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Impact of GnRH Analogues and Exogenous Progesterone Supplementation in Treatment of Ovarian Inactivity for Primiparous and Multiparous Dromedary She-Camels in Egypt

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Abstract

The present investigations were designed to deal with the problem of ovarian inactivity of Dromedary camel. Twenty she-camels were divided into two equal groups as primiparous or multiparous. The same protocol was applied on both groups which was two doses of Receptal® (10µg GnRH analogue) with 10 days apart and exogenous progesterone (PRID) insertion at day zero and was removed at day 10. Blood samples were taken several days for analysing Follicle-stimulating hormone (FSH), Progesterone (P_4) and Estradiol (E_2). Also, Follicular Size was measured using ultrasound. Significant differences were obtained in FSH, P_4 and E_2 along days of treatment. Moreover, multiparous had higher levels of FSH and E_2 than primiparous. On the other hand, no significant difference in P_4 level was recorded between groups. In general, treatment induced significantly a new follicular wave and stimulates follicle growth from 8.406 mm (day13) up to 12.791 mm (day 15 of PRID insertion), nevertheless, no significance in follicular size between groups was observed. She-camels in both groups revealed a noticed response to treatment protocol which was observed via estrous signs. Pregnancy rate doesn't reveal a significant difference between groups. We can conclude that, a combination of 1.55 g of exogenous P_4 and two doses of 10µg GnRH analogues can enhance emergence of follicular development up to pre ovulatory size and significantly alter hormonal profile of primiparous and multiparous she camels with inactive ovaries.

KEYWORDS
Inactive-ovaries, Ultrasonography, She-camel, Primiparous, Multiparous.

INTRODUCTION

The pattern of reproduction in dromedary camels in comparison to other farm animals is different (Kaufmann, 2005). This difference can be attributed to a variety of factors, including a later age of puberty and maturity than others; breeding and reproducing are restricted to specific times of the year, primarily low-temperature months due to a strong seasonal tendency; a prolonged gestation period of up to 390 days; and an increased incidence of ovarian dysfunction, such as prolonged follicles structureless in the postpartum period (Skidmore *et al.*, 1996). Sufficient sources of food together with ambient climate during the season of breeding can improve body condition scores and, as a result, enhance ovarian activity (Ainani *et al.*, 2018; Gherissi *et al.*, 2020). Likewise, other farm animals, the dromedary camels, have many reproductive problems, mainly specific to ovarian functions during the season of reproduction, like ovarian inactivity, which is manifested clinically in the form of repeat breeding or doesn't accept mating behavior (Ali *et al.*, 2010). Many causes are incriminated in the occurrence of inactive ovaries in she-camels, like loss of body weight and, as a result, low body condition score (Tibary and Anouassi, 1997; Gherissi *et al.*, 2020) and also, low level of gonadotropins secreted from the anterior lobe of the hypophyseal gland. The anterior pituitary secretion, on the other hand, may be normal, but the main issue represented by decreased ovarian sensitivity to gonadotropins secreted hormones that inhibit follicular growth may be due to nutritional deficiency (Hegazy *et al.*, 2004). Tibary and Anouassi (1997) reported that the clinical diagnosis of ovarian inactivity is based on the absence of follicular growth at two successive ultrasonographic ovarian examinations seven days apart. Meanwhile, they classified ovarian structures into inactive ovaries as those containing follicles less than 3 mm in diameter. Several studies have been conducted to improve reproductive performance parameters and to overcome problems of seasonality and lowering fertility in dromedary camels. For instance, ovulation-synchronization protocols and progesterone releasing intra-vaginal releaser which improved conception rate up to 83.3% (El-Hassanein *et al.*, 2010). The combination between controlled internal drug release (CIDR) and GnRH can be effective in the treatment of summer anestrus in she-camels by enhancing ovarian activity (Monaco *et al.*, 2012). The same authors stated that ovarian follicular dynamics and growth of primiparous and multiparous camels during seasonal anestrus can be improved when CIDR and PMSG are used, and the best results are obtained in primiparous she-camels. Only a few researchers attempt to stimulate ovarian activity in she-camels either during breeding

