Effect of Cesarean Section on Postpartum Ovulation and Changes in Serum LH in Postpartum Rats[1] (36958)

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Ying *et al.* (1) have reported that the period occupied by the initial triggering process for ovulation in the individual postpartum rat is relatively brief, however, for the whole population, the period extended from early morning to late evening. They suggested that the time of ovulatory surge of LH is determined by the time of parturition, the endogenous surge of estrogen, and a sudden withdrawal of progesterone. However, copulation or cervical stimulation produced ovulation under certain circumstances (2–8). This raises the question that the passing of embryos through the cervical canal may serve as a stimulation triggering the process of postpartum ovulation. The objective of this study was to examine whether the process of parturition *per se* initiates the ovulatory surge of LH in the postpartum animals.

Methods and Materials. Sprague-Dawley virgin female rats (90 days old) were obtained from Holtzman Company, Madison, WI and housed in temperature-controlled, artificially lighted quarters in which the lights went on at 5 AM and off at 7 PM EST. The midpoint of the dark period is considered as "midnight colony time" and all times are reported in relation to that. All animals were provided with Purina Lab Chow and water *ad libitum*. Vaginal smears were taken daily before 10 AM throughout the experiment. On the evening of proestrus the animals were caged with males and mating was verified by observation of sperm in vaginal smear and/or copulation plug in the vagina the next morning. This was designated as Day 1 of pregnancy.

Animals were observed for delivery from 6 AM to 4 PM at 2 hr intervals using the convention described by Hoffman and Schwartz (9). On Day 22 of pregnancy, the animals were operated upon under ether anesthesia using the standard techniques of laparotomy and hysterectomy. The cervical end of both uterine horns was exposed through a longitudinal incision and the cranial fetus and placenta were removed. In the sham controls, only the incision and suture were performed. A second method for performing cesarean section involved complete hysterectomy. However, no significant difference was observed between these two methods. The young were removed from the uterus and kept in a regular 37° incubator from 2 to 4 hr. They were then caged with their mother. The mothers were killed the day after parturition did or would have occurred to verify the incidence of ovulation. An aliquot of 0.5 ml of blood was collected at different times from individual animals in both experimental and sham control groups for the radioimmunoassay of serum LH. LH was analyzed using the radioimmunoassay kits available from the National Institutes of Health with minor modification (10). The LH values are expressed as nanograms of NIAMD-Rat-LH-I-1 per milliliter of plasma. Data were analyzed by Student's *t* test.

Results. Sixty-three percent (5/8) of cesarean sectioned rats ovulated compared with 88% (7/8) of the sham controls (Table I). In both groups the average number of ova shed per ovulating rat was approximately the same: 11.57 ± 0.92 for controls and 11.17

[1] Supported by NIH Grant HD-03736; The Ford Foundation; The Bing Fund, and The William F. Milton Fund.

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TABLE I. Effect of Cesarean Section on Ovulation in Postpartum Rats.

Treatment	No. rats ovulated/ total no. rats	% Ovul.	Av no. ova/ ovulating rat ± SE
Sham control	7/8	88	11.57 ± 0.92
Experimental	5/8	63	11.17 ± 0.98

± 0.98 for experimental animals. An LH surge seemed to occur around 3:00 PM on Day 23 of pregnancy in both groups (Table II).

Discussion. The present study demonstrates that the passage of embryos through the cervical canal *per se* is not prerequisite to triggering the ovulatory surge of gonadotropin in the postpartum rat as determined by the radioimmunoassay of serum LH. At the time of preparation of this manuscript, Johnson, Zarrow and Denenberg (11) reported that there are no significant differences between ovulation times in rats following cesarean section on Day 23 and ovulation times in rats following normal deliveries. However, they have observed that when pregnancy was terminated by cesarean section on Days 20, 21 or 22 of gestation, the animals ovulated after midnight of Day 24 postmating, suggesting luteal regression must occur before ovulation. This is in agreement with our postulation that the withdrawal of progesterone on Day 21 (12), together with a sudden surge of estrogen around Day 22 (13), initiates the ovulatory surge of gonadotropins and consequently the postpartum ovulation (1).

Parturition in the rat is always associated with a rather sudden increase in uterine contractile activity 2 to 3 hr prior to the expulsion of the first young. Uterine activity remains high throughout the delivery of the litter but disappears soon after the last young and placenta are cast (14). The concept of "progesterone-block" of the uterine contractile wave as suggested by Knaus (15) and elaborated upon by Csapo (16, 17) and Kuriyama and Csapo (18) perhaps also applies to the initiation of the postpartum ovulation. This has been further demonstrated by the fact that administration of high doses of progesterone (1, 19) or antiestrogen (Ying and Greep, unpublished data) during the late stage of pregnancy not only postpones parturition but also affects the postpartum ovulation.

TABLE II. Changes of Serum LH in Postpartum Rats.

	Serum LH (ng/ml)		
Treatment	10 AM (23)	3 PM (23)	8 AM (24)
Sham control	7.3 ± 0.7	28.6 ± 2.4	8.6 ± 0.6
Cesarean sectioned	4.8 ± 1.6	24.6 ± 4.8	6.8 ± 1.2

Summary. Cesarean section on Day 22 of pregnancy has no effect on ovulation as determined by the incidence of ovulation and the radioimmunoassay of serum LH. This study demonstrates that parturition per se is not the prerequisite to triggering the LH surge responsible for ovulation in the postpartum rat.

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Received Sept. 1, 1972. P.S.E.B.M., 1973, Vol. 142.