EFFECT OF NEW AND USED CIDR DEVICES ON OVARIAN FOLLICULAR GROWTH AND FERTILITY IN SEASONALLY ANESTROUS CROSSBRED EWES AND EWE LAMBS

Samir Z. El-Zarkouny and Adel N. M. Nour El-Din

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ABSTRACT

The aim of the present study was to examine the effect of progesterone priming with new or used controlled internal drug release (CIDR) device for 14 days on ovarian follicular growth and fertility traits in Rahmani x Romanov crossbred ewes and ewe lambs during the non-breeding season. Fourteen ewes and ten ewe lambs were divided randomly into four groups based on their age and body weight. First group (G1) was treated with a new CIDR device containing 300mg progesterone (n=7 ewes), and the second group (G2) received a previously used CIDR (n=7 ewes). The CIDRs were left in situ for 14 days. Both groups (G1+G2) were given 750 IU i.m. injection of pregnant mare serum gonadotropin (PMSG) at CIDRs withdrawal. The third group (G3) received a new CIDR device containing 300mg progesterone (n=5 ewe lambs) and the fourth group (G4) received a previously used CIDR (n=5 ewe lambs). Both groups (G3+G4) were given 4μg i.m. injection of GnRH at CIDR removal. Estrus was detected using normal rams with crayon markers. Blood samples were collected from the animals at days 0 (CIDR removal), +1 from ewe lambs, +3 from ewes, and +10 from both ewes and ewe lambs. Ovarian structures were recorded by ultrasonography (US) at the same pervious times. Ewes that received either new or used CIDR had more (P<0.05) total number of follicles (TNF) on d +3 ultrasound scanning (US2) than d 0 (US1). New and used CIDRs had no effect on the number of small follicles (≤3mm) either in ewes or ewe lambs. Therefore, ewes had more (P<0.01) large follicles (>3mm) on d +3 (US2) than d 0 (US1). However, type of CIDR had no effect on the diameter of large follicles (DLF) either in ewes or ewe lambs. Conception rates were similar (71%) for ewes treated with either new or used CIDR devices. Similar trend was found in ewe lambs with conception rates of about 40%. No significant differences in serum progesterone concentrations were found at the time of CIDR removal in all animal groups. At d +10 after CIDR removal, ewes had higher (P<0.01) concentrations of serum progesterone, greater number (P<0.05) of CLs, and greater (P<0.05) mean area of CLs compared with ewe lambs. Results indicate that the re-use of CIDR for 14 days to induce estrus during the non-breeding season in sheep is a valid choice and increases the economic return with no negative effects on the ovulatory follicles and conception rates.

Key words: *ewes, CIDR, PMSG, ovarian follicles, fertility*

INTRODUCTION

Estrus induction during the breeding and non-breeding season has become an indispensable practice in sheep and goat farms. Intravaginal sponges impregnated with 60mg medorxyprogesterone acetate (MPA) and 40mg fluoroprogesterone acetate (FPA) are the first methods for induction of estrus in sheep and goats. A controlled intravaginal drug release (CIDR) device containing 300mg progesterone was developed for goats and sheep (CIDR-G) in New Zealand (Welch *et al.*, 1984). Progesterone treatments with CIDR continued for various durations ranging from 5-8 d (short-term) to 14d (long-term) with indifferent conception rates in sheep (Vinoles *et al.*, 2001). Release of progesterone from delivery devices declines over time (Greyling *et al.*, 1994). Therefore, a short-term treatment (5-8d) provides exposure to higher average concentration of progesterone during the treatment period which has been effective with anestrous ewes (Rodriguez-Iglesias *et al.*, 1996; Knight *et al.*, 2001). However, prolonged progesterone exposure using intravaginal devices induces subluteal serum progesterone concentration in sheep toward the end of treatment period (Vinoles *et al.*, 1999). In cattle, perturbed follicular wave pattern and development of persistent follicles due to prolonged exposure to low progesterone concentration have been proposed to be the leading cause of infertility (Savio *et al.*, 1993; Anderson and Day, 1994). In sheep, effect of aged follicles on pregnancy rate is controversial. Some investigators (Johnson *et al.*, 1996; Vinoles *et al.*, 2001) reported that aged follicles would reduce pregnancy rates. However, Evans *et al.* (2001) found that ovulation of aged follicles after 14-d progestagen-based estrus synchronization protocol produced competent oocytes, good quality embryos, and full-term lambs.

