

## EFFECT OF ACUTE IRRADIATION ON MORPHOLOGICAL FEATURES OF THE LUNGS

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**Abstract: Background:** Acute radiation exposure impacts human health variably depending on the frequency, duration, and radiation sensitivity of different organs. **Specific Background:** While immune organs, mucous membranes, exo- and endocrine glands, and gonads are known to be highly sensitive to acute radiation, less is understood about the specific effects on less sensitive organs such as the lungs. **Knowledge Gap:** Despite established knowledge on the sensitivity of various organs to radiation, there is limited research focusing on the morphological changes occurring in the lungs as a result of acute radiation exposure. **Aims:** This study aims to investigate the morphological alterations in lung tissue following acute radiation exposure to better understand its impact on this organ. **Results:** The study reveals distinct morphological changes in the lungs under acute radiation conditions, including alterations in cellular structure and tissue integrity. These findings highlight the specific effects of radiation on lung tissue compared to other less sensitive organs. **Novelty:** This research provides new insights into the impact of acute radiation on lung morphology, contributing to a more comprehensive understanding of radiation effects beyond the commonly studied highly sensitive organs. **Implications:** Understanding the morphological changes in the lungs due to acute radiation exposure is crucial for improving radiation protection strategies and treatment protocols for individuals exposed to high levels of ionizing radiation.

**Keywords:** Radiation, Lung, Labile Cells, Dystrophy, Necrosis.



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### Introduction

In the process of irradiation, the membrane of biological tissues first becomes destabilized: an increase in membrane permeability leads to the entry (infiltration) of liquid and various micro and macro elements, including calcium ions, into the cell, the activation of proteins that are freely located in the cytoplasm (inactivated enzymes), and the damage of intracellular structures of lysosomal enzymes. (decomposition) and leads to the development of hydropic dystrophy in the epithelia of kidney tubules. Hepatocyte hypoxia due to venous congestion in the liver tissue leads to the development of fatty dystrophy with large, medium and small droplets.

External ionizing radiation occurs only during its impact on the body, under its influence various radioactive substances appear in the body. For a certain time, the infected organism becomes a carrier of these radionuclides, as a result of which internal radiation develops (Ulanova A.M. et al., 2016; Uzbekov D.E. et al., 2016; Singh V.K., Seed T.M., 2020). Radioactive substances can enter the body through the skin, gastrointestinal tract, and respiratory tract. After that, they become a source of internal radiation and spread to other organs and tissues of the body through blood and lymph flow.

The pathogenesis of radiation sickness is explained by the direct and indirect effects of ionizing radiation on the body. The direct effect of radiation on the protein is related to its denaturation. In this

case, the physical and chemical processes associated with the depolymerization of nucleic acids in damaged cells are disturbed. In this case, cell membrane permeability increases, radiation-sensitive cell components include nuclear chromosomes and cytoplasm (Rozhdestvensky L.M., 2019).

The indirect effect of radiation is explained by the formation of radiolysis of water, which makes up 70-80% of the body, when water is ionized, radicals with oxidizing and alkaline properties are formed. In addition, the formation of atomic hydrogen, hydroperoxyl radicals, hydrogen peroxide is also important. Free oxidizing radicals enter into an enzymatic reaction, as a result of which active sulfhydryl groups are converted into inactive disulfide compounds. These biochemical processes lead to a decrease in the catalytic activity of enzyme systems, which in turn leads to a decrease in DNA and RNA in cell nuclei, which disrupts the processes of their renewal (Akleev A.A., Dolgushin I.I., 2018; Murzina E.V. . et al., 2020).

