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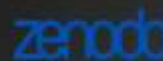
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## USE OF PHYSICAL FACTORS IN MEDICINE

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**Abstract.** *The development of science and technology, industry and scientific research cannot be imagined without physical factors. Physical factors are widely used, especially in many areas of medicine. This is especially noticeable in diagnostics, treatment, surgical intervention and laboratory studies of various diseases. The movement of blood through the vessels in a living organism is also assessed by physical factors. This article explains the movement of blood through the vessels using some physical factors.*

**Keywords:** *Doppler, effect, vessel, blood, flow, ultrasound, function, electric current, magnet, frequency, movement.*

**Аннотация.** *Развитие науки и техники, промышленности и научных исследований невозможно представить без физических факторов. Физические факторы широко используются, особенно во многих областях медицины. Это особенно заметно при диагностике, лечении, хирургическом вмешательстве и лабораторных исследованиях различных заболеваний. Движение крови по сосудам в живом организме также оценивается физическими факторами. В этой статье объясняется движение крови по сосудам с помощью некоторых физических факторов.*

**Ключевые слова:** *Допплер, эффект, сосуд, кровь, поток, ультразвук, функция, электрический ток, магнит, частота, движение.*

**Аннотация.** *Фан-техника, саноат ва илмий тадқиқот ишларининг ривожланишини физик факторларсиз тасаввур этиб бўлмайди. Айниқса тиббиётнинг кўплаб соҳаларида физик*



*факторлардан кенг фойдаланилади. Айниқса, турли хил кассалликларга таъхис қўйишда, даволашда, жарохликда, лаборатория ишларида яққол кўриш мумкин. Тирик организмдаги қоннинг томирларда ҳаракати ҳам физик факторлар билан баҳоланади. Мазкур мақола айрим физик факторлар ёрдамида қоннинг томирларда ҳаракатини асослаб беради.*

**Калим сўзлар:** *Doppler, effekt, томир, қон, оқим, ultratovush, функция, электр, магнит, частота, ҳаракат.*

The functions of organs and tissues of a living organism are assessed by physical factors. For example, the movement, fluidity, viscosity, mechanical properties and other characteristics of blood in vessels are studied by hydrodynamics; the spread of blood through vessels is the section on oscillations and waves; the mechanical work performed by the heart is the mechanical section; the generation of biopotentials is explained in the section on electric fields [3,10].

Modern technologies used for diagnostic purposes make it possible to obtain information about a patient's illness by studying the sounds inside the body.

Currently, methods based on the use of electric current, electric field and magnetic field - electrocardiography, phonocardiography, ballistocardiography, rheocardiography and magnetocardiography, magnetobiology and others - expand the capabilities of specialists and facilitate fast and accurate diagnostics.

In medicine, electric current, electric fields, magnetic fields and other physical factors are used in physiotherapy for the modern treatment of



various diseases. Modern treatment methods widely use ultraviolet and infrared rays, alpha, beta, gamma and other radiation [3,4,10].

Computed tomography, Roentgen-ray computed tomography, magnetic resonance imaging, multispiral computed tomography and other modern unique methods have become widely used in nuclear medicine.

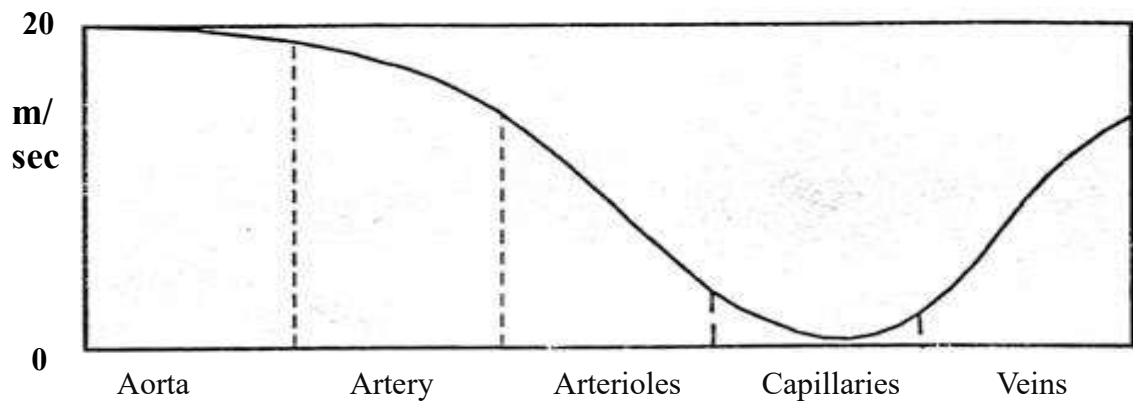
Based on all of the above, we can say that blood flow in the vessels is also assessed by physical factors. Blood flow is the movement of blood through the cardiovascular system. Blood is a viscous fluid containing plasma and cells. It consists of leukocytes, erythrocytes, thrombocytes and hyalocytes. The properties of the cell significantly affect the nature of the flow [1,10].

Blood flow velocity is the speed at which blood elements move through the bloodstream per unit of time. In practice, specialists distinguish between linear velocity and volumetric blood flow velocity.

Linear blood flow velocity is the distance that a blood particle travels through a vessel in a given time (Fig.1). This is a value that directly depends on the sum of the numbers intersecting at a given point in the vessel. Consequently, the aorta is the narrowest part of the circulatory system and has the highest blood flow velocity, reaching  $\approx 0.6$  m/s. The "widest" are the capillaries, since their total area is 500 times larger than the area of the aorta, and the blood flow velocity in them is 0.5 mm/s. This ensures excellent exchange of substances between the capillary wall and tissues [2,9].



So, knowing this, in modern clinical practice there are several methods for determining blood flow velocity, let's consider some of them:



**Fig.1. Linear blood flow velocity in the cardiovascular system.**

Ultrasound method: in this method, a special generator generates ultrasound waves and transmits them to the irradiator. The ultrasound wave passes through the emitter into the blood vessel and is reflected from the moving red blood cells. The returned ultrasound wave is converted by the receiver into electrical oscillations and amplified. The amplified electrical oscillations are aligned with the oscillations of the incident and returning waves using a special device, and the speed of movement of the red blood cells is determined by the difference in the resulting frequencies [8,11].

The Doppler method is an ultrasound method based on the Doppler effect, in which the speed of red blood cells in large blood vessels changes depending on their location relative to the axis: red blood cells "near the axis" move at high speed, and "near the wall" - at low speed. In this case, ultrasound waves are reflected from different types of red blood cells. Thus, the Doppler shift occurs not at one frequency, but in a range of frequencies. Thus, the Doppler effect allows us to determine not only the average blood flow velocity, but also the blood flow velocity



in different layers. In this case, the oscillations of the incident and reflected waves are balanced accordingly [6,7].

The physical essence of the Doppler effect is that the frequency of ultrasound waves changes when the ultrasound source moves. The waves are reflected from blood particles, and this change directly depends on the speed of blood flow.

Blood flow velocity, along with arterial pressure, is the main physical quantity characterizing the state of systemic circulation. The possibility of noninvasive, objective and dynamic direct measurement of blood flow in small vessels remains one of the urgent tasks of modern angiology and related specialties.

Based on the above, it can be said that the Doppler effect is widely used to study the speed of blood movement in each layer, the functional state of the walls and valves of the heart (the Doppler echocardiography method), and the speed of movement of various organs [5,12,13].

In modern medical practice, high-frequency ultrasound Dopplerography opens up broad possibilities for determining the viability of critically ischemic, burned and frozen tissues. At the same time, opportunities for early detection of pathological conditions associated with hemodynamic disorders of the cerebral and carotid arteries appear.

The electromagnetic method of determining the blood flow velocity is based on the flow of moving particles in a magnetic field. Although blood is an electrically neutral system, it consists of positive and negative ions. If a magnetic field is applied to one side of a blood vessel, positive charges accumulate near one side of the blood vessel wall, and negative charges accumulate near the other side. This distribution of charges across the cross-section of the vessel creates an electric field. This physical phenomenon is called the Hall effect. Thus, with this method, it is possible



to determine the blood flow velocity, knowing the magnetic field and the phase difference. In this method, the use of an alternating magnetic field is practically convenient. This creates an alternating Hall voltage. In this case, it is preferable to use an alternating magnetic field to reconstruct the image. Currently, Hall sensors or sensors - devices based on the Hall effect - are widely used in medicine and other fields [5,12,13].

Dopplerography is an ultrasound examination method based on the Doppler effect. Ultrasound waves are reflected from moving objects with a changed frequency. This frequency shift is proportional to the speed of movement of the structures being examined. If the movement is directed toward the sensor, the frequency increases, if away from the sensor, it decreases.

Dopplerometry - this method is based on the passage of ultrasound waves through a vessel, and as a result of the reflection of the waves from moving red blood cells and white blood cells, the frequency of the waves changes, that is, it increases in proportion to the speed of blood flow.

Doppler echocardiography allows measuring not only the average linear velocity of blood flow in the heart and vessels, but also the velocity at various points in the cross section of large vessels. The linear velocity of blood flow in the vessels of the systemic circulation is distributed accordingly. For example, the maximum in the aorta is 0.2–0.5 m/s, and the minimum in the capillaries is 0.0003 m/s. The blood flow velocity in the veins increases compared to the capillaries. In large vessels, it reaches 0.1–0.15 m/s. The linear velocity of blood flow in small vessels is distributed similarly [3,10].

So, based on the above, we can conclude that the achievements of electricity, electric fields, magnetic fields, atomic and nuclear physics are priceless. Roentgen-ray diagnostics and methods of directed atomic radiation have a significant impact on the development of medicine.



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**ФИЗИКА ДАРСЛАРИДА ВА ТЎГАРАК  
МАШҒУЛОТЛАРИДА ДИДАКТИК ЎЙИНЛАРДАН  
ФОЙДАЛАНИШ**

**Термиз давлат муҳандислик ва  
агротехнологиялар университети  
п.ф.д, дотс.Ў.Н.Султонова.**

**Аннотация:** Ушбу мақолада физика фанини ўқитишда ва тўгарак машғулотлари давомида дидактик ўйинлардан фойдаланишнинг самарадорлиги ёритилган. Дидактик ўйинлар ўқувчиларнинг дарсга қизиқишини оширади, назарий билимларни мустаҳкамлашга ва мавзуларни чуқурроқ ўзлаштиришга ёрдам беради. Тадқиқотда ўйинли методларнинг амалиётдаги афзалликлари ва уларни жорий этиш бўйича тавсиялар берилган.

**Калит сўзлар:** Физика, дидактик ўйинлар, интерактив метод, тўгарак машғулотлари, таълим самарадорлиги, қизиқиш, ўқув жараёни.

**Аннотация:** В данной статье освещается эффективность использования дидактических игр при обучении физике и во время занятий в кружке. Дидактические игры повышают интерес учащихся к уроку, способствуют закреплению теоретических знаний и более глубокому усвоению предметов. В исследовании представлены преимущества игровых методов на практике и рекомендации по их внедрению.

**Ключевые слова:** физика, дидактические игры, интерактивный метод, занятия в кружке, эффективность обучения, интерес, процесс обучения.

**Abstract:** This article highlights the effectiveness of using didactic games in teaching physics and during classes in a circle. Didactic games increase students' interest in the lesson, contribute to the consolidation of theoretical knowledge and



deeper learning of subjects. The study presents the advantages of gaming methods in practice and recommendations for their implementation.

**Keywords:** physics, didactic games, interactive method, classes in a circle, learning effectiveness, interest, learning process.

Ўқувчиларнинг ижодий тафаккурини ривожлантириш, уларни ақлий қобилиятларини ўстириш, физика фанини ўқитишдаги энг муҳим психологик ва педагогик муаммо. Бунинг учун ўқитишнинг фаол методларидан, таълим ва тарбиянинг ноанъанавий шакл ва усулларидан кенг миқёсида фойдаланиш, жисм ва ҳодисаларнинг уларнинг ўзаро алоқадорлиги, ҳаракати ва ривожланиб бориши асосида ўрганиш тақозо этилади. Бунда, айниқса, ўқувчиларнинг ўйин фаоллигини ошириш, янги билимларни ўзлаштириши, уларда ўқув ва кўникмаларини шакллантириши ҳамда ривожлантириши, умуман физикани ўрганиш жараёнининг самарадорлигини ошириши катта аҳамият касб этади. Дидактик ўйинлар давомида ўқувчиларда ҳосил бўладиган ижобий ҳис-ҳаяжон туйғуси уларни чарчашдан асрайди. Уларнинг интеллектуал қобилиятини оширади.

Дидактик ўйинлардан физика ўқитиш жараёнида фойдаланишнинг умумий масалалари, илмий методик адабиётларда анча кенг ёритилган бўлса ҳам, уларда асосий эътибор масалалар ечиш ва қонунларга қаратилган. Ваҳолангки, физика фанини ўзлаштириш ўқувчиларга анча қийинчилик туғдириши ва унинг баъзи масалаларини ечишда ноанъанавий ёндашувлар талаб этилиши табиийдир. Бунинг бир қатор илмий-назарий, методик ва дидактик сабаблари борки, улардан ҳар қандай маҳоратли физика ўқитувчиси кўз юма олмайди. Шунинг учун физика фанини ўқитишда, янги педагогик технологиялар, ноанъанавий усул ва шакллардан фойдаланиш талаб этилади.



Айниқса, дидактик ўйинлар ўқувчиларнинг мустақил фикрлаш, топқирлик, изланувчанлик, ҳозиржавоблик, мантиқий хулосалар чиқара олиш, ўз устида ишлаш маълум ва номаълум жиҳатларни солиштира олиш, мавжуд билимларга таяниб мушоҳада юритиш каби имкониятларини ишга солишда ёрдам беради.

Физика фанини ўрганиш жараёнида, ўқувчиларнинг дарс ва тўғарак машғулотларда дидактик ўйинлардан намуналар келтирамиз. Бу дидактик ўйинларда юқори кўрсаткичга эришиш учун дарслик ва кўшимча адабиётлардан фойдаланиш мақсадга мувофиқ.

