SPECIFIC ACTIVITIES OF MONOAMINE OXIDASE, A NEURO-TRANSMITTER REGULATOR, IN HUMAN FALLOPIAN TUBE

by

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The fallopian tube plays an important role in the process of reproduction in human, specifically during the sperm and ovum transport, being itself an organ for fertilisation and zygote development and lastly by transferring the blastocyst to uterus in due course for the implantation. It is well established that tubal musculature plays the cardinal role in co-ordinating all those actions. (Blandau and Young 1961; Borell *et al* 1957). Fluorescence studies reveal that there are much innervation in isthmic part than in ampullary and fimbrial parts of fallopian tube (Brundin 1965). Both adrenaline and nor-adrenaline are powerful stimulants to human fallopian tube although of lesser degree during the luteal phase (Coutino *et al* 1970). Human fallopian tube exhibits regional difference in the epinephrine content concommittant with the fluctuation in the progesterone level and it was also observed that norepinephrine concentration of the internal segments was 2-3 times greater than that of external and middle portion during the follicular phase (Dujovne *et al* 1976).

The functional significance in the changes in oviductal neurotransmitter content and their regulation by monoamine oxidase is not very well understood. The present study attempted to evaluate the specific activity of M.A.O. in different phases of menstrual cycle in various segments of human fallopian tube which might have an important bearing on the understanding of the process of reproduction occuring in the fallopian tube. This study has also been extended to lactational amenorrhoea and puerperium to find out any alteration.

Materials and Methods

Collection and anatomical separation of the fallopian tube:—Human fallopian tubes were collected by total salpingectomy operation from healthy women with regular menstrual history and without any apparent tubal pathology. These were obtained from subjects undergoing sterilisation operation in the department of Obstetrics & Gynaecology in S.S.K.M. Hospital with Gas (N_2O) and oxygen (O_2) anaesthesia and with intramuscular injection of atropine (1/100 gr.) phenergan (25 mgm) and pethidine (50 mgm) as premedication.

Tubes were kept in ice until further processing was made. They were then

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thoroughly washed with chilled saline to remove blood. After removing adherent tissue by dissection, anatomical separation of ischmic, ampullary and fimbrial regions of the follopian tube were made. All operations were done at 0-4°C.

Groups under study: Groups for experimental study were made on the basis of particular phase and cycle date of menstruation at the time of collection of the fallopian tube.

(1) Preovulatory phase.
(2) Ovulatory phase (as also noted by cytological hormone status, basal body temperature).
(3) Postovulatory phase.
(4) Lactational amenorrhic phase.
(5) Puerperal phase.

The rare chemical such as Benzylamine was obtained from sigma chemicals. All other chemicals used were of analar grade.

Processing of the Tissue: The anatomically separated parts of the human fallopian tubes were separately homogenized in 0.1 M phosphate buffer, P_H 7.4 at 0-4°C. After homogenization it was strained through a cheese cloth and was centrifuged at 1000 x G for 10 minutes at 0-4°C. The supernatant was used as the source of the enzyme, Monoamine oxidase.

Measurement of Enzyme Activity: The spectrophotometric assay consisted in the measurement of benzaldehyde produced during the oxidative de-amination of benzylamine and depends upon the difference in absorption spectrum of benzaldehyde and benzylamine at 250 nm.

The assay system contained 1 ml. of 0.2 M phosphate buffer, P_H 7.2, 0.1 ml. of 0.1 M benzylamine sulphate, enzyme and water and final volume was made upto 3 ml. A blank containing no substrate was run simultaneously. The increase in absorbance at 250 nm. was noted at 15 seconds interval.

The molar extinction coefficient of benzaldehyde is 13,000 and the specific activity of the enzyme was expressed as umoles of benzaldehyde formed per minute per milligram of protein.

Protein determinations were made according to the method of Lowry *et al* with bovine serum albumin as standard Lowry *et al* 1951).

Results

Table I shows that the specific activity of Monoamine oxidase in the isthmus is significantly high during ovulation and late postovulatory periods. The mid-preovulatory phase (5-8 cycle days) bears no significant difference in the level of Monoamine oxidase activity in the different parts of the fallopian tube when compared with both ovulatory and postovulatory phases.

The specific activity of monoamine oxidase in the isthmus at 12-16 cycle days is significantly high in comparison to prior-ovulation phase i.e. at 9-11 cycle day. This high specific activity predominates also towards the early days (17-21) of postovulatory period.