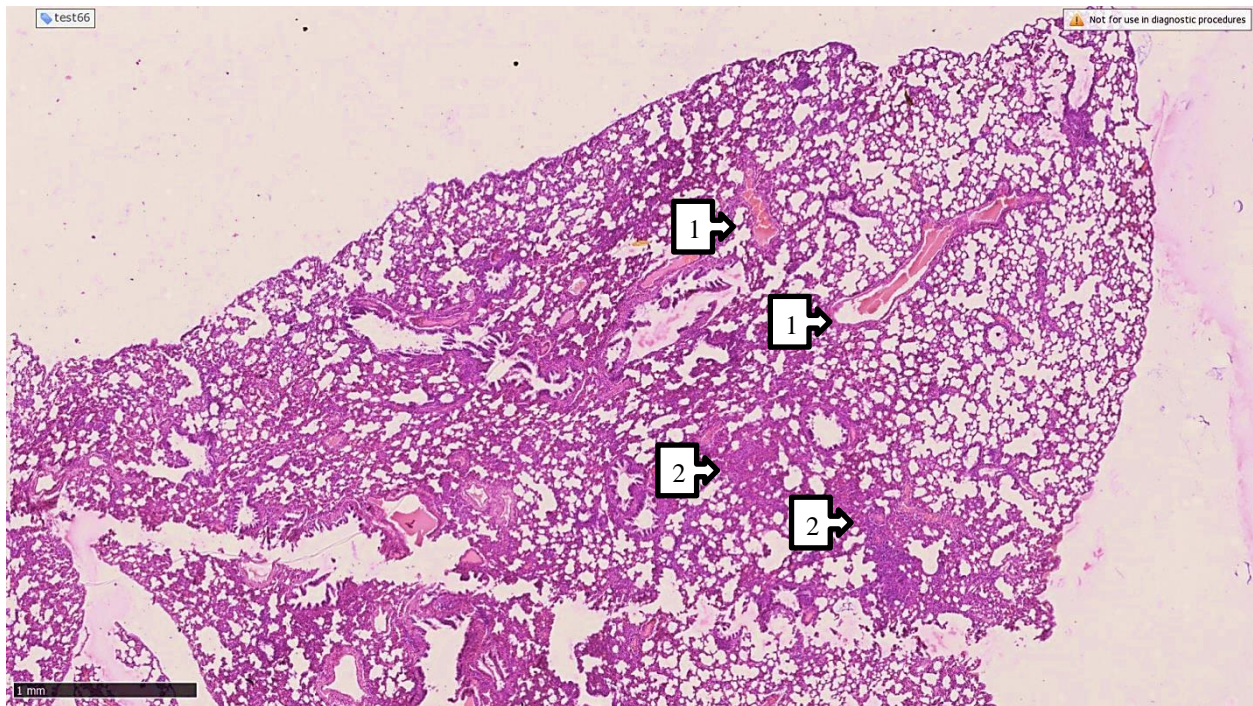
After chest radiation, respiratory damage is very common in large-volume pulmonary radiation in lung, breast, esophagus, and hematologic tumors. Clinical signs of acute radiation injury occurring 1-3 months after radiation therapy include shortness of breath, cough, and fever, which are characterized as radiation pneumonitis. Symptomatic pneumonitis occurs in 5–10% of patients irradiated for mediastinal lymphoma or breast cancer, and is more common in patients with lung cancer (Marks et al., 2010). In this phase, release of proteins into the alveoli, infiltration of inflammatory cells, and epithelial desquamation occur. When exposure limits are exceeded, pneumonitis can be severe and fatal. Affected alveoli are replaced by connective tissue. Fibrous pneumonitis may also develop. Radiation fibrosis of the lungs can be asymptomatic, but with the development of fibrosis there is a slight deterioration of lung function. The volume of breathing decreases, the rate of breathing increases with a decrease in the maximum breathing capacity of the lungs. Chronic respiratory failure may develop, preceded by shortness of breath, reduced exercise capacity, and cyanosis. In addition, the lungs are very susceptible to the penetration of microorganisms and chronic respiratory infection.

**Purpose of work.** The purpose of this research work is to study and evaluate the changes in the morphological characteristics of the lungs under the influence of acute radiation in an experimental way.