Availability of controlled internal drug release CIDR-G devices to sheep producers is limited in Egypt. The reuse of CIDR-G devices to induce estrus during the natural non-breeding season is warranted under the condition that the used devices do not exert any deleterious effects on ovulatory follicles and conception rates. The goal of the present study was to investigate the effects of progesterone priming with new CIDR-G compared to used CIDR-G for 14 d on follicular characteristics, ovulation, and conception rates in ewes and ewe lambs during their natural non-breeding season.

Department of Animal Production, Faculty of Agriculture, Alexandria University, Alexandria, Egypt 21545

MATERIAL AND METHODS

A total of 14 Rahmani x Romanov crossbred ewes (3-5 years old, 40-50 kg body weight), and 10 ewe lambs (9-12 month old, 30-40 kg body weight) were used in these experiments. Animals were raised in a privately-owned sheep farm located 90 km south of Alexandria Governorate. Ewes lambed during the past lambing season and their lambs were weaned 4 weeks before the start of this study. Animals were housed in open barns during the day and were kept in closed pens during the night time. Ewes were fed on dry rice straw mixed with molasses and Egyptian Berseem freely plus 0.5 kg of commercial concentrate mixture/ewe/day. Shade, water, and mineral blocks were freely accessible.

Experimental design:

Experiment 1. The experimental design and protocols are shown in Fig. 1. In December 2006, 14 ewes were divided randomly into two equal groups of 7 animals each based on their age and body weight. The first group (G1) received a new controlled internal drug release (CIDR-G) device containing 300mg progesterone (Pharmacia & Upjohn limited company, Auckland, NZ) for 14 days. The second group (G2) received a re-used CIDR for 14 days after cleaning with antiseptic solution. Both groups were given 750 IU i.m. injection of pregnant mare serum gonadotropin (PMSG), (Folligon, Intervet, Boxmeer, Holland) at CIDR removal. Estrus was detected by introduction of normal libido rams harnessed with apron and crayon markers immediately after the CIDR removal. Marked ewes were isolated and naturally inseminated twice with 12-h intervals.

Experiment 2. Concurrently with experiment 1, 10 ewe lambs were divided into two equal groups (G3 and G4). Each group received either new CIDR-G (G3) or used CIDR (G4) that have been previously used for 14 days. Ewe lambs were injected with 1 mL GnRH (Buserelin acetate-Receptal®) at CIDR removal. Estrus detection and inseminations were carried out as in Experiment 1.

Blood samples were collected from the jugular vein of all treated animals at the time of CIDR removal (d0), and following CIDR removal time (d+1 in ewe lambs and d+3 in ewes) and 10 days later from both ewes and ewe lambs. Serum was obtained by centrifugation of blood samples at 3500 rpm for 15 min and was stored at -20°C until assay of progesterone (P4) concentration by an enzyme immunoassay (ELISA) method using commercial kits provided by Calbiotech, Inc., Spring Valley, CA. The range of the standards used was 0.0 - 30.0 ng/ml. The inter- and intra-run precision had coefficients of variation of 2.9 and 4.8%, respectively.

Concurrently with bleeding times, ovarian structures of ewes and ewe lambs were examined by an ultrasound scanner (Dynamic Imaging Concept MLV, Livingston, Scotland) with 5-7.5 MHz linear array transducer. Ultrasound scannings (US) of ovaries were performed on d0 (US1) to count the numbers of small follicles (≤3mm) and the numbers and diameters of large follicles (>3mm) in both ewes and ewe lambs, and on d+1 and d+3 (US2) in ewe lambs and ewes, respectively. Numbers and diameters of corpora lutea on each ovary were also examined on d+10 after CIDR removal in both ewes and ewe lambs. Number of CLs was considered as the number of ovulations. Pregnancy was diagnosed by ultrasound on d 30 after insemination.

Statistical analysis: Conception rates (%) data were analyzed by Proc Catmod (SAS, 2002). The model included animals (ewes or ewe lambs) and treatments (new or used CIDR). Serum progesterone concentrations at days 0 and +10 after CIDR removal, and the numbers and area of corpora lutea at d +10 after CIDR removal were analyzed in a model containing treatments (new and used CIDR) and animals (ewes and ewe lambs) as main effects with their interaction in the model using the procedure GLM (SAS, 2002). Total number of follicles, numbers of small follicles (≤3mm), numbers of large follicles (>3mm), mean diameter of large follicles were analyzed in a separate model that included treatments (new and used CIDR), animals (ewes and ewe lambs), and days (d0 and +1/+3) as main effects with their interaction.