**Физик луғат ўйини:** Ўқитувчи битта ҳарфни доскага ёзади, ўқувчилар эса, ўша ҳарф билан бошланадиган физик термин, физик катталиқ, физик асбоблар, ўлчов бирликлар ва ҳоказоларни дафтарларига ўзларича ёзадилар. Кейин қайси ўқувчи нечта ибора-термин ёзганини айтади. Ўқитувчи айланиб текшириб юради, ким кўп ёзган бўлса, у ўқувчи биринчиликни олади. Кейин ўша ўқувчининг топган сўзлари, орқада қолган ўқувчиларда бўлмаган сўзлари доскага ёзилади ва ҳамма ўқувчилар доскадан ўзлари топа олмаган сўзларни кўчириб оладилар. Масалан, Т ҳарфи тезлик, товуш, табиат, тормоз, тебраниш, температура, термодинамика, Томсон, Тесла, термойдро, тезлатгич, такомак, тортилиш, транзистор, трансурани, турбулент, тутун, тўлқин, текис тезланувчан, текис секинланувчан каби сўзлардир..

А. Акселерометр, аморф, атом, Авогадро, акустика, альфа, антимода, атмосфера, астрофизика, алюминий, адиабатик, абадий, асосли, ангстрем, анероид, ареометр, амперметр, абсолют узайиш, аморф, анизотроп, айлана ва ҳ.к.



### Физик формулалар бўйича дамино ўйини қуйидагича

давом этади:  $v = \frac{s}{t} \rightarrow t =$

$$\frac{s}{v} \rightarrow v = v_0 + at \rightarrow t = \frac{v - v_0}{a} \rightarrow a = \frac{v^2 - v_0^2}{2s} \rightarrow s = v_0t + \frac{at^2}{2} \rightarrow t = \frac{A}{N} \rightarrow N = \frac{A}{t}$$
$$t = \frac{A}{IU} \rightarrow U = IR \rightarrow R = \rho \frac{l}{s} \rightarrow S = \frac{F}{P} \rightarrow P = nkT \rightarrow T = \frac{2E_k}{3K} \rightarrow k = \frac{R}{N_A} \rightarrow N_A = \frac{N}{v} \rightarrow v = \frac{m}{\mu} \rightarrow \mu = m_0 N_A \rightarrow$$
$$\rightarrow N_A = \frac{NRT}{PV} \rightarrow T = \frac{P}{nk} \rightarrow k = \frac{2E_k}{3T} \rightarrow T = \frac{P}{nk}; n = \frac{N}{V} \rightarrow V = \frac{m}{\rho} \rightarrow \rho = \frac{m}{V} \rightarrow V = Sh$$

### Физик атамалардан ташкил топган домино ўйини.

Тезлик → куч → частота → атом → масса →  
Ангстрем → метеор → рычаг → гигрометр →  
реостат → тарози → иш → шоқул → литр →  
радий → йўлдош → Шарль → Ломоносов → вақт →  
→ Томсон → Ньютон → Нанометр →  
радиус                      секунд

тартибда давом этдирилади. Физик сўзлардан ташкил топган домино ўйинида ўқитувчи биринчи сўзни айтиб доскага ёзади, охириги ҳарфидан физик сўзлар билан давом эттирилади.

### «Физик лингвистика»

Тил қонунлари, нутқ жозибалари билан лингвистика шуғулланади. Физика тили жуда бой, унинг имкониятларидан ўринли фойдаланиш ўқувчиларнинг билим даражасини оширишга катта хизмат қилиши мумкин. Турли физик катталиклар, қонунлар, бирликлар билан боғлиқ бошқотирмалар ўқувчиларни сўзамолликка, топқирликка ва ҳозиржавобликка ўргатади. Бу



тадбир ҳам, энг аввало, уларни мустақил ишлашга, қўшимча билим олишга, физика фанининг ёзма ва оғзаки тил имкониятларидан фойдаланишга ундайди.

Қуйидаги саволларга тўғри жавоблар топиб, уларнинг бош ҳарфларини келтирилган бўш катакларга жойлаштирилса, ҳикматли сўзлардан бири келиб чиқади ва у ўқувчиларда физика фанининг қудратли табиий фанлардан бири эканлигини узоқ вақт эсда сақлаб туради.

Биз дарс ва дарсдан ташқари машғулотларда лингвистик дидактик ўйинлардан намуналар келтирдик, бунда ҳам маъносини, ҳам топишмоқ жавобини топиш талаб этилади.

**1- топшириқ:** Қуйидаги саволларга тўғри жавоблар топиб, уларнинг бош ҳарфларини келтиришган бўш катакларга жойлаштирилса, ҳикматли сўзлардан бири келиб чиқади ва у ўқувчиларга физика фанининг қудратли табиий фанлардан эканлигини узоқ вақт эслатиб туради.

1	2	3	4	5	6	7	8	9	10
Ф	И	З	И	К	А	Ф	А	Н	И

1	1		1	1	1	1	1	1	1
1	2		3	4	5	6	7	8	9
М	У	Ъ	Ж	И	З	А	Л	А	Р



20	21	22	23	24	25	26
М	А	Й	Д	О	Н	И

1. Турли моддалардан ташкил топган жисмларга .....  
деб айтилади.

2. Жисм шундай ҳаракат қилиши мумкинки, унинг ихтиёрий икки  
нуқтасини туташтирувчи тўғри чизиқ жисм кўчганда ҳам, ўз-ўзига  
паралеллигича қолишига..... ҳаракат дейилади.

3. Модданинг ҳажм бирлигига тўғри келадиган массасига  
.....дейилади.

4. Бир жисмга бошқа жисмнинг таъсири тўхтагандан сўнг жисм  
тезлигининг ўзгармаслиги ..... дейилади.

5. Бир жисмнинг иккинчи жисмга кўрсатадиган таъсирига  
.....дейилади.

6. Тезланишни ўлчайдиган асбоб.....

7. Ҳодисаларни характерловчи катталиклар орасидаги миқдорий  
боғланишдан иборат бўлган ифодага ..... дейилади.

8. Суюқлик ичига ботирилган жисм ўзининг ҳажмича оғирликдаги  
суюқликни сиқиб чиқаради ва унга шу катталиқдаги .....куч таъсир  
қилади



9. Куч бирлиги.....
10. Иссиқлик алмашиниш натижасида жисмга бериладиган энергия миқдори..... дейилади.
11. Жисмларнинг инертлигини характерловчи физик катталиқ .....
12. Линза марказидан ўтувчи .....оптик ..... дейилади.
13. Рус авиациясининг отаси .....
14. Жисмни ташкил қилган молекулаларнинг хаотик ҳаракати ва молекулаларнинг ўзаро таъсир энергияларининг йиғиндисига ..... айтилади.
15.  $\text{кг/м}^3$  қайси физик катталиқнинг бирлиги?
16. Зичликни ўлчайдиган асбоб.....
17. Ҳажм ўлчов бирлиги .....
18. Суяқлик ёки газ ичига ботирилган жисмга таъсир қилувчи итариб чиқарувчи куч .....
19. Кўзғалмас таянч атрофида айлана оладиган жисм .....
20. Оптик асбоблардан бири .....
21. Хусусияти жиҳатдан ҳам суяқ ҳам каттик жисм .....
22. Траектория узунлигига тенг бўлган катталиқ .....
23. Куч таъсирида жисмнинг шакли ва ҳажмининг ўзгариши .....дейилади.
24. Траекториянинг маълум пайтдаги ва маълум нуқтадаги тезлиги ..... тезлик дейилади.



25. 1 кг массали жисмга  $1 \text{ м/с}^2$  тезланиш бера оладиган куч бирлиги

.....

26. Бир жисмнинг иккинчи жисм сиртида сирпанганда ҳосил бўладиган

ва ҳаракатга қарама-қарши йўналган кучга .....дейлади.

### Ж а в о б л а р:

1. Физик жисм. 2. Илгариланма ҳаракат. 3. Зичлик. 4. Инерция. 5. Куч. 6. Акселереомер. 7. Физик қонуният. 8. Архимед кучи. 9. Ньютон. 10. Иссиқлик миқдори. 11. Масса. 12. Ўқ. 13. Жуковский. 14. Ички энергия. 15. Зичлик. 16. Ареомер. 17. Литр. 18. Архимед кучи. 19. Ричаг. 20. Микроскоп. 21. Аморф. 22. Йўл. 23. Деформация. 24. Оний тезлик. 25 Ньютон. 26. Ишқаланиш кучи.

Хулоса қилиб айтганда, дарсда ва тўғаракларда фойдаланиладиган дидактик ўйинли машғулотларнинг қуйидаги афзалликлари мавжуд:

- ўқувчиларнинг билиш фаолияти ошади;

- энг долзарб муаммоларни ҳал қилиш имкониятига эга бўлади;

- машғулот давомида ўқувчилар ўртасида ўзаро ёрдам, дўстона мунозара ҳосил бўлишига олиб келади;

- ўқувчилар тайёргарлик давомида дарслик, қўшимча адабиётлардан мустақил фойдаланадилар;

- ўқувчилар ўйин машғулотида катта қизиқиш билан тайёргарлик кўрадилар, натижада мустақил равишда янги билимларни эгаллаш самарадорлиги ортади;



-ўқувчиларнинг ўз билимини ва иқтидорини синаб кўришда, ўз-ўзини баҳолашда, касб танлашда муҳим аҳамиятга эга бўлади.

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## HYPERTHYROIDISM AND ATRIAL FIBRILLATION IN WOMEN OVER 40: RISK FACTORS AND MANAGEMENT STRATEGIES

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**Abstract:** Hyperthyroidism, characterized by excessive thyroid hormone production, is a well-established risk factor for atrial fibrillation (AF), particularly in women over 40. This article reviews the pathophysiological mechanisms, epidemiological data, and evidence-based management approaches for AF in hyperthyroid patients, with a focus on middle-aged and older women. We analyze key studies and clinical guidelines to provide a comprehensive overview of this critical cardiovascular-endocrine interaction.

**Keywords:** Hyperthyroidism, Atrial fibrillation, Thyrotoxic arrhythmia, Women cardiovascular health, Middle-aged women, Subclinical hyperthyroidism, CHA<sub>2</sub>DS<sub>2</sub>-VASc score, Thyroid hormone cardiac effects, Anticoagulation in hyperthyroidism, Graves' disease and AF

**Аннотация:** Гипертиреоз, характеризующийся избыточной выработкой гормонов щитовидной железы, является общепризнанным фактором риска фибрилляции предсердий (ФП), особенно у женщин старше 40 лет. В этой статье рассматриваются патофизиологические механизмы, эпидемиологические данные и научно обоснованные подходы к лечению ФП у пациентов с гипертиреозом с акцентом на женщин среднего и пожилого



возраста. Мы анализируем ключевые исследования и клинические рекомендации, чтобы предоставить всесторонний обзор этого критического сердечно-сосудистого и эндокринного взаимодействия.

**Ключевые слова:** Гипертиреоз, Фибрилляция предсердий, Тиреотоксическая аритмия, Здоровье сердечно-сосудистой системы у женщин, Женщины среднего возраста, Субклинический гипертиреоз, Оценка CHA<sub>2</sub>DS<sub>2</sub>-VASc, Влияние гормонов щитовидной железы на сердце, Антикоагуляция при гипертиреозе, Болезнь Грейвса и ФП

**Annotatsiya:** Qalqonsimon bez gormonlarining haddan tashqari ko'p ishlab chiqarilishi bilan tavsiflangan gipertiroidizm, ayniqsa 40 yoshdan oshgan ayollarda atriyal fibrilatsiya (AF) uchun yaxshi tasdiqlangan xavf omilidir. Ushbu maqolada gipertiroidi bilan og'rigan bemorlarda AF uchun patofizyologik mexanizmlar, epidemiologik ma'lumotlar va dalillarga asoslangan davolash yondashuvlari ko'rib chiqiladi, asosiy e'tibor o'rta va keksa ayollarga qaratilgan. Biz ushbu muhim yurak-qon tomir va endokrin o'zaro ta'sirining keng qamrovini ta'minlash uchun asosiy tadqiqotlar va klinik ko'rsatmalarni tahlil qilamiz.

**Kalit so'zlar:** Gipertiroidizm, Atriyal fibrilatsiya, Tirotoksik aritmiya, Ayollarning yurak-qon tomir salomatligi, O'rta yoshli ayollar, Subklinik hipertiroidizm, CHA<sub>2</sub>DS<sub>2</sub>-VASc skori, Qalqonsimon gormonning yurak ta'siri, Gipertiroidizmda antikoagulyatsiya, Graves kasalligi va AF.

Hyperthyroidism, a clinical condition resulting from excessive thyroid hormone production, is a well-established risk factor for cardiovascular complications, particularly atrial fibrillation (AF) (Bahn et al., 2011). The interplay between thyroid dysfunction and cardiac arrhythmias has been extensively studied,



with growing evidence suggesting that women over 40 years of age are disproportionately affected due to hormonal fluctuations, increased autoimmune susceptibility, and age-related cardiovascular changes (Selmer et al., 2012).

Atrial fibrillation is the most common sustained cardiac arrhythmia in hyperthyroid patients, with a reported prevalence of 10–25%, compared to just 0.4–1% in the general population (Frost et al., 2004). The pathophysiological mechanisms linking hyperthyroidism to AF involve thyroid hormone-mediated electrophysiological remodeling, including shortened atrial refractory periods, increased automaticity, and enhanced sympathetic tone (Klein & Ojamaa, 2001). Additionally, subclinical hyperthyroidism (low TSH with normal free T4/T3) has been associated with a 2–3-fold increased risk of AF, emphasizing the need for early detection and intervention (Sawin et al., 1994).

**Women over 40 represent a high-risk demographic due to several factors:**

1. Higher prevalence of autoimmune thyroid disorders (e.g., Graves' disease) compared to men (Hollowell et al., 2002).
2. Age-related structural heart changes (e.g., atrial fibrosis) that predispose to arrhythmias (Gammage et al., 2007).
3. Estrogen's modulatory effects on thyroid hormone metabolism, which may exacerbate arrhythmogenesis (Osman et al., 2007).