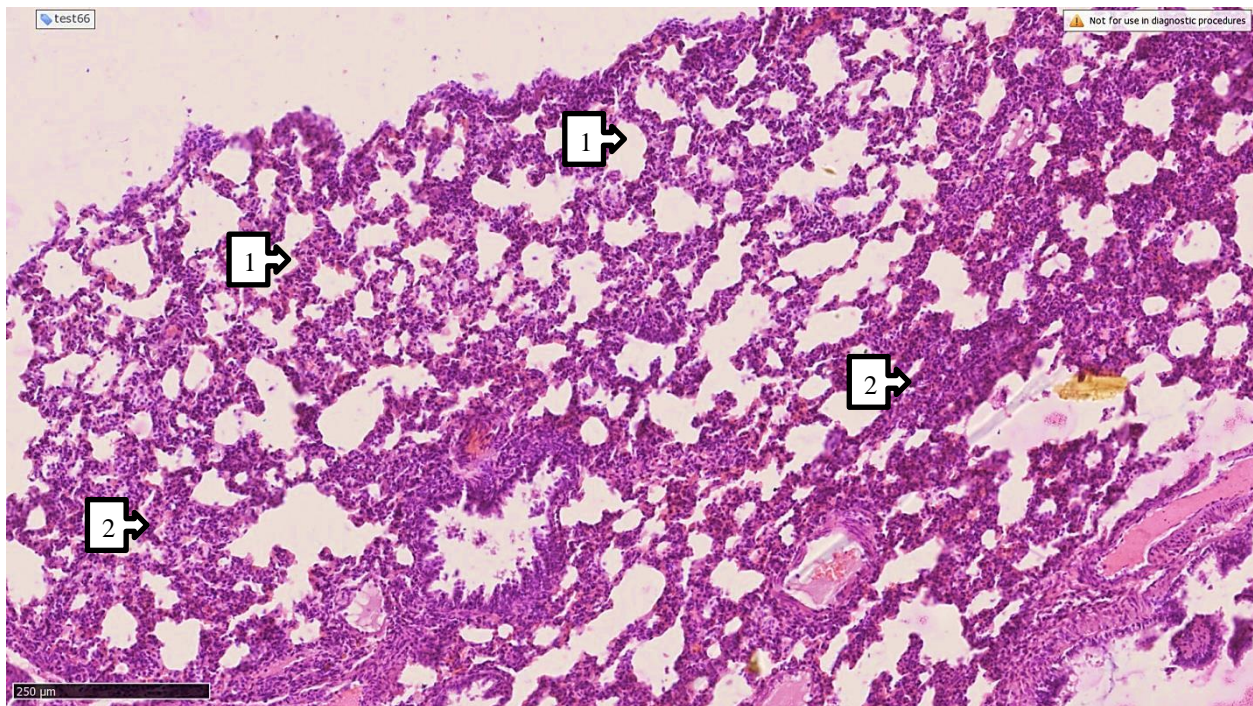
## Methods

30 purebred male rats weighing 160-180 g were selected for experimental studies. All laboratory animals were kept under standard vivarium conditions and were of the same age. Researches were conducted in compliance with the rules of humane treatment of animals regulated by the "Rules for conducting work using experimental animals" (January 16, 2018, No. 18), approved by the ethics committee of the Bukhara State Medical Institute named after Abu Ali Ibn Sina.

Lungs isolated from albino rats exposed to a single 6 Gray dose of acute radiation under laboratory conditions were fixed in 10% formalin and stained with hematoxylin and eosin. The micropreparations were photographed under a microscope with dimensions of 4x10, 10x10, 20x10, 40x40, 60x10, 80x10.



**Figure 1.** In the lung tissue, the fullness of venous blood vessels is determined against the general background (1), atelectasis in the alveolar spaces in the center of the lung tissue and swelling in the interstitial wall are determined (2). Paint G-E. 4x10.



**Figure 2.** The alveolar wall is thickened (1), foci of leukocyte infiltration are identified in the parabronchial branches (2). Paint G-E. 10x10.

## Results and Discussion

### Results

The study assessed the morphological changes in lung tissue following acute irradiation. Histological analysis revealed several significant alterations:

1. **Cellular Damage:** Acute radiation exposure resulted in noticeable damage to lung

- epithelial cells. Microscopic examination showed a high incidence of cell necrosis and apoptosis, particularly in the alveolar and bronchial epithelium. Damaged cells exhibited swelling, membrane blebbing, and karyorrhexis, indicative of severe cellular injury.
2. **Inflammatory Response:** There was a marked increase in inflammatory cell infiltration in the irradiated lung tissues. Neutrophils and macrophages were predominantly observed in the interstitial spaces and alveolar regions. This inflammatory response was accompanied by edema and hemorrhage, which contributed to the overall tissue damage.
  3. **Fibrosis:** Prolonged exposure led to the development of fibrotic changes. Collagen deposition was evident in the interstitial areas of the lung, with increased fibrosis in the alveolar septa. This fibrotic response is indicative of an attempt at tissue repair but also signifies long-term damage and potential functional impairment.
  4. **Altered Architecture:** The architectural integrity of the lung was compromised, with observed distortion of alveolar structures and disruption of normal bronchial patterns. The changes were particularly pronounced in regions exposed to higher doses of radiation, leading to significant alterations in lung morphology.

## Discussion

The observed morphological changes highlight the vulnerability of lung tissue to acute radiation exposure. The damage to epithelial cells, characterized by necrosis and apoptosis, underscores the high sensitivity of lung epithelium to ionizing radiation. This cellular injury disrupts the normal function of the lungs and contributes to impaired gas exchange.

