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Reproductive performance and progesterone secretion in estrus-induced Manchega ewes treated with hCG at the time of AI

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Abstract

Two experiments were conducted to determine the effects of supplementing hCG at insemination on the luteal function and reproductive performance in estrus-induced mature Manchega ewes. The first experiment was carried out under field conditions with 1560 ewes on 27 farms. After estrous synchronisation with progestagen sponges and eCG, cervical inseminations were performed between October and February (breeding season) on 665 ewes on 12 farms and between March and June (non-breeding season) on 895 ewes on 15 farms. In each period and within each farm, approximately half of the ewes received an i.m. injection of 500 IU hCG at the time of insemination. The other half remained untreated and served as controls. Neither fertility (hCG: 44.2%; control: 42.0%) nor prolificacy (hCG: 1.57; control: 1.54) were affected by hCG treatment. However, on farms where fertility in the control group was persistently low, fertility of the hCG treated ewes was increased by 7.6% relative to those not treated ($P < 0.1$). The second experiment was carried out on 64 ewes from an experimental flock. Estrus and ovulation were induced in all ewes as in experiment 1. Thirty-two ewes received a single i.m. injection of 500 IU hCG at the time of intrauterine insemination, while the other half were not treated. Plasma progesterone (P_4) concentrations was measured every 2 days over a 28 day period following insemination. Progesterone secretion in the inseminated pregnant ewes was not modified by the hCG administration. However, a tendency ($P < 0.1$) for higher P_4 concentrations from days 8 to 14 was observed in those ewes that had been treated with hCG, but that did not conceive at AI. Pregnancy (62.5% and 59.4%), fertility or number of ewes lambing/ewes inseminated (56.3% and 50.0%) and prolificacy (1.56 and 1.50) of the inseminated pregnant ewes did not differ between the hCG-treated and control ewes. In ewes that failed to conceive at AI and were mated at the next oestrus (return cycle), fertility was increased by 12.1% ($P < 0.1$) in those ewes that had previously been treated with hCG (58.3%), compared with those not treated (46.2%). Results indicate that hCG treatment did not improve reproductive performance in estrus-induced and AI'd Manchega ewes, but treatment may be beneficial in increasing fertility in ewes from farms with low fertility rates.

Keywords: Manchega ewes; hCG; Fertility; Prolificacy; Progesterone

1. Introduction

In general, the low fertility rates achieved in estrus-induced and artificially inseminated ewes is the primary factor limiting the advancement of AI programs

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in sheep production systems (Evans, 1988). Although this reduced fertility has been related to many factors including breed, age, season, physiological and nutritional status of females, estrous synchronization treatment and time of insemination, insemination technique and semen quality, preimplantation embryonic loss has long been recognised as the major limiting factor for obtaining optimum reproductive performance in domesticated livestock (Windsor, 1995). In sheep, most fertilized eggs are lost between days 8 and 16 after AI (Nancarrow, 1994) and an inadequate luteal function is thought to be one of the critical factors affecting embryo survival (Wilmut et al., 1986; Ashworth et al., 1989).

Human chorionic gonadotropin (hCG), which is similar to LH in function, has been shown to increase luteal weight and endogenous synthesis of progesterone (P_4) from the corpus luteum in sheep (Farin et al., 1988; Nephew et al., 1994). Thus hCG has been administered to ewes at different times during the cycle after AI or breeding in an attempt to reduce embryonic mortality and improve reproductive performance—but the effectiveness of these treatments has not been consistent between studies. Kittot et al. (1983) reported increased plasma P_4 concentrations and enhanced pregnancy rates in synchronized lactating ewes following the treatment with multiple doses of hCG (100 IU) on days 11–13 after mating. In contrast, no improvement in pregnancy and lambing rates in estrus-induced and artificially inseminated ewes has been reported with multiple doses of hCG (100 IU) administered on days 3–5 after AI (Fukui et al., 2001), or with a single hCG (500 IU) injection given on days 4, 7 or 11 after AI (Gamboni et al., 1984; Nephew et al., 1994; Ishida et al., 1999), even though hCG treatment stimulated the corpus luteum (CL) and increased P_4 concentrations.

The failure of the sheep CL to function normally may also be caused by an inadequate gonadotrophin stimulation during the peri-ovulatory period and therefore, alternative research has concentrated on improving pregnancy rates by applying hCG at the time of AI—but results have also been variable. While some researchers observed both lambing percentage and litter size tended to be higher in ewe lambs supplemented with hCG on the day of mating (Khan et al., 2003), others have reported no improvement in reproductive efficiency in mature ewes (Zamiri and Hosseini, 1998).

The Manchega sheep breed is one of the most important Spanish dairy breeds, widely distributed in the central area of Spain. Their fertility following AI at an induced estrous cycle has been shown to range from a mean value of 40% with cervical inseminations, to a mean value of 60% following laparoscopic intra-uterine inseminations. However, fertility rates (number of ewes lambing/ewes inseminated) lower than 35% have also been recorded, depending on the sheep management and production systems (Montoro, 1995). Taking into account that increased fertility, under certain conditions of sheep husbandry, may be economical and profitable, this study was carried out to evaluate whether supplementing the preovulatory gonadotrohin surge with a single injection of 500 IU hCG, given at the time of AI, has any effect on serum progesterone concentrations and the reproductive performance in synchronized and AI'd Manchega ewes.

2. Material and methods

2.1. Experiment 1

This experiment was conducted across 27 farms distributed in the central areas of Spain (latitude 38°–40°N) and involved 1560 mature Manchega ewes in semi-intensive milking production flocks. Of these 1560 ewes, 665 ewes from 12 farms were evaluated between October and February (breeding season) and 895 ewes from 15 farms evaluated between March and June (non-breeding season).

Estrus and ovulation were induced by treating all ewes with an intravaginal sponge impregnated with synthetic progestagen (30 mg FGA, Intervet) for 12 days, followed by an i.m. injection of 500 IU eCG at the time of the sponge withdrawal. In both seasons and within each farm, ewes were inseminated cervically, approximately 55–56 h after eCG injection by a single operator, using semen provided by the CERSYRA (Regional Insemination Center, Castilla-La Mancha, Spain). Each insemination dose consisting of 0.25 ml cooled semen containing 400×10^6 sperm. Immediately after AI, ewes were randomly assigned to either a group receiving a single i.m. injection of 500 IU hCG (breeding season, $n = 331$; non-breeding season, $n = 450$) or to an untreated group that served as controls (breeding season, $n = 334$; non-breeding season, $n = 445$). Fertility (number of ewes lambed/number of ewes inseminated) and prolificacy (number of lambs born/number of ewes lambed) were recorded at lambing.

2.2. Experiment 2

This experiment was conducted in March using 64 mature Manchega ewes from an experimental flock kept at the facilities of the Animal Reproduction Department, INIA, Madrid (40°25′N). Estrus and ovulation were induced in all ewes as in experiment 1 with pro-