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Original Article

Changes in Amount of Tears with Reproductive Cycle in Normal Adult Females

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Objective: To explore the changes in tear film with different phases of the female reproductive cycle.

Methods: A descriptive type cross sectional study was carried out with the assistance of self-designed proforma on sample size of 30 female volunteers (60 eyes) having normal reproductive cycle. Age ranged from 17 to 34 years. Every participant was examined in each (menstrual, follicular, ovulational and luteal) phase of menstrual cycle, with Schirmer strips. Friedman Post HOC test for several related samples were applied.

Results: Mean tear production was 13.4±3.57mm, 9.23±3.91mm, 12.97±3.22mm and 13.37±2.95mm in menstrual, follicular, ovulatory and luteal phase respectively. Tears levels were significantly low in follicular phase with $p<0.0001$.

Conclusion: Tear production rate varied during the four different phases of reproductive cycle. Tear production rate is lowest in follicular phase of reproductive cycle. So clinicians should consider this factor in the females of respective age group presenting with dry eye symptoms.

Key Words: menstrual phase, follicular phase, ovulatory phase, luteal phase, tear film

Introduction:

Tears are secreted in the form of a very thin film, that is a significant layer secreted by tiny glands located in lids and it is comprised of three layers.

Upper or outer most being oily layer is composed of fats formed as a result of secretions of Meibomian glands and their co-partners glands of Zeiss, lining the edge of eye lids. Underneath lies aqueous or lacrimal layer, that is secreted by glands of Krause and Wolfring but lacrimal glands also have some role in its secretion. Being the middle and the bulky layer, it is the major constituent of tear film, serves as primary source of vital nutrients (i.e. oxygen) to the avascular cornea.

Beneath aqueous layer there is a very fine and adherent layer namely mucous layer formed by the Goblet cells which are present in conjunctival fornices.

Mucous layer due to its sticky nature extends the contact time of tear film with corneal surface keeping it moist for longer period and reduces the chances of dryness.[1]

Tear film primarily functions in providing optical medium of refraction, mechanical lubrication, nutritional nourishment and protection. Tears spread on ocular surface in such a manner that with blinking motion they are evenly swiped across the ocular surface [2].

Inadequate product of tears or unhealthy tear film due to disturbance in any of constituent layers can lead to a chronic state of eye, known as dry eye. In these circumstances, anterior ocular surface not being getting adequate moisture, starts drying out. Resulting in severe complications, responsible for severe threats to visual status of eye and causing a serious harm to corneal integrity.[3]

Patient having dry eyes have several symptoms such as scorching sensation, foreign body sensation, weariness of eyes, difficulty in blinking due to heaviness of eye lids, full bloody eye color, excessive watering followed by severe draughty state, ropey discharge, periodic eye ache and foggy vision.[4]

Factors that increase the probability of dryness of eyes include aging, female gender, Inflammation of Meibomian glands, Unhealthy diet with inadequate amount of Vit. A and Omega-3 fatty acids, Infection of skin adjacent to eyes, Ocular conditions, like blepharitis, and Surgical or laser treatment of eye[5]

Tear film can be assessed by Qualitative method and Quantitative method. Qualitative assessment of tear film includes quality of tears and tear break up time (TBUT). There are two ways of assessing: fluorescein dyes testing and examination of tear break up time with just the help of tearscope.[6] Quantitative assessment of tear film includes Schirmer test, Phenol red thread test, Tear prism height test etc.[7]

In Schirmer test, special paper strips made up of Whattman Filter Paper 41. These 35mm long and 5mm strips are inserted in eyes inside the lower lid while patient is looking towards roof. Anesthetic drops are instilled in the eyes to suppress watering due to irritation caused by Schirmer strip. After 5 minutes, strip is taken out and results are recorded. Wetting length less than 10mm indicates toward severe dryness, 10-15mm is normal range, while more than 15mm wetting refers towards further assessment to rule out the cause of excessive watering from eyes. As both eyes secrete balanced amount of tears, so result of both eyes must be the same.[8,9]

The menstrual cycle accounts for arranged alterations in a female body preparing for pregnancy. It consists of some anatomical and physiological changes.[10]The uterus develops a new lining called as endometrium for a preparatory process for a fertilized egg, but when there is no fertilized egg to initiate then it sheds off resulting in monthly menstrual or reproductive cycle.[11] An average cycle lasts for 28 days. During early teen ages and as proceeding with age towards menopause, the cycle gets longer and longer and then ultimately stops.[12]

There are certain endocrine hormones involved in the menstrual cycle. These hormones include estrogen and progesterone primarily. The Estrogen being involved in formation of lining of uterus and increase in ovulation causes progesterone to release. Along with estrogen, the progesterone causes the lining of endometrium to burst up.[13] Reproductive cycle of normal adult female can be divided into four phases namely; Menstrual, follicular, ovulatory and luteal phase.

The whole reproductive cycle is either under direct or indirect control of Pituitary gland. It pours follicular stimulating hormone (FSH) and luteinizing hormone (LH) into blood stream which excites ovaries to secrete estrogen and progesterone which prepare female body for the process of fertilization by making changes in uterus.

Amount of tear production and quality of tear film depends upon several hormones. Androgen, progesterone, estrogens and prolactin have neuronal effect on secretory mechanism of tear film.[14] Every sex hormone has its specific effect on tear production and its stability. Any fluctuation in its stability and volume may lead to dry eye.[15]

Greater risk of dry eye in women rather than men makes it clear that it is associated with sex hormones. Further studies have correlated dry eye with estrogen production, it controls some inflammatory procedures which may result in dry eye.[16]

Studies have revealed that both the quality and quantity of tears is directly handled by mixed hormonal and neural mechanism of body. Sex hormones (androgens), i.e.

progesterone, Estrogen, prolactin etc. are believed to significant hold on the morphology and routine working of tear glands[17]

Aims and Objectives

The aims and objectives of study were:

- To assess the change in amount of tears with reproduction cycle in normal adult females
- To observe and look for any supporting factors governing his change.

