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OVARIAN PULSATION AND ALLIED PHENOMENA IN LUCILIA SERICATA MEIG.

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On opening the abdominal cavity of a living, female fly with undeveloped ova, one generally finds the ovaries contracting rhythmically. Contraction chiefly involves the calyces, for contraction of the ovarioles is spasmodic and ephemeral, and the oviducts contract only occasionally, usually as the result of mechanical stimulation.

This pulsation, though affected by stimuli external to the organs, is more or less independent of them, for the ovaries often continue this action for hours in Ringer's solution, even when separated from the body of the insect. Moreover if, for any reason, ovaries which have been left for some hours have ceased to pulsate, the addition of warm (30°C.) Ringer's will often initiate pulsation for several hours longer.

The ovaries are seldom motionless in a freshly dissected specimen, but sometimes pulsate feebly and soon stop, apparently as a result of the shock of operation. In such cases any one of a variety of stimuli may initiate pulsation. Crystals of ordinary table salt dropped upon them will often have this effect; so too, will sugar, although it is less effective. Mechanical stimuli initiate pulsation; even a stream of liquid passed over the organs often having that effect. But, with the specimens I used, no single stimulus invariably produced the same result - excepting eserine and acetylcholine bromide, the effects of which will be described later in this paper. Occasionally none of the stimuli, singly or together, had any observable result upon pulsation.

There is no evident consistency in the rate, vigor, or synchrony of ovarian pulsation. Even in a single specimen the two ovaries seldom contracted at the same rate, although it was not unusual for them to do so alternately. Contraction often appeared to take place simultaneously in the entire ovary; at other times a visible wave of contraction passed from the margins inward toward the center, which became briefly elevated, so that the surface of the organ was momentarily convex. Less frequently a wave of contraction passed from the cephalic margin of the organ toward the oviduct. Cases of incomplete contraction were also observed: in such cases the margins of the organ were active, while the rest of the body was motionless.

The period of contraction varied from 0.8 seconds to nearly a minute, depending upon the specimen and circumstances. In some cases the rate increased or decreased without apparent cause. Some specimens exhibited an increase in both rate and vigor for a time and then gradually slowed and finally stopped.

Contraction of individual ovarioles was observed only a few times and then only in fresh specimens. Each acts independently of the others. A wave of constriction passes from the free end of the organ to the calyx. The oviducts contract occasionally, generally by shortening of the tube. Erratic contractions of the accessory glands and spermathecal ducts also occur. Contractions of the latter may bring the reservoirs in contact with one another in a way which suggests a boxer striking his fists together.

Pulsations of the ovarian calyces appear never to occur in flies with matured ova; nor is any movement of the reproductive ducts evident in such specimens. Movements which produce descent of the ova must occur, but perhaps are inhibited in dissected

specimens. The close packing of the ova and consequent limitation of free space in such specimens must, however, limit internal movements: it is difficult to understand how pulsation could take place under such circumstances.

In considering the effects of eserine and acetylcholine upon ovarian pulsation it is necessary to point out that the experimental results obtained upon other organisms with the aforementioned substances have not been entirely consistent. A number of students have pointed out that acetylcholine, although it raises the blood pressure, also produces vasodilation. Heilbrunn has summarized the results of the studies on the action of the drug, and the few references I have studied in detail support his conclusions that the action of acetylcholine varies with different organisms and under different circumstances. Interpretations also differ as to the effect that acetylcholine has upon various invertebrates. Thus, while Beauvallet maintains that its action on the gut of molluscs is similar to the results obtained with the gut of vertebrates, Roeder (1939), in experimenting on the central nervous system of insects, concludes that injected acetylcholine, even in the presence of eserine has little effect upon the behavior of the experimental animal. He emphasizes the fact that the effect of eserine alone may result from a cholinergic condition brought about by inhibition of the esterase action of the tissues on acetylcholine normally produced. He did find that acetylcholine produces increased impulse discharges in isolated insect nerve.

Thus it is difficult to decide whether the effects of eserine result from the action of the drug directly or to suppression of the organic esters which act upon acetylcholine. Be that as it may, when eserine is added to the Ringer's solution in which living fly ovaries are kept there is usually an increase in the vigor and rhythm of contraction. A higher concentration of the drug inhibits all movement; the ovaries remaining strongly contracted. (Similar effects, by the way, may be observed on the activities of the gut). On the other hand, acetylcholine alone seems to reduce both the speed and ryhthm of contraction, and in excessive amounts produces a condition of permanent relaxation and stasis. Pulsation is most nearly normal, though increased, when eserine and acetylcholine are applied together. The results of these observations appear in the accompanying table.

Table I. Effects of Eserine and Acetylcholine Hydrobromide on Ovarian Pulsation in Lucilia

Specimen	Acetylcholine	Specimen	Eserine
1	Rate of pulsation increased; arrhythmic, with partial relaxation.	1	Intermittent, irregular pulsations becoming rhythmic and strong.
2	Pulsation initiated in motionless organs; period of relaxation longer than that of contraction.	2	Pulsations irregular but intensified.
3	Pulsation in one ovary only. Partial relaxation of active organ.	3	Contractions of right ovary complete; left relaxed and motionless.
4	Organs relaxed and motionless excepting at margins.	4	With acetylcholine, slight acceleration and complete contraction.
5	Pulsations slow and incomplete, but slowly accelerating.	5	Pulsations resumed which had stopped under acetylcholine.
6	Right ovary arrhythmic and partially relaxed; left rhythmic and vigorous.	6	Pulsation feeble. Finally stopped with ovaries contracted.
7	Ovaries motionless in relaxed position.	7	With acetylcholine, pulsations initiated from stasis.
8	Pulsations slower after eserine.	8	Results negative.
9	Slower after eserine; intervening periods of inactivity in relaxed condition.	9	Pulsations slower but more complete.
10	Pulsations slower after eserine with partial relaxation.	10	Ovaries stopped in contracted position. Solution very concentrated.

The function, if any, of ovarian pulsation, is not clear. Each ovary is richly supplied with tracheal branches from two adjacent spiracles. This suggests that the organ requires a relatively large amount of oxygen, and it may be that pulsation increases its diffusion. On the other hand, it may be that pulsation has no significance beyond the fact that automatic contractility is an inherent property of the calyx tissue.

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