

Article

Hormonal Restructuring in the Body of Women During the Menstrual Cycle in the Context of the Influence on the Vocal Apparatus

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Abstract: Fluctuations in hormones during the menstrual cycle affect the vocal apparatus. During the follicular stage, a woman's voice improves every day until ovulation. After ovulation, with changes in hormonal balance, the vocal apparatus undergoes changes. Impaired vocalization of high notes, lack of breathing, and hoarseness accompany a woman several days before and during menstruation.

Keywords: voice apparatus, menstruation, menstrual cycle, voice disorder, estrogens, progesterone.

1. Introduction

It is well known that the larynx is a hormone-dependent organ. Throughout a person's life it undergoes changes under the influence of thyroid, sex and growth hormones. These changes have their own peculiarities depending on the sex and age of the person and from this point of view more attention is paid to the female vocal apparatus. During the menstrual cycle, with each phase, the female body undergoes significant changes. Especially strongly these changes affect the professionals of the vocal sphere.

2. Aim

To summarise significant changes in the body during the different phases of the menstrual cycle and to assess their contribution to changes in vocal function.

3. Discussion

3.1 Follicular.

Each new cycle begins with menstruation, during which the main visible process is the renewal of the epithelium in the uterus [1]. This is ensured by the coordinated work of the hypothalamus and pituitary gland [1]. The pituitary gland secretes oxytocin in amounts necessary to influence the uterine musculature to renew itself [1]. There is also the release of vasopressin, which increases blood pressure and affects the distal renal tubules, which leads to water retention, changes in vascular permeability favours the release of the liquid component of blood into the intercellular space [1-3]. The result of these processes, among other things, is oedema of laryngeal structures.

During the follicular phase, as ovulation approaches, estrogens gain their activity and quantity [2]. Estradiol (E2) as its most active form during the most active years of a woman's life [2].

E2 interacts in the body with estrogen receptors (ER-alpha and ER-beta) [2]. It is formed from androgens and is a kind of anabolic. There are receptors for estrogen on blood vessels, muscles, nervous tissue, bones, secretory cells [4]. The effects of estrogen in the body besides those related to the regulation of sexual functions are quite diverse [4]. Estrogen receptors have been proven to be present in skeletal muscles and heart muscles [2-4]. Estrogens have a significant effect on mitochondria [3]. The interaction between estrogen and mitochondrial receptors ensures regulation of their function, vascular, muscle and neuronal defence, modulation of ATP and AFC production, antioxidant defence, and calcium metabolism [4, 7].

There are 2 lines of action [3]. It is not for nothing that estrogens are called defenders of the organism, they prevent bone resorption, have an anabolic effect, maintain the integrity of the extracellular matrix, participate in collagen metabolism [4, 6]. In addition, they support cardiac vessels due to the activation of NO-synthetase and prevent the development of CHD [5]. Exchange



of water, nitrogen, salts in the body, to maintain an optimal balance [3-5]. All these effects and interactions maximise quality voice in the days before ovulation [13]. Optimal fluid balance ensures adequate hydration and fullness of the vocal folds [4, 13]. Keeping calcium and other elements in balance promotes well-adjusted muscle function currently [2-4, 13].

Also, estrogens increase the expression of progesterone receptors, so that it becomes active after ovulation (Fig. 1) [4].

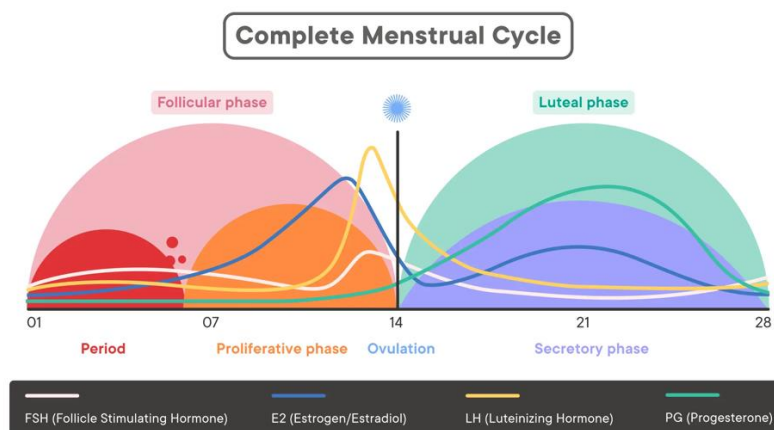


Figure 1. Phases of the menstrual cycle with a schematic indication of the amount of hormones (Source of borrowing - resources of the World Wide Web - <https://helloclue.com/articles/cycle-a-z/the-menstrual-cycle-more-than-just-the-period>)

3.2 Luteal.

Progesterone belongs to the group of progestagens, steroid hormones [2]. Its main mass is synthesised by the corpus luteum, which is formed after the ovum is released. Also, this hormone is synthesised by the placenta, during pregnancy [2, 3].