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season or during out season with limited results. On the other hand, trials of treatment ovarian inactivity are still few (Agarwal *et al*., 1996; Quzy *et al*., 2013). The transition period started two months ahead of the breeding season and the recorded follicular growth did not exceed 4mm diameter or less which appear as a black periphery on the ovarian surface (Dholpuria *et al*., 2012) some of these small follicles rarely attain mature follicular size (1-2cm) during the non-breeding season (Manjunatha *et al*., 2012) or the transition phase (Sghiri and Driancourt, 1999). Skidmore *et al*. (1996) and Vyas *et al*. (2008) reported that during breeding season the mature visible follicle size was 1-2cm. Some cases of ovarian dysfunction were recorded as a case of ovarian cysts with very low incidence ranged between 0.9% to 14.0% (Hegazy *et al*., 2004; Ali *et al*., 2010; Ainani *et al*., 2018), and such animals tend to be repeat breeders and reproduction failure (Vyas *et al*., 2008; Ali *et al*., 2010). Trials of ovarian cyclicity induction are still restricted and limited to some hormonal protocols to induce follicular growth dynamics as trials help small follicular size to reach maturity and induced ovulation, these approaches include clinical application and use of ecG (Agarwal *et al*., 1996), GnRH (Bono *et al*., 1991; Ismail *et al*., 1998). or melatonin implants (Dholpuria *et al*., 2012).

GnRH administration encourages the emergence of new follicular waves within 2 to 3 days and increase the number of medium-sized follicles. While the second dose of GnRH can assist and augment medium-size follicles to reach the large-size and maturity for consequent induced ovulation. The exogenous progesterone (PRID) as the source of an exogenous progesterone acts fundamentally by a negative feedback effect on the hypothalamus and pituitary gland to encourage a complete releasing to GnRH but once PRID removed a sudden drop in P_4 level happen after peak point of concentration. This allows a great release of GnRH and induction of new follicular waves and resumption of normal ovarian cyclicity that may reach maturity size. Chaves *et al*. (2002) reported that she-camel can be synchronized during the breeding season using CIDR which increases the P_4 level following CIDR insertion and decrease E_2 concentration which remained low until CIDR removal, start to increase again. Abd-El Hamid (2015) observed that the she-camels synchronized with the CIDR showed a significant interaction between days and treatment in P_4 level.

The present study was designed to plain the incidence as well as management of ovarian inactivity in dromedary camels as one of infertility problems in primiparous and multiparous she-camel using two doses of 10µg GnRH analogues and 1.55 g of exogenous progesterone (PRID) on follicular development, hormonal profile, and oestrus induction response.

MATERIALS AND METHODS

Animals

This study was conducted on 20 one-humped dromedary she-camels during the breeding season from December 2020 to April 2021. Animals were reared at west Egyptian coast, Matrouh governorate and classified into two equal groups as 10 primiparous (6-7 years) and 10 multiparous (9-14 years). She-camels were fed on a desert plant (grazing) as the main source of nutrition. The body condition score ranged between (1.75 to 2.25) according to PISC (2004). The present investigation under number 8/2020 was prepared according to the guidelines for the using and caring of the animals and follows the animal Ethics and welfare in the Faculty of Veterinary Medicine, Alexandria University and according to the Egyptian's laws. Animal experiments followed the Institutional Animal Care and Use Committee (IACUC) Alexandria University, which is compatible with the guidelines of the International Animal Ethics committee.

Diagnosis of ovarian inactivity

The female's genitalia were examined grossly for pathological affections (Tibary and Anouassi, 1997) Two successive ultrasound examinations of both ovaries ten days apart and according to Eiwishy (1987) and Skidmore *et al*. (1996) were used as the bases for diagnosis of ovarian inactivity, the follicular structures were categorized into inactive ovaries when ovaries containing follicles < 3mm, growing follicles >3 mm to 9 mm, ovulatory follicles 10-19mm and over mature 20-24 mm or aged follicles 25-30mm as described in Fig. 1. Furthermore, all she-camels were subjected to ultrasonography for detection of follicular dynamics after treatment on day zero (PRID insertion +10µg GnRH), day 10 (PRID removal+ 10 µg GnRH), day 13, and day 15 of PRID insertion to follow up the large size follicles.

Blood Sampling

Blood samples from the jugular vein were collected for confirming the ultrasonographic diagnosis. Diagnosis of ovarian inactivity was confirmed by two blood serum samples before starting treatment with 10 days interval which was carried out at the same time of ultrasound examination. Several blood samples were collected from the jugular vein after starting treatment for assessing hormonal profile (FSH, P_4, and E_2) response during and after treatment, On day zero (PRID insertion +10µg GnRH), day 5, day 7, day 10 (PRID removal+10µg GnRH), day 13, and day 15 of PRID insertion.