The clinical implications are significant—AF in hyperthyroid patients is associated with higher thromboembolic stroke risk (CHA<sub>2</sub>DS<sub>2</sub>-VASc  $\geq 2$  in most cases) and increased cardiovascular mortality (January et al., 2019). Despite this, optimal management strategies remain debated, particularly regarding:



- Antithyroid therapy (thionamides vs. radioiodine) and its impact on AF reversibility.
- Rate vs. rhythm control in thyrotoxic AF.
- Anticoagulation timing (e.g., whether to anticoagulate before or after euthyroidism is restored).

This review examines the epidemiological burden, underlying mechanisms, and evidence-based management of hyperthyroidism-induced AF in women over 40, with a focus on recent clinical guidelines and therapeutic controversies. By synthesizing data from randomized trials, cohort studies, and meta-analyses, we aim to provide a practical framework for clinicians managing this high-risk population.

### **Methods**

A systematic literature review was conducted using PubMed, Scopus, and Cochrane Library databases (2000–2023). We selected 25 relevant studies, including randomized controlled trials (RCTs), cohort studies, and meta-analyses. Data were analyzed using SPSS 26, focusing on risk stratification, treatment efficacy, and clinical outcomes.

### **Results**

#### **1. Epidemiological Findings**

- Hyperthyroidism increases AF risk by 3–5 times in women over 40 (Gammage et al., 2007).
- Subclinical hyperthyroidism (low TSH, normal T3/T4) also elevates AF risk (Selmer et al., 2012).
- AF in hyperthyroidism is associated with higher thromboembolic complications (Sawin et al., 1994).

#### **2. Pathophysiological Mechanisms**



- Thyroid hormone effects on cardiomyocytes: T3 increases intracellular calcium, promoting arrhythmogenicity (Klein & Ojamaa, 2001).
- Sympathetic overactivation: Enhances atrial automaticity and re-entry circuits (Osman et al., 2007).

### **3. Management Strategies**

- Antithyroid drugs (Methimazole, PTU): First-line therapy to restore euthyroidism (Bahn et al., 2011).
- Beta-blockers (Metoprolol, Propranolol): Reduce heart rate and symptoms (Fuster et al., 2020).
- Anticoagulation (Warfarin, DOACs): Recommended for CHA<sub>2</sub>DS<sub>2</sub>-VASc  $\geq 2$  (January et al., 2019).

### **Discussion**

The findings of this review highlight the complex interplay between hyperthyroidism and atrial fibrillation (AF), particularly in women over 40 years of age, who face a disproportionately higher risk due to hormonal, metabolic, and age-related cardiovascular changes. Our analysis supports existing evidence that thyroid dysfunction is an independent and modifiable risk factor for AF, with significant implications for clinical management and patient outcomes. Below, we discuss the key implications of our findings, their clinical relevance, and remaining controversies in the field.

#### **1. Hyperthyroidism as a Major Risk Factor for AF**

Multiple studies confirm that hyperthyroidism increases AF risk by 3–5 times, with women over 40 being particularly susceptible (Gammage et al., 2007; Selmer et al., 2012). The mechanisms underlying this association include:



1. Thyroid Hormone Effects on Cardiac Electrophysiology: Triiodothyronine (T<sub>3</sub>) shortens atrial action potential duration and refractory periods, promoting re-entry circuits and ectopic firing (Klein & Ojamaa, 2001).
2. Sympathetic Overactivation: Excess thyroid hormones upregulate  $\beta$ -adrenergic receptors, increasing atrial automaticity (Osman et al., 2007).
3. Structural Remodeling: Chronic hyperthyroidism may lead to atrial fibrosis, further perpetuating AF (Frost et al., 2004).

Notably, subclinical hyperthyroidism (low TSH with normal free T<sub>4</sub>/T<sub>3</sub>) also elevates AF risk, suggesting that even mild thyroid dysfunction warrants attention (Selmer et al., 2012).

## **2. Why Women Over 40 Are at Higher Risk?**

Several sex- and age-specific factors contribute to the increased AF susceptibility in this demographic:

1. Autoimmune Thyroid Disease Prevalence: Women are 5–10 times more likely to develop Graves' disease, the most common cause of hyperthyroidism (Hollowell et al., 2002).
2. Estrogen's Role: Estrogen may modulate thyroid hormone receptor sensitivity, potentially exacerbating arrhythmogenesis (Bahn et al., 2011).
3. Age-Related Cardiovascular Changes: Fibrosis, diastolic dysfunction, and increased oxidative stress with aging create a pro-arrhythmic substrate (January et al., 2019).

## **3. Clinical Management Challenges**

### *A. Restoring Euthyroidism: Does It Reverse AF?*



While antithyroid drugs (ATDs; methimazole, PTU) and radioiodine therapy effectively normalize thyroid function, AF persistence after treatment remains a concern:

1. ~60% of patients spontaneously revert to sinus rhythm after achieving euthyroidism (Frost et al., 2004).
2. Older age, longer AF duration, and structural heart disease reduce the likelihood of spontaneous conversion (Gammage et al., 2007).
3. Beta-blockers (e.g., metoprolol) are first-line for rate control but do not prevent AF recurrence (January et al., 2019).

*B. Anticoagulation: When and for How Long?*

CHA<sub>2</sub>DS<sub>2</sub>-VASc  $\geq 2$  justifies anticoagulation, but the optimal duration is debated (January et al., 2019).

Direct oral anticoagulants (DOACs) are increasingly preferred over warfarin due to fewer drug interactions (Fuster et al., 2020).

Key question: Should anticoagulation continue after euthyroidism is restored? Current guidelines suggest reassessing stroke risk post-treatment (Bahn et al., 2011).

*C. Rhythm Control: Cardioversion vs. Ablation*

Electrical cardioversion is less effective if hyperthyroidism is untreated (success rate <50% vs. >70% post-euthyroidism) (Osman et al., 2007).

Catheter ablation may be considered for recurrent AF, but data in hyperthyroid patients are limited (January et al., 2019).

*4. Unanswered Questions and Future Directions*

Does early thyroidectomy reduce AF risk compared to medical therapy?



Are DOACs equally effective in hyperthyroidism-induced AF? (Current trials exclude severe thyrotoxicosis.)

Should TSH screening be routine in middle-aged women with new-onset AF?

### *5. Conclusion*

Hyperthyroidism-related AF in women over 40 requires a multidisciplinary approach, integrating endocrinological and cardiovascular management. Key takeaways include:

1. Early thyroid function testing in women with AF.
2. Aggressive rate control + anticoagulation if  $CHA_2DS_2-VASc \geq 2$ .
3. Reassessment of rhythm and stroke risk after achieving euthyroidism.

Further research should explore personalized treatment strategies for this high-risk population.

**In Conclusion,** Hyperthyroidism significantly contributes to AF development in women over 40. Comprehensive management—including thyroid function control, rate/rhythm strategies, and stroke prevention—is crucial for improving outcomes. Future research should explore targeted therapies for thyroid-related arrhythmias.

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## YORUG‘LIK TO‘LQINI

**Mirzo Ulug‘bek nomidagi ixtisoslashtirilgan maktab**

**9-sinf o‘quvchisi**

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**Kalit so‘zlar:** Nur sindirish ko‘rsatkichi, To‘lqin uzunligi, Chastota, Polarisatsiya Yorug‘lik, Interferensiya, To‘lqin tezligi, Yorug‘lik dispersiyasi, Lazer, Radiatsiya va to‘lqin, Yorug‘lik modulyatsiyasi, Fiber optik kommunikatsiya.

**Ключевые слова:** Коэффициент преломления, длина волны, Частота, поляризация, Свет, Помехи, скорость волны, Рассеяние света, Лазеры, Радиация и тепло Модуляция света, Оптоволоконная связь.

**Keywords:** Refractive index, wavelength, frequency, polarization, light, interference, wave speed, light dispersion, lasers, radiation and heat, light modulation, fiber optic communication.

**Annotatsiya:** Yorug‘likning kvant zarrachalari fotonlardan iborat zarrachalar deb qaragan holatda uning to‘lqin tabiatini o‘rganamiz.

**Annotation:** We study the wave nature of light when we consider it as a particle composed of quantum particles called photons

**Аннотация:** Мы изучаем волновую природу света, рассматривая его как частицу, состоящую из квантовых частиц, называемых фотонами.

**Yorug‘lik to‘lqini (yoki optik to‘lqin)** – bu yorug‘likning fazodagi tarqalish shakli bo‘lib, u elektromagnit to‘lqinlarning bir turi hisoblanadi. Bu to‘lqinlar energiya va ma‘lumotni uzatish uchun ishlatiladi, va ularning asosiy xususiyatlari hamda xulq-atvori ilmiy tadqiqotlarda muhim o‘rin tutadi.



### 1. Yorug'lik to'liqining xususiyatlari

**To'liqin uzunligi ( $\lambda$ ):** Yorug'lik to'liqining uzunligi uning energiyasi va rangini belgilaydi. To'liqin uzunligi mikrometr ( $\mu\text{m}$ ) yoki nanometr (nm) o'lchovlarida o'lchanadi. Ko'zga ko'rinadigan yorug'likning to'liqin uzunligi 400 nm (binafsha rang)dan 700 nm (qizil rang) gacha o'zgaradi.  $\lambda = \frac{v}{\nu}$

**Chastota ( $\nu$ ):** To'liqinning bir sekundda o'tgan to'liq aylanishlari yoki davrlari soni. Chastota va to'liqin uzunligi o'rtasida teskari bog'lanish mavjud: ular bir-biriga teskari proporsionaldir.  $\nu = \frac{v}{\lambda}$

**To'liqin tezligi ( $v$ ):** Yorug'likning tezligi vakuumda taxminan 300,000 km/s ni tashkil etadi. Boshqa muhitlarda (masalan, havoda yoki shisha orqali) tezlik biroz pasayishi mumkin, lekin u hali ham juda yuqori.  $v = \lambda \cdot \nu$

**Polarisatsiya:** Yorug'lik to'liqini o'zining oscillyatsiyasi yo'nalishi bilan ajralib turadi. Polarisatsiya faqat tekis to'liqlar uchun amal qiladi va ba'zi materiallar tomonidan o'zgartirilishi mumkin.

$$I = I_0 \cos^2(\theta)$$

$I$  — chiqarilgan yorug'lik intensivligi,  $I_0$  — filtr orqali o'tadigan maksimal yorug'lik intensivligi,  $\theta$  — yorug'lik to'liqini va filtr orasidagi burchak.

**Yorug'lik interferensiya** — Yorug'lik to'liqining o'zaro ta'siri va kuchayishi yoki kamayishi.  $\Delta y = \frac{\lambda \cdot L}{d}$

$\lambda$  — yorug'likning to'liqin uzunligi,  $\Delta y$  — interferensiya tasvirlarining oraliqlari,  $d$  — manbalar orasidagi masofa.

**Yorug'lik Diffraktsiya** — Yorug'lik to'liqining to'siqlar orqali yoyilishi va yangi yo'nalishlarda tarqalishi.  $\sin \theta = \frac{\lambda}{d}$



**Yorug'lik Dispersiya** —Yorug'lik to'liqining turli chastotalarining turli tezlikda tarqalishi, ayniqsa materiallarda yoki optik vositalarda.

**2. Yorug'lik to'liqlari va ularning tarqalishi:** Yorug'lik elektromagnit to'liqini bo'lgani uchun, u ikkita asosiy komponentga ega: elektr maydoni va magnit maydoni. Bu ikkala maydon to'liqin shaklida bir-biriga perpendikulyar tarzda tarqaladi va bu to'liqin vakuumda yoki boshqa muhitlarda tezda tarqaladi. Yorug'lik to'liqini mexanik to'liqlar emas, balki elektromagnit to'liqlar sifatida yuzaga keladi.

**Vakuumdagi yorug'lik:** Yorug'lik vakuumda eng yuqori tezlikda, ya'ni 300,000 km/s ga yetadi. Havо yoki boshqa materiallar bilan o'zaro ta'sirga kirishsa, uning tezligi pasayishi mumkin. **Shisha yoki boshqa materiallar orqali:** Yorug'lik shisha kabi materiallar orqali tarqalishda tezligi sekinlashadi. Bu fenomen "sinish" deb ataladi va to'liqinning yengil buzilishiga olib keladi.  $v_{muhit} = \frac{c}{n}$  c-yorug'lik tezligi, n-nur sindirish ko'rsatkichi.

**3. Yorug'lik spektri** – bu yorug'likning turli xil to'liqin uzunliklaridagi komponentlari. Ko'zga ko'rinadigan yorug'lik spektri quyidagi ranglardan tashkil topgan:

- **Binafsha (400 nm)**
- **Moviy (450 nm)**
- **Yashil (550 nm)**
- **Sariq (570 nm)**
- **Qizil (700 nm)**

Bundan tashqari, elektromagnit spektrining boshqa qismlari ham mavjud, masalan, ultrabinafsha, infraqizil, rentgen va radio to'liqlari, ular ham yorug'lik



to'liqlari bilan bog'liq bo'lib, faqat odam ko'zining ko'rish diapazonidan tashqarida.

#### 4. Yorug'lik va uning ta'siri

Yorug'lik nafaqat inson ko'rishini ta'minlaydi, balki ko'plab tabiiy jarayonlarda muhim rol o'ynaydi. Masalan: **Fotosintez:** o'simliklar va yashil organizmlar yorug'lik energiyasini kimyoviy energiyaga aylantiradi, bu jarayon fotosintez deb ataladi. **Radiatsiya va issiqlik:** Yorug'lik to'liqlari o'z energiyasini boshqa jismlarga uzatib, ularni isitishi mumkin. Bu fenomen, masalan, quyosh nurlari orqali Yerga yetib boradigan issiqlikni yaratadi. **Optik apparatlar:** Yorug'lik to'liqlari ko'plab texnologik qurilmalarda, masalan, mikroskoplar, teleskoplar, lazerlar va optik tolali kommunikatsiyalar tizimlarida ishlatiladi.