Materials and Methodology:

Study Design:

- Descriptive type cross sectional study

Inclusion Criteria:

- Individuals of age 16 years up to meno-pause
- Individuals having normal reproductive cycle
- Verbal and cooperative client

Exclusion Criteria:

- Uncooperative Individuals
- Individuals suffering from any ocular disease which causes dry eye
- Individuals having hormonal imbalance

Individuals with any other systemic abnormality/ disability.

Sample Size:

- Thirty volunteers

Data Collection Method:

- by screening and recording the readings by Schirmer strips.
- Data were entered using SPSS 20. Avoiding any biased entry, doubly entered in two different computers. All data was cleaned and analyzed.

Results:

Table No. 1: Age Of Participant

Number (N)	30
Mean	24.00
Range	17
Minimum	17
Maximum	34

All the female correspondents in the study were belonging to age group 17 to 34 years.

Table No. 2: Environmental Conditions On Testing Place

	Frequency	Percent
Normal	3	10.0
Warm	17	56.7
Slightly cold	10	33.3
Total	30	100.0

10 % tests were performed outside the rooms, 56.7% tests were performed inside room having warm environment. 33.3% females were examined under cold conditions.

Table No. 3: Ocular Disease Causing Dry Eye

Ocular Disease	Frequency	Percent
Absent	28	93.3
history of stye	1	3.3
history of chalazion	1	3.3
Total	30	100.0

93.3% females of chosen sample were free from any ocular manifestation which could result in the disturbing the normal tear production. 3.3% females were having history of stye, and similar was the percentage of females having history of chalazion i.e. 3.3%

Table No. 4: Systemic Disease Affecting Eyes

Systemic Disease	Frequency	Percent
Absent	22	73.3
skin infection near eyes	1	3.3
androgen suppressant drugs usage	7	23.3
Total	**30**	**100.0**

In the selected group of females for research, 73.3% females were free from any systemic disease affecting the normal functioning of tear glands. 3.3% females were having skin infection near the eyes. While 23.3% females reported to use androgen suppressant drugs.

Table No. 8: Computer Using Duration

Computer Using	Frequency	Percent
Duration Normal usage	22	73.3
extended usage	1	3.3
rare usage	7	23.3
Total	**30**	**100.0**

73.3% volunteers were normal computer users and 3.3% reported that they are habitual of overnight computer user. 23.3% were very rare user of the computer.

Table No. 9 Reproductive Cycle

Re productive Cycle	Frequency	Percent
normal	17	56.7
slight variations	12	40.0
frequently disturbed	1	3.3
Total	30	100.0

56.7% female participants were having normal reproductive cycle, 40% reported to have slight variations, only 3.3% observed frequently disturbed reproductive cycle.

Table No. 10:Reproductive Hormone Level In Blood

Reproductive Hormone Level In Blood	Frequency	Percent
Normal	20	66.7
history of hormonal imbalance	5	16.7
disturbed	5	16.7
Total	**30**	**100.0**

66.7% females had normal hormones, 16.7% had slight variations sometimes. 16.7% reported that they have been diagnosed for hormonal disturbance previously.

Table No. 11

Type	N	Range	Min	Max	Mean	SD
Menstrual Phase	30	12.00	8.00	20.00	13.40	3.57
Follicular Phase	30	13.00	5.00	18.00	9.23	3.91
Ovulation Phase	30	13.00	7.00	20.00	12.97	3.22
Luteal Phase	30	10.00	9.00	19.00	13.37	2.95

Average tears production in the follicular phase of reproductive cycle was recorded minimum. Mean value is this phase was 9.23mm, which was less than the value of any other phase.

Discussion:

It has been observed that ocular surface is an estrogen dependent unit, which is a female reproductive hormone released during menstrual cycle. Moreover, meibomian and lacrimal gland's proper functioning and integrity is strongly dependent on level of reproductive hormones in blood. So tear film production and stability is however related to production of estrogen during reproduction cycle in normal adult females. To verify this relationship of tear film and female reproductive hormones, quantitative analysis of tears should be carried out during different phases of reproductive cycle

Relationship between female reproductive hormones and dry eye syndrome had always been questionable. But in the recent past, there had been quite some study regarding the fluctuation in the ocular surface parameters such as amount of tear production.

The study was carried out in the context of the possible and probable changes in the amount and integrity of the tears during the female reproductive cycle. Proceeding with this important question many studies were carried out in different parts of the world. The hypothesis was analyzed demographically and repeatedly. From the results it is hereby concluded that there is a definite relationship among the changes in the tear quantity with the female reproductive cycle in normal adult females. Several hormones such as estrogen, androgen and prolactin were found to active in bringing the change in the tear film. Several other variables were revealed during the study i.e., the effect of menopause and post and pre-menopausal secretion of the tears (amount).

Moreover it is evident that the females who had changes in the reproductive cycle also suffered from the changes in the ocular surface and dry eye. Specifically, in the second phase of reproductive cycle (follicular phase), there is a significant decrease in tear production rate. So clinicians should consider this factor in the females of respective age group presenting with dry eye symptoms.

The association of the female reproductive cycle and changes in the tears integrity in terms of amount and secretion was quite evident from the above conducted study.

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