Experimental Design

She-camels diagnosed with inactive ovaries were divided into; 10 primiparous aged 6-7 years with hormonal profile as follow; FSH being 2.00 ±0.11mg/ml, P_4 being 0.35 +0.14ng/ml and E_2 being 20.12 ±03pg/ml. Meanwhile, 10 multiparous she-camels aged 9-14 years, with hormonal profile as follow; FSH being 2.11±0.13 mg/ml, P_4 being 0.42±0.03 ng/ml and E_2 being 21.19±1.23 pg/ml.

Preparation

Before starting hormonal treatment, both groups of she-camels were supplemented with 2 doses of 10 ml injection of minerals mixture 3 days apart (Mineral Fort® Jurox, Australia) that containing zinc 40 mg/ml, selenium 5 mg/ml, manganese 10 mg/ml and copper 5 mg/ml and also two doses of 10 ml injection 3 days apart of (Antoplex® lab tornel S.A, Mexico containing) that had Vit B12 (500 mcg/ml), Vit C (5 mg/ml), Iron citrate (0.020g/ml), Vit B5 (3mg/ml), Vit B1 (50mg), Vit B2 (0.6mg/ml), Vit B6 (3mg/ml), Vit B3 (45.0mg/ml), Choline (6mg/ml), Inositol (6mg/ml) and Phenol as preservative (0.5 mg/ml).

Treatment protocols

The same protocol was applied in multiparous as well as primiparous she-camels as follow; At day zero, intra muscle injection of 2.5 ml Receptal® (10 µg GnRH, Intervet, USA) with PRID® DELTA insertion (progesterone releasing intra-vaginal device) vaginal distributing plastic device containing 1.55 g progesterone (ceva santé animale-Z. I Très Le Bois-22600 Loudéac-France) inserted intra-vaginal for 10 days (El-Maaty *et al*., 2019).

On day10, a second dose intramuscular injection of 2.5 ml Receptal® (10 µg GnRH) and PRID was removed. After PRID removal, vaginal cavity washed with mild antiseptic (Betadine vaginal douche) due to induced vaginitis by PRID.

Serum biochemical analysis

Estradiol (E_2) and progesterone (P_4) were determined using highly specific ELISA Kits (Fine Test®, China). Also, follicle-stimulating hormone (FSH) was estimated by the enzymatic immunoassay (Medix Biotech INC. Catalog number KIF 4057) according to the procedure reported by (Engvall, 1980).

Mating and she-camel sexual behaviour

All treated she-camels were observed for detecting sexual reaction toward males, vaginal congestion and for the appearance of scanty white viscous mucus at vulva lips. Females were naturally mated by known fertile males with proven fertility when a mature follicle (10-20 mm) was visible by ultrasonography (Fig. 2).

Statistical Analysis

Data of hormones concentrations and follicle sizes were analyzed using the GLM procedure of SAS (2004) for finding out the effect of each treatment and time and their interaction. Also, Duncan multiple range tests (Duncan, 1955) were used to test the significant differences between means of the two groups. Also, Chi-square analysis was used for testing the effect of treatment on reproductive performance traits as response rate, conception rate from first and second service, total conception rate, and pregnancy rate at a confidence interval of 95%.

RESULTS

Hormonal Changes

As shown in Table 1, serum level of the studied hormones recorded a significant higher level in multiparous group compared with the primiparous group. Days had a significant effect on all hormones' levels. Also, the interaction effect between treatment and days was significant on FSH and E_2. Changes in follicular size (mm) and follicle-stimulating hormone (FSH, mg/ml), estradiol

