

THE EFFECTIVENESS OF PROGESTERONE HORMONE OR PGF2 α AND hCG APPLICATION TO INCREASE REPRODUCTIVE EFFICIENCY OF POSTPARTUM OF ANESTRUS PE GOATS

Muhammad Syawal¹, Tuty L. Yusuf^{2*}, and Muhammad Agil²

¹Post Graduate Student of Reproductive Biology Major, Faculty of Veterinary Medicine, Bogor Agriculture University, Bogor, Indonesia

²Department of Clinical Reproduction and Pathology, Faculty of Veterinary Medicine, Faculty of Veterinary Medicine, Bogor Agriculture University, Bogor, Indonesia

*Corresponding author: tutylaswardi@gmail.com

ABSTRACT

This study aimed to improve reproductive condition of postpartum anestrus of Etawa crossbreed (PE) goats using PGF2 α hormone or progesterone (controlled internal drug release/CIDR-G) and improve pregnancy success from artificial insemination (AI) with human chorionic gonadotrophin (hCG) hormone administration. Administration of progesterone increased estrus by 100%, which was higher than the 70% produced from prostaglandin F2 alfa (PGF2 α) administration. Estrus onset in CIDR group (35.80 $\pm$ 13.33 hours) was faster than PGF2 α group (45.6 $\pm$ 9.2 hours). Clinical signs of vulva (redness and swollen) were more intense in CIDR-G group (80% and 70%, respectively) compared to PGF2 α group (70% and 57%, respectively). Estrus duration in PGF2 α group (52.17 $\pm$ 3.34 hours) was longer than CIDR-G group (49.61 $\pm$ 3.56 hours). Pregnancy success in group given hCG was 66.7% while in non-hCG group was 50%. In conclusion, CIDR-G and PGF2 α administration is effective to induce estrus of postpartum anestrus PE goats. Administration of hCG at the onset of estrus is effective to improve pregnancy success.

Key words: hCG, PE goat, PGF2 α , postpartum anestrus, progesterone

ABSTRAK

Penelitian ini bertujuan memperbaiki kondisi reproduksi pada kambing peranakan Etawa (PE) anestrus postpartum dengan menggunakan hormon prostaglandin F2 alfa (PGF2 α) atau progesteron (controlled internal drug release/CIDR-G) dan meningkatkan keberhasilan kebuntingan hasil inseminasi buatan (IB) dengan hormon human chorionic gonadotrophin (hCG). Pemberian progesteron menghasilkan estrus 100% lebih tinggi dibanding PGF2 α estrus 70%. Onset estrus kelompok CIDR (35,80 $\pm$ 13,33 jam) lebih cepat dibandingkan kelompok PGF2 α (45,6 $\pm$ 9,2 jam). Gejala klinis vulva (kemerahan dan kebengkakan) lebih tinggi intensitasnya pada kelompok CIDR-G (80% dan 70%) dibanding PGF2 α (70% dan 57%). Intensitas kebasahan (lendir vulva) bukan merupakan pengamatan utama. Lama estrus kelompok PGF2 α (52,17 $\pm$ 3,34 jam) lebih lama dibanding kelompok CIDR-G (49,61 $\pm$ 3,56 jam). Kebuntingan pada kelompok yang diberi hCG sebesar 66,7% dan Non hCG 50%. Kesimpulan, progesteron (CIDR-G) atau PGF2 α efektif menginduksi terjadinya estrus kembali pada kambing PE anestrus postpartum. Pemberian hCG saat onset estrus efektif untuk dapat meningkatkan angka kebuntingan.

Kata kunci: hCG, kambing PE, PGF2 α , anestrus postpartum, progesteron

INTRODUCTION

Etawa breed (Peranakan Etawa/PE) goats are productive and easily adapt to local environment. Breeders prefer these goats because they are easy and cheap to maintain. The demand for goat has been increasing while the goat population is still low. Based on livestock and animal health statistics (Ditjenak, 2013), the goat population in 2013 was 18.576.192 with an increase of only 0.03% (67.0330 goats) compared to the previous year (2012) which was 17.905.862 goats.