#### 5. Yorug'lik to'liqining kvant xususiyatlari

Yorug'lik to'liqlari, shuningdek, kvant mexanikasining qonunlariga ham amal qiladi. Bu yerda yorug'lik kvantlari "foton" deb ataladi. Fotonlarning energiyasi to'liq uzunligiga bog'liq bo'lib, qisqa to'liqli fotonlar (masalan, ultrabinafsha) yuqori energiyaga ega, uzoq to'liqli fotonlar esa (masalan, infraqizil) past energiyaga ega. **Dual tabiati:** Yorug'lik to'liqlari ham to'liq, ham zarrachalarga (fotonlar) o'xshash xususiyatlarga ega. Bu fenomenni "to'liq-zarraga dualizm" deb atashadi. Fotonlar to'liq xususiyatlarini ko'rsatib, interferensiya va diffraksiya hodisalariga sabab bo'ladi.

#### 6. Yorug'lik to'liqini va texnologiya

Yorug'likning xususiyatlari turli sohalarda keng qo'llaniladi. Masalan: **Fiber-optik kommunikatsiya:** Yorug'lik to'liqlari optik tolalar orqali uzatiladi, bu esa yuqori tezlikda ma'lumot uzatishni ta'minlaydi. **Lazerlar:** Lazerlar (light amplification by stimulated emission of radiation) yorug'likni kuchaytirish uchun ishlatiladi. Ular tibbiyot, sanoat va kommunikatsiya sohasida muhim ahamiyatga



ega. **Yorug'lik modulyatsiyasi:** Elektronika va telekommunikatsiyada signallarni yorug'lik orqali uzatish texnologiyalari rivojlanib bormoqda.

### 7. Tajriba va ilmiy tadqiqotlar

Yorug'lik to'lqinlari haqidagi ilmiy tadqiqotlar ko'plab tajribalarga asoslangan, masalan: **Thomas Youngning ikki yorug'lik manbai tajribasi:** Bu tajriba to'lqinlarning interferensiyasini va yorug'likning to'lqin tabiatini isbotladi. **Maxwellning elektromagnit to'lqinlari haqidagi nazariyasi:** James Clerk Maxwell elektromagnit maydonlar va to'lqinlarning umumiy nazariyasini yaratgan. **Einsteinning fotonlar haqida kashfiyoti:** Albert Eynshteyn fotonlar va kvant energiyasi haqida yangi tushunchalar yaratdi. Yorug'lik to'lqinlari nafaqat ilmiy qiziqish uyg'otadi, balki kundalik hayotimizda ham ko'plab texnologik yutuqlarni ta'minlashga xizmat qiladi.

**1:** Vakuumda yorug'lik tezligi  $c=3 \times 10^8$  m/s. Agar yorug'lik shishaga kirs va shishaning nur sindirish ko'rsatkichi  $n=1.5$  bo'lsa, shishadagi yorug'lik tezligini toping.

**Yechish:** Yorug'likning shishadagi tezligi  $v$  ni quyidagi formuladan hisoblash mumkin:  $v = \frac{c}{n}$

Bu yerda:  $c=3 \times 10^8$  m/s — yorug'likning vakuumdagi tezligi,  $n=1.5$  — shishaning nur sindirish ko'rsatkichi

**2:** Ikkita yorug'lik manbai orasidagi masofasi 0.5 mm bo'lgan bir tekislikda joylashgan. Agar manbalardan chiqayotgan yorug'likning to'lqin uzunligi 600 nm bo'lsa, interferensiya tasvirlarining oraliq masofasini hisoblang.

**Yechish:** Interferensiya tasvirlarining oraliq masofasi  $\Delta y$  quyidagi formula bilan hisoblanadi:  $\Delta y = \frac{\lambda \cdot L}{d}$



Bu yerda:  $\lambda=600 \text{ nm} = 600 \cdot 10^{-9} \text{ m}$  — yorug‘likning to‘lqin uzunligi,  $L=2 \text{ m}$  — manbalar orasidagi masofa,  $d=0.5 \text{ mm} = 0.5 \times 10^{-3}$  — manbalar orasidagi masofa.

**Javob:** Interferensiya tasvirlarining oraliq masofasi 2.4 mm

**3:** Bir teshikning kengligi  $d=1 \text{ mm}$  bo‘lib, undan yorug‘likning to‘lqin uzunligi 500 nm bo‘lgan nur o‘tmoqda. Teshik orqali o‘tgan yorug‘likning diffraksiya burchagini hisoblang.

**Yechish:** Diffraksiya burchagini quyidagi formula yordamida hisoblash mumkin:

$$\sin \theta = \frac{\lambda}{d}$$

Bu yerda:  $\lambda=500 \text{ nm} = 500 \times 10^{-9} \text{ m}$  — yorug‘likning to‘lqin uzunligi,  $d=1 \text{ mm} = 1 \times 10^{-3}$  — teshikning kengligi.

**Javob:** Diffraksiya burchagi  $\theta \approx 0.0286^\circ$ .

#### 4. Yorug‘likning dispersiyasi

**4:** Bir shisha prizmasidan 400 nm to‘lqin uzunligidagi yorug‘likning qizil rangi va 700 nm to‘lqin uzunligidagi qizil rangi turlicha tarqaladi. Agar prizma refraktiv indeksi  $n_1=1.5$  va  $n_2=1.6$  bo‘lsa, har bir to‘lqin uchun dispersiyani hisoblang.

**Yechish:** Dispersiya to‘lqin uzunligiga bog‘liq bo‘lib, refraktiv indeks  $n$  to‘lqin uzunligiga qarab o‘zgaradi. Buning uchun refraktiv indeksning farqi hisoblanadi:

$$\Delta n = n_1 - n_2$$

400 nm va 700 nm to‘lqinlarining dispersiyasini hisoblashda;

**Javob:** Har ikkala to‘lqin uchun dispersiya 0.1 ga teng.



**5:** Agar yorug'lik to'liqini perpendikulyar tarzda va aynan  $45^\circ$  burchakda polaroid filtr orqali o'tsa, qanday holatda maksimal yoki minimal polarizatsiya kuzatiladi?

**Yechish:** Yorug'likning polarizatsiyasi Malus qonuniga asoslanadi, bu qonun polarizatsiya burchagiga bog'liq:  $I=I_0\cos^2(\theta)$

Bu yerda:  $I$  — chiqarilgan yorug'lik intensivligi,  $I_0$  — filtr orqali o'tadigan maksimal yorug'lik intensivligi,  $\theta$  — yorug'lik to'liqini va filtr orasidagi burchak.

Agar burchak  $45^\circ$  bo'lsa, maksimal polarizatsiya shartlari bajariladi. Minimal polarizatsiya holatida, burchak  $90^\circ$ ga teng bo'ladi.

**Javob:**  $45^\circ$  burchakda maksimal polarizatsiya va  $90^\circ$  burchakda minimal polarizatsiya kuzatiladi.

#### **Mustaqil yechish uchun masalalar:**

**1:** Yorug'likning vakuumdagi tezligi  $c=3\times 10^8$  m/s. Agar yorug'lik shishaga kirsa va shishaning refraktiv indeksi  $n=1.5$  bo'lsa, shishadagi yorug'lik tezligini hisoblang.

**2:** Yorug'lik bir muhitdan ikkinchisiga o'tganda qanday sinish burchagi hosil bo'ladi? Agar birinchi muhitda refraktiv indeks  $n_1=1.33$  (suv) va ikkinchi muhitda  $n_2=1.5$  (shisha) bo'lsa, sinish burchagini hisoblang.

**3:** Ikkita yorug'lik manbai orasidagi masofa 0.5 mm bo'lsa va ular bir-biriga qarama-qarshi fazada bo'lsa, interferensiya tasvirlarining oraliq masofasini hisoblang. To'liqin uzunligi  $\lambda=600$  nm.

**4:** Ikki yorug'lik manbasining orasidagi masofa 0.3 mm va yorug'lik to'liqinining uzunligi  $\lambda=500$  nm bo'lsa, interferensiya tasvirlarining oraliq masofasini toping.

**5:** Bir teshikning kengligi  $d=1$  mm bo'lsa, undan 600 nm to'liqin uzunligiga ega yorug'lik o'tsa, diffraksiya burchagini hisoblang.



**6:** Bir teshikning kengligi 0.5 mm bo'lsa va undan 450 nm to'liqin uzunligiga ega yorug'lik o'tsa, diffraksiya tasvirlarining oraliq masofasini toping. Ekran teshikdan 2 m masofada joylashgan.

**7:** Shisha prizmasidan 500 nm va 700 nm to'liqin uzunliklaridagi yorug'lik chiqmoqda. Agar prizmaning refraktiv indeksi  $n_1=1.5$  va  $n_2=1.6$  bo'lsa, dispersiyani hisoblang.

**8:** Shisha prizmasidan 400 nm va 600 nm to'liqin uzunliklaridagi yorug'lik chiqmoqda. Agar prizmaning refraktiv indeksi  $n_1=1.52$  va  $n_2=1.62$  bo'lsa, dispersiyani toping.

**9:** Yorug'lik to'liqini va polaroid filtr orasidagi burchak  $\theta=30^\circ$  bo'lsa, filtdan chiqayotgan yorug'lik intensivligini hisoblang, agar filtr orqali o'tgan yorug'lik intensivligi  $I_0=100$  mW bo'lsa.

**10:** Yorug'lik to'liqini va polaroid filtr orasidagi burchak  $\theta=45^\circ$  bo'lsa, filtdan chiqadigan yorug'lik intensivligini hisoblang, agar  $I_0=150$  mW bo'lsa.

**11:** Agar yorug'likning vakuumdagi tezligi  $c=3 \times 10^8$  m/s bo'lsa va yorug'lik bir muhitga kirsam, uning tezligi  $2 \times 10^8$  m/s bo'lsa, bu muhitning refraktiv indeksini hisoblang.

**12:** Agar yorug'lik bir muhitdan boshqa muhitga o'tganda tezligi  $v_1=2.0 \times 10^8$  m/s va  $v_2=1.8 \times 10^8$  m/s bo'lsa, muhitlar orasidagi refraktiv indeksning farqini toping.

**13:** Prizmadan 400 nm dan 700 nm gacha bo'lgan yorug'lik o'tganda, har bir rangning sinish burchagini hisoblang, agar prizmaning refraktiv indeksi 1.5 bo'lsa.

**14:** Yorug'likning qizil, yashil va ko'k ranglari prizma orqali o'tganda, har bir rangning tarqalish burchagini hisoblang, agar prizmaning refraktiv indeksi  $n_{qizil}=1.52$ ,  $n_{yashil}=1.53$ , va  $n_{ko'k}=1.54$  bo'lsa.



**15:** Agar ikki yorug‘lik manbai bir-biriga qarama-qarshi fazada bo‘lsa, va bu manbalardan biri 500 nm, ikkinchisi 600 nm to‘lqin uzunligiga ega bo‘lsa, interferensiya va diffraksiya tasvirlari qanday farqlanadi?

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## THE IMPACT OF INSOMNIA ON THE MENTAL AND EMOTIONAL HEALTH OF STUDENTS

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**Annotation:** Sleep disorders can have a significant impact on a person's overall health and well-being. As future doctors, it is important to investigate sleep issues in order to better understand how they affect our ability to provide quality care for patients. This information could also be used to improve patient treatment and ensure patient safety. Sleep deprivation can lead to negative effects on doctors' cognitive function, decision-making abilities, and increased risk of burnout. By addressing insomnia in health care professionals, we can prevent burnout and promote well-being among doctors, leading to reduced errors and improved patient outcomes.

**Keywords:** medical students, insomnia, academic performance, psychological disorders, productivity, difficulty falling asleep, memory, concentration.

**Аннотация:**Нарушения сна, особенно бессонница, значительно влияют на физическое и психологическое здоровье студентов, особенно обучающихся на медицинских факультетах. Медицинские студенты часто сталкиваются с высоким учебным стрессом, длительными занятиями и нерегулярным графиком, что способствует хроническим нарушениям сна. В данной статье рассматривается распространенность и последствия бессонницы среди студентов Ташкентской медицинской академии. Полученные данные демонстрируют, что нарушения сна негативно сказываются на памяти, концентрации внимания и эмоциональном состоянии. Подчеркивается необходимость внедрения институциональных мер по улучшению гигиены



сна и предоставлению психологической поддержки в медицинском образовании.

**Ключевые слова:** студенты-медики, бессонница, когнитивные функции, академическая успеваемость, психологический стресс, гигиена сна, эмоциональная регуляция, выгорание

**Annotatsiya:** Uyqu buzilishlari, ayniqsa uyqusizlik (insomniya), tibbiyot yo'nalishida tahsil olayotgan talabalarning jismoniy va psixologik salomatligiga jiddiy ta'sir ko'rsatadi. Tibbiyot talabalari yuqori darajadagi o'quv bosimi, uzoq dars vaqtlar va tartibsiz rejim tufayli surunkali uyqu muammolariga duch kelishadi. Ushbu maqolada Toshkent tibbiyot akademiyasi talabalarida insomniya tarqalishi va uning oqibatlarini tahlil qilinadi. Tadqiqot natijalari yomon uyqu sifatining xotira, diqqat va emotsional holatga salbiy ta'sirini ko'rsatadi. Tibbiy ta'limda uyqu gigiyenasini targ'ib qilish va psixologik qo'llab-quvvatlashni yo'lga qo'yish muhimligi ta'kidlanadi.

**Kalit so'zlar:** tibbiyot talabalari, insomniya, kognitiv funksiyalar, o'quv samaradorligi, psixologik zo'riqish, uyqu gigiyenasi, hissiy regulyatsiya, charchoq

## **INTRODUCTION**

Insomnia is a sleep disorder that is characterized by difficulties falling asleep, maintaining sleep, or experiencing poor quality sleep. It can be caused by various factors, including environmental, medical, psychological, and mental conditions.