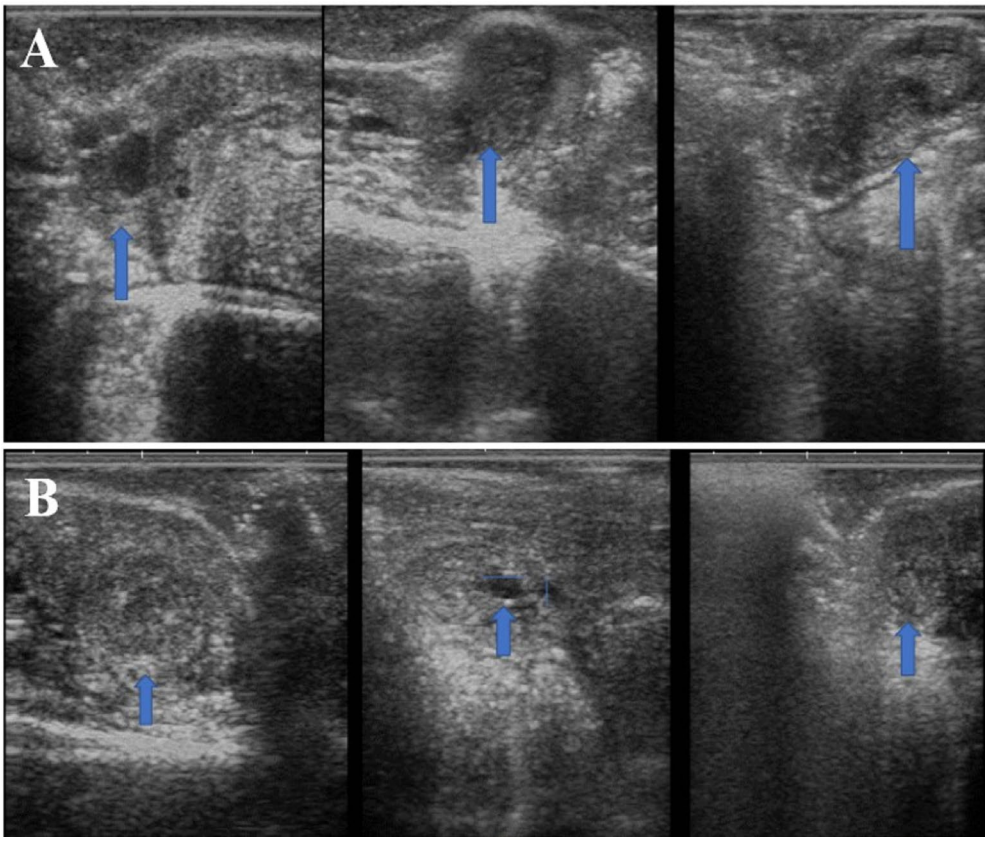

Fig 1. Ultrasonographic scanning of ovarian inactivity in primiparous (A) and multiparous (B) she-camels (Ovarian surface without any follicular growth in some cases and small size follicles < 3mm in diameter in other cases).

Table 1. Means of follicular size (mm) and follicle-stimulating hormone (FSH, mg/ml), estradiol (E_2, pg/ml) and progesterone (P_4, ng/ml) concentrations in primiparous (A) and multiparous (B) she-camels.

Trait	Treatment		SEM	P-Value		
	A	B		Treatment (T)	Day (D)	T*D
FSH	4.341[b]	5.725[a]	0.208	< 0.001	< 0.001	< 0.001
P_4	1.193	1.262	0.062	0.144	< 0.001	0.061
E_2	29.238[b]	33.281[a]	1.212	< 0.001	< 0.001	< 0.001
Follicular Size	7.753	7.908	0.422	0.513	< 0.001	0.256

[a-b] means with different superscript in the same row are differ (P<0.05)