Etawa breeders goats have good reproductive potential such as younger onset of puberty (6-10 months) and reach maturity (reproductive organs are ready for pregnancy) at 10-12 months old with a body weight of 55-60 kg. In addition, the litter size is 1.3-1.7 goats, with relatively short gap between childbirth (240 days) (Sutama *et al.*, 2007). Breeders usually manage PE goats traditionally, hence there is a lot of postpartum anestrus cases. Post partum anestrus could occur due to mistakes in reproduction management. Postpartum anestrus could last for a long duration; it could even last for more than 200 days (Freitas, 2004).

The administration of reproductive hormone for postpartum anestrus goats could improve reproductive

function by restoring normal estrus to goats. Administration of intravaginal progesterone at certain times could produce negative feedback mechanism and initiate follicle development after revocation, hence restoring estrus (Fonseca *et al.*, 2005). Low artificial insemination (AI) yields such as reported by Tambing and Sariubang (2008) showed pregnancy rate of only 25%. This was caused by several factors, one of them was inaccurate hormone combination during estrus synchronization (Hastono, 2000). In order to optimize AI result in postpartum anestrus PE goats, it is needed to improve reproductive condition of postpartum anestrus PE goats by administering progesterone hormone (controlled internal drug release/CIDR-G) intravaginally and PGF2 α intramuscularly, as well as administration of hCG at the onset of estrus to improve pregnancy success from AI.

MATERIALS AND METHODS

Experimental Animals

The animals used in this study were 30 female PE goats, aged 4-5 years old, weighed 35-40 kg. All goats were clinically healthy and experienced postpartum anestrus for 2-4 months. The goats were divided into 3 treatment groups with 10 goats each. The feed given

was good quality legume (*Calliandra calothyrsus*) and 16% gross protein concentrates (700 g/e/h). Grass and drinking water were provided ad libitum.

Hormonal Intervention

Progesterone hormone (CIDR-G) was administered intravaginally with the help of CIDR-G applicator planted for 12 days. Intramuscular injection of 5 mg PGF2 α for each goat was given twice with interval of 11 days.

Estrus Detection

Estrus response was observed every three hours by introducing male goat teaser that wear apron into female goat pen. Goats were considered estrus positive (estrus onset) if they remained silent when mounted by the male teaser

Artificial Insemination

Goats in estrus condition were divided into 3 groups: group A was given 450 IU hCG/goat, group B was not given hCG, and group C was the control group. Afterwards, AI was conducted using insemination gun and speculum. Parameters used in this study were estrus response (Percentage of goat in estrus during estrus observation), estrus onset (the time needed to reach estrus after CIDR was released or since administration of the second PGF2 α hormone), estrus intensity (intensity level of clinical signs in vulva such as swollen, redness, and presence of mucus), estrus duration (the duration between estrus onset until rejecting to be mounted by male goat, and pregnancy rate (number of goats that gave birth divided by total number of goats that was artificially inseminated). The estrus intensity was classified into 2 categories: Scarlet (bright red)/presence of swelling/large amount of mucus (++) and moderate red/moderate swelling/scanty mucus (+).

Data Analysis

Estrus onset and estrus duration were analyzed using analysis of variance (ANOVA), while estrus percentage, estrus intensity, and pregnancy rate were analyzed descriptively.

RESULTS AND DISCUSSION

Estrus Response

In this study, 4 out of 10 (40%) goats in the control group achieved estrus (Table 1). The return of estrus was possible caused by feeding with high quality feed (PK= 16%). As stated by de Santiago (2008), feeding and environmental factors could affect the balance of reproductive hormones which could then induce normal estrus cycle. Gonzalez-Stagnaro (1984) also stated that

anestrus occurs because of reproductive management error and poor feed quality.

The result above was different from CIDR-G group where 100% of goats achieved estrus (Table 1). The same result was stated by Dewi *et al.* (2011) in which administration of CIDR for 10 days on anestrus goats produce 100% estrus response. Administration of CIDR-G containing progesterone hormone produces negative feedback mechanism on hypothalamus to reduce GnRH secretion. After CIDR was released, drastic reduction of blood progesterone would induce hypothalamus to secrete GnRH (positive feedback) due to estradiol stimulation will stimulate anterior pituitary to secrete FSH and LH (Menchaca *et al.*, 2007).