Its receptors are also scattered throughout the body [8]. It is important to evaluate its effects on the nervous system. Progesterone acts as an inhibitor of central nervous system activity by interacting with nuclear and membrane receptors, and its metabolites bind to neurotransmitter and GABA receptors [9]. Therefore, symptoms such as weakness and lethargy may be observed, also, during pregnancy it causes some sedation and in very high doses it induces sleep [10]. Thus, it indirectly affects the processes of voice and speech formation.

Progesterone in normal concentration promotes the excretion of fluid from the body (progesterone blocks the mineralcorticoid receptor) and a decrease in the secretion of mucous glands, which is observed some time before menstruation [3]. This is provided by a decrease in aldosterone activity and natriuresis [11]. The amount of intercellular fluid decreases. But when its amount falls, aldosterone starts to compensate and there is an increase in fluid retention and oedema [4, 11, 13]. Also, progesterone promotes desquamation of vocal fold epithelium [3, 4, 13]. The relaxing effect of progesterone also extends to the muscles, mainly the uterus, this is necessary so that it does not contract, during the phase of the cycle and in pregnancy [12]. There is still controversy in scientific circles about the presence of progesterone receptors [4, 6]. But it is unequivocally accepted that its fluctuations influence vocal folds [3].

It is in the last days before menstruation, when the influence of progesterone is at its maximum that rapid fatigue, inability to sing or difficulty in singing high notes, hoarseness, and lack of breathing begin [2-5]. Also impaired breathing and muscle coordination has been noted in women with painful menstruation. Because of the pain syndrome, the cortical muscles are tense, and spasms of the laryngeal muscles can be observed.

4. Conclusions

It is well known that the menstrual cycle and fluctuations in hormone levels affect vocal function. At the same time, this influence can be both direct and indirect, mediated through the nervous system, fluid balance, microelements in the body. But despite this, there is still quite little reliable information in the muscles and mucosa of the larynx. In our opinion, this is a great asset of our organism, which should be studied further.



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References

1. Sinha E, Hannah K, Beate D, Christine K, Sarah S. Menstrual cycle-related fluctuations in oxytocin concentrations: A systematic review and meta-analysis. *Frontiers in Neuroendocrinology*, 2019, 52; 144-155.
2. Zamponi V, Mazzilli R, Mazzilli F. *et al.* Effect of sex hormones on human voice physiology: from childhood to senescence. *Hormones*, 2021, 20: 691-696.
3. Voelter C, Kleinsasser N, Joa P. *et al.* Detection of hormone receptors in the human vocal fold. *Eur Arch Otorhinolaryngol*, 2008, 265: 1239-1244.
4. Ventura-Clapier R, Piquereau J, Veksler V, Garnier Anne Estrogens, Estrogen Receptors Effects on Cardiac and Skeletal Muscle Mitochondria. *Frontiers in Endocrinology*, 2019, 10.
5. Linda RN, Serdar EB, Estrogen production and action. *Journal of the American Academy of Dermatology*, 2001, 45(3): 116-124.
6. Starostina SV, Statsenko YA, Svistushkin VM. Optimisation of an integrated approach to voice correction for endocrinopathies (analytical review). *Probl Endokrinol (Mosk)*. 2022, 68(2):48-55. (in Russian.)
7. Babichev VN. Receptor mechanisms of action of sex hormones. Can a receptor work without a ligand?, *Problems of Endocrinology*, 2006, 52(1): 32-38. (in Russian.)
8. Baulieu EE, Robel P. Neurosteroids: a new brain function? *J Steroid Biochem Mol Biol*, 1990, 37(3): 395-403.
9. Bali N, Arimoto JM, Iwata N, Lin SW, Zhao L, Brinton RD, Morgan TE, Finch CE. 2012. Differential responses of progesterone receptor membrane component-1 (Pgrmc1) and the classical progesterone receptor (Pgr) to 17 β -estradiol and progesterone in hippocampal subregions that support synaptic remodelling and neurogenesis. *Endocrinology*. 2012, 153(2): 759-769.
10. Teran-Perez G, Arana-Lechuga Y, Esqueda-Leon E, Santana-Miranda R, Rojas-Zamorano JA, Velazquez Moctezuma J. *iMinimi Reviews in Medicinal Chemistry*, 2012, 10(11): 1040-1048.
11. Cable JK, Grider MH. Physiology, Progesterone. In: *StatPearls*. StatPearls Publishing, Treasure Island (FL), 2023.
12. Hari Kumar KVS, Garg A, Ajai Chandra NS, Singh SP, Datta R. Voice and endocrinology. *Indian Journal of Endocrinology and Metabolism*. 2016, 20(5): 590.
13. Afsah O. Effects of hormonal changes on the human voice: a review. *Egypt J Otolaryngol*, 2024, 40(22).

