Ovarian responses and serum LH levels after retraction or removal of the oviduct in Japanese quail

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Summary. The effects of oviduct removal, oviduct displacement or sham-operation were studied in Japanese quail (Coturnix coturnix japonica). No significant differences were observed between the treatments for body weight, number of follicles ≥6 mm diam., or number of ruptured follicles. Retraction or removal of the oviduct resulted in similar significant increases (P < 0.05) in ovarian weight, diameter of the largest follicle, and serum LH levels when compared with the controls. Injection of yolk into normal hens did not cause any change. It is suggested that the oviduct normally exerts an inhibitory control on ovary growth without appreciable effect on ovulation rate.

Introduction

The early research on avian oviduct removal or sectioning is replete with contradictions. According to Yarrell (1827) and Tegetmeier (1867) the ovary of birds in which the reproductive tract was removed fails to enlarge, while Sutton (1885) showed that oviduct removal caused ovarian regression. Sellheim (1907) and Pearl & Curtis (1914) suggested that the ovarian atrophy found by earlier workers was probably the result of the trauma of operation rather than physiological effects specific to oviduct removal, because birds without oviducts had ovaries similar to those of the controls after a period of recovery. When oviduct removal preceded sexual maturity, ovarian development appeared normal.

The present study was a re-examination of utero-ovarian interactions in birds.

Materials and Methods

Experiment 1

Twenty-four female Japanese quail of a white-egg laying strain were used. The birds were housed in a communal pen until they were 26-27 days of age and randomly assigned to one of three treatment groups. Birds were anaesthetized with an i.p. injection of approximately 0.3 ml sodium pentobarbital—saline solution (15 mg/ml) which usually caused rapid onset of anaesthesia of short duration. Surgery was carried out under clean but not necessarily sterile conditions. The first treatment consisted of laparotomy and movement of viscera to verify the presence of an oviduct. The second treatment was a gentle retraction of the oviduct without severing the attachment between the oviduct and cloaca, but severing the normal vascular and neural connections with the anterior part of the tract. The third treatment consisted of a gentle retraction of the oviduct and severance at the junction with the cloaca. The free oviduct was removed from the body cavity. Abdominal incisions were closed with two or four sutures of 4-0 to 6-0 silk in the muscle and a similar number for the skin wound.

All birds were placed in individual quail laying batteries in a 14 h light/24 h schedule. Food and water were always available. Egg production was recorded daily until 3 weeks after the first egg was obtained from a laparotomized control bird. All birds were then bled and killed by cervical dislocation. At autopsy, ovarian weight, diameter of the largest follicle, number of visible ruptured follicles, number of follicles ≥6 mm diameter, body weight and oviduct weight (if present) were obtained. Serum samples were frozen at -20°C until assay for LH by a radioimmunoassay specific for avian LH (Wentworth, Burke & Birrenkott, 1976). The sensitivity of the assay was 0.5 ng/ml and the intra-assay coefficient of variation was 6.0%.
The results were assessed by analysis of variance, Duncan's New Multiple Range Test, and correlations were calculated for all factors considered (Steel & Torrie, 1960).

**Experiment 2**

This experiment differs from the first only in the age and strain of birds used. Eighteen female Japanese quail of the Wisconsin wild-type random-bred strain were randomly subjected to the above three treatments at 23–24 days of age.

**Experiment 3**

Twelve adult female Japanese quail of the strain used in Exp. 2 were randomly subjected to one of two treatments. Birds in the first group received no treatment. The treatment of Group 2 consisted of injections of 2·9 g yolk material collected fresh on the day of injection from quail eggs. Care was taken to harvest and inject this material with sterile equipment. Intraperitoneal injections were given every other morning for 14 days, after which all the birds were killed and examined as above.

**Results**

The results for Experiments 1 and 2 are presented in Table 1. In Exps 1 and 2 there were no significant differences observed for replication or treatment × replicate interaction for any of the variables studied. There were no significant differences between the three treatments for body weight, number of follicles ≥6 mm in diameter, or number of ruptured follicles. The control birds had a mean oviduct weight which was significantly greater than that of birds with a retracted oviduct (P < 0·005). At autopsy, birds with retracted oviducts had malpositions of the reproductive tract and often had closure of the duct in one or more areas.