Out of the 10 goats injected with PGF2 α , only 7 goats (70%) achieved estrus. This is due to at the time of administration, the 3 goats probably had no active corpus luteum (CL) in their ovaries or their body has not recovered, hence a new estrus cycle could not be started, and no active CL was formed. On the other hand, the estrus response shown by the other 7 goats (70%) after PGF2 α administration was probably caused by persistent CL (CLP). Mac Millan *et al.* (1991) found 75-100% estrus response after PGF2 α administration on postpartum anestrus goats. Wurlina *et al.* (2005) stated that PGF2 α administration is only effective if CL is present in the ovaries. In this study, the highest estrus response was in the CIDR-G group (100%), followed by PGF2 α group (70%), and control (40%). These results indicated that CIDR-G or PGF2 α administrations able to assist the estrus induction on postpartum anestrus PE goats and was better compared to control group.

Estrus Onset

The result showed that estrus onset occur earlier in CIDR-G group (35.81 $\pm$ 13.33 hours) compared to PGF2 α group (45.59 $\pm$ 9.23 hours) although it was statistically not significant ($P>0.05$). This difference was probably caused by variation in ovarian activity in each goat due to the hormonal interventions used.

CIDR-G group provides a longer time for hypothalamus to be primed by progesterone. Caraty and Skinner (1999) stated that hypothalamus priming by progesterone could increase hypothalamic sensitivity towards estradiol. Hypothalamus becomes more sensitive to estradiol due to the reduction of minimum threshold for estradiol to stimulate GnRH secretion by the surge center in hypothalamus. Progesterone administration would increase the number of estradiol receptors in medio-basal hypothalamus. This is the main part of goat hypothalamus that responds towards estradiol and induce preovulatory LH surge. Increased estradiol receptors would augment positive feedback generated as a response toward

Table 1. Response, onset, and estrus duration after CIDR-G hormone and PGF2 α administration on postpartum anestrus PE goats

Parameters	Groups		
	Control	CIDR-G	PGF2 α
Intervention goats	10	10	10
Estrus response (%)	40	100	70
Estrus onset (hours)	168-192	35.81 $\pm$ 13.33	45.59 $\pm$ 9.23
Estrus duration (hours)	52.96 $\pm$ 1.60	49.61 $\pm$ 3.56	52.17 $\pm$ 3.34

estradiol (Blache *et al.*, 1994).

Meanwhile, progesterone priming in PGF2 α group occurred normally, that is in the luteal phase, which varies in each individual. In contrast, priming occurred at the same time and last longer in the CIDR group; hence when CIDR was released, drastic progesterone level drop in the body caused positive feedback on hypothalamus by estradiol to secrete GnRH in large amount and anterior pituitary would be stimulated to secrete FSH and LH, resulting in good follicle growth (Menchaca and Rubianes, 2001; Diskin *et al.*, 2002).

Estrus Duration

In this study, estrus duration in the control, CIDR-G, and PGF2 α group were 52.96 ± 1.60 hours, 49.61 ± 3.56 hours, and 52.17 ± 3.34 hours respectively; which were did not differ significantly ($P > 0.05$). Estrus duration in goats is about 24-48 hours with an average of 36 hours (Wildeus 2006). Dewi *et al.* (2011) reported that body condition score and LH surge could affect estrus duration. Late LH surge during estrus due to low blood estrogen level could affect estrus duration. Other studies using CIDR showed shorter estrus duration were 36.61 ± 2.5 hours (Sunendar, 2008) and 32.4 ± 1.47 hours (Dewi *et al.*, 2011). Meanwhile, the estrus duration generated by PGF2 α administration in this study (52.17 ± 3.34 hours) was similar to study by Tambing and Sariubang (2008), which was 50.10 ± 1.50 hours, and Ahmed *et al.* (1998) with average estrus duration of 52.6 hours. However, it was different with Romano (1998) conducted in Nubian goats with average estrus duration of 39.4 hours.

Estrus Intensity

In the CIDR-G and PGF2 α groups, goats that showed obvious clinical signs of redness on vulva (++) were 80% and 70%, respectively and swelling (++) were 71% and 57%, respectively. This result showed that CIDR-G intervention resulted in more obvious intensity compared to PGF2 α group. Vaginal mucus production in the CIDR-G group was relatively similar to PGF2 α group (50% vs 43%). Vaginal mucus was not included as a main observation because it varies in each goat. Estrus clinical signs could be seen in Figure 1.