RESULTS

Data for total numbers of follicles (TNF), numbers of small follicles (≤3mm), numbers of large follicles (>3mm), and diameters of large follicles (DLF) are presented in Table 1. There were interactions ($P<0.01$) between animals (ewes vs. ewe lambs) and time of ultrasound scanning (US1 vs. US2) in the TNF. Both ewes treated with new (G1) or used (G2) CIDR devices had more ($P<0.05$) TNF on d+3 (US2) than on d0 (US1). However, there were no significant differences between ewes treated with new or used CIDR devices in the TNF. Similarly, there were no significant differences between ewe lambs treated with either new (G3) or used (G4) CIDR devices. In general, ewes (G1+G2) had more ($P<0.05$) overall mean TNF (3.11±0.37) than ewe lambs (G3+G4, 1.75±0.20).

No effect of treatment (new CIDR and used CIDR) was found on the numbers of small follicles (≤3mm) either in ewes or ewe lambs. Also, no differences were found in the numbers of small follicles between scanning dates US1 and US2 in either ewes or ewe lambs. However, ewes had more ($P<0.05$) overall numbers of small follicles (1.29±0.20) than ewe lambs (0.50±0.17).

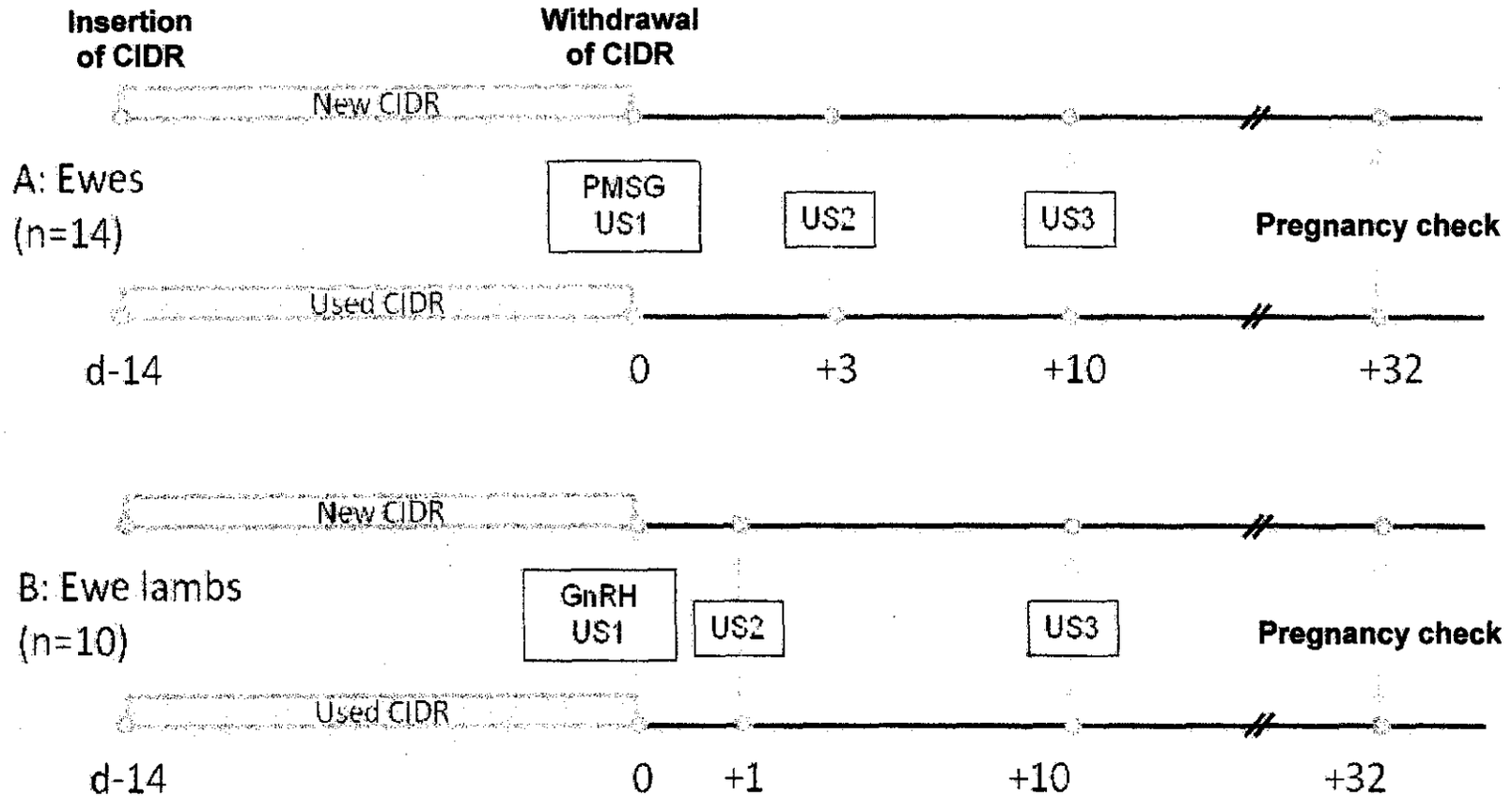

Fig. 1: Experimental design showing estrus induction protocols in ewes (A) and ewe lambs (B) treated with new and used CIDR devices for 14 d and injected with PMSG (ewes) and GnRH (ewe lambs) at CIDR withdrawal.

US1: ultrasound scanning of ovaries at CIDR removal (d0) in ewes and ewe lambs.
US2: ultrasound scanning of ovaries (d+1) in ewe lambs and (d+3) in ewes.
US3: ultrasound scanning of ovaries d+10 to observe CL and ovulations in ewes and ewe lambs.

Table 1. Ovarian follicular parameters for (Rahmani × Romanov crossbred) ewes and ewe lambs recorded at CIDR withdrawal (d0) by ultrasound scanning (US1) and US2 (d +1) in ewe lambs and (d +3) in ewes during the non-breeding season (means ±SE)

Items Ultrasound		Ewes			Ewe lambs		
		New CIDR	Used CIDR	Overall means	New CIDR	Used CIDR	Overall means