The inflammatory response observed in irradiated lung tissues suggests that acute radiation not only causes direct cellular damage but also triggers a robust inflammatory reaction. This inflammatory process can exacerbate tissue damage and lead to further complications, such as chronic inflammation and secondary infections.

The development of fibrosis following acute radiation exposure is a critical finding, as it indicates a long-term response to radiation injury. Fibrotic changes can lead to decreased lung compliance and impaired respiratory function, highlighting the potential for long-term respiratory complications in individuals exposed to high doses of radiation.

Alterations in lung architecture, including the distortion of alveolar and bronchial structures, further emphasize the detrimental impact of acute irradiation. These structural changes can compromise lung function and contribute to the clinical symptoms observed in patients exposed to radiation.

In summary, the study provides important insights into the morphological effects of acute irradiation on lung tissue. The findings underscore the need for effective radiation protection measures and therapeutic interventions to mitigate lung damage and preserve respiratory health in affected individuals.

## Conclusion

During the morphological examination of the lung tissue on acute radiation, on the general background of the lung tissue, the fullness of the veins and vessels, atelectasis in the alveolar walls in the center of the lung tissue and swelling in the interstitial walls, alveolar wall in the castles, the fullness of blood vessels, the presence of desquamation foci in the mucous membrane of the bronchioles, emphysematous expansions with foci were seen. Dystrophic and devastation foci in alveoli, metaplastic changes (transition to a single-cell structure) were achieved in the epithelia of the bronchial mucosa.

## References

- [1] Rakhmatovna, A. G. (2021). Efficiency of PDT in severe cervical dysplasia. *ACADEMICIA: An International Multidisciplinary Research Journal*, 11(3), 2566-2568.

- [2] Rakhmatovna, A. G. (2021). Efficiency of PDT in severe cervical dysplasia. *ACADEMICIA: An International Multidisciplinary Research Journal*, 11(3), 2566-2568.
- [3] DAVRONOVICH, D. R., АКХМАТОВА, G. R., & SHOKIROV, B. S. (2020). Dynamics of the Immune Status of Women in the Treatment of Human Papilloma Virus (Hpv) of the Cervix. *JournalNX*, 6(06), 733-735.
- [4] Ахматова, Г. Р. (2022). ВЛИЯНИЕ РАЗНЫХ ФАКТОРОВ ПРИ ОБРАЗОВАНИЕ ЗЛОКАЧЕСТВЕННЫХ ОБРАЗОВАНИЙ ТИМУСА (ОБЗОР ЛИТЕРАТУРЫ). *Scientific progress*, 3(3), 61-66.
- [5] Rakhmatovna, A. G. (2021). Efficiency of PDT in severe cervical dysplasia. *ACADEMICIA: An International Multidisciplinary Research Journal*, 11(3), 2566-2568.
- [6] DAVRONOVICH, D. R., АКХМАТОВА, G. R., & SHOKIROV, B. S. (2020). Dynamics of the Immune Status of Women in the Treatment of Human Papilloma Virus (Hpv) of the Cervix. *JournalNX*, 6(06), 733-735.
- [7] Ахматова, Г. Р. (2022). ПРОГНОЗ ЦИТОКИНОВ ПРИ ЦЕРВИКАЛЬНЫХ ПОРАЖЕНИЙ ВИРУСА ПАПИЛОМЫ ЧЕЛОВЕКА (ВПЧ). *Scientific progress*, 3(4), 865-870.
- [8] Nurmurodovna, B. M. (2022). Morphological Changes in Various Tissues in Rats with Chronic I Nurmurodovna, B. M. (2022).
- [9] Morphological Changes in Blood Glucose and Liver Glycogen in Rats during Intoxication of Heavy Metal Salts. *Research Journal of Trauma and Disability Studies*, 1(9), 87-92  
Intoxication with Heavy Metal Salts. *Spanish Journal of Innovation and Integrity*, 7, 65-69.
- [10] Ахматова, Г. Р. (2022). ПРОГНОЗ ЦИТОКИНОВ ПРИ ЦЕРВИКАЛЬНЫХ ПОРАЖЕНИЙ ВИРУСА ПАПИЛОМЫ ЧЕЛОВЕКА (ВПЧ). *Scientific progress*, 3(4), 865-870.
- [11] Rakhmatovna, A. G. (2022). The Effect of Hpv on the Cervix. *Journal of Intellectual Property and Human Rights*, 1(11), 52-55.
- [12] Rakhmatovna, A. G. (2022). The Role of Cytokines in the Formation of Cervical Cancer. *Central Asian Journal of Literature, Philosophy and Culture*, 3(12), 195-199.
- [13] Rakhmatovna, A. G. (2023). Change of the Cervix under the Action of the Human Papiloma Virus. *Scholastic: Journal of Natural and Medical Education*, 2(2), 117-119.
- [14] Rakhmatovna, A. G. (2023). Early Diagnosis of Cervical Cancer Caused by HPV. *Scholastic: Journal of Natural and Medical Education*, 2(5), 196-199.
- [15] Rakhmatovna, A. G. . (2023). Diagnosis of Cervical Cancer Caused by HPV. *Scholastic: Journal of Natural and Medical Education*, 2(5), 192–195. Retrieved from <https://univerpubl.com/index.php/scholastic/article/view/1481>
- [16] Олимова А. З., Шодиев У. М. Репродуктив Ёшдаги эркакларда бепуштлик сабаблари: Бухоро тумани эпидемиологияси //Scientific progress. – 2021. – Т. 2. – №. 7. – С. 499-502.
- [17] Zokirovna O. A., Abdurasulovich S. B. Ovarian Diseases in Age of Reproductive Women: Dermoid Cyst //IJTIMOIY FANLARDA INNOVASIYA ONLAYN ILMIY JURNALI. – 2021. – Т. 1. – №. 6. – С. 154-161.
- [18] Olimova A. Z. ECHINOCOCCOSIS OF LIVER OF THREE MONTHLY WHITE RAT //Scientific progress. – 2022. – Т. 3. – №. 3. – С. 462-466.
- [19] Олимова А. З. Морфологические и морфометрические особенности печени белых беспородных трех месячных крыс после тяжёлой черепно-мозговой травмы вызванной

