ABSTRACT

Introduction: The fallopian tube is the vital part of reproductive system where the fertilization of ova takes place. It also acts as a transporting channel for passing the ova and the products of conception to the uterus. To perform these vital functions fallopian tubes undergo various histological variations during various phases of oestrus cycle.

Material & Methods: Histology of fallopian tubes of 50 female rabbits were studied by using H & E staining. Study of the cytology of vagina of the animal decided the phase of the oestrus cycle i.e. proestrus, oestrus, metaestrus and diestrus phases by Papaniculou's staining.

Observations and Results: The study revealed histological changes in relation to various phases of oestrus cycle. Epithelial surface area was maximum in oestrus phase. Secretory cells were most active in metaestrus and diestrus phases. Ciliary cells were prominent in proestrus and oestrus phases. The vascular activity was found maximum in oestrus phase.

Keywords: Fallopian tube, oestrus cycle, proestrus, oestrus, metaestrus, diestrus, phases.

INTRODUCTION

The fallopian tube was first identified as a distinct entity from the uterus by Greek anatomist Fallopius (1561) in sheep and human and so named after him. However the detailed discussion of the intricacies of oviduct was only taken up by Williams (1891). Since then studies of fallopian tube have made a steady progress. An extensive and detailed study of the human reproductive biology has attracted worldwide attention with a view to stop, check or control the population explosion in the world. About 30% of infertile women all over the world have associated fallopian tube pathology. Now-a-days with the introduction of IVF, this aspect of infertility has been neglected [1].

The fallopian tube is an important part of female reproductive system that receives the ovum, provides appropriate environment for its fertilization and transports it to the uterus. Not only this, the tubal fluid provides nutrition and conducive environment to the sperm for fertilization. To perform these vital functions the fallopian tube undergoes histological and histochemical changes during various phases of oestrus cycle viz proestrus, oestrus, metaestrus and diestrus. The histological variations in these phases were studied and evaluated in relation to their functional aspect.

MATERIAL AND METHODS

Assessment of different phases of estrus cycle was done by studying vaginal smears. Vaginal smears were made from the experimental animals. The external genital parts of the female rabbit was prepared in the morning from the normal saline washings, the saline moistened cotton swab was inserted in vagina. The smear was made on the clean sterilized glass slide. It was then fixed in ethyl alcohol.
and solvent ether (1:1) for two hours and finally stained with the Papaniculou's staining. The stained slides were studied under light microscope for their cytological appearance to ascertain various phases of sexual/ estrus cycle.

For histological study, the fallopian tubes were obtained from fifty female rabbits and arranged in different phases of estrus cycle. The fallopian tubes were fixed in 10% formal saline for 24 hours. The tubes were processed and transverse thin micro sections of four different parts of the fallopian tube i.e. from medial to lateral - intramural, isthmus, ampulla and infundibulum was taken. Slides were studied under light microscope after H & E staining.

**OBSERVATIONS AND RESULTS**

The histological changes in various cyclic phases were most marked in the infundibulum and ampulla and least in isthmus and intramural segments of fallopian tube.

**Pro-Oestrus Phase (Fig. 1 & 2):**

In pro-oestrus phase, the epithelium showed a papilliferous pattern. The lining cells were low columnar and cylindrical with scanty eosinophilic cytoplasm and elongated nuclei. No evidence of secretion was seen in the living cells. The submucosa showed few blood vessels. The muscle layer consisted of spindle shaped muscle fibers.

**Oestrus Phase (Fig. 3 & 4):**

The sections of the fallopian tube showed a qualitatively similar histological appearance in various parts of the tube. Most pronounced changes were seen in the lining mucosa, which showed an arborescent pattern with frond's and papillae. The lining cells were tall cylindrical and hypertrophied with eosinophilic cytoplasm and elongated oval, round and spheroid nuclei. At some places the prominent hypertrophied ciliary cells were discernable. No evidence of secretion was seen in the cells. The submucosa showed vascularized stromal tissue. The muscular layer consisted of elongated spindle cells.

**Meta-Oestrus Phase (Fig. 5 & 6):**

In this phase, the lining mucosa showed columnar cells with cytoplasm showing bleb formation and protrusions towards the luminal surface. The luminal border of the lining epithelium showed fraying with secretion. The lamina propria showed mild vascularization. The muscular coat showed no significant changes.