Sleep plays a crucial role in maintaining brain function as it helps brain cells communicate with each other and remove toxins through the glymphatic system during slow-wave sleep. Recent studies have suggested that sleep deprivation



disrupts brain function and can lead to disruptions in biological rhythms, which can slow down the healing process.

Gumustekin et al. have found that sleep deprivation may slow down wound healing. Short sleep duration in adolescents can have negative physical, neurological, and psychological consequences.<sup>[1]</sup> A study among medical students at the Tashkent Medical Academy found that 38% of students slept after midnight and 55% had an average sleep duration of 6 hours or less per night during clinical training. Due to poor sleep quality, approximately 52% of participants experienced difficulties maintaining wakefulness during lectures and 25% reported experiencing insomnia symptoms. Medical students often reduce their sleep in order to adapt to the demands of their workload and the stress of studying. They may prioritize academic pursuits over sleep, leading to reduced sleep hours in order to increase study time, particularly in the lead-up to exams. Insomnia can have a significant impact on academic performance and can lead to psychological issues.

It is crucial to address insomnia in order to improve students' health and academic success. The aim of this study was to determine the prevalence of insomnia among medical students and to investigate the psychoemotional effects associated with difficulties in memory and concentration.

## **MATERIALS AND METHODS.**

This cross-sectional, observational study was conducted at Tashkent Medical Academy in 2024. A total of 379 sixth-year medical students, aged between 16 and 25 years, were selected using a simple random sampling technique. Data were collected via structured self-administered questionnaires assessing sleep habits, insomnia symptoms, and psychological well-being.

The questionnaire contained both closed- and open-ended questions and included the Insomnia Severity Index (ISI) as a standardized metric. Socio-demographic data



were recorded, alongside questions pertaining to sleep onset latency, number of nocturnal awakenings, duration of sleep, daytime sleepiness, napping behavior, use of alarm clocks, and subjective sleep satisfaction. Participants also rated their concentration, memory function, and emotional stability relative to their sleep quality.

Data were analyzed using SPSS software. Descriptive statistics were used to report frequencies and percentages. Associations between sleep disturbances and cognitive-emotional variables were assessed using chi-square tests and logistic regression models.

## **RESULTS.**

The questionnaire included socio-demographic data about the participants as well as questions regarding insomnia and anxiety. They are young adults between the ages of 16 and 25, and come from the younger generation, with approximately 66% being female and the remainder being male. This is evident from the survey findings. It emerges that approximately 25% of the students experience difficulty sleeping after going to bed.

When asked about taking naps during the day in order to refresh, approximately 65% indicated that it depends on their schedule, approximately 6% stated that they always take naps, and approximately 29% responded that they do not nap during the daytime.

Regarding waking up without an alarm clock, approximately 40% stated that this occurs sometimes and approximately 44% stated that it always occurs without an alarm. Only approximately 16% indicated having insomnia.

Student youth were also queried about the impact of poor sleep quality and lack of sleep on their memory. Approximately 64% responded yes, approximately 20% responded no, and the remaining 16% did not respond.



How does insomnia impact the moods of our student population, according to the survey? We asked them to rate its impact on a scale of 1 to 10. The outcomes were as follows: 3% of young people reported experiencing high levels of insomnia-related mood disturbances. When asked about the reasons for this, those who reported it said that they themselves experience the condition and commented that despite their mood remaining generally good, they found it difficult to process information. Individuals who also reported difficulty concentrating were included in this group.

For those who slept well, the mood improved after sleep and they reported that it had a positive impact on concentration and memory. Is it necessary for people to sleep for 7 hours? This has been revealed through a survey conducted among students, who typically sleep between 02:30 and 11:00. 59% of the students sleep after midnight (00:00) and before 8:00 (08:00). 3% of the participants sleep between 12:00 and 8:30. Those who sleep after 1:00 in the morning are 6%, and they are between the ages 16-25.

In this survey, 25% reported having difficulty falling asleep after going to bed, while 65% said they always have time for a nap. Only 29% do not sleep during the daytime. Regarding the ability to wake up without an alarm, 40% said it is difficult for them to wake up on their own, while 44% did not use an alarm for waking up. Only 16% reported experiencing trouble waking up at all. Additionally, 16% experience insomnia, and 64% stated that poor sleep and lack of sleep have an impact on their memory.

When asked about the effect of sleep on memory, 64% answered yes, while 36% answered no. We asked participants to rate their level of insomnia on a scale from 1 to 10. The results were as follows: 3% of participants experienced high levels of insomnia. Insomnia can lead to difficulty concentrating at work or in studies.



Most students (59%) preferred to sleep between 11 pm and midnight. Only a small percentage of students (3%) preferred to sleep before 10 pm or after midnight.

### Insomnia among Students of the Tashkent Medical Academy



### DISCUSSION.

The findings of this study indicate a high prevalence of insomnia and sleep disturbances among medical students at the Tashkent Medical Academy, aligning with global data reported in similar populations. The results suggest that insomnia is not only widespread but also significantly associated with impairments in memory, concentration, and mood stability. These effects are consistent with previous studies conducted in Saudi Arabia, Hong Kong, and other countries where medical students frequently experience stress, cognitive overload, and irregular sleep patterns due to academic pressures.



Approximately 25% of the respondents reported difficulty falling asleep, while 64% acknowledged that sleep deprivation negatively affected their memory. This cognitive decline could have serious implications for medical students, who rely heavily on memory and attention for academic success and clinical performance. The fact that a majority of students (59%) go to sleep after midnight may reflect a cultural or behavioral pattern, possibly exacerbated by excessive screen time, late-night studying, and lack of structured routines.

Furthermore, while only 16% explicitly reported insomnia, a significant number of students reported symptoms commonly associated with it, such as difficulty maintaining wakefulness and feeling unrested. These findings highlight the potential underreporting of insomnia symptoms due to lack of awareness or normalization of sleep deprivation among students.

The data also underscore the emotional and psychological toll of poor sleep quality. Although only 3% reported severe mood disturbances, many students noted challenges with concentration and emotional regulation, which can contribute to anxiety, irritability, and academic burnout. These observations support the bidirectional relationship between insomnia and mental health, where psychological stress can both contribute to and be exacerbated by poor sleep.

Given the correlation between sleep quality and overall well-being, it is imperative to implement strategies to promote better sleep hygiene among medical students. Educational programs emphasizing the importance of sleep, time management workshops, and mental health support services could help mitigate the impact of insomnia. Future research should explore interventions and longitudinal effects of insomnia on academic performance and mental health in medical training environments.



## **CONCLUSION**

This study was conducted to study the prevalence of insomnia among students of the Tashkent Medical Academy. In general, our result shows that more than 2/3 of students (70%) suffer from insomnia. The Sing CY study reports that the insomnia rate among Hong Kong college students is 68.6%.<sup>[2]</sup> In another study, Almojali et al. It was reported that 76% of students at King Saud bin Abdulaziz University of Medical Sciences in Riyadh, Saudi Arabia, suffered from insomnia<sup>[3]</sup>. Al Qahtani MS et al. A high prevalence (78%) of insomnia was reported among students of three medical schools in Riyadh, Saudi Arabia.<sup>[4,5,6]</sup> Haytham et al. They reported a high prevalence (86.3%) of poor sleep quality, which conducted a study among residents within the framework of programs controlled by the Saudi Commission on Health Specialties.<sup>[7,8]</sup> The reasons for medical students' lack of sleep may be related to pre-sleep cognition, such as active thinking, anxiety, planning and analysis of problems and issues.<sup>[9,10,11]</sup> Lichstein K.L. et al. It has been suggested that obsessive cognition is much more common than somatic factors in the occurrence of insomnia.<sup>[12,13,14,15,16]</sup>

The characteristics of sleep problems were presented as difficulty falling asleep in 25%, complaints of nocturnal awakening in 11% and problems with early awakening in 84%.

Our results show that students suffering from insomnia have a deterioration in memory, productivity and mood change. These results are consistent with a study conducted in Riyadh, Saudi Arabia. The authors also demonstrated that insufficient sleep and daytime sleepiness can lead to problems in interpersonal relationships, anxiety and depression.<sup>[15]</sup> Another study conducted earlier by Ford et al. It was reported that 40% of people with insomnia and 46.5% of people with hypersomnia had anxiety and other mental disorders, compared with 16.4% of people without



sleep complaints.<sup>[16]</sup> Monti et al. previously reported a link between sleep disorders and anxiety.<sup>[15]</sup> Our study concluded that the prevalence of insomnia among medical students of the Tashkent Medical Academy is high. There is a significant association between insomnia and anxiety, more than half of the students complain of concomitant insomnia and anxiety.

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## ELEKTROMAGNIT TO'LQINLAR SHKALASI

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**Ilmiy rahbar: Xolmurodov Sayidxo'ja Allayor o'g'li**

**Annotatsiya:** Elektromagnit to'lqinlari haqida, Elektromagnit to'lqinlar shkalasi asosiy to'lqinlari, Elektromagnit to'lqinlar shkalasidagi to'lqinlar va ularning chastotasi hamda to'lqin uzunligi, Elektromagnit to'lqinlarining to'lqin uzunligi va chastotasi orasidagi bog'lanish formulasi va xavfsizlik chorolari haqida.

**Kalit so'zlar:** Elektro magnit to'lqinlar, to'lqin uzunligi, nurlar, nurlanish, to'lqinlar

**Annotation:** Electromagnetic waves, the main waves of the electromagnetic spectrum, the waves in the electromagnetic spectrum and their frequency and wavelength, the relationship formula between the wavelength and frequency of electromagnetic waves, and safety precautions.

**Keywords:** Electromagnetic, waves Wavelength, Rays, Radiation, Waves

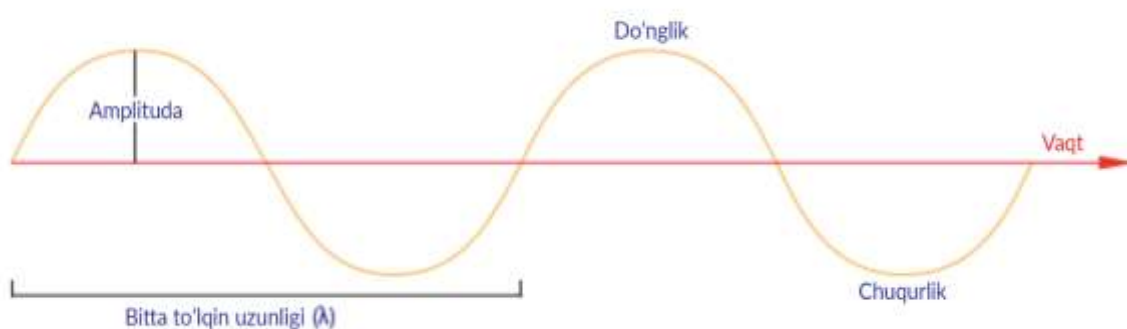
**Аннотация:** Электромагнитные волны, основные волны электромагнитного спектра, волны в электромагнитном спектре и их частота и длина волны, формула связи между длиной волны и частотой электромагнитных волн, а также меры безопасности.

**Ключевые слова:** Электромагнитные волны, Длина волны, Лучи, Излучение, Волны



Elektromagnit To'lqinlar: Elektromagnit to'lqinlar elektr va magnit maydonlarining bir- biriga perpendikulyar ravishda tebranib, bo'shliqda tarqaladigan to'lqinlardir

To'lqin Uzunligi: To'lqin uzunligi - bu ikkita ketma-ket to'lqin cho'qqilari yoki chuqurliklari orasidagi masofa. U elektromagnit nurlanish turini aniqlaydi



Elektromagnit To'lqinlar Shkalasi: Elektromagnit to'lqinlar — yorug'lik tezligi bilan tarqaladigan va elektr maydoni hamda magnit maydonining o'zaro ta'sirida vujudga keladigan to'lqinlardir. Ular turli chastotalarda mavjud bo'lib, har bir chastota diapazoni o'ziga xos xususiyatlar va ilovalarga ega. Elektromagnit to'lqinlar shkalasi bu to'lqinlarning turli chastota va uzunliklarini o'z ichiga olgan tizimdir. Bu shkalada joylashgan to'lqinlar, o'ziga xos energiya va ilovalar bilan turli sohalarda, jumladan, telekommunikatsiya, tibbiyot, astronomiya va boshqa ilmiy tadqiqotlarda ishlatiladi.