- экспериментальным путём //BARQARORLIK VA YETAKCHI TADQIQOTLAR ONLAYN ILMİY JURNALI. – 2021. – Т. 1. – №. 6. – С. 557-563.
- [20] Oglu M. Z. M., Zokirovna O. A. МОРФОЛОГИЧЕСКИЕ И МОРФОМЕТРИЧЕСКИЕ ПАРАМЕТРЫ ПЕЧЕНИ БЕЛЫХ БЕСПОРОДНЫХ КРЫС, ПЕРЕНЕСШИХ ЭКСПЕРИМЕНТАЛЬНУЮ ЧЕРЕПНО-МОЗГОВУЮ ТРАВМУ ПОСЛЕ МЕДИКАМЕНТОЗНОЙ КОРРЕКЦИИ //JOURNAL OF BIOMEDICINE AND PRACTICE. – 2023. – Т. 8. – №. 1.
- [21] Олимова А. З., Турдиев М. Р. БУХОРО ШАҲРИДА МЕЪДА ВА ЎН ИККИ БАРМОҚЛИ ИЧАК ЯРАСИ УЧРАШ ЭПИДЕМИОЛОГИЯСИ //Oriental renaissance: Innovative, educational, natural and social sciences. – 2022. – Т. 2. – №. 4. – С. 642-647.
- [22] Zokirovna O. A. Modern Concepts of Idiopathic Pulmonary Fibrosis //American Journal of Pediatric Medicine and Health Sciences. – 2023. – Т. 1. – №. 3. – С. 97-101.
- [23] Zokirovna O. A. Pathology of Precancerous Conditions of the Ovaries //American Journal of Pediatric Medicine and Health Sciences. – 2023. – Т. 1. – №. 3. – С. 93-96.
- [24] Зокировна, Олимова Азиза и Тешаев Шухрат Джумаевич. «Морфологические аспекты печени белых беспородных крыс после тяжелой черепно-мозговой травмы, вызванной экспериментально в виде дорожно-транспортного происшествия». Scholastic: Journal of Natural and Medical Education 2.2 (2023): 59-62.
- [25] Zokirovna O. A. Comparative characteristics of the morphological parameters of the liver at different periods of traumatic brain injury //Euro-Asia Conferences. – 2021. – С. 139-142.
- [26] Zokirovna O. A. Macroand microscopic structure of the liver of threemonthly white rats //Academic research in educational sciences. – 2021. – Т. 2. – №. 9. – С. 309-312.
- [27] Олимова А. З. Частота Встречаемости Миомы Матки У Женщин В Репродуктивном Возрасте //BARQARORLIK VA YETAKCHI TADQIQOTLAR ONLAYN ILMİY JURNALI. – 2021. – Т. 1. – №. 6. – С. 551-556.
- [28] Zokirovna O. A., Abdurasulovich S. B. Ovarian Diseases in Age of Reproductive Women: Dermoid Cyst //IJTIMOIY FANLARDA INNOVASIYA ONLAYN ILMİY JURNALI. – 2021. – Т. 1. – №. 6. – С. 154-161.
- [29] Zokirovna O. A. Cytological screening of cervical diseases: pap test research in the bukhara regional diagnostic center for the period 2015-2019. – 2022.
- [30] Zokirovna O. A., PREVALENCE R. M. M. EPIDEMIOLOGY OF CANCER OF THE ORAL CAVITY AND THROAT IN THE BUKHARA REGION //Web of Scientist: International Scientific Research Journal. – 2022. – Т. 3. – №. 11. – С. 545-550.
- [31] Olimova A. Z. The frequency of occurrence of my uterus In women of reproductive age //JOURNAL OF ADVANCED RESEARCH AND STABILITY (JARS). – 2021. – Т. 1. – №. 06. – С. 551-556.
- [32] Olimova Aziza Zokirovna. (2023). MODERN PRINCIPLES OF THE EFFECT OF HEMODIALYSIS THERAPY ON HEART RATE. International Journal of Integrative and Modern Medicine, 1(1), 80–85. Retrieved from <http://medicaljournals.eu/index.php/IJIMM/article/view/28>
- [33] Olimova Aziza Zokirovna. (2023). PATHOMORPHOLOGICAL CHARACTERISTICS OF THE EPIDIDYMIS UNDER IRRADIATION. International Journal of Integrative and Modern Medicine, 1(1), 96–100. Retrieved from <http://medicaljournals.eu/index.php/IJIMM/article/view/31>

