Contrast-enhanced ultrasound in the differential diagnosis of focalnodular hyperplasia and hepatocellular liver adenoma

Usarov Mukhriddin Shukhratovich, Otakulov Zafar Shavkat ugli, Rakhmonqulov Sherzod Hamidovich

The aim of the study was to increase the effectiveness of differential diagnosis of benign focal neoplasms using contrast — enhanced ultrasound (CUSI).

Materials and methods. A retrospective analysis of the results of examination of 37 patients with morphologically verified benign liver neoplasms was performed. According to clinical and morphological data, patients were divided into two groups: patients with focalnodular hyperplasia (FNG)-22 people, and patients with hepatocellular adenoma (HCA) — 15 people. All patients underwentmultiparametric ultrasound examination with liver CUI.

Results. With almost equal intensity of filling of the FNG and HCA with contrast agent (96 and 80%, respectively), the FNG is characterized by an early onset of contrast (WASH IN) of the focus in the arterial phase (AF) of the study; according to the parameter "start of contrast in the focus", it significantly differs from the HCA ($p<0.05$). Specific signs of FNG: the "wheel spokes" symptom and an increased intensity of accumulation of RCD — 96% of cases, contrasting formation from the center to the periphery-86% of cases, the absence of the phenomenon of washing out of RCD (WASH-OUT). HCA is characterized by complete (100%) and more intense (80%) centropetal (80%) filling of the focus. There are no specific types of vascular pattern. In 6 (40%) patients, the WASH-OUT phenomenon and "relative hyperechogenicity" in the portal phase (PF) of the study were determined.

Conclusion: CUSI is an effective method of differential diagnosis of FNH and HCA.

Key words: focal neoplasms of the liver, contrast-enhanced ultrasound, focalnodular hyperplasia, hepatocellular adenoma

Introduction

Among liver neoplasms, there are two large groups: malignant and benign tumors. The morphological type of neoplasm has a significant impact on the choice of treatment method [1, 2]. The availability and widespread use of modern methods of radiation diagnostics lead to an annual increase in newly detected cases of liver neoplasms in patients of various age groups.

According to the conclusions published in 1994 by an international group of experts sponsored by the World Congress of Gastroenterology, benign liver tumors are a heterogeneous group of

formations of different cellular origin. Some types of such tumors are important in clinical practice, while others are less important for it. The term "focal nodular hyperplasia hyperplasia" was proposed in 1958 by H. A. Edmonson. Until relatively recently, focal nodular hyperplasia of the liver (FNH) was considered a rare focal formation of the liver. Today, taking into account the widespread use of modern imaging methods, the frequency of diagnosed cases of FNH reaches 8% among all primary tumors and 25% in the group of benign liver neoplasms. The prevalence of this tumor in the population reaches 0.9-3%, and it is considered the second геман-гиомыmost common benign liver tumor after hemangioma [3]. According to the literature, from 80 to 95% of neoplasms are diagnosed in women aged 30-40 years [4]. The pathogenesis of FNG is not fully clear. According to some authors, their component is a benign tumor-an adenoma. According to other data, this is the reaction of hepatic cells to local vascular malformations [5]. The International Working Committee (1995) classified FNH as a regenerative formation, and today, according to the European Association for the Study of the Liver (EASL), the pathogenesis of FNH is based on polyclonal hepatocellular proliferation, which is caused by local arterial malformation[6]. The validity of this theory is indicated by the absence of somatic mutations that play a role in the development of liver tumors and cause dysregulation of genes encoding angiogenesis-stimulating ангиогенезаproteins, such as angiopoietins [7]. Small tumors in most cases (66-80% of patients) do not have characteristic clinical manifestations and are detected accidentally during examination

patients on a different occasion. Large nodes, especially with a subcapsular location, can manifest themselves in the form of pain in the right hypochondrium. FNG has no risk of malignant degeneration and rarely causes complications in the form of intra-abdominal bleeding. Diagnosis of FNH is important because it is a benign tumor, surgical removal of which, based on the absence of the risk of malignant degeneration, is recommended in extremely rare cases, primarily associated with complications that have occurred and the impossibility of excluding the malignant nature of the liver neoplasm [8].

HCA is considered a rare benign liver tumor that can be detected at any age. It is diagnosed more often in women in a ratio of 12: 1. The incidence of HCA and its prevalence are insufficiently studied. According to published data, the prevalence is 0.001-0.004%, that is, approximately 1000 times less than FNH [9]. The pathogenesis of this tumor is not fully known (there are only various assumptions on this issue) [10]. Until the middle of the last century, almost nothing was known about this tumor. In recent decades, HCA is more often diagnosed in young women (mostly 30-40 years old). According to some data, up to 85% of patients diagnosed with HCA have a history of taking oral contraceptives, and prolonged oral use increases the incidence by 30-40 times [11-13].

The relationship between the high risk of HCA during the use of contraceptives is emphasized by isolated publications on the regression of HCA after their withdrawal.