Total numbers of follicles (TNF)	(US1)	1.71±0.42^{b}	2.14±0.46^{b}	1.93±0.30	1.80±0.37	1.60±0.40	1.70±0.26
	(US2)	4.14±0.77^{a}	4.43±0.75^{a}	4.29±0.52^{A}	2.20±0.58	1.40±0.24	1.80±0.33^{B}
				3.11±0.37^{A}			1.75±0.20^{B}
Numbers of small follicles (≤3mm)	US1	1.29±0.36	1.00±0.38	1.14±0.25	0.80±0.49	0.60±0.40	0.70±0.30
	(US2)	1.29±0.52	1.57±0.43	1.43±0.33^{A}	0.20±0.20	0.40±0.24	0.30±0.15^{B}
				1.29±0.21^{A}			0.50±0.17^{B}
Numbers of large follicles (>3mm)	US1	0.43±0.20^{b}	1.14±0.40^{b}	0.79±0.24	1.00±0.32	1.00±0.00	1.00±0.15
	(US2)	2.86±0.83^{a}	2.86±0.88^{a}	2.86±0.58	2.00±0.45	1.00±0.00	1.50±0.27
				1.82±0.37			1.25±0.16
Diameters of large follicles (DLF)	(US1)	6.63±2.29	5.22±0.55	5.75±0.86	4.55±0.30	5.62±0.39	5.14±0.30
	(US2)	6.10±0.67	6.46±0.51	6.30±0.40	5.24±0.12	5.34±0.14	5.29±0.09
				6.09±0.40			5.22±0.15

Within each group, means with different small letters within columns for each parameter differ significantly (P<0.05).
Overall means with different capital letters within rows for each parameter differ significantly (P<0.05).

There were no interactions between animals (ewes vs. ewe lambs) and time of ultrasound scanning (US1 vs. US2) in the numbers of large follicles (>3mm). Ewes that received either new (G1) or used (G2) CIDR devices had more (P<0.01) large follicles on d +3 (US2) than on d 0 (US1). There were no differences between ewes treated with new and those treated with used CIDR devices in the numbers of large follicles. Similarly, there were no significant differences between ewe lambs treated with either new (G3) or used (G4) CIDR devices. In general, ewes had more large follicles (>3mm) compared to ewe lambs, but differences were not significant. Treatment (new CIDR and used CIDR) had no effect on the diameters of large follicles (DLF) either in ewes or ewe lambs. Also, no significant differences in the diameters of large follicles (DLF) were found between scanning dates (US1 and US2) either in ewes or ewe lambs.