- [34] Olimova Aziza Zokirovna. (2023). THE INCIDENCE OF CANCER OF THE ORAL CAVITY AND PHARYNX IN THE BUKHARA REGION. *International Journal of Integrative and Modern Medicine*, 1(1), 86–89. Retrieved from <http://medicaljournals.eu/index.php/IJIMM/article/view/29>
- [35] Olimova Aziza Zokirovna. (2023). INFLUENCE OF ALCOHOL INTOXICATION ON THE HEART TISSUE OF RATS IN THE EXPERIMENT. *International Journal of Integrative and Modern Medicine*, 1(1), 90–95. Retrieved from <http://medicaljournals.eu/index.php/IJIMM/article/view/30>
- [36] Olimova Aziza Zokirovna. (2023). Modern Aspects of the Etiology of Gastric Ulcer and Its Complications. *American Journal of Pediatric Medicine and Health Sciences (2993-2149)*, 1(3), 163–166. Retrieved from <http://grnjournal.us/index.php/AJPMHS/article/view/208>
- [37] Zokirovna O. A., Jumaevich T. S. Morphological Aspects of the Liver of White Outbred Rats After Severe Traumatic Brain Injury Caused Experimentally in the Form of a Road Accident // *Scholastic: Journal of Natural and Medical Education*. – 2023. – T. 2. – №. 2. – С. 59-62.
- [38] Aziza Zokirovna Olimova GASTRIC ULCER AND ITS COMPLICATIONS // *Scientific progress*. 2022. №3. URL: <https://cyberleninka.ru/article/n/gastric-ulcer-and-its-complications> (дата обращения: 28.09.2023).
- [39] Olimova Aziza Zokirovna. (2022). TECHNIQUE FOR CUTTING BIOPSY AND SURGICAL MATERIAL IN THE PRACTICE OF PATHOLOGICAL ANATOMY AND FORENSIC MEDICINE. *Web of Scientist: International Scientific Research Journal*, 3(7), 116–120. <https://doi.org/10.17605/OSF.IO/PSQ59>
- [40] Zhumayevich N. F., Zokirovna O. A. PATHOMORPHOLOGY OF GASTRIC CANCER // *BARQARORLIK VA YETAKCHI TADQIQOTLAR ONLAYN ILMIY JURNALI*. – 2022. – С. 330-333.
- [41] Zokirovna O. A. Epidemiological and Etiological Data of Morphogenesis and Pathomorphology of Congenital Heart Diseases in Children // *American Journal of Pediatric Medicine and Health Sciences*. – 2023. – T. 1. – №. 4. – С. 88-91.