<table>
<thead>
<tr>
<th>Table 1. Effect of manipulation or removal of the oviduct in Japanese quail (no. in parentheses)</th>
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<tbody>
<tr>
<td>Control (12)</td>
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<tr>
<td>Body weight (g)</td>
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<tr>
<td>Ovary weight (g)</td>
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<tr>
<td>No. of follicles ≥ 6 mm diameter</td>
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<tr>
<td>No. of ruptured follicles</td>
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<tr>
<td>Diameter of largest follicle (cm)</td>
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<tr>
<td>Oviduct weight (g)</td>
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<tr>
<td>LH (ng/ml)</td>
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Values are mean ± s.e.m.; those with different superscripts within rows are significantly different (P < 0·05).

Trauma of the oviduct caused by retraction or removal resulted in a significant (P < 0·05) increase in ovarian weight over that of the sham-operated controls. The sham-operated controls also had a significantly smaller (P < 0·05) diameter of largest follicle when compared with the other two treatments. There were no significant differences for any of the variables (P < 0·05) between the birds in which the oviduct had been retracted and those in which the oviduct had been removed. Serum LH levels were significantly elevated by both treatments in which the oviduct was removed from its neural and vascular connections (Table 1).

All three treatments exhibited a significant positive correlation between the diameter of the largest follicle and ovarian weight. No significant differences were found between treatments for the correlation of the number of ruptured follicles and the weight of the ovary. The relationship between ovarian weight and the number of follicles ≥6 mm was significantly different (P < 0·01) for the two treatments in which the oviducts were manipulated and both of these results were significantly different from those of the control group (P < 0·01).
Analysis of the data from Exp. 3, with respect to the same measurements taken in Exp. 1 and 2, showed no significant differences between the yolk-injected and control groups.

Discussion

Oviduct removal or retraction resulted in significant increases in ovary weight and diameter of the largest follicle, but had no influence on the number of follicles >6 mm in diameter, suggesting that the oviduct normally exerts an inhibitory control on the ovary. The results of Exp. 3 show that these increases in ovarian weight and follicle size were not due to resorption and recycling of yolk material ovulated into the body cavity, although yolks placed into the body cavity of hens are reabsorbed within 24 hours (Sturkie, 1955).

The numbers of ruptured follicles showed that there was no change in ovulation rate in the experimental birds. Wood-Gush & Gilbert (1970) have shown an increased frequency of multiple ovulations in chickens with the ovary transplanted away from its normal site and this has been confirmed by Scott (1974). Our results, showing elevated levels of serum LH and normal numbers of ruptured follicles in oviduct-traumatized birds, suggest that there is no blockage to ovulation in these birds and that there should in fact be an enhancement of the ovulatory process. The fact that no increased frequency of ovulation occurred in our birds may be due to neural factors operating on the ovary in situ in the absence of a functional oviduct. The work of Ferrando & Nalbandov (1969) and Liu Kao & Nalbandov (1972), like that of Huston & Nalbandov (1953) and van Tienhoven (1953), suggests a neural involvement in regulation of ovulation. Our data, like those of Juhasz & van Tienhoven (1964), Scott (1974) and Gentle & Wood-Gush (1977), support the concept that the innervation of the ovary plays a large part in the timing and sequence of ovulation.

The evidence presented here also indicates the existence of a humoral agent from the oviduct which directly inhibits ovarian growth or affects the hypothalamic–pituitary axis to modulate gonadotrophin output. The occurrence of ovarian hypertrophy when the ovary was transplanted away from its normal site (Gilbert & Wood-Gush 1970) suggests a direct local effect (see Gilbert & Wood-Gush, 1971) and local utero-ovarian relationships of this type have been described for mammals (Del Campo & Ginther, 1972, 1973). Indirect feedback of an hormonal factor to the hypothalamus and/or pituitary is not fully supported by the data of Gilbert & Wood-Gush (1970), but the possibility cannot be discounted without more work on the onset of ovarian growth after oviduct trauma.

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References


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