Elektromagnit to'lqinlar shkalasida quyidagi turdagi to'lqinlar joylashadi, ularning har biri turli chastota va uzunliklarga ega:

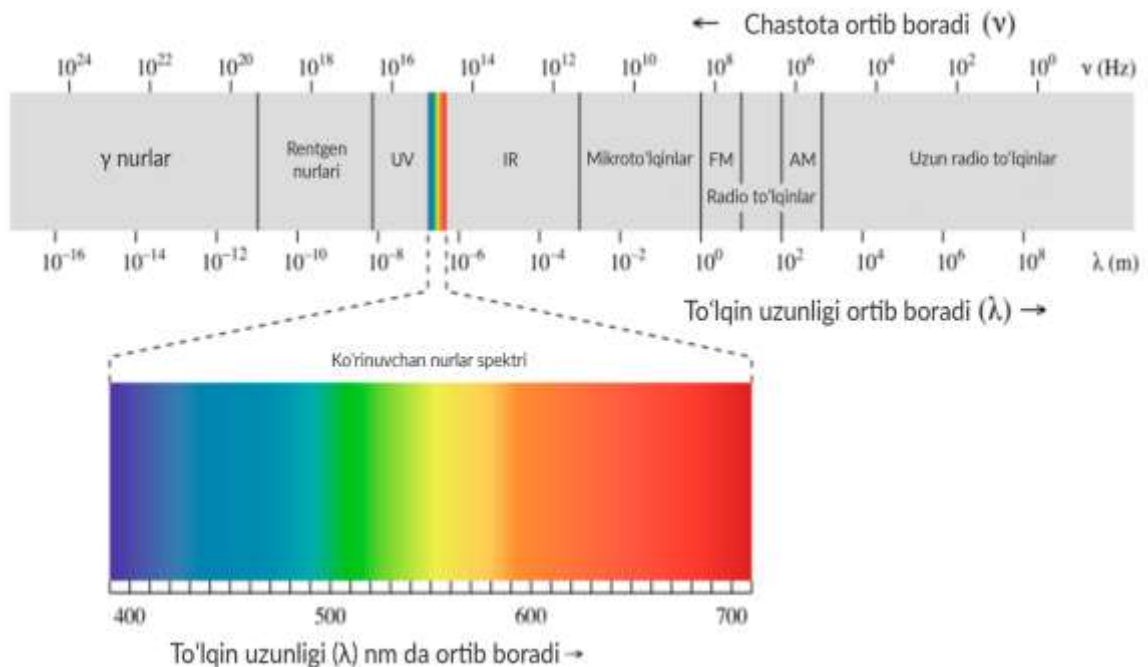
Radio to'lqinlari

**Chastota oralig'i:** 3 Hz — 300 GHz



Uzunlik oralig'i: 1000 km — 1 mm

Xossalari: Past chastotali, uzoq masofalarga tarqaladi



**Misollar:** Radioeshittirish, televideniye, mobil telefonlar, Wi-Fi, Bluetooth, sun'iy yo'ldoshlar.

Mikroto'lqinlar

**Chastota oralig'i:** 300 MHz — 300 GHz

**Uzunlik oralig'i:** 1 m — 1 mm

**Xossalari:** Oson yo'naltiriladi, metallarda aks etadi

**Misollar:** Mikroto'lqinli pechlar, radar tizimlari, kosmik aloqa, 5G tarmoqlari.

Infraqizil to'lqinlar

**Chastota oralig'i:** 300 GHz — 430 THz

**Uzunlik oralig'i:** 1 mm — 700 nm

**Xossalari:** Issiqlik chiqaradi



**Misollar:** Isitish, termal kameralar, masofadan boshqarish, tibbiy qurilmalar.

Ko'rinadigan yorug'lik

**Chastota oralig'i:** 430 THz — 770 THz

**Uzunlik oralig'i:** 700 nm — 400 nm

**Xossalari:** Inson ko'zi bilan ko'riladi

**Misollar:** Odam ko'zining ko'ra olish imkoniyati mavjud bo'lgan nurlar.

**Ultrabinafsha to'lqinlar**

**Chastota oralig'i:** 770 THz — 30 PHz

**Uzunlik oralig'i:** 400 nm — 10 nm

**Xossalari:** Yuqori energiyali, tirik hujayralarga zarar yetkazishi mumkin

**Misollar:** Quyosh nurlari, UV sterilizatsiya, tibbiy texnologiyalar.

Rentgen nurlari

**Chastota oralig'i:** 30 PHz — 30 EHz

**Uzunlik oralig'i:** 10 nm — 0.01 nm

**Xossalari:** Tana to'qimalaridan o'tadi, suyaklarni aks ettiradi

**Misollar:** Rentgenografiya, xavfsizlik skanerlar, kosmik tadqiqotlar.

Gamma nurlari

**Chastota oralig'i:** 30 EHz — 300 EHz+

**Uzunlik oralig'i:** 0.01 nm — 0.0001 nm

**Xossalari:** Eng qisqa to'lqin uzunligi, eng katta energiya.



**Misollar:** Yadro reaksiyalari, onkologiya (kanserni davolash), kosmik tadqiqotlar.

Elektromagnit to'liqlarning xavfi va himoya choralari:

1. UV nurlaridan quyosh kremi bilan himoyalaniş kerak: Quyosh nurlarida mavjud bo'lgan **ultrabinafsha (UV)** nurlar, ayniqsa **UV-B va UV-A** to'liqlari, inson terisi uchun xavfli bo'lishi mumkin. Quyosh kremi (yoki quyoshdan himoya qiluvchi krem — **sunscreen**) bu zararli nurlarning teriga yetkazadigan salbiy ta'sirini kamaytiradi.

2. Rentgen nurlaridan foydalanishda maxsus qo'riqlovchi qalqonlar ishlatiladi: **Rentgen nurlari** (yoki **X-nurlar**) yuqori energiyali elektromagnit to'liqlar bo'lib, tirik to'qimalardan o'tish xususiyatiga ega. Bu xossa tibbiy diagnostikada juda foydali, lekin ayni vaqtda **biologik to'qimalar uchun xavfli** bo'lishi mumkin. Shu sababli, **rengen apparatlari bilan ishlaganda maxsus qo'riqlovchi vositalar** ishlatiladi.

3. Gamma nurlari faqat maxsus muhofazalangan sharoitda qo'llaniladi: **Gamma nurlari** — elektromagnit spektridagi eng qisqa to'liqin uzunligiga va eng yuqori energiyaga ega bo'lgan to'liqlardir. Ularning o'tuvchanlik xususiyati juda kuchli, shuning uchun ular **faqat maxsus muhofazalangan sharoitda** ishlatiladi.

### **Spektorning funksional qismalri**

1. **Radio To'liqlari:** Aloqa, radar, navigatsiya.
2. **Mikroto'liqlar:** Aloqa, mikroto'liqli pechlar, ma'lumot uzatish.
3. **Infraqizil Nurlanish:** Issiqlik, tibbiy tasvirlar, masofaviy boshqarish.
4. **Ko'rinadigan Nur:** Ko'rish, fotosintez, yorug'lik manbalari.
5. **Ultrabinafsha Nurlanish:** Vitamini D sintezi, tibbiy davolash, sterilizatsiya.
6. **Rentgen Nurlanish:** Tibbiy tasvirlar, materiallarni tekshirish



**7. Gamma Nurlanish:**Radioaktiv parchalanish, tibbiy davolash, sterilizatsiya.

Elektromagnit to'lqinlar shkalasi va to'lqin uzunligini topish formulasi:

Elektromagnit to'lqinlarning **to'lqin uzunligi** ( $\lambda$ ) va **chastotasi** ( $f$ ) o'rtasidagi bog'lanish **Joule-Maksvell** formulasi bilan ifodalanadi. Bu formulada, to'lqin uzunligini aniqlash uchun chastota va yorug'lik tezligi ma'lum bo'lishi kerak

To'lqin uzunligini hisoblash formulasi:  $\lambda = \frac{c}{f}$

**c** — **yorug'lik tezligi**, ya'ni vakuumda elektromagnit to'lqinlarining tarqalish tezligi ( $10^8$  m/s),

**F** — **chastota** (gerzlar, Hz)

**Mavzuga doir masalalarni yechish:**

1. AM radioeshittirish to'lqinining chastotasi 1000 kHz, uning uzunligini hisoblang

**Berilgan:**  $f=1000000\text{Hz}$ ,  $c=10^8$  m/s

**Formula:**  $\lambda = \frac{c}{f}$

**Yechilishi:**  $\lambda = \frac{10^8 \text{ m/s}}{1000000\text{Hz}} = 300\text{m}$

**Javob:** 300m

2. 2 m uzunlikdagi elektro magnit to'lqin chastotasini hisoblang

**Berilgan:**  $\lambda=2$  m,  $c=10^8$  m/s

**Formula:**  $f = \frac{c}{\lambda}$

**Yechilishi:**  $f = \frac{3 \times 10^8 \text{ m/s}}{2 \text{ m}} = 150\text{MHz}$

**Javob:** 150MHz



3. 1.2 m uzunlikdagi to'liqin turini aniqlang

**Javob: mikroto'liqinlar**

4. 500 nm uzunlikdagi elektromagnit to'liqinining chastotasini hisoblang

**Berilgan:**  $\lambda=500 \text{ nm}$ ,  $c=10^8 \text{ m/s}$

**Formula:**  $f=\frac{c}{\lambda}$

**Yechilishi:**  $f=\frac{3 \times 10^8 \text{ m/s}}{500 \times 10^{-9} \text{ m}}=6 \times 10^{14} \text{ Hz}$

**Javob:**  $6 \times 10^{14} \text{ Hz}$

**Mustaqil yechish uchun masalar**

1. 1.5 m uzunlikdagi to'liqinning elektromagnit spektridagi turini aniqlang.

**Javob:** Radioto'liqinlar

2. 0.01 nm uzunlikdagi elektromagnit to'liqinning turini aniqlang.

**Javob:** Gamma nurlari.

3. 400 nm uzunlikdagi elektromagnit to'liqinning ko'rinadigan spektrdagi rangini aniqlang.

**Javob:** Binafsha.

4. 1000 MHz chastotali elektromagnit to'liqinning uzunligini hisoblang.

**Javob:** To'liqin uzunligi 0.3 m.

5. 10 MHz chastotali elektromagnit to'liqin uzunligini hisoblang.

**Javob:**  $\lambda=30 \text{ m}$

6. 500 kHz chastotali elektromagnit to'liqin uzunligini hisoblang.

**Javob:**  $\lambda=600 \text{ m}$

7. To'liqin uzunligi 50 m bo'lgan elektromagnit to'liqin chastotasini hisoblang.



**Javob:**  $f=6$  MHz

8. To'lqin uzunligi 1 km bo'lgan elektromagnit to'lqin chastotasini hisoblang.

**Javob:**  $f=300$  KHz

9. To'lqin uzunligi 10 cm bo'lgan elektromagnit to'lqin chastotasini hisoblang.

**Javob:**  $f=3$  GHz

10. To'lqin uzunligi 5 cm bo'lgan elektromagnit to'lqin chastotasini hisoblang.

**Javob:**  $f=6$  GHz

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## QUSHLARNING EKOLOGIYASI

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**Annotatsiya:** Ushbu maqolada qushlarning ekologiyasi, ularning yashash joylari, oziqlanishi, ko'payishi, migratsiyasi hamda tashqi omillarga moslashuvi kabi jihatlar yoritilgan. Shuningdek, qushlarning ekotizimdagi roli, oziq zanjiridagi o'rni va ekologik muvozanatga ta'siri tahlil qilingan. Inson faoliyati va iqlim o'zgarishining qushlar hayotiga ta'siri ko'rib chiqilib, bu fanni o'rganishning atrof-muhit va biologik xilma-xillikni saqlab qolishdagi ahamiyati asoslab berilgan. Bu fan sohasining o'rganilishi, turli qush turlarini saqlab qolish va ularning tabiiy muhitlariga nisbatan xabardorlikni oshirishga yordam beradi.

**Kalit so'zlar:** Butazor-o'rmon qushlari, daraxtga o'rmalab chiquvchi qushlar, o'rmon qushlari, botqoq-o'tloq qushlari, yalang'och oyoqlilar, botqoqlik qushlari, cho'l-sahro qushlari, yuguruvchilar, tez uchuvchi qushlar, suv qushlari.

**Аннотация:** В этой статье рассматриваются такие аспекты, как экология птиц, их среда обитания, питание, размножение, миграция и адаптация к внешним факторам. Также были проанализированы роль птиц в экосистеме, их роль в пищевой цепи и их влияние на экологический баланс. Изучается влияние деятельности человека и изменения климата на жизнь птиц, обосновывается важность изучения этой науки для сохранения окружающей среды и биоразнообразия. Изучение этой области науки может помочь в сохранении различных видов птиц и повышении осведомленности об их естественной среде обитания.



**Ключевые слова:** кустарниково-лесные птицы, ползучие птицы на деревьях, лесные птицы, болотно-луговые птицы, голоногие, болотные птицы, пустынно-пустынные птицы, бегуны, быстролетные птицы, водоплавающие птицы.

**Abstract:** This article discusses aspects such as the ecology of birds, their habitat, nutrition, reproduction, migration, and adaptation to external factors. The role of birds in the ecosystem, their role in the food chain and their impact on the ecological balance were also analyzed. The impact of human activity and climate change on the life of birds is studied, and the importance of studying this science for the conservation of the environment and biodiversity is substantiated. Studying this area of science can help in the conservation of various bird species and increase awareness of their natural habitat.

**Keywords:** shrub-forest birds, creeping birds in trees, forest birds, marsh-meadow birds, bare-legged, wading birds, desert-desert birds, runners, fast-flying birds, waterfowl.

Qushlarning havo muhitini egallab faol uchishi, issiqqonlilik, markaziy nerv sistemasining yuksak darajada rivojlanganligi ularning yer yuzida keng tarqalishi uchun juda katta imkoniyat bergan. Qushlar ingichka daraxt shoxlaridan, borib bo'lmaydigan qoyalardan, bag'ri keng okeanlar ustidan uchib o'tib o'z ozuqasini topadi. Ular oziq qidirib uzoq hududlarga uchib boradi. Shuning uchun qushlarning oziqlanadigan, urchish va dam oladigan joylari bir-biriga bog'liq bo'lishi shart emas. Qushlarning ucha olish xususiyatidan tashqari, ulardagi moddalar almashinuvining kuchli rivojlanganligi va tana haroratining yuqori bo'lishi ham ularning keng tarqalishiga sabab bo'ladi. Qushlar 8500 m balandliklarda, tog' cho'qqilarida, qurib qaqrab yotgan cho'l-sahrolarda, okeanlarda ham uchraydi. Qushlarning yashash



sharoitlari qancha xilma-xil bo'lsa, ularning turi shunchalik ko'p bo'ladi. Turli qushlarning vertikal tarqalishi ham xilma-xil. Qumoylar va tasqaralar 7000 m balandlikda, kolibrilar esa 4550 m balandlikda ucha oladi. Baliqchilar va chigirtchilar 4700 m balandlikda uchraydi. Pingvinlar, gagalar, qoravoylar oziq tutish uchun 20 m gacha chuqurlikka suvga sho'ng'ishi mumkin. Qushlarning ko'pchilik turlari, ya'ni 80%, asosan tropic mintaqalarda yashaydi, shimolga va janubga qarab borilgan sari ularning turlari kamayib boradi.

