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UTERINE CAPACITY IN RABBITS. FIRST RESULTS

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ABSTRACT

An unilateral ovariectomized group (ULO) with 64 does and 69 control does were used to study ovulation rate, embryo and fetal survival and their relationships. No differences were found between both groups for ovulation rate (OR). Number of implanted (IE) and live embryos (LE) and litter size at birth were smaller in ULO than control does (11.08, 10.85, 7.51 in ULO and 12.37, 12.17 and 9.75 in control group respectively). Embryo survival was lower in ULO does, but fetal survival appears to be the same in both ULO and control does. Litter size at birth (LS) was scarcely related to ovulation rate (b=0.18, R^2=0.03, R^2/R^2_{max}=0.12). A positive regression was found between IE and OR, and between LS and IE in both groups.

INTRODUCTION

The experiments of selection on litter size have had little success in rabbits (Rochambeau 1988). As in pigs the situation appears to be the same (Haley et al. 1988), it has been suggested to select litter size through its components, ovulation rate and prenatal survival (Johnson et al., 1984). However, no improvement in litter size has been found when ovulation rate was selected in pigs (Johnson et al., 1984) and mice (Bradford, 1969). The small genetic and phenotypic correlations found in rabbits between ovulation rate and either litter size and prenatal survival, the high correlations between prenatal survival and litter size and the moderatly high heritability of prenatal survival suggest that prenatal survival could be used as a trait for indirect selection on litter size (Blasco et al., 1992).

Prenatal survival can be divided into embryo survival (before implantation) and fetal survival (from implantation to birth). Uterine capacity, measured as the maximun number of fetuses that the dam is able to support at birth or at a specific stage of gestation, has been suggested as way to study prenatal survival free of the variaton in this trait produced by differences in ovulation rate (Christenson, et al.1987). Unilateral ovariectomy causes in the rabbit a doubling of ovulation rate in the remaining ovary (Fleming, et al. 1984). As there is no transuterine migration in rabbits, the uterine horn corresponding to the functional ovary is challenged by a high number of embryos and the uterine capacity of the doe could be expressed.

Uterine capacity depends on two main traits: number of implantation sites that the uterus is able to accept, and fetal mortality. It is possible to observe the number of implantation sites in rabbits at 12 days of gestation by laparoscopy, without damaging litter size (Santacreu et al. 1990). This paper shows the first results of ovulation rate, embryo and fetal survival and litter size of a selection experiment on uterine capacity in rabbits.

MATERIAL AND METHODS

Animals

An experimental unilateral ovariectomized group (ULO) with 64 does, and a control group (C) with 69 does from a synthetic line were used in the experiment. This line was founded by mating crossbred males and crossbred females from two different origins, and had been selected on litter size at weaning for 11 generations.

The left ovary was removed in the ULO group before puberty (at 14 to 16 weeks of age). A laparascopy was performed in all ULO does and in 30 control does during their second gestation, 12 days after mating, and number of corpora lutea, live and regressed embryos were recorded.

Surgical techniques

Left side ovariectomies were performed via midventral incision. After grasping the ovary with haemostatic tongs, a ligation was placed around the oviduct and blood vessels and the ovary was removed.

The laparoscopy technique was developed by F. García, and it has been described in full detail by Santacreu et al. (1990). This technique allows to count corpora lutea and number of embryos very accurately without damaging litter size.

Traits analyzed

OR: ovulation rate -estimated as number of corpora lutea-.
LE: live embryos -estimated as the number of normal uterine swellings-.
RE: regressed embryos -estimated as number of small uterine swellings with reduced vascular supply-.
LS: litter size at birth (total of young rabbits born).
IE: implantation sites (LE+RE).
PS: prenatal survival (LS/OR).
FS: fetal survival (LS/LE).
ES: embryo survival (LE/OR).
IS: implantation survival (LE/IE).
IR: implantation ratio (IE/OR).

Statistical Analysis

To investigate the relationships between traits, linear and quadratic regressions were performed. The ratio R^2/R^2_{max} was calculated -R^2 being the coefficient of determination of the regression-. This ratio represents better than R^2 the goodness of the adjustement of the averages of a trait for each class of an other trait (for example, the averages of litter size obtained for each value of number of corpora lutea) (Draper and Smith, 1981).

RESULTS AND DISCUSSION

Table 1 shows the means and descriptive parameters of ULO and control groups. As the means and standard deviations are expected to be higher in the control group, the coefficient of variation is given to compare the variability of the traits in both groups avoiding scale effects.