Data for conception rates (%), serum concentrations of progesterone (P4, ng/ml) determined at d0 and+10 after CIDR removal, and both numbers and areas of corpora lutea (CLs) recorded at d+10 after CIDR removal are presented in Table 2. Conception rates showed similar values (71%) in ewes treated with either new (G1) or used (G2) CIDR devices. Similar conception rates (40%) were also found in ewe lambs treated with either new (G3) or used (G4) CIDR devices. No significant differences were found in conception rates between ewes and ewe lambs.

The overall mean serum concentrations of P4 at the time of CIDR removal in ewes or ewe lambs were significantly different (2.57 ±0.82 vs 2.09 ±0.80 ng/ml, respectively, Table 2). The overall mean concentration of serum P4 (P<0.01), numbers of CLs (P<0.05), and mean areas of CLs (P<0.05) at d+10 after CIDR removal revealed significant increases in ewes compared to ewe lambs with no interaction detected between treatment and animals.

DISCUSSION

The present results indicate that conception rates showed similar values in ewes (71%) or ewe lambs (40%) treated with either new or used CIDR devices for 14 days. Breeding ewes out of their natural breeding season with such conception rates is acceptable in most sheep practices. In the present study, the insertion of a used CIDR for 14 days did not have any deleterious effects on conception rates. The present data suggest priming with P4 (new CIDR) or lower P4 (used CIDR) for long duration (14 d) with PMSG injection at the time of CIDR removal would produce and ovulate oocytes with acceptable fertility competence in ewes. These data are in accordance with data previously reported by Evans *et al.* (2001) who demonstrated that ewes treated with progestin sponges for 14 days and given PMSG at sponge removal ovulated follicles with aged oocytes that were equally competent to be fertilized and developed to good quality embryos. The pregnancy success rate was higher with PMSG treatment (Luther *et al.*, 2007). Similarly, PMSG treatment at sponge withdrawal increased pregnancy following AI in Dorper ewes (Zeleke *et al.*, 2005).

In the mean time, concentrations of serum P4 were elevated toward the end of treatment and become insignificantly different between new and used CIDR-treated ewes. Similarly, ewe lambs that received new or used CIDR devices did not have any difference in serum concentrations of P4 at CIDR removal time. The fact that ewe lambs had numerically lower conception rates is probably due to injection of ewe lambs with GnRH instead of PMSG at CIDR removal unlike ewes where twins are desired.

No differences in total numbers of follicles were found between ewes or ewe lambs that were treated with either new or used CIDR devices at the end of progestin treatment (d0). On d+3, ewes had more follicles regardless of the type of CIDR they received. This may be attributed to the PMSG treatment at CIDR removal, while this effect was not seen in ewe lambs that were treated with GnRH at CIDR removal. Ewes that received either new or used CIDR had more large follicles (>3mm) on d+3 (US2) than on d0 (US1). This effect on the numbers of ovulatory follicles in ewes is due to PMSG injection at CIDR removal (d0). No effect of progestin treatment was found on follicular dynamics. Similarly, Letelier *et al.* (2009) reported that reducing the dose of fluorogestone from 40 to 20 mg did not affect significantly ovarian follicular dynamics in sheep. However, Flynn *et al.* (2000) reported that in the absence of luteal progesterone in ewe lambs, single progestin sponge for 14 d resulted in higher LH pulse frequency and ovulation of persistent follicles with larger maximum diameter compared with controls.