According to the WHO classification, HCA refers to benign hepatocellular tumors of epithelial nature. The course of HCA is mostly asymptomatic. Despite its benign nature, HCA is dangerous, as there are risks of bleeding and malignancy [14]. HCA larger than 5 cm in diameter, located subcapsularly, are often complicated by spontaneous rupture and bleeding. According to M. Bieze et al. (2014), with экзофитныхeven smaller exophytic adenomas, the risk is significantly higher, which dictates the need for emergency surgery [15, 16]. We should not discount the available literature data that indicate the presence of a risk of HCA malignancy [17]. According to J. H. Foster et al. (1994), this risk persists even with a long period of observation of a stable tumor condition [18].

Differential diagnosis of HCA is associated with certain difficulties. In particular, HCA and hepatocellular carcinomas (HCC) have many common features not only when using various medical imaging methods, but also when analyzing them morphologically [10, 18]. There are no specific laboratory symptoms. Alpha-fetoprotein levelsremain within the normal range in both FNH and liver adenoma. Only in 50% of cases, there may be an increase in the level of liver enzymes, which in itself is not veryspecific. Other laboratory parameters remain within the normal range.

The advantages and disadvantages of instrumental diagnostic methods are well known [19]. It should be noted that when performing a differential diagnosis of these two neoplasms, the ultrasound picture obtained using traditional ultrasound (ultrasound) is non-specific. Until recently, it was believed that the recognition of most HCA, as well as the differential diagnosis of adenomas and nodular hyperplasia using ultrasound is impossible. Computer tomography (CT) images of HCA and FNG also have a lot in common. In the study in the native phase, the density of these neoplasms does not significantly differ, and the dynamics of contrast agents are quite close. Currently, the most informative imaging method is MRI, but according to the literature, certain morphological subtypes of adenomas can cause serious difficulties in differential diagnosis with HCA and FNH [20].

In comparison with standard referencemethods (histological studies, CT or MRI), contrast-enhanced ultrasound (CUSI) has comparable information content indicators, but it is easier to use and more cost-effective [21]. When using CUSI, the basis for differential diagnosis between different morphological types of liver neoplasms is different qualitative and quantitative characteristics, as well as types of vascular patterns of neoplasms, which have much in common

with those of CT and MRI with contrast. However, for the correct interpretation of images, it is necessary to take into account a number of features related to the pharmacodynamics of contrast agents. Ultrasound contrast agents (USCP), in particular, the preparation of sulfur hexofluoride "Sono-view" BRACCO SUISSE (Switzerland), find-

сяIt occurs exclusively in the vascular lumen. At the same time, iodine-containing contrast agents used in CT and gadolinium-containing contrast agents used in MRI are distributed in the intercellular space [22].

Objective: to improve the effectiveness of differential diagnosis of benign focal neoplasms using CUSI.

Materials and methods

A retrospective analysis of the results of examination of 37 patients with benign focal neoplasms of the liver, who were treated in the State Budgetary Institution "Research Institute-Regional Clinical Hospital No. 1 named after Professor S. V. Ochapovsky" ofthe Ministry of Health of the Krasnodar Territory in 2015-2017, was carried out. Among them, there were 10 men and 27 women, the age of patients ranged from 23 to 78 years. The conducted research meets the standardsof the Declaration Helsinki. All patients received written voluntary informed consent to participate in the study.

The criterion for inclusion of patients in the groups was the presence of morphological verification of neoplasms. The criterion for excluding patients from the study was the presence of gross somatic pathology, primarily associated with a violation of central hemodynamics, which could affect the kinetics and dynamics of USCP in the vascular bed [23]. Depending on the morphological conclusion, all patients were divided into 2 groups: 22 patients with FNH and 15 patients with HCA. Patients underwent a multiparametric ultrasound examination, including liver CUSI. In our work, we used ultrasound scanners Aixplorer "Super Sonic Imagine"(France) and Acuson S2000"Siemens" (Germany), which have operating modes with ultrasound contrast agents. Contrast-enhanced ultrasound was performed after obtaining prior informed consent, in the patient's standard position-lying on his back or on his left side with his right arm thrown back behind his head. As a contrast agent, the ultrasound contrast preparation "So-novyu" was used, which was administered intravenously in a bolus of 1.0-1.5 ml through an 18-20 G peripheral catheter inserted into the cubital vein. After administration of the contrast agent, the catheter was flushed with 1-3 ml of 0.9% chlorine solution.

ридаIn accordance with the recommendations of WFUMB-EFSUMB 2012, the video clip of the study was recorded immediately after the introduction of ultrasound therapy. Arterial phase assessment (AF) was performed without interruption, while portal and late phase assessment (PF) scans were interrupted. No complications associated with the use of ultrasound therapy were recorded.