Both groups ULO and control had the same ovulation rate, showing a compensatory ovarian hypertrophy in the remaining ovary of the ULO does, as reported by Fleming et. al (1984) in rabbits and Christenson et. al (1987) in pigs. The number of implantation sites is very high in the ULO group (11.08), although significantly lower then the number found in the control group (12.37). There are substantial differences among uterine horns in the number of implantation sites, being the C.V. 0.28. A part of this variation can depend on differences in ovulation rate (the mean being 14.60, but the standard deviation 2.63), but also on a higher number of abnormal embryos and imature follicules in ULO does. Lamberson et al.(1989), in ULO female mice, reported a higher mortality prior than after implantation, suggesting that the main causes could be imature ova and abnormal embryos. Fleming et. al (1984) found in rabbits a higher number of imature follicles as a result of hemiovariectomy. Koening et al. (1986) found a higher percentage of imature ovules in pig line selected on high ovulation rate. Finally, it would be possible to find differences among uterine horns in their ability to accept

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implantation sites (Adams, 1962).

Despite the high number of implantation sites in ULO does, embryo survival is lower in ULO does but fetal survival appears to be the same in the ULO and in the control group, which is a remarkable result.

Table 2 shows the results of the regressions. As none of the quadratic adjustments gave a significant quadratic term, only linear adjustments are given.

Litter size is scarcely related to ovulation rate (figure 1), as has been shown by Santacreu et al. (1992) among others. An interesting result is the positive regression of number of implantation sites on ovulation rate in the ULO females (figure 2), which shows that, as an average $-R^2/R^2_{max}$ is high, but R^2 is low-, the uterine horn would have been able to accept some more implantation sites if the ovulation rate had been higher.

It seems that a large number of implantation sites produces, as an average, large litter sizes (figure 3) in the ULO group, The low value of the R^2/R^2_{max} of the control group disagree with the high value found by Santacreu et al.(1992) in other experiment. Selection on litter size of ULO does will probably affect both fetal survival and number of implantation sites.

TABLE 1. Means (μ), standard errors of the mean (SE), standard deviations (σ), and coefficient of variation (CV) of unilateral ovariectomized does (ULO) and control group. Second gestation.

	ULO DOES				CONTROL DOES				SIG. LEVEL
	μ	SE	σ	CV	μ	SE	σ	CV	
OR	14.60	0.34	2.63	0.18	14.13	0.49	2.71	0.19	N.S
IE	11.08	0.39	3.09	0.28	12.37	0.44	2.41	0.19	*
RE	0.23	0.07	0.53	2.30	0.20	0.10	0.55	2.75	N.S
LE	10.85	0.39	3.05	0.28	12.17	0.47	2.59	0.21	*
LS	7.51	0.34	2.58	0.34	9.75	0.45	3.36	0.34	*
PS	0.53	0.03	0.19	0.35	0.66	0.04	0.24	0.36	*
FS	0.72	0.03	0.22	0.29	0.76	0.05	0.25	0.33	N.S
ES	0.75	0.03	0.19	0.26	0.87	0.02	0.13	0.15	*
IS	0.98	0.01	0.05	0.05	0.98	0.01	0.05	0.05	N.S
IR	0.76	0.02	0.19	0.25	0.88	0.02	0.12	0.13	*

N.S: no significant differences between groups. (*): $P < 0.05$

OR: ovulation rate, IE: implanted embryos, RE: regressed embryos, LE: live embryos, LS:total rabbits born, PS: prenatal survival, FS: foetal survival, ES: embryo survival, IS: implantation survival, IR: implantation ratio.

TABLE 2.- Statistics from simple linear regression between different traits from second gestation of ULO does.

	ULO DOES			
Y	IE	LS		
X	OR	OR	IE	LE
A	3.54	4.88*	2.28*	2.53*
(SE)	2.04	1.90	1.02	1.04
b	0.52**	0.18	0.47**	0.46**
(SE)	0.14	0.13	0.09	0.09
R^2	0.19	0.03	0.34	0.31
R^2/R^2_{max}	0.71	0.12	0.71	0.75
RSD	2.80	2.56	2.12	2.16
F	14.04	1.97	28.20	24.93

	CONTROL DOES			
Y	IE	LS		
X	OR	OR	IE	LE
A	2.73	5.07	2.94	3.07
(SE)	1.55	3.44	3.29	3.09
b	0.68**	0.29	0.49	0.49
(SE)	0.11	0.24	0.26	0.25
R^2	0.59	0.06	0.12	0.13
R^2/R^2_{max}	0.79	0.09	0.27	0.26
RSD	1.58	3.49	3.36	3.35
F	79.8	1.45	3.67	4.01

*: $P<0.05$; **: $P<0.01$; A:intercept; SE: standard error; b: regression coefficient, R^2: coefficient of determination, RSD:residual standard deviation; F: value of the F-ratio.