Administration of PSMG in ewes at time of CIDR removal resulted in more (P<0.05) large follicles (>3mm) on d +3 (US2) and more ovulations as reflected by the increase (P<0.05) in the numbers of produced CLs, large (P<0.05) CL area and more efficient luteal function. This was expressed mainly in elevated (P<0.05) serum progesterone concentrations in ewes 10 d after PMSG injection compared to ewe lambs. Similar data by Barret *et al.* (2004) showed that progesterone concentrations were increased in ewes treated with PMSG compared to controls during d 7 to 17 after sponge removal. The authors also reported that PMSG-enhanced progesterone may increase pregnancy rate in sheep. This explains the acceptable pregnancy rates noted in this study with ewes (71%)

Table 2. Conception rate (%), progesterone concentrations at days (0 and +10) after CIDR removal, and numbers and area of corpora lutea at d (+10) after CIDR removal in Rahmani x Romanov crossbred ewes and ewe lambs treated with new and used CIDR during the non-breeding season. (means±SE)

Items	Ewes			Ewe lambs		
	New CIDR (G1, n =7)	Used CIDR (G2, n=7)	Overall means	New CIDR (G3, n=5)	Used CIDR (G4, n=5)	Overall means
Conception rate (%)	71	71	71	40	40	40
P4 at CIDR removal, d0 (ng/ml)	3.73±1.54	1.41±0.25	2.57±0.82	1.76±0.33	2.42±1.65	2.09±.80
P4 after CIDR removal, d+10 (ng/ml)	6.80±1.42^{a}	7.21±1.36^{a}	7.01±0.95^{A}	1.30±0.36^{b}	4.1±1.98^{ab}	2.71±1.06^{B}
Numbers of CL after CIDR removal, d+10	2.00±0.38^{a}	1.70±0.29^{a}	1.86±0.23^{A}	1.40±0.24^{ab}	1.0±0.00^{b}	1.20±0.13^{B}
Mean CL area (mm2) after CIDR removal, d+10	60.83±9.13^{a}	57.28±10.27^{a}	59.10±6.62^{A}	43.80±11.54^{ab}	28.82±0.42^{b}	36.33±5.99^{B}

Overall means with different capital letters within rows differ significantly (P<0.05).
Means with different small letters within rows differ significantly (P<0.05).

that were treated with PMSG after CIDR removal and lower pregnancy rates in ewe lambs (40%) that were treated with GnRH. In addition, a minimum level of progesterone is required to support embryo survival in sheep (Bari *et al.*, 2003). Therefore, the greater pregnancy rates in the PMSG-treated ewes in the current study may be attributed to a greater number of ovulations per ewe and subsequently elevated levels of circulating progesterone 10 days after CIDR removal (Luther *et al.*, 2007).

Gonadotropins have often been used to stimulate ovarian activity following progestin treatment in sheep (Menchaca and Rubianes, 2004; Gordon, 2005). The use of both pregnant mare serum gonadotropin (PMSG) and gonadotropin releasing hormone (GnRH) treatments have been shown to provide a more compact ovulation in ewes (Evans, 1988; Menchaca and Rubianes, 2004; Zeleke *et al.*, 2005). GnRH treatment near the end of progestin treatment may decrease the estrus response (Luther *et al.*, 2007). However, GnRH treatment in the absence of PMSG resulted in a lower estrus response. When GnRH was administered 24 h after progestin withdrawal and PMSG treatment (d0), the LH surge and the subsequent ovulation were advanced in pygmy goats (Pierson *et al.*, 2003). Van Cleeff *et al.* (1998), Gordon (2005) and Luther *et al.* (2007) reported that GnRH treatment 36 h after progestin removal could induce ovulation before the normal expression of estrus. This may explain lower pregnancy rates in ewe lambs injected with GnRH 24h after CIDR removal in the absence of PMSG compared to ewes injected with PMSG at CIDR removal in the current study.

CONCLUSION

It could be concluded that low P4 priming for 14 d with a used CIDR device plus PMSG given at CIDR removal can produce acceptable conception rates. Sheep producers can utilize with confidence the previously used CIDR devices, after cleaning, as a source of progestin plus administering PMSG at CIDR removal in estrus synchronization protocols in sheep bred out of breeding season. Injected PMSG at CIDR removal increased the numbers of large follicles that eventually ovulated and improved conception rates. GnRH injection 24h after CIDR removal in ewe lambs produced inferior conception rates compared to PMSG given at time of CIDR removal in ewes.

