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# SPONTANEOUS CONTRACTIONS OF THE HUMAN OVARY *IN VITRO*

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The mechanism controlling the last step in ovulation—ejection of the follicular contents—is not yet fully explained. Several hypotheses have been proposed, for example, increased intrafollicular pressure (Bartelmez, 1912; Smith, 1934; Jensen & Zacharia, 1960), contractions of the follicular wall (Lipner & Maxwell, 1960), and enzymatic breakdown (digestion) of the follicular wall (Espey & Lipner, 1965; Espey, 1967; Espey, Slagter, Weymouth & Rondell, 1965; Espey & Rondell, 1968; Rondell, 1970) but none has been proven to be the mechanism of ovulation. However, it is agreed by all that a fully developed stigma is essential for ovulation. Recently, spontaneous contractions of cat ovaries *in vitro* were demonstrated and a response to adrenergic drugs was shown (Rocereto, Jacobowitz & Wallach, 1969). These contractions were assumed to be under the control of sympathetic impulses mediated through the adrenergic innervation (Jacobowitz & Wallach, 1967; Rocereto *et al.*, 1969) to the smooth muscle cells found in the ovarian stroma (Catchpole, Gersh & Pan, 1950; Bloom & Fawcett, 1968) and follicular wall (Lipner & Maxwell, 1960; Fink & Schofield, 1970). It was suggested that the contractions were involved in the process of ovulation in the cat (Rocereto *et al.*, 1969).

This stimulated us to test human ovaries for spontaneous contractions *in vitro* in order to explore the possibility that such contractions are involved in the mechanism of ovulation.

Twenty-two normal ovaries (eleven left and eleven right ovaries) from fifteen women were used in this study. Ovaries with many enlarged cysts or with adhesions due to previous inflammation in the pelvis were excluded.

The ovaries were cleaned of connective tissue and put in Locke's solution for transfer to the laboratory. The age of the women ranged from 37 to 62 years, the mean age being 45 years. All underwent total abdominal hysterectomy for reasons other than the presence of malignancy. The phase of the menstrual cycle was determined by rating of an endometrial biopsy. Eight were in the proliferative phase of the cycle, five in the secretory phase, and two had atrophic endometrium. The apparatus used was developed by Freund, Wiederman & Saphier (1963), for measuring contractions *in vitro* of the reproductive tract of the female rat and guinea-pig. It is a system with constant perfusion of

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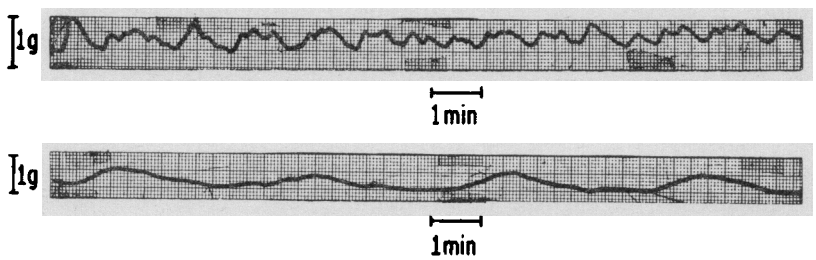
Locke's solution at a constant temperature and a $pO_2$ of 710. The contractility of the ovaries was studied for an average time of 6 hr. Contractions were evaluated by: (1) force (amplitude) in g; (2) frequency (contractions)/hr; (3) duration in min.

Seven ovaries (31·8%) showed spontaneous contractions of various patterns (Text-fig. 1) for periods of 30 to 180 min. Average values were calculated from data obtained in each 30-min period. The mean force was 0·25 g (range 0·07 to 0·46 g). The mean frequency was 21·3 contractions/hr (range 8 to 44). The mean duration of contraction was 2·03 min (range 1·06 to 3·18 min). Although the length of each experiment was relatively short, the performance of the individual ovary with respect to force and duration was almost the same during the whole experiment. With respect to frequency, two ovaries showed a decline from twenty-three and twenty-four contractions to ten and twelve contractions/hr but the other five maintained the same frequency throughout the experiment. There was no apparent correlation between force, frequency and duration of contraction on the one hand, and the age of the women, the endometrial phase or the side from which the ovary was taken, on the other.




TEXT-FIG. 1. Patterns of contractions of human ovaries *in vitro*. Above: Exp. 1; below: Exp. 2.

Only one third of the ovaries showed spontaneous contractions. We cannot satisfactorily explain this fact, but, since the women involved in the study were at the end of their fertile period or beyond it, it seems possible that the involutional process in the ovary might also affect its contractile ability. In a group of selected cats, Rocereto *et al.* (1969) found that only 60% of the cat ovaries had spontaneous contractions *in vitro*, despite the fact that the cat's ovary is richer in adrenergic innervation than the human ovary and the cats were young and fertile. Rocereto *et al.* (1969) assumed that the cat ovary undergoes spontaneous contractions *in vivo*. As a working hypothesis, we may also assume that the human ovary has spontaneous contractions *in vivo*.

Although the mean force of contractions of the human ovary (1·25 g) is small relative to the intrafollicular pressure measured in the rat, 23 mm $H_2O$ (Blandau & Rumery, 1963), or rabbit, 112 mm $H_2O$ (Rondell, 1964), it may be an important factor in the mechanism of ovulation. The bulging stigma is the weakest area on the mature follicle (Blandau & Rumery, 1963; Espey & Lipner, 1965; Espey *et al.*, 1965). It is proposed that the integrity of the follicular surface may depend on its tensile strength. It will remain intact as long as the tensile strength is greater than the tension produced by the ovarian contraction. The progressive breakdown of the collagen in the area of the stigma constantly decreases its tensile strength. At one of the contractions, the balance of forces changes.

The force of contraction, although small by itself, is higher than the tensile strength in the stigma, with the result that there is an opening of the stigma and the extrusion of the follicular contents. The process of ovulation then takes place.

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