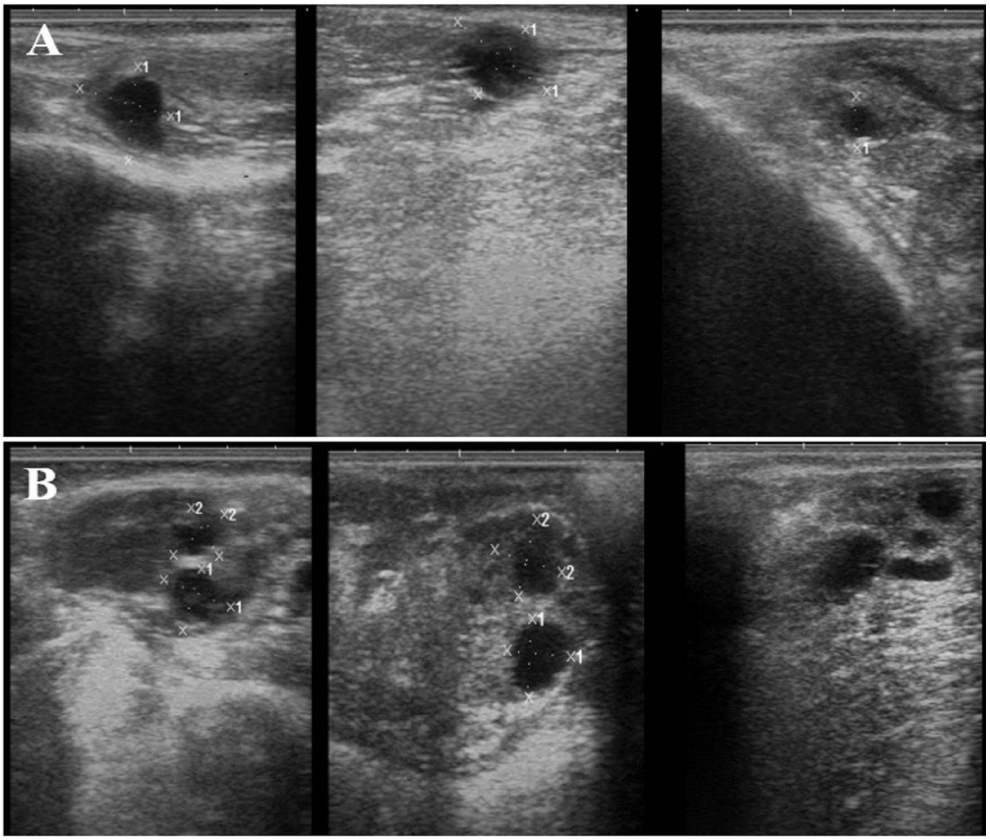

Fig 2. Ovarian follicular growth with variable sizes (medium and large or pre-ovulatory follicles) after treatment of ovarian inactivity in primiparous (A) and multiparous (B) she-camels with PRID as an exogenous source of progesterone and two doses of GnRH with ten days interval.

(E_2, pg/mL) and progesterone (P_4, ng/mL) concentrations during the experimental period were shown in Table 2. Progesterone level (P_4) increased gradually after PRID insertion as a source of exogenous progesterone till day 10 and sudden drop after PRID removal to the minimum level (0.385 ng/ml) at day 15 of PRID insertion. Also, estrogen level (E_2) recorded a decreasing level until day 10 (PRID removal and GnRH injection) and a significant increase to a higher level obtained at day 15 (64.82 pg/ml) of PRID insertion and at the same time the largest follicles size (12.79 mm) was obtained. According to the data recorded in Table 1, the effect of the treatment protocol on the primiparous and multiparous she-camels point to a significant difference between the two groups in hormonal profile as follow: FSH being 4.341 and 5.725 mg/ml, E_2 being 29.238 and 33.281 pg/ml in primiparous and multiparous she-camels, respectively as a response to the treatment protocol. On the other hand, no significant difference could be reported in the P_4 level between the two groups although P_4 dramatically increased after PRID insertion.

Fig. 3 illustrate the changes in serum follicle-stimulating hormone (FSH, mg/ml), estradiol (E_2, pg/mL) and progesterone (P_4, ng/mL) concentrations in primiparous and multiparous she-camels from day 0 (PRID insertion) up to day 15 (5 days after PRID removal). The comparison between the effect of the treatment protocol on follicle stimulating hormone serum level (FSH mg/ml) in both groups revealed that a significant elevation in FSH serum level between both groups when the same protocol was applied at days 10 (PRID removal) and days 13 and 15 of PRID insertion as described in Fig. 3. Also, E_2 levels were different between groups at days 5 and 15 with priority of primiparous. Furthermore, no difference between groups was observed for P_4 along with treatment period.