Isthmus of the subjects with lactational amenorrhoea shows a significantly high specific activity of monoamine oxidase when it is compared to that of preovulatory (early or late) and early postovulatory phases. The enzyme activity in the ampullary part of lactational amenorrhoeic subjects is also higher than that of late preovulatory (9-11 days). Fimbrial activity also bears a significance with respect to early postovulatory phase.

In puerperal subject the isthmus of the fallopian tube shows sufficiently and significantly high activity with respect to the late post-ovulatory (23-28 cycle date).

TABLE 1

Monoamine Oxidase Activity in Different Parts of Human Fallopian Tube during Different Phases of Menstrual Cycle, Lactational Amenorrhoea and Puerperium

Phase of menstrual cycle & clinical conditions	Cycle Date (Days)	No. of observation	Specific Activity (Mean ± S.E.M.) (u moles benzaldehyde/min./mg. protein)		
			Isthmus	Ampulla	Fimbria
Preovulatory	1- 3	5	140.37 ± 25.38 a, b, c	132.39 ± 25.95	160.16 ± 32.86
	5- 8	7	272.28 ± 82.96	220.17 ± 50.71	333.31 ± 105.28
	9-11	7	226.26 ± 35.37 c, i	191.89 ± 69.63k	213.21 ± 79.64
Ovulatory	12-16	5	*429.36 ± 74.70 a, e, d	*178.71 ± 25.13	234.77 ± 69.97
Postovulatory	17-21	6	170.21 ± 53.48 d, g	123.41 ± 12.04	126.75 ± 18.11 i
	23-28	12	329.70 ± 60.07 b, j	191.98 ± 41.91	227.13 ± 64.28
Lactional Amenorrhoea		7	508.87 ± 97.34 e, f, g	387.69 ± 144.51k	365.04 ± 94.23 i
Puerperium		3	624.07 ± 231.26 j	202.07 ± 48.52	216.54 ± 65.46

Statistical Analysis by 't' test

a, $P > .01$; b, $P < .02$; c, $P < .05$; d, $P < .02$;
* $P < .02$ e, $P < .01$; f, $P < .02$; g, $P < .02$;
i, $P < .05$; j, $P < .001$; k, $P < .05$

Discussion

The importance of neuromuscular mechanism in the isthmus and specially the ampullary-isthmus junctions has been the subject of much interest in the physiological mechanism of ovum transport. The present study revealed a very high specific activity of monoamine oxidase, a neurotransmitter regulator, in the isthmus during ovulation. It suggested thereby a possible regulation of the isthmic contriction tone at this critical time for the process of reproduction so that the ovum might not drop into the uterus before the blastocyst development. It was reported that adrenergic stimulation seemed to control the passage of the ovum into the uterus through its effects on the tubal isthmus and the uterotubal junction (Coutino *et al* 1970). It was evident from the present study that the specific activity of the enzyme was augmented under oestrogenic phase of the cycle, in contrast, it declined under progestogenic influence. It was further interesting to note that oestrogen predominance enhanced α adrenergic receptor activity while progesterone that of ß receptors (Moawad and Kim 1974). Thus, the release of catecholamines by adrenergic nerve endings and their regulation by monoamine oxidase together with the influence of ovarian oestrogen and progesterone were the important determinants in the regulation of ovum transport.

It could be further noted from the present study that the enzyme activity was found to be significantly low in the ampulla during ovulation which might have an important effect on this region of fertilization giving no constriction tone like isthmic sphincters. This was confirmed by the fact that ampulla had sparse adrenergic nerves and had no

close contacts with smooth muscle of the tube. (Brundin 1965; Daniel *et al* 1975).

The presence of high specific activity of monoamino oxidase in the isthmus and also in the ampulla suggested a modification of tubal function under condition of lactational amenorrhoea. In puerperium, high muscular activity of the uterus reflected the isthmic tone which in turn resulted in the high level of monoamino oxidase activity. This might be due to a close structural relationship between uterine muscle and isthmic one.

Summary

Monoamine oxidase, a modulator of neurotransmitter's action in human fallopian tube was present in all the three segments i.e. isthmus, ampulla and fimbria. During ovulation the high specific activity of the enzyme in the isthmus indicated a maintenance of isthmic tone in this region possibly due to rapid release of catecholamines and their turn over. The specific activity of the enzyme declined after ovulation. During ovulation the ampullary part showed significantly low specific activity of the enzyme thus facilitating this region to the process of fertilization having no adrenergic influence. In lactational amenorrhoea and puerperium, high monoamine oxidase activity in the isthmus—ampulla and isthmus respectively suggested a modified tubal function.

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