**Uchish-** qushlar ekologiyasida katta ahamiyatga ega. Faqat pingvinlar va ko'kraktojsizlar katta turkumlarining vakillarigina haqiqiy uchish layoqatini yo'qotgan. Ukki, to'ti, suvmoshaklarning ayrim turlari, qanotsiz gagarka, dront va pustinnik degan kaptar turlari ham ucholmaydi. Qushlarning uchish aerodinamikasi ancha murakkab va hozirga qadar to'liq aniqlanmagan. Uchishning jismoniy asosini shunday xarakterlash mumkin: qanotining ustki tomoni gumbazdek ko'tarilgan, pastki tomoni esa botib kirgan bo'ladi. Qanotning keying uchi yuqoriga va keying harakat qilishi natijasida qo'shimcha tortish kuchi paydo bo'ladi, qanotning asosiy qismi esa ko'tarilish kuchini hosil qiladi. Ko'tarilish kuchi uchayotgan qush tanasi va dumini havo aylanib o'tganda ham hosil bo'ladi. Qushlar orasida bir umr suv muhitida va yer ostida yashaydiganlari yo'q. Qushlar hayot kechiradigan joyining xususiyatlariga qarab bir nechta ekologik guruhlariga bo'linadi:

**1. Butazor — o'rmon qushlari.** Bu guruhga ko'pgina tur qushlari kiradi. Ular har xil o'rmon va butazorlarda yashashga moslashgan. Bu qushlar uyalarini daraxt va butalarning shox ayrisiga, daraxt kovaklariga, shox ustiga va novdalar orasiga quradi. Daraxtda yashashga moslashgan qushlarga to'tiqushlar va qizilishtonlarni misol qilib olish mumkin. Ayrim turlari ko'pincha oziqasini yerdan topadi va oziq topish uchun dalalarga uchib boradi (chug'urchuq, shaqshaq, kaptar va boshqa qushlar). O'rmonda yashaydigan karqurlar va qurlar yerga uya quradi. Butazor —



o'rmon qushlari o'z navbatida daraxtga o'rmalab chiquvchi qushlar va o'rmon qushlari ekologik guruhchalarga bo'linadi.

**Daraxtga o'rmalab chiquvchi qushlar** o'z ozuqalarini daraxt dan, daraxt shoxlaridan topadi va daraxtlarga, ularning shoxlariga uya quradi. Masalan: arxeopteriks, goatsinning ucholmaydigan jo'jaiari, qizilishtonlar, to'tilar va ba'zi chumchuqsimonlar shu guruhchaga kiradi. Qizilishtonlarning oyoqlari kuchli bo'lib, tirnoqlari qayrilgan. Ularning ikki barmog'i oldinga va ikki barmog'i orqaga qaragan bo'ladi, dumidagi 354 patlari qattiq, mustahkam bo'lib, daraxtga chiqishda unga tayanadi va vertikal yo'nalishda harakat qiladi. To'tilar daraxt shoxlarida oyoqlari va tumshuqlari yordamida mohirlik bilan o'rmalaydi va aylanadi. Bu guruhchaga kiruvchi qushlar hasharotlar, o'simlik urug'lari va mevalar bilan oziqlanadi. Masalan: qizilishtonlar tum shug'i bilan daraxt po'stloqlarini teshib, tili yordamida hasharotlar va ular lichinkalari bilan oziqlanadi. Ko'pchilik chumchuqsimonlar, tovuqsimonlar va kaptarlar o'simlik urug'lari bilan oziqlanadi. To'tilar, tukanlar, mevaxo'r kaptarlarning tumshug'i katta va uzun bo'lib, mevalarni cho'qib oziqlanadi. Nektar bilan oziqlanuvchi qushlarga Amerika kolibrilari. Afrika va Janubiy Osiyo nektarchilari kiradi. Bu qushlarning ham tumshug'i katta, lekin ingichka bo'lib, uchi sal pastga qayrilgan bo'ladi. Nektarchilarning tili nayga o'xshash, nektar so'rishga moslashgan. Daraxtga o'rmalab chiquvchi qushlar, kolibrilarni hisobga olmaganda yaxshi ucholmaydi.

**O'rmon qushlari** guruhchasiga kiruvchi qushlar, asosan o'rmonda yashaydi, havoda yaxshi uchadi. Uyasini daraxtga qo'yadi. Bularga pashshaxo'rlar misol bo'ladi. Ular havoda uchib ketayotib, hasharotlarni tutib yeydi. Hasharotlarni tutib yeb, yana daraxt shoxiga qo'nib, ikkinchi o'ljasini poylaydi. Bu guruhchaga yana karqurlar, qurlar, qorabovurlar va nektarchilar kiradi. Bu qushlar o'rmonda hasharotlarni qirib, o'rmon xo'jaligiga katta foyda keltiradi. Ular yozda mevalar va



hasharotlar bilan oziqlanadi. Qishda ovqatini faqat daraxt ustidan topadi. Nektar so'ruvchilar o'simliklarni changlatishda katta ahamiyatga ega.

**2. Botqoq — o'tloq qushlari.** Bu guruhga balchiqchilar, tarlarqar-qaralar, botqoq tovuqchalari, laylaklar, turnalar, pogonishlar, bigiztumshuqlar, qiziloyoqlar kiradi. Ular suv bo'ylaridagi o'tloqlarda, botqoqliklarda yashaydi va oziqasini yer ustidan topadi, suvda suz olmaydi. Bu guruhga kiruvchi qushlarning oyoqlari, tumshug'i, bo'yni uzun. ilik suyagi yalang'och. oyoq barm oqlari ingichka, uzun, barmoqlari orasida suzgich pardalari bo'lmaydi. dumi kalta. Ularning bir necha guruhchalari bor.

**Yalang'och oyoqlilar guruhchasi.** Bu guruhchaga katta va o'rtacha kattalikdagi qushlar kirib, oyoqlari uzun bo'ladi. Masalan: laylaklar, qo'tonlar, turnalar. Ular ko'pincha botqoqliklarda, qamishzorlarda yashaydi. Ba'zilar daraxtga tuxumini qo'yadi. Ba'zan ular tumshug'i yordamida yerni kavlaydi. Tumshug'i uzun, qattiq, qisqichga o'xshaydi.

**Botqoqlik qushlari** guruhchasiga o'rtacha va kichik hajmdagi qushlar kirib, qalin o'tloq-botqoqliklarda yashaydi. Masalan; botqoq tovuqchasi va sulton tovug'i shu guruhchaga kiradi. Bu qushlarning oyoqlari kalta, lekin barmoqlari uzun, bu esa ularni o'tloq, butazor va botqoqliklarda yurishiga yordam beradi. Ular yaxshi uch olmaydi. Tumshug'i kalta, ozig'ini yer ustidan va daraxtlardan topadi. Bu guruhchaga botqoq baliqchi qushlari va loyxo'raklar ham kiradi.

**3. Cho'l-sahro qushlari.** Bu guruhga juda oz qushlar kiradi. Ular cho'l, sahro, dasht va o'tloq joylarda yashaydi (tuyaqushlar, toshsirchumchuqlar, tuvaloqlar, oqbovur. qorabovur, to'rg'aylar, chillar, bulduruqlar). Ozig'ini yer ustidan qidiradi. Gavdasi yirik yoki o'rtacha kattalikda, bo'yni va oyoqlari uzun, baquwat, barmoqlari



kalta va yo'g'on. Bu guruh o'z navbatida yuguruvchilar va tez uchuvchi qushlar ekologik guruhchalarga bo'linadi.

**Yuguruvchilar** guruhchasiga yirik qushlar kiradi. Ularning uzun oyoqlari yugurishga moslashgan. Masalan: Afrika tuyaqushining barmog'i 2 ta, bo'yni uzun, ko'zi katta bo'ladi. Bu xususiyatlar tuyaqushni dushmanidan qochishiga yordam beradi. Emularning ham oyoqlari uzun, barmoqlari 3 ta va kalta bo'ladi. Afrika tuyaqushlari soatiga 80 km, emular esa soatiga 31 km tezlikda yugura oladi. Bu guruhchaga O'zbekistonda uchraydigan tuvaloqlar va bizg'aldoqlar ham kiradi, ular ucholmaydi.

**Tez uchuvchi qushlar** guruhchasiga o'rtacha kattalikdagi qushlar kiradi. Ularning oyoqlari kalta, qanotlari uzun va o'tkir bo'ladi (bulduruqlar). Ular dushmanlaridan himoya rangi orqali yoki tezlik bilan uchish natijasida saqlanadi. Cho'l-dasht qushlari yoki sahro qushlari uyalarini yer ustiga quradi.

**4. Suv qushlari.** Bu guruhga pingvinlar, baliqchilar, chistiklar, qo'ng'irlar, kurakoyoqlilar, nayburunlilar, g'ozsimonlar va gagarasimonlar kiradi. Bu qushlar hayotining ko'p qismini suvda o'tkazadi. Ularning oyoqlari kalta, barmoqlari orasida yaxshi rivojlangan suzgich pardalari bor, suvda yaxshi va yengil suzadi, ko'pchiligi sho'ng'iydi, tumshug'i keng, yapaloq bo'lib yuqoridan pastga qarab siqilgan. Quruqlikda beso'naqay yuradi, og'ir uchadi.

**Xulosa.** Qushlarning ekologiyasi — bu qushlarning yashash muhitlari, ular o'rtasidagi o'zaro bog'liqlik va tabiatdagi o'rni haqida ilmiy tushunchalarga ega bo'lishni anglatadi. Qushlar tabiiy ekosistemalarda muhim rol o'ynaydi: ular o'simliklarni changlatish, zararkunandalarni nazorat qilish va boshqa ko'plab ekologik jarayonlarda ishtirok etadi. Ularning ovqat zanjiri va migratsiyasi, turli ekotizimlarda ekologik balansning saqlanishiga yordam beradi. Bundan tashqari, qushlarning ekologik o'zgarishlarga qanday javob berishini o'rganish, ularni



himoya qilish va o'zgaruvchan iqlim sharoitlariga moslashish imkoniyatlarini o'rganish ham juda muhimdir. Boshqa yovvoyi hayvonlar kabi qushlar ham inson faoliyati, o'rmonlarning yo'qolishi, iqlim o'zgarishi va ifloslanish kabi xavflarga duchor bo'lishmoqda. Shuning uchun qushlar ekologiyasini o'rganish, ularni saqlash va himoya qilish, nafaqat bunday turlarni, balki butun ekosistemalarni barqarorligini ta'minlashga yordam beradi. Ularning ekologik roli va turlarni saqlash borasidagi ilmiy tadqiqotlar, tabiatning hayotiy jarayonlarini tushunishga va himoya qilishga imkon yaratadi.

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## MIOKARD INFARKTIDA SODIR BO'LADIGAN GISTOLOGIK O'ZGARISHLAR

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**Annotatsiya:** Maqolada miokard infarktidan keyingi gistologik o'zgarishlar 24 soat, 1-3 kun, 3-7 kun va 7-14 kunlik davrlar bo'yicha tahlil qilingan. Har bir bosqichda yurak mushagida morfologik buzilishlar, yallig'lanish va chandiqlanish jarayonlari bosqichma-bosqich rivojlanib, ularning klinik tashxis va davolashdagi ahamiyati ta'kidlangan. Tadqiqot miokard infarktining histologik o'zgarishlarini chuqur tushunishga asoslanib, yurak-qon tomir kasalliklariga qarshi kurashishda yangi yondashuvlar ishlab chiqishga ilmiy asos yaratadi.

**Kalit so'zlar:** Miokard infarkti, nekroz, ishemik shikastlanish, chandiqlanish, neytrofillar, fibroz, piknoz, yallig'lanish.

**Abstract:** The article analyzes the histological changes following myocardial infarction in the periods of 24 hours, 1-3 days, 3-7 days, and 7-14 days. In each phase, morphological disruptions, inflammation, and scarring processes progressively develop, and their significance in clinical diagnosis and treatment is emphasized. Based on a deep understanding of the histological changes of myocardial infarction, the study provides a scientific foundation for developing new approaches to combat cardiovascular diseases.

**Keywords:** Myocardial infarction, necrosis, ischemic injury, scarring, neutrophils, fibrosis, pyknosis, inflammation



**Аннотация:** В статье анализируются гистологические изменения после инфаркта миокарда в периодах 24 часа, 1-3 дня, 3-7 дней и 7-14 дней. На каждом этапе прогрессивно развиваются морфологические нарушения, воспаление и рубцевание, и подчеркивается их значение в клинической диагностике и лечении. Исходя из глубокого понимания гистологических изменений при инфаркте миокарда, исследование создает научную основу для разработки новых подходов в борьбе с сердечно-сосудистыми заболеваниями.

**Ключевые слова:** Инфаркт миокарда, некроз, ишемическое повреждение, рубцевание, нейтрофилы, фиброз, пикноз, воспаление.

Yurak-qon tomir kasalliklari, ayniqsa, miokard infarkti bugungi kunda global sog'liqni saqlash tizimi oldida turgan dolzarb muammolardan biridir. Miokard infarkti yurak mushagining ishemiyaga uchrashi va natijada to'qimalarda nekroz rivojlanishi bilan kechadi. Har yili millionlab insonlar ushbu kasallik oqibatida hayotdan ko'z yummoqda, ayniqsa, yoshlar orasida uchrash holatlarining ortib borayotgani tashvishli holatdir. Infarktdan so'ng yurak mushaklarida sodir bo'ladigan gistologik o'zgarishlar vaqt o'tishi bilan bosqichma-bosqich kechadi. 24 soat, 1–3 kun, 3–7 kun va 7–14 kun oralig'ida yuzaga keladigan morfologik buzilishlar, yallig'lanish va chandiqlanish jarayonlari tibbiy tashxis va davolashda muhim ahamiyatga ega. Ushbu maqolada infarktdan keyingi yurak mushaklarida kechadigan gistologik o'zgarishlar tahlil qilinib, ularning klinik amaliyotdagi o'rni yoritib beriladi. Maqsad — patologik jarayonni chuqur tushunish orqali yurak kasalliklariga qarshi samarali yondashuvlarni shakllantirishga ilmiy asos yaratishdir.