Ultrasonographic Scanning and Follicular Dynamics

According to Table 2, a significant increases in the follicular

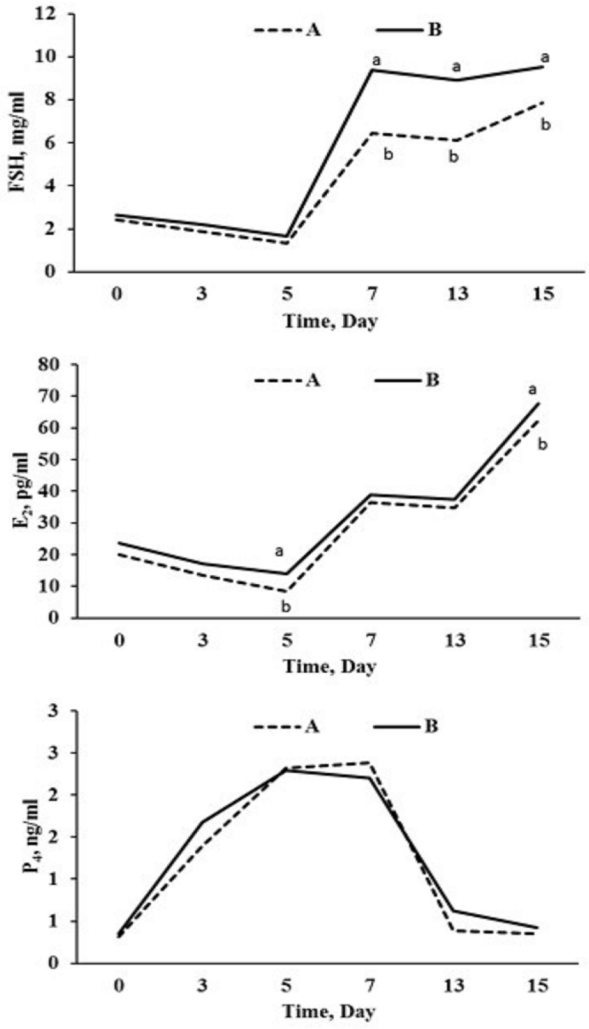

Fig. 3. Change in serum follicle-stimulating hormone (FSH, mg/ml), estradiol (E_2, pg/ml) and progesterone (P_4, ng/ml) concentrations in primiparous (A) and multiparous (B) she-camels from day 0 (PRID insertion) up to day 15 (5 days after PRID removal).

coincides with a significant increase in hormonal serum levels (FSH and E_2). Ultrasonographic scanning of the ovaries (Figs. 1 and 2) revealed follicular size (2.271 mm at day zero), (8.406 mm at day 13 at 3rd day of PRID removal & 2nd dose of 10µg GnRH which can be described as medium-size follicle) and (12.791 mm at day15 of PRID insertion).

Reproductive Performance

Data obtained from Table 3 revealed a significant response of ovaries to the treatment in both groups. This response was represented in the acceptance of females to mating and the appearance of clinical signs of estrus cycle on external genitalia (redness, swelling, white viscous mucus, and slight edema of vulva lips). Meanwhile, 1st service conception in multiparous she-camels is better than primiparous group. Nevertheless, 2nd service conception in primiparous she-camels is better than multiparous group. The results of pregnancy rate revealed a great similarity in both groups with no significant difference.

Pregnancy Diagnosis

Pregnancy suspected when she-camels were evaluated for cocking of tail in the presence of a male at 15-20 days of mating and confirmed 40 days post-mating using ultrasonography for detection of uterine horn foetal fluid and embryo proper as presented in Fig. 4.

DISCUSSION

Negligible follicular development and ovarian inactivity in she-camels address a significant problem in the reproduction of she-camels. The current examinations were intended to manage this issue by means of determination and treatment of ovarian dormancy. The obtained results revealed significant variations in serum hormonal profile (FSH, E_2, and P_4) along days of treatment. Furthermore, significant differences were recorded between two groups in FSH and E_2 with priority of multiparous she-camels. Moreover, no significant difference in P_4 level was recorded between groups although a significant increase was obtained along days of treatment. On the other hand, hormonal treatment (PRID and GnRH) significantly induces a new follicular wave and stimulates follicles growth from 8.406 mm at day 13 up to 12.791 mm at day 15, nevertheless, no significance changes in follicular size was observed between both groups.