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الملخص العربى

تأثير استخدام الـ CIDR الجديد والمعاد إستخدامه على نمو الحويصلات المبيضية والخصوبة فى نعاج وحوليات أغنام خليط الروماتوف الخاملة جنسياً

سمير زكى الزرقونى وعادل نور الدين محمد

قسم الإنتاج الحيوانى – كلية الزراعة – جامعة الإسكندرية

الهدف من هذه الدراسة هو إختبار تأثير المعاملة بالبروجستيرون عن طريق إستخدام الـ CIDR الجديد أو المستخدم مسبقاً لمدة ١٤ يوم على نمو الحويصلات المبيضية والخصوبة فى نعاج وحوليات خليط الرحمانى والروماتوف وذلك خارج موسم التناسل . إستخدم فى الدراسة أربعة عشرة نعجة وعشرة حوليات قسمت عشوائياً إلى أربعة مجاميع على أساس العمر والوزن . المجموعة الأولى (٧ نعاج) تلقت CIDR جديد يحتوى على ٣٠٠ مجم بروجستيرون ، والمجموعة الثانية (٧ نعاج) تلقت الـ CIDR المعاد إستخدامه بعد تطهيره وكلتا المجموعتين تم حقنها عضلياً بـ ٧٥٠ وحدة دولية من الـ PMSG وذلك فى وقت إخراج الـ CIDR. والمجموعة الثالثة خمس حوليات تلقت الـ CIDR الجديد المحتوى على ٣٠٠ مجم بروجستيرون. والمجموعة الرابعة تلقت الـ CIDR المستخدم مسبقاً بعد تطهيره وعددها خمس حوليات أيضاً . وكلتا المجموعتين الأخيرتين حقنت عضلياً بـ ٤ ميكروجرام من الـ GnRH عند إزالة الـ CIDR. وتمت مراقبة الشياع بإستخدام ذكور طبيعية معلّمة بمادة ملونة (كشافة). وتم جمع عينات الدم من الحيوانات فى يوم إزالة الـ CIDR واليوم التالى له فى مجاميع الحوليات وفى اليوم الثالث فى مجاميع النعاج وأخيراً فى اليوم العاشر بعد إزالة الـCIDR من كل المجاميع. والتراكيب المبيضية تم تسجيلها بإستخدام جهاز السونار فى نفس أوقات جمع عينات الدم. أظهرت النتائج أن النعاج المعاملة سواء بالـ CIDR الجديد أو المعاد إستخدامه إزداد العدد الكلى للحويصلات المبيضية بها ($p < 0.05$) فى الفحصة الثانية (اليوم الثالث من إزالة الـ CIDR) بالمقارنة بالفحصة الأولى (يوم إزالة الـ CIDR) . إستخدام الـ CIDR الجديد أو المعاد إستخدامه لم يكن له تأثير على عدد الحويصلات المبيضية الصغيرة (أقل من ٣ مم) وذلك فى كل المجاميع المعاملة ، وكذلك فإن النعاج أظهرت زيادة ($p < 0.01$) فى عدد الحويصلات الكبيرة (الأكبر من ٣ مم) فى الفحصة الثانية بالمقارنة بالفحصة الأولى. نوع الـ CIDR المستخدم (جديد أو مستخدم مسبقاً) لم يكن له تأثير على قطر الحويصلات المبيضية الكبيرة وذلك فى كل المجاميع . ومعدلات الحمل كانت متساوية تماماً (٧١٪) فى مجموعتي النعاج بغض النظر على نوع الـ CIDR جديد أم مستخدم مسبقاً. ونفس الإتجاه تم ملاحظته فى مجموعتى الحوليات ولكن معدل الحمل كان حوالى ٤٠٪ تقريباً. لم يتم اكتشاف أى فروق معنوية فى مستوى البروجستيرون فى السيرم وقت إزالة الـ CIDR فى كل مجاميع الحيوانات . وفى اليوم العاشر من إزالة الـ CIDR إرتفع مستوى البروجستيرون ($p < 0.01$) وإزداد عدد الأجسام الصفراء ($p < 0.05$) وكذلك المساحة الكلية للأجسام الصفراء ($p < 0.05$) فى النعاج وذلك بالمقارنة بالحوليات . وبالتالى فإن نتائج هذه الدراسة تدل على أن إعادة استخدام الـ CIDR مرة أخرى بعد تطهيره لمدة طويلة (١٤ يوم) لحث الشياع خارج موسم التناسل للأغنام تعتبر طريقة جيدة وإقتصادية حيث لم يكن له تأثير سلبى على عدد الحويصلات الصالحة للتبويض ولا على معدل الحمل .

الكلمات الدالة : الحويصلات المبيضية – النعاج – الخصوبة – CIDR – PMSG