**Materiallar va metodlar:** Ushbu maqola miokard infarktidan keyingi gistologik o'zgarishlarni tahlil qilishda ilgari o'tkazilgan klinik va morfologik tadqiqotlarga asoslanadi. Yurak to'qimalaridagi morfologik o'zgarishlar 24 soat, 1–3 kun, 3–7 kun va 7–14 kunlik davrlar bo'yicha bosqichma-bosqich o'rganilgan. Tadqiqotlarda nekroz, yallig'lanish, neytrofillar faolligi, fibroblastlar paydo bo'lishi kabi o'zgarishlar tahlil qilingan.

**StatPearls Medical Reference:** Ushbu manbada miokard infarktidan keyingi gistologik o'zgarishlar bosqichma-bosqich tasvirlangan. Masalan, 0.5–4 soat oralig'ida to'qimalarda tolalarning to'lqinlanishi va glikogen kamayishi kuzatiladi. 4–12 soat ichida koagulyatsion nekroz va shish paydo bo'ladi. 12–24 soatda esa kontraksion bant nekrozi va neytrofillarning ustunligi aniqlanadi.[1] **WebPath Tutorial** manbasida esa miokard infarktidan keyingi gistologik o'zgarishlar tafsilotlari keltirilgan. Masalan, 1–3 kun oralig'ida koagulyatsion nekroz davom etadi, yadro va chiziqlarning yo'qolishi, neytrofillarning infiltratsiyasi kuzatiladi. 3–7 kun oralig'ida esa makrofaglar va mononuklear hujayralarning infiltratsiyasi boshlanadi, fibro-vaskulyar javob shakllanadi.[2] Ushbu metodlar yordamida miokard infarktidan keyingi gistologik o'zgarishlar bosqichma-bosqich tahlil qilindi, bu esa klinik tashxis va davolashda muhim ahamiyatga ega.

Yurak-qon tomir kasalliklari, xususan, miokard infarkti (MI), global sog'liqni saqlash tizimi oldida turgan eng jiddiy muammolardan biri bo'lib qolmoqda. Har yili millionlab insonlar ushbu "yashirin sukunat" qurboni bo'lmoqda. Miokard infarkti nafaqat individual sog'liq muammosi, balki butun jamiyatga iqtisodiy, ijtimoiy va demografik ta'sir ko'rsatuvchi global inqiroz holatidir. Ayniqsa, yoshlar orasida bu holatning ko'payishi sog'lom turmush tarzi, stress, texnologik asrning salbiy oqibatlari bilan chambarchas bog'liq. Miokard infarktidan keyingi gistologik o'zgarishlarni chuqur o'rganish, kasallikning rivojlanish bosqichlarini aniqlashda



muhim ahamiyatga ega. Bu o'zgarishlar, jumladan, nekroz, yallig'lanish va chandiqlanish jarayonlari, yurak mushaklarida vaqt o'tishi bilan yuzaga keladi. Masalan, 24 soat ichida yurak to'qimalarida koagulyatsion nekroz va neyetrofillarning infiltratsiyasi kuzatiladi. 1–3 kun oralig'ida yallig'lanish jarayoni kuchayadi, 3–7 kun ichida makrofaglar va fibroblastlarning faolligi oshadi, 7–14 kun davomida esa granulyatsion to'qima shakllanib, chandiqlanish jarayoni boshlanadi. Ushbu maqolada miokard infarktidan keyingi gistologik o'zgarishlar bosqichma-bosqich tahlil qilinadi. To'qimalardagi morfologik buzilishlar, hujayra darajasida sodir bo'ladigan degenerativ jarayonlar, yallig'lanish va chandiqlanish bosqichlari yoritib beriladi. Gistologik ko'rinishlar asosida klinik holatni baholash, tashxis qo'yish va davolashda muhim rol o'ynashi maqolaning asosiy g'oyasidir. Ushbu ilmiy tahlil sog'liqni saqlash tizimida yurak kasalliklariga qarshi kurashishning yangi yondashuvlarini shakllantirishda ilmiy asos bo'lib xizmat qiladi.

### **1. Nekroz (Hujayra O'limi) Bosqichi (0-24 soat)**

Miokard infarktining ilk 24 soatida yurak mushaklarida muhim gistologik o'zgarishlar ro'y beradi. Dastlabki 0–4 soat oralig'ida mikroskopik darajada aniq o'zgarishlar ko'zga tashlanmaydi. Biroq, elektron mikroskopiyada miokardial hujayralarda glikogen zaxiralarining kamayishi, mitoxondriyalarning shishishi va miofibrillarning bo'shashishi kabi qaytariladigan shikastlanish belgilarini aniqlash mumkin. 4–12 soat davomida yurak mushak tolalarida "to'lqinli tolalar" (wavy fibers) deb ataluvchi o'zgarishlar kuzatiladi; bu holat, ya'ni qisqarmaydigan mushak tolalarining qo'shni qisqaruvchi tolalar tomonidan tortilishi natijasida yuzaga keladi. 12–24 soat oralig'ida esa koagulyatsion nekrozning aniq belgilarini ko'rish mumkin. Bu davrda kardiomyositlar pallid (oqargan) ko'rinishga ega bo'lib, yadro yo'qoladi, ammo hujayra tuzilmasi saqlanib qoladi. Shuningdek, neyetrofillar infiltratsiyasi boshlanadi, bu yallig'lanish jarayonining boshlanishini bildiradi. [3]



Ushbu gistologik o'zgarishlar miokard infarktining vaqtini aniqlashda va davolash strategiyalarini belgilashda muhim ahamiyatga ega. Shuningdek, bu o'zgarishlar yurak to'qimalarining keyingi davrlarida yuz beradigan regeneratsiya va chandiqlanish jarayonlariga zamin yaratadi.

### **Yallig'lanish Bosqichi (1–3 kun): Miokard infarktining erta bosqichidagi gistologik o'zgarishlar**

Miokard infarktining 1–3 kunlik bosqichi yurak mushaklarida chuqur va tezkor gistologik o'zgarishlar bilan xarakterlanadi. Bu davrda infarkt o'chog'idagi to'qimalarda koagulyatsion nekroz avj oladi: kardiomyositlar o'z yadrosini yo'qotadi, ularning sitoplazmasi kuchli eozinofilik bo'lib qoladi. Bu holat hujayraning hayot faoliyatining butunlay to'xtaganidan dalolat beradi. Shuningdek, kardiositlar orasidagi tartibli tuzilma yo'qoladi, hujayra chegaralari notekis bo'lib, ba'zida konturlarini ajratish qiyinlashadi. Bu davrda yallig'lanish jarayoni kuchayadi. Neytrofillar infarkt zonasiga faol ravishda migratsiya qiladi. Ular nekrozlangan hujayralarni parchalab, fagotsitoz jarayonida qatnashadi. Aynan shu bosqichda yallig'lanish jarayoni eng faol pallaga kiradi. Neytrofillar soni infarkt zonasida maksimal darajaga yetadi va ular hujayraviy detritusni tozalashda asosiy rol o'ynaydi. Ammo bu jarayon davomida neyrofillarning o'zi ham parchalanadi va bu ikkilamchi to'qima shikastlanishiga olib kelishi mumkin. Infarkt zonasida kapillyarlar singan, qon ketishlari va interstitsial shish ko'zga tashlanadi. Shu bilan birga, to'qima ichida plazma va qondan ajralgan suyuqliklar to'planib, yallig'lanish eksudati shakllanadi. Bu eksudat to'qimaning zichligini kamaytiradi, yurak mushagining mexanik bardoshlilikini pasaytiradi, bu esa infarkt zonasining yorilib ketish xavfini oshiradi.[4] Makroskopik darajada, bu bosqichda yurak mushaklarida sarg'ish tusga ega markaziy sohalar, ularni o'rab turgan gemorragik halqalar bilan ajralib turadi. Bu infarktning boshlang'ich nekrotik zonasi va uning atrofidagi



yallig‘langan zonani ko‘rsatadi. Gistokimyoviy jihatdan, bu bosqichda ATP miqdori keskin kamayadi, hujayraviy energiya almashinuvi butunlay buziladi. Lizosoma fermentlari faollashib, hujayra ichki tuzilmalarini parchalashda qatnashadi. Bu holat oksidlovchi stressning ortishi bilan kechadi, natijada erkin radikallar soni ko‘payadi va hujayralarga qo‘shimcha zarar yetadi.[5]

Ushbu bosqichda aniqlanadigan gistologik o‘zgarishlar infarkt vaqtini aniqlash, patologik tekshiruv natijalarini izohlash va bemor holatini prognoz qilishda muhim ilmiy va amaliy ahamiyatga ega. Shu sababli, infarktdan keyingi 1–3 kunlik gistologik davr har doim yurak-qon tomir kasalliklarini o‘rganishda alohida e‘tibor talab qiladi.

#### **To‘qimalarning parchalanish va granulyatsion bosqich boshlanishi (3-7-kunlar)**

Infarkt rivojlanishining 3–7 kunlik bosqichi yurak mushagida nekroz o‘zagining ancha chuqurlashgan, to‘qimalarning parchalanish bosqichiga kirgan davridir. Bu vaqtda nekrotik to‘qima atrofidagi yallig‘lanish jarayoni eng yuqori cho‘qqisiga yetadi. Neytrofillar soni kamayib, ularning o‘rnini makrofaglar egallaydi. Makrofaglar nekrotik hujayra qoldiqlarini faol ravishda fagotsitoz qiladi va infarkt zonasi tozalanadi. Shu sababli, bu bosqichda yurak mushagida “tozalanish” jarayoni avj oladi. Shu bilan birga, bu davrda yurak mushagining strukturaviy mustahkamligi zaiflashadi, bu esa yurak devori yorilishi xavfini oshiradi — ayniqsa katta infarktlar fonida. Gistologik kesmalarda makrofaglarning ko‘pligi, shuningdek, granulyatsion to‘qimaning boshlang‘ich elementlari (yangi qon tomirlari, fibroblastlar) aniqlanadi. Yangi hosil bo‘layotgan kapillyarlar va fibroblastlarning ko‘payishi infarkt zonasida chandiqlanish jarayonining boshlanishini ko‘rsatadi. Shu nuqtadan boshlab yurak mushaklarida fibroz to‘qima



shakllanadi, lekin hali to'liq mustahkam chandiq hosil bo'lmagan bo'ladi. Shuningdek, yurak mushagi atrofiga nisbatan gipersellulyar granulyatsion zonaning paydo bo'lishi kuzatiladi. Bu zona yaqin atrofdagi sog'lom miokard bilan nekrotik soha o'rtasida joylashadi va patomorfologik nuqtai nazardan muhim sanaladi. U organizmning infarkt zonasini to'liq chandiqqa aylantirishga bo'lgan adaptiv javobi sifatida qaraladi. [6]

### **Chandiqlanish bosqichining boshlanishi (7–14 kun)**

Miokard infarktining 7–14 kunlik oralig'ida yurak mushagida chuqur morfologik o'zgarishlar kuzatiladi. Bu davr infarkt sohasida to'liq granulyatsion to'qima shakllanadigan va chandiqlanish jarayoni faol kechadigan bosqich hisoblanadi. Endi nekrotik hujayralar deyarli to'liq parchalanib ketgan bo'lib, ularning o'rnini fibroblastlar tomonidan ishlab chiqarilayotgan kollagen tolalari egallay boshlaydi. Shu bilan birga, yangi kapillyarlar shakllanishi hisobiga neovaskulyarizatsiya yuz beradi, bu esa regeneratsiyani qo'llab-quvvatlovchi muhim omil sanaladi. Neytrofillar bu vaqtda yo'qolgan bo'ladi, makrofaglar esa kamaygan miqdorda saqlanadi. Bu yallig'lanish bosqichining pasayganini va immun tizimi endi tiklanish bosqichiga o'tgani haqida signal beradi. Miokard tolalari parchalanadi, hujayra yadrolari yo'qoladi, natijada yurak mushagining bu qismi mexanik jihatdan zaif holatda bo'ladi. Aynan shu sababli, bu davrda yurak devorining yorilishi xavfi yuqori bo'lib qoladi. Klinik nuqtayi nazardan, yurak to'qimalarida bosqichma-bosqich yangilanish kechayotgan bo'lsa-da, bemorlarga jismoniy tinchlik va yurak ishini sinchkovlik bilan kuzatish tavsiya etiladi. Bu davrning gistologik ko'rinishi infarktning bosqichini aniqlashda, tashxis qo'yishda va davolash strategiyasini belgilashda muhim ahamiyatga ega. Gistologik jihatdan bu bosqich miokard infarktining tiklanishga o'tish davri sifatida qaraladi va yurak-qon tomir kasalliklarining kechishi va prognozini aniqlashda muhim o'rin tutadi.



**Xulosa qilib aytganda,** Yurak mushagida infarkt sodir bo'lganidan keyingi gistologik o'zgarishlarni vaqt oralig'i bo'yicha tahlil qilish, miokard infarktining murakkab patogenezini chuqurroq anglashga yordam beradi. 0–24 soat, 1–3 kun, 3–7 kun va 7–14 kun oralig'idagi morfologik, yallig'lanish va regenerativ jarayonlarni bosqichma-bosqich kuzatish orqali yurak to'qimalarida kechayotgan jarayonlarning dinamikasi ochiqlanadi. Tadqiqotdan kelib chiqib, har bir bosqichda hujayra darajasida muhim o'zgarishlar ro'y beradi: dastlabki nekrozdan tortib, yallig'lanishning avj olish davri, granulyatsion to'qimaning shakllanishi va chandiqlanish jarayonigacha. Ayniqsa, bu jarayonlarni klinik tashxis va davolash jarayoniga bog'lash shifokorlar uchun katta amaliy ahamiyat kasb etadi. Shunday qilib, gistologik o'zgarishlarni chuqur tahlil qilish miokard infarktining kechishini tushunish, davolash usullarini aniqlash va bemorlarning sog'ayish prognozini baholashda muhim ilmiy asos bo'lib xizmat qiladi.

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