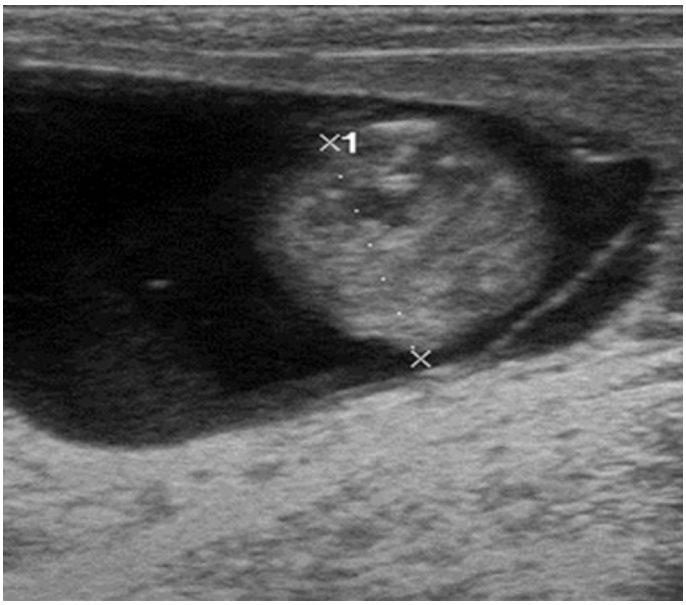

Fig 4. Ultrasonographic pregnancy diagnosis of she-camels at 40 days after mating.

The ovarian activity of she-camels is affected by many factors during breeding and non-breeding seasons such as the nutritional value, which affect mainly the follicular growth all over the year (Arthur and Al Hindi, 1985). Moreover, the body condition score and age-stages (Hussein *et al*., 2008), temperature, and relative humidity were also affecting the follicular growth (Arthur and Al Hindi, 1985; Abdel Rahim and El Nazier, 1992). Some reports indicated a high rate of ovarian inactivity and failure of conception during the month of May to October and this problem may be due to the high temperature and bad nutritional condition in summer days (Tibary and Anouassi, 1997; Tibary *et al*., 2005). Also, it was recorded that the incidence of ovarian inactivity increased with low condition scores regardless she-camels age, as the she-camels with 5-8 years have 32.3% ovarian inactivity and she-camels with 8-15 years have 11.62% ovarian inactivity (Hussein *et al*., 2008), while she-camels of more than 15-20 years have

Table 2. Changes in follicular size (mm) and follicle-stimulating hormone (FSH, mg/ml), estradiol (E_2, pg/mL) and progesterone (P_4, ng/mL) concentrations during the experimental period.

Trait	Days					
	0	5	7	10	13	15
FSH	2.511^{d}	2.019^{e}	1.475^{f}	7.766^{b}	7.374^{c}	8.614^{a}
P_4	0.331^{c}	1.525^{b}	2.309^{a}	2.302^{a}	0.493^{c}	0.385^{c}
E_2	21.583^{d}	15.058^{e}	10.775^{f}	37.492^{b}	35.963^{c}	64.816^{a}
Follicular Size.	2.271^{c}	-	-	-	8.406^{b}	12.791^{a}

$^{a-b}$ means with different superscript in the same row are differ (P<0.05)

Table 3. Reproductive performance of primiparous (A) and multiparous (B) she-camels after treatment.

Trait	A	B
Response rate (No. of animals respond/ animal treated)	80.952	88.235
1st service/conception rate	35.294^{b}	53.333^{a}
2nd service /conception rate	47.059	33.333
Total conception rate	82.353	86.667
Pregnancy rate	57.143	58.824

$^{a-b}$ means with different superscript in the same row are differ (P<0.05)

31.32% ovarian inactivity. Ovarian inactivity in the current study was associated with lowered hormonal levels in primiparous and multiparous group.

The P_4 remained low (<1ng/ml), as the main source of P_4 is corpus luteum which increases P_4 level after mating and ovulation (Skidmore *et al*., 1996) and these results coincides with results from this study before supplementation with an exogenous source of P_4. Regarding E_2 level during the breeding season, the estrogen level greatly increased with follicular growth in the primiparous and multiparous she-camels with minimal follicular growth at day 0 (PRID insertion and GnRH injection) and higher E_2 level obtained at the largest follicular size at 5th day after PRID removal, similar results were obtained by Agarwal *et al*. (1996); Tibary and Anouassi (1997); Tibary *et al*. (2005) and Hussein *et al*. (2008).

FSH basal levels were recorded in inactive ovaries (2.26±0.09mg/ml) in the breeding season and in the non-breeding season (2.16±0.11 mg/ml) with follicular growth less than 3 mm (Hussein *et al*., 2008). Meanwhile, FSH basal level was reported in the present study before starting of treatment protocols with minimal follicular size. In the current study, the PRID insertion on the day zero together with 10 µg GnRH administration followed by another dose of GnRH on day 10 in both groups can alert hormonal profile and follicular dynamics changes. Moreover, P_4 level dramatically increased from basal level on day zero to the maximum level on day 10 then decreased to basal level on day 15 in primiparous and multiparous groups. The current results are in agreement with the results of El-Maaty *et al*. (2019) who reported that the CIDR application as a source of an exogenous progesterone has a significant increase in serum P_4 level during the breeding season. Also, E_2 level greatly decreased till day 13 then a significant increase reaching the maximum level at day 15, which agreed with the results of El-Maaty *et al*. (2019). Meanwhile, the follicular size recorded a significant change along days of treatment in both groups and the follicular dynamics was changed with the hormonal pattern and gradually increased with time advancement and the large follicle size recorded at day 15.