OR: ovulation rate, IE: implanted embryos, LE: live embryos , LS: litter size.

Fig.1- Ovulation rate (OR) and Litter size (LS)

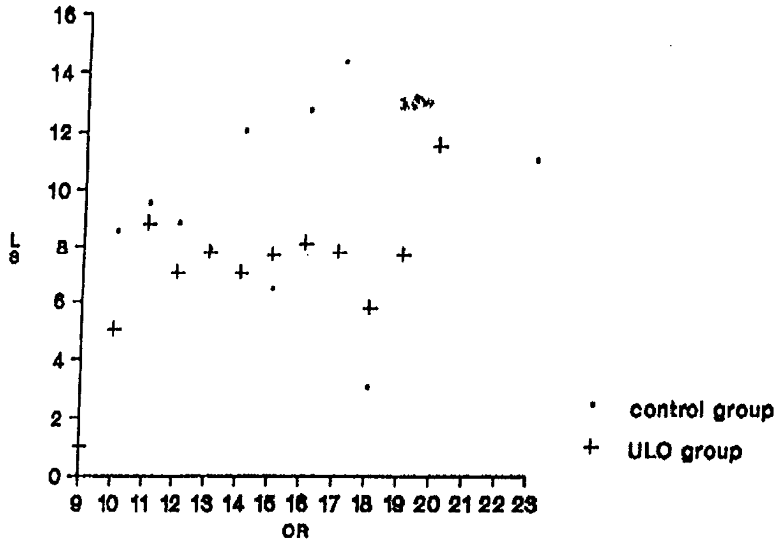


Fig 2.- Ovulation rate (OR) and Implantation points (IE)

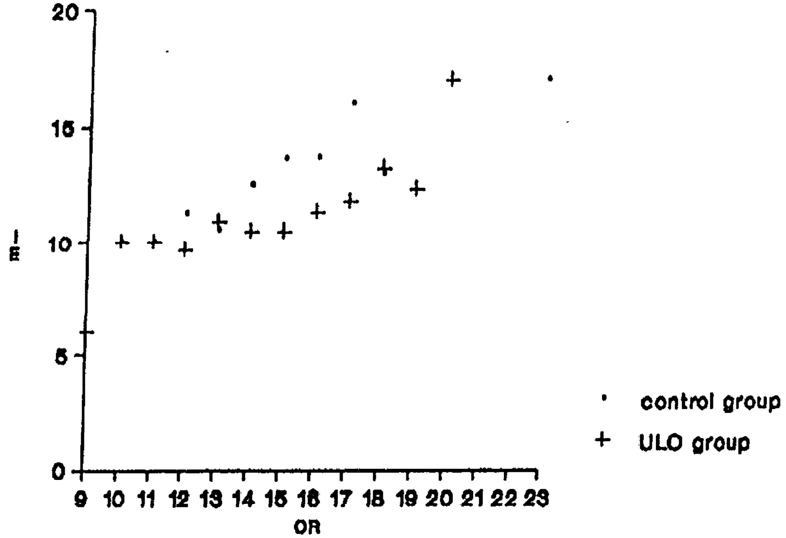
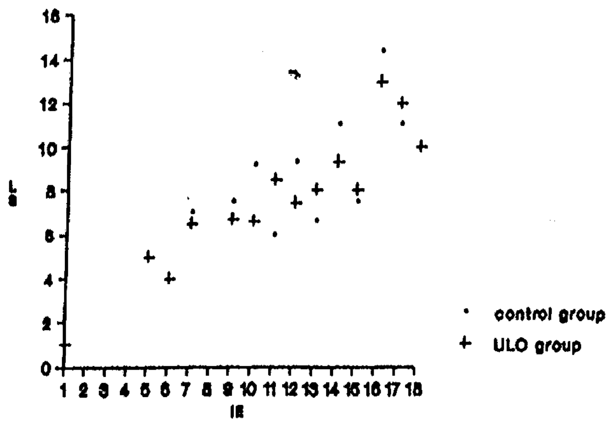


Fig 3.- Implantation points (IE) and Litter size (LS)



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