The difference in estrus intensity between each individual is affected by blood estrogen level. Higher estrogen level would result in more obvious estrus intensity, mainly in form of redness and swelling of vulva (Popalayah *et al.*, 2013). Subsequently, Siregar

et al. (2004) stated that goats in estrus excreted clear and viscous fluid, as well as redness and swelling of vulva.

High estrogen level would increase positive feedback on hypothalamus. Estrogen increase GnRH discharge frequency from hypothalamus which subsequently affects pituitary to secrete preovulatory FSH and LH, resulting in ovulation (Bearden *et al.*, 1980). Estradiol would provide blood supply to vagina causing an increased cellular activity around the vagina, resulting in temperature elevation and intracellular fluid accumulation, leading to swelling of vulva (Lammoglia *et al.*, 1998).

Pregnancy Rates of AI after hCG Administration

This study showed that pregnancy rates in hCG group (66.7%) was higher than non-hCG group and control group (50% and 25%, respectively). Hafez (2000) stated that high blood estradiol level would trigger LH surge from anterior pituitary (pre-ovulatory LH surge). Ovulation occurs within 51-62 hours after CIDR release or 25-36 hours after the initial of estrus (Suharto *et al.*, 2008).

The combination of each hormonal intervention (CIDR-G or PGF2 α) with hCG in this study increased pregnancy rates. hCG hormone is an analogue of LH whose function is to assist the follicle maturation and ovulation. hCG administration at the onset of estrus would stimulate follicles to accelerate the occurrence of ovulation. Freitas *et al.* (1997) stated that the time needed from hCG administration at the onset of estrus until ovulation was 13.7 ± 5.0 hours. Jainudeen and Hafez (1993), reported that ovulation was estimated occur 24-36 hours after estrus onset, whereas AI should ideally by performed before ovulation occurs.

In this study, AI was performed 12 and 24 hours after estrus onset. After hCG administration, animals experienced faster ovulation (13.7 ± 5.0 hours) compared to their natural time. This indicates that AIB (by hCG administration) conducted before or just before ovulation, while spermatozoa and ovum were still in their fertile time, would improve the opportunity of fertilization as well as pregnancy.

CONCLUSION

From this study, it could be concluded that progesterone hormone (CIDR-G) or PGF2 α



Figure 1. Clinical signs of estrus in PE goats

administration are very effective to induce estrus occurrence on postpartum anestrus PE goats. Furthermore, hCG administration at the onset of estrus is effective to increase pregnancy rate.

