The Effect of Estrogen and Progesterone on Genital Tract Weight and Glycogen Content in Ovariectomized Guinea Pigs[1] (36104)

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Investigation of the female guinea pig genital tract glycogen thus far have been limited to qualitative histochemical evaluation and localization. The uterine stromal cells contain traces of glycogen localized in the cytoplasm of surface epithelial cells during estrus and metestrus. The cervical epithelium is almost devoid of glycogen, but some can be identified in the stromal cells underlying the *lamina propria* (1). The guinea pig vaginal glycogen reportedly increases during the proestrus and estrus stage of the cycle (1–3) in the cytoplasm of the prickle cell layer. The administration of a single dose of 88 μg of estradiol benzoates to immature guinea pigs did not affect uterine glycogen; it increased the weight but not the water content (4). There have been, however, no investigations of quantitative glycogen changes in uterine, cervical, or vaginal tissue following either induced estrus or ovarian hormone adminstration in the castrated guinea pig.

Methods. A total of 20 guinea pigs, castrated for a year, were used. Estrus was induced in one group with 1 μg of estradiol benzoate (Schering, Progynon) at 0 and 24 hr, followed by 0.4 mg of progesterone (Schering, Proluton) at 48 hr. The animals were isolated after this last injection and stimulated manually each hour by stroking the back (5), to test for lordosis, so the latency of the first positive response and duration of estrus could be determined. The remaining groups were administered estrogen in doses of either 1 or 100 μg at 8 a.m. for 0 and 24 hr and an oil injection at 48 hr. Once estrus had been detected in the estrogen–progesterone group, the animals were sacrificed within 2 hr and the genital tract rapidly removed. Since complete, rapid removal of the vagina was not feasible, only a small amount of tissue was removed for determination of glycogen and water content. An aliquot of tissue was immediately frozen in dry ice while another was air dried to constant weight to determine water content. At the time of chemical determination, the tissue was weighed, thawed and hydrolyzed with 30% KOH; the amount of glycogen was determined with the anthrone reagent (6) and expressed as μg/100 mg of tissue wet weight. The results were analyzed by analysis of variance, followed by the Newman-Keuls tests for individual comparison (7).

Results. The amount of uterine tissue increased significantly from the castrated levels as a result of either estrogen or estrogen and progesterone administration ($p<.01$), Table I, but there were no significant weight differences between the different estrogen treatments. The uterine tissue responded maximally with the lower level of estradiol (1 μg) and either greater amounts (100 μg) of estrogen or estrogen in combination with progesterone were without effect. The weight of cervical tissue increased significantly above the castrated levels with either the 100 μg of estradiol or 1 μg of estradiol plus progesterone, but not with the lower estradiol dosage.

The amount of glycogen in uterine and

[1] Publication No. 530 of the Oregon Regional Primate Research Center; supported by Grants RR-00163 and MH 08634 from the National Institutes of Health, United States Public Health Service.

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TABLE I. Weight, Water and Glycogen Content of Guinea Pig Uterus, Cervix and Vagina Following Ovarian Steroid Administration.

Tissue	Treatment			
	Castrated	1.0 μg Estrogen	100 μg Estrogen	1.0 μg Esgrogen 0.4 mg Progesterone
	Weight (mg)			
Uterus	447.8 ± 64.8[a]	942.6 ± 64.6	1020.9 ± 99.4	1015.4 ± 111.9
Cervix	154.3 ± 15.5	213.6 ± 16.1	308.5 ± 28.6	264.4 ± 40.2
Vagina	—	—	—	—
	Glycogen (μg/100 mg wet weight)			
Uterus	53 ± 5	54 ± 12	58 ± 2	73 ± 8
Cervix	101 ± 10	178 ± 18	88 ± 5	81 ± 3
Vagina	82 ± 19	134 ± 27	98 ± 8	69 ± 7
	Water (%)			
Uterus	76.3 ± 1.6	79.7 ± 0.9	80.3 ± 0.5	80.4 ± 2.5
Cervix	72.4 ± 1.5	74.1 ± 0.8	75.3 ± 0.5	73.1 ± 1.2
Vagina	65.8 ± 4.3	66.6 ± 2.0	73.0 ± 1.7	73.5 ± 1.6

[a] Five animals in each group.

vaginal tissue was not significantly affected by the ovarian steroids at any level and did not differ significantly from the castrated levels. However, the cervical glycogen content was significantly greater ($p<.01$) in the group administered 1 μg of estradiol, but not with the larger amounts of estrogen or estrogen in combination with progesterone.

The tissue water content did not differ significantly between either castrates or treatments in any tissue. The water content in the uterus was always greater than either cervical or vaginal tissue.

Discussion. In rat (8) and hamster uterine tissue (9) glycogen synthesis is maximum with 1 μg of estradiol and completed by 12 hr. The guinea pig is unique in laboratory species investigated in that the uterine glycogen content is unaffected by either small or large amounts of estradiol, or a combination of two ovarian steroids. Hamster (10) and rat (11) cervical tissue exhibits a cyclic rise in glycogen content at estrus and the hamster responds in a linear positive manner with dose and time to increasing levels of estradiol (9). The cervical tissue glycogen levels in the rat are greater than vaginal tissue, but less than uterine tissue levels (12) and glycogen synthesis is maximal with 25 μg of estradiol. In the castrated guinea pig, however the response of cervical tissue to glycogen content is greater than either uterine or vaginal tissue and the maximal glycogen content occurs with a lower dose of estrogen.

Topical administration of small quantities or injection of increasing amounts of estradiol causes a positive increase in the amount of glycogen in either the rat (13) or the hamster vaginal tissue (9). The guinea pig vaginal glycogen, however, did not differ with hormone levels administered, indicating the vaginal tissue of this species does not react to estrogen administration as the rat or the hamster.

While the cervix, uterus, and vagina are anatomically united in all species, their ability to synthesize glycogen differs within specific areas of the tract and also exhibits species differences. The maximum glycogen synthetic activity appears to be in the cervix of the rat and guinea pig, but in both cervix and vaginal tissue in the hamster. This is due to species differences of either the estrogen receptors or the action of estrogen on the enzyme glycogen synthetase. The guinea pig cervical tissue reacts maximally to small amounts of estradiol, and increased amounts of estrogen or estrogen and progesterone are without effect.

Summary. The uterus and cervix of the castrated guinea pig increased in weight in response to administration of different doses

of estrogen and progesterone. Unlike the rat and hamster, uterine and vaginal glycogen synthesis was unaffected by administration of estrogen, while cervical tissue glycogen content increased significantly with the lower amount of estrogen. The uterine tissue contained the greatest water content of the genital tract. There were no differences in water content between treatments.

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Received July 19, 1971. P.S.E.B.M., 1972, Vol. 139.