The high level of hormones in serum due to absorbed P_4 from the CIDR device in the vagina and sudden drop after CIDR removal are in agreement with results of Skidmore (2011). Vaughan (2011) concluded that the large follicles could be regressed by an exogenous P_4, but the follicular growth not completely stopped. The existing dominant follicles regressed and a new wave of emergence by administration of P_4 every 2 days. Whereas Chaves *et al*. (2002) stated that the follicular growth stopped and sexual hormones changed after using CIDR up to 7 days. Swelum and Alowaimer (2015) observed that during the 2-4 days following CIDR removal a new follicular emergence after sudden fall of P_4 is like the results of this study. Contrary to results from thepresent study, Monaco *et al*. (2013) described that using CIDR at the beginning and middle of the non-breeding season revealed no significant results in the emergence of new follicular waves and the number of follicles.

Ali *et al*. (2008) recorded that the high level of E_2 attributed to the presence of Graafian follicles while low level of E_2 may be attributed to regressing follicles and these results agree with the achieved results, whereas PRID removal was followed by a significant rise in E_2 level which coincided with increased follicular size. The current study revealed a significant decrease of E_2 level after the PRID application in both treated groups followed by a significant increase in E_2 level at 13 and 15 days of PRID insertion, this may be attributed to ovarian follicular growth inhibited by exogenous progestin at insertion then the resumption of ovarian cyclicity induce E_2 surge and these results in agreement with Ghoneim *et al*. (2015). A harmonious results obtained by Hozyen *et al*. (2017) was carried on llama species where the application of the CIDR for 16 days drastically decrease E_2 level than a significant increase obtained after CIDR removal.

The previous published data on dromedaries and Lama guanaco, showing a close wave-like pattern in the E_2 and follicle size development (Manjunatha *et al*., 2012). Nevertheless, this study was carried out during the breeding season and ambient temperature, and the observed minimal follicular growth and inactivity may be attributed to nutritional factors. An estrus synchronization and the ovulation enhancement can be done by GnRH alone (Bono *et al*., 1991; Skidmore *et al*., 1996; Ismail *et al*., 1998), or in combination with progesterone implants (Monaco *et al*., 2012). Quzy *et al*. (2013) described that GnRH administration can induce a mature follicle 6-8 days post-injection. Similar results were observed by Bono *et al*. (1991) and Skidmore (2018) after GnRH treatment, but these results coincided with the obtained results whereas, a mature follicle observed on the ovarian surface on day 15 of PRID insertion and after 2nd dose of GnRH injection on day 10. Vyas *et al*. (2008) recorded low pregnancy rate up to 25% of synchronized she-camels. Meanwhile, the obtained lowered pregnancy rate after the equine chorionic gonadotropin use. On the other side, Quzy *et al*. (2013) observed an improvement of the pregnancy rate with different synchronization programs (65.11%, 61.53%, 50% with ecG, ov-synch, and PG, respectively). These results look like those obtained in the current study, in the primiparous (57.193%) and multiparous (58.824%) she-camels after the application of the treatment protocol in both groups. Although, the pregnancy rate improved in both groups, with no significant difference between the two treated groups.

CONCLUSION

Serum hormones levels (FSH, E_2, P_4) differ significantly along days of treatment before and after PRID insertion. There are significant differences between two groups in FSH, E_2 levels with priority of multiparous. No significant difference in P_4 level between both groups although its level differs significantly along days of treatment. Hormonal treatment (PRID 1.55gm of P_4 and 10µg GnRH) may induce a new follicular wave and stimulates follicles growth from 8.406mm at day 13 up to 12.791 mm at day 15 of PRID insertion, nevertheless, no significance of follicular size between both groups. She-camels in both groups respond significantly to treatment protocol which noticed via response rate (estrous signs appearance). Also, pregnancy rate doesn't reveal significant difference between groups.

CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

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