REFERENCES

- Ahmed, M.M.M., S.E. Makawi, and A.S. Jubara. 1998. Synchronization of oestrus in Nubian goats. **Small Rum. Res.** 30:113-120.
- Blache, D., M. Batailler, and C. Fabre-Nys. 1994. Oestrogen receptors in the preoptichypothalamic continuum: immunohistochemical study of the distribution and cell density during oestrous cycle in ovariectomized ewe. **J. Neuro Endocrinol.** 6:329-339.
- Caraty, A. and D.C. Skinner. 1999. Progesterone priming is essential for the full expression of the positive feedback effect of estradiolin inducing the preovulatory gonadotropin-releasing hormone surge in the ewe. **Endocrinology.** 140(1):166-170.
- De Santiago-Miramontes, M.A., R. Rivas-Muñoz, M. Muñoz-Gutiérrez, B. Malpaux, R.J. Scaramuzzi, and J.A. Delgadillo. 2008. The ovulation rate in anoestrous female goats managed under grazing conditions and exposed to the male effect is increased by nutritional supplementation. **Anim. Reprod. Sci.** 105:409-416.
- Dewi, R.R., Wahyuningsih, and D.H. Widayati. 2011. Respons estrus pada kambing Peranakan Etawa dengan body condition score 2 dan 3 terhadap kombinasi implant controlled internal drug release jangka pendek dengan injeksi prostaglandin F2 Alpha. **J. Ked. Hewan.** 5:11-14.
- Diskin, M.G., E.G. Austin, and J.F. Roche. 2002. Exogenous hormonal manipulation of ovarian activity in cattle. **Domest. Anim. Endocr.** 23:211-228.
- Ditjenak. Direktorat Jenderal Peternakan. 2013. **Statistik Peternakan 2013.** Direktorat Jenderal Peternakan, Departemen Pertanian RI, Jakarta.
- Fonseca, J.F., J.H. Bruschi, I.C.C. Santos, J.H.M. Viana, and A.C.M. Magalhaes. 2005. Induction of estrus in non-lactating dairy goats with different estrous synchrony protocol. **Anim. Reprod. Sci.** 85:117-124.
- Freitas, V.J.F., D. Rondina, D.M. Nogueira, and A.A. Simplicio. 2004. Postpartus anoestrus in Anglo-Nubian and Saanen goats raised in semi-arid of North-eastern Brazil. **Livestock Prod. Sci.** 90:219-226.
- Gonzalez-Stagnaro, C. 1984. Comportamiento reproductivo de las razas locales de rumiantes en el tropico americano. In **Reproduction des Ruminants en Zone Tropicale.** Chemineau, P., D. Gauthier, and J. Thimonier (Eds.). Les Colloques de l'INRA 1984, Paris.
- Hafez, B. and E.S.E. Hafez. 2000. **Reproduction in Farm Animals.** Lippincot Williams & Wilkins, Philadelphia.
- Hafez, E.S.E. 1993. Semen Evaluation. In **Reproduction in Farm Animals.** E.S.E. Hafez (Ed.). 6th ed. Lea and Febiger, Philadelphia.
- Hastono. 2000. Penyerempakan berahi pada domba dan kambing. **Anim. Product.** 2(1):1-8.
- Lammoglia, M.A., R.E. Short, S.E. Bellows, M.D. Macneil, and H.D. Hafs. 1998. Induced and synchronized estrus in cattle. **J. Anim. Sci.** 76:1662-1670.
- Macmillan, K.L., V.K. Taufa, D.R. Barnes, and A.M. Day. 1991. Plasma progesterone concentrations in heifers and cow treated with a new intravaginal device. **Anim. Reprod. Sci.** 26:25-40.
- Menchaca, A., and E. Rubianes. 2001. Effect of high progesterone concentrations during the early luteal phase on the length of the ovulatory cycle of goats. **Anim. Rep. Sci.** 68:69-76.
- Menchaca, A., V. Miller, V. Salveraglio, and E. Rubianes. 2007. Endocrine, luteal and follicular responses after the use of the short-term protocol to synchronize ovulation in goats. **Anim. Reprod. Sci.** 102:76-87.
- Popalayah, Ismaya, and N. Ngadiyono. 2013. Efektivitas penggunaan controlled internal drug release (CIDR) terhadap respon estrus. **Buletin Peternakan.** 37(3):148-156.
- Romano, J.E. 1998. Effect of two doses of cloprostenol in two schemes for estrous synchronization in nubian goats. **Small Rum. Res.** 28:171-176.
- Siregar, T.N., N. Areuby, G. Riady, and Amiruddin. 2004. Efek pemberian PMSG terhadap respon ovarium dan kualitas embrio kambing lokal prepuber. **Med. Ked. Hewan.** 20(3):108-112.
- Suharto, K., A. Junaidi, A. Kusumawati, and T.W. Diah. 2008. Perbandingan fertilitas antara kambing peranakan etawaEtawa skor kondisi tubuh (SKT) kurus versus ideal setelah sinkronisasi estrus dan inseminasi buatan. **Med. Ked. Hewan.** 24(1):49-54.
- Sutama, I.K. 2007. Tantangan dan peluang peningkatan produktivitas kambing melalui inovasi teknologi reproduksi. **Prosiding Lokakarya Nasional Kambing Potong.** Bogor:51-60.
- Tambing, S.N. and M. Sariubang. 2008. Kajian Komponen Teknologi Inseminasi Buatan (IB) pada Induk Kambing. **Seminar Nasional Teknologi Peternakan dan Veteriner 2008.** Bogor:552-555.
- Wildeus, S. 2006. Reproductive Management of the Meat Goat. <http://www.clemson.edu/agronomy/goats/handbook/reproduction.html>.
- Wurlina. 2005. Pengaruh berbagai dosis prostaglandin F2α terhadap kualitas birahi pada kambing lokal. **Med. Ked. Hewan.** 21(2):84-87.