**Di-Oestrus Phase: (Fig. 7 & 8)**

The lining mucosa showed low columnar and cuboidal cells with scanty cytoplasm and bare nuclei, suggestive of secretory activity. The ciliary cells were not discernable. The rest of the changes resembled with that of meta-oestrus phase.
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Fig. 3: Photomicrograph showing dense, packed and abundant serosal connective tissue with minimal epithelial surface area in intramural part of fallopian tube in oestrus phase (H&E X 270)

Fig. 4: Photomicrograph showing loose and scanty serosal connective tissue, epithelium is highly developed with extensive surface area, tall columnar secretory cells are inactive, ciliary cells are prominent in infundibular part of fallopian tube in oestrus phase (H&E X 270)

Fig. 5: Photomicrograph showing coarser bundles of circular smooth muscle fibres, dense packed serosal connective tissue and poorly formed primary folds in intramural part of fallopian tube in metaoestrus phase (H&E X 270)

Fig. 6: Photomicrograph showing isolated smooth circular muscle fibers, arborising pattern, with moderate epithelial surface area and active secretory tall columnar cells in infundibular part of fallopian tube in metaoestrus phase (H&E X 270)

Fig. 7: Photomicrograph showing packed serosal connective tissue, coarser bundles of circular muscle fibres with minimal epithelial surface area in intramural part of fallopian tube in diestrus phase (H&E X270)

Fig. 8: Photomicrograph showing few isolated circular muscle fibers, arborising pattern primary, secondary and tertiary mucosal folds with smaller epithelial surface area and active secretory cells in infundibular part of fallopian tube in diestrus phase (H&E X120)
Histological parameters showed different findings in different phases of sexual cycle (Table 1).

**Table 1: Histological changes in the tubal structure in different phases of oestrus cycle**

<table>
<thead>
<tr>
<th>Histological Parameter</th>
<th>Phases of Oestrus cycle</th>
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<tbody>
<tr>
<td></td>
<td>Pro-Oestrus</td>
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<tr>
<td>Epithelial surface area</td>
<td>Large</td>
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<tr>
<td>Secretory Cells</td>
<td>Inactive</td>
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<tr>
<td>Ciliary Cells</td>
<td>Prominent</td>
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<tr>
<td>Vessel</td>
<td>Vascularised</td>
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**DISCUSSION**

The survey of literature showed that the proportion and character of secretory cells differ in different animal species and even in animals of same species and these differences depend upon the portion of tube studied and phase of the reproductive cycle represented. The present study done in rabbit showed that the epithelial surface area was greater in proestrous and oestrus phases in all segments of the tube. Kumar and Srivastava (1995) reported arborising pattern primary, secondary and tertiary mucosal folds with height proportionately greater than width and slender appearance in infundibulum [2]. So the area proportionately increased with greater arborisation of the epithelial folding especially in infundibulum. This implied increased functional activity of tubal epithelium in proestrus and oestrus phases of sexual cycle.

The secretory cells in tubal epithelium were found active in metaestrus and diestrus phases when progesterone activity is high. In this regard, tubal secretory cells and endometrial cells behaved alike to progesterone. Some authors observed a cyclic variation in activity of secretory cells in the tube [3-5]. The secretory cells appeared low columnar and often their bare nuclei were extruded out of cytoplasm which was noticed in metaestrus phase. This finding runs parallel with that of Allen (1922) who also noted the same feature [6]. The secretion formed by secretory cells might have nutritional importance for egg. That is why the secretory cells became active after oestrus phase, when ovulation has occurred. Since embryologically tubal and endometrial epithelium are related both structurally and functionally, their identical response to the ovarian hormones is reconcilable. Changes in the shape and density of secretory granules in different phases of sexual cycle was noted by different authors [7,8]. Bjorkmann and Fredrickson (1961) observed changes in size of secretory cells in luteal phase [9].

The ciliary cells were prominent in proestrus and oestrus phases of sexual cycle. Such a periodic alteration in ciliary cells have been recorded by Iwata (1929) [10]. In human fallopian tubal epithelium, these specialized ciliated cells have hair-like projections on the free surface. With help of this structure, they move the secretions of secretory cells along the free surface of the epithelial membrane.

Any abnormality in ciliary activity of cells will affect propagation of ovum to primed uterus and might result in tubal implantation. Sowmya et al. (2014) has reported that the incidence of tubal gestation varies from 1 in 300 to 1 in 150 pregnancies and it contributes significantly to the maternal mortality and morbidity [11]. Lack of secretory activity due to any cause might lead to lack of supply of nutrition and proper milieu to fertilized ovum, thereby interfering with its maturation and development. A detail knowledge of phasial behavior will help in understanding the propagation and implantation of fertilized ovum. Early diagnosis and intervention will help in reducing the maternal mortality and morbidity due to ectopic pregnancy.

**CONCLUSION**

The histological study of fallopian tube revealed structural and functional changes in relation to various phases of sexual cycle. During proestrus and oestrus phases, the mucosa showed structural cellular growth attesting relation with estrogen. Likewise the functional secretory activity was greatest during metaestrus and diestrus phase suggesting relation with progesterone. This secretory activity seems to bear nutritional importance for passing ova through the tube. The ciliary cells, prominent during oestrus and proestrus
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phases, may be helpful in flushing the secretions along the tube.

REFERENCES