 2000; Royal et al. 2000). E. coli or LPS led to fluctuations in the secretion of these hormones PGF2α and PGE2 (Herath et al. 2006). The current results agree with those reported by Waldman et al. (2001) who found that there was a strong inverse association between the likelihood of non-return and the concentration of progesterone in cows at mating time. Conceived cows had a higher frequency of d10 post-service progesterone concentration compared to non-conceived cows (Busch et al. 2008). Table (4) shows that 21-day post-service progesterone concentrations were higher in treated cows than in untreated cows, perhaps responsible for and/or promoting higher pregnancy rates in treated cows than in untreated cows. The results obtained agree with those stated by Lemley et al. (2010) who recorded that the rise in progesterone after mating was associated with improved retention in pregnancy and growth in embryonic development. Rivera et al. (2011) stated that less development and quality of cow embryos are attributed to lower levels of progesterone in lactating dairy cows during follicle formation. Cerri et al. (2011) found that higher progesterone concentrations before and after service were associated with increased fertility. Progesterone affects ovarian and uterine functions during conception by direct or indirect methods and also in the early stages of embryo development. During follicular growth, a drop in plasma progesterone levels is associated with lower fertility rates and impedes embryo survival during early pregnancy periods (Inskeep, 2004 and Pursley and Martins, 2011). A high level of progesterone affects pregnancy by causing synchrony between the uterus and embryos. However, a low uterine system level of progesterone does not induce important changes in dairy cows to host and retain embryos (Kenyon et al., 2013 and Randi et al., 2016). The present findings showed, that during the estrous cycle, progesterone concentrations reached a lower level at estrus but, in estradiol, they had higher concentrations of these fluctuations or modifications which had a positive effect on conception. Progesterone is immunosuppressive, while estradiol has been used to treat uterine disease and can support immunity (Lewis, 2003). In cows with subclinical endometritis, estradiol concentrations were lower compared to healthy cows 21 days postpartum (Green et al. 2011). Kasimanickam et al. (2005) suggested an increase in the uterine defenses when progesterone concentrations were low in dairy cows. Cows with uterine diseases are less likely to ovulate the first primary follicle than normal cows (8% vs. 40%) and are more likely to have abnormal progesterone concentrations (58% vs. 39%) (Sheldon et al., 2008). Dairy cows with uterine infections have slower development of the first postpartum dominant follicle from 7 to 16 days after calving, have less plasma estradiol concentrations, and are less susceptible to ovulation (Sheldon et al., 2002). Williams et al. (2007) found decreased follicle development and estradiol secretion in cows with uterine infections besides a decline in progesterone concentrations after the first post-calving corpus luteum formation. Sheldon et al. (2009b) showed that a drop in follicular size and estradiol concentrations is caused by uterine disease. In cows with greater uterine pathogen load, the diameter of the corpus luteum was smaller and progesterone concentrations declined (Williams, 2013). Changes in liver transcription for genes linked to steroid hormone production and inflammation were correlated with subclinical endometritis in dairy cows. These modifications resulted in impairments in fertility (Akbar et al., 2014).
Table 4. Concentrations of progesterone (ng/ml) at estrus, 7th, 15th and 21st days post-service and estradiol-17β (pg/ml) in treated and untreated Baladi cows

<table>
<thead>
<tr>
<th>Items</th>
<th>Treated cows (10 cows)</th>
<th>Untreated cows (10 cows)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pregnant</td>
<td>Non-pregnant</td>
</tr>
<tr>
<td><strong>Progesterone (ng/ml)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>At estrus</td>
<td>0.38±0.09</td>
<td>0.22±0.04</td>
</tr>
<tr>
<td>7th days post-service</td>
<td>3.22±0.03</td>
<td>2.11±0.01</td>
</tr>
<tr>
<td>15th days post-service</td>
<td>5.81±0.06</td>
<td>3.32±0.04</td>
</tr>
<tr>
<td>21st days post-service</td>
<td>8.23±0.12</td>
<td>0.20±0.01</td>
</tr>
<tr>
<td><strong>Estradiol-17β (pg/ml)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>At estrus</td>
<td>32.3±0.32</td>
<td>18.3±0.22</td>
</tr>
</tbody>
</table>

a, b: values within the same row having different superscripts are significantly different at P <0.05.

1- Conception rate calculated from the first service.

CONCLUSION

The current study demonstrated improvement in post-partum reproductive performance in cows treated with oxytetracycline and prostaglandin F2α during the puerperium period. So, the study recommends that small breeders should treat their cows during the puerperium period.

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