After CUSI, all patients underwent percutaneous liver biopsy under ultrasound control. For its implementation, the semi-automatic system Unebbevyurbusip "OrIMe^" (Germany) with a 16-S needle was used. The criteria for inclusion of patients in the study were the absence of ascites, platelet count not less than 80*109, INR-less than 2.5. The material obtained during the biopsy was placed in a 10% solution of neutral buffered formalin. The drug was fixed for 12-24 hours. Alcohol wiring was carried out according to the standard method. After the preparation of serial sections with a thickness of 3-5 microns, coloring was carried out

hematoxylin-eosin, picrofuxinaccording to Van Gieson. Statistical processing of the results was performed using Statistica 6 and SPSS 17.0 software.

Results and discussions

To solve the tasks set in the study, the groups evaluated the qualitative and temporal parameters of the USCP dynamics presented in Table 1.

The obtained indicators of the dynamics of the intake and leaching of USCP in the focus, depending on the nosology, are presented in Table 2.

According to the data obtained, the WASH-OUT phenomenon was not observed in the group of patients with FNH and in 9 patients (60%) with HCA.

Table 2 shows that statistically significant differences were found in the parameter "beginning of contrast in the focus" between the FNH and HCA groups ($p<0.005$). Microscopic description: the tumor has a trabecular structure, is represented by hepatocyteswith diffuse fatty and balloon dystrophy, with rounded regular nuclei, with the absence of portal tracts and bile ducts. Adjacent liver tissue with preserved lobular structure, with discomplexation

hepatic beams, with single lobular-ми necrosis, portal tracts are not dilated with weak lymphocytic infiltration. Mature adipose tissue with preserved histological structure. Conclusion: hepatocellular liver adenoma with fatty and balloon dystrophy. Chronic portobular hepatitis of minimal degree of activity. The KpoYeN index is 2 points. Fibrosis 0.

Conclusion

In our work, KUSI has proven to be a fairly fast and effective method of differential diagnosis of FNH and HCA. Characteristic features of FNH are: earlier onset of focus contrast in comparison with HCA ($p<0.005$), increased vascularization in the AF of the study, contrast enhancement in the form of a "wheel with spokes"-96% of cases, filling the formation with contrast "from the center to the periphery" — 86% of patients. In our opinion, the absence of a characteristic vascular pattern, the presence of such signs as increased and intensive filling of the USCP neoplasm in the AF of the study (in our study, 80% of patients), the presence of the sign "relative hyperechogenicity in the PF of the study" (40%), as well as the phenomenon of "washing out of the contrast agent", which in our study It was present in 40% of patients with HCA, making differential diagnosis of liver adenomas one of the most difficult among all focal neoplasms of the liver. In our opinion, any doubts about the differential diagnosis of liver foci should be resolved in the direction of their morphological verification. Interdisciplinary discussions are very important when choosing treatment tactics for liver foci. In the presented clinical example, the pathoanatomical conclusion was changed when discussing treatment tactics. The pathologist should evaluate the material of puncture biopsies based on clinicaland morphological comparisons. All of the above highlights the need for continued research in this area.

List of literature

1. Abdurakhmanovich , K. O., & Javlanovich , Y. D. (2022). Magnetic Resonance Tomography for Damage to the Ligamentous Structures of the Knee Joint. CENTRAL ASIAN JOURNAL OF MEDICAL AND NATURAL SCIENCES, 3(2), 27-34. Retrieved from https://cajmns.centralasianstudies.org/index.php/CAJMNS/article/view/617
2. Abdurakhmanovich , K. O., & Servetovna , A. A. (2022). Guidelines for Ultrasound Examination in Gynecological Diseases. CENTRAL ASIAN JOURNAL OF MEDICAL AND NATURAL SCIENCES, 3(2), 22-26. Retrieved from https://cajmns.centralasianstudies.org/index.php/CAJMNS/article/view/616
3. Abdurakhmanovich, K. O., & ugli, G. S. O. (2022). Ultrasonic Diagnosis Methods for Choledocholithiasis. Central Asian Journal Of Medical And Natural Sciences, 3(2), 43-47.
4. Abdurakhmanovich, K. O., & ugli, G. S. O. (2022). Ultrasound Diagnosis of the Norm and Diseases of the Cervix. Central Asian Journal Of Medical And Natural Sciences, 3(2), 58-63.
5. Abdurakhmanovich, K. O., & ugli, G. S. O. (2022). Ultrasound Diagnosis of the Norm and Diseases of the Cervix. CENTRAL ASIAN JOURNAL OF MEDICAL AND NATURAL SCIENCES, 3(2), 58-63.

6. Abdurakhmanovich, Khamidov Obid, Akhmedov Yakub Amandullaevich, Ataeva Saodat Khurshedovna, Ametova Alie Servetovna, and Karshiev Behruz Orif ugli. 2021. “Role of Kidney Ultrasound in the Choice of Tactics for Treatment of Acute Renal Failure”. CENTRAL ASIAN JOURNAL OF MEDICAL AND NATURAL SCIENCES 2 (4), 132-34. https://doi.org/10.47494/cajmns.v2i4.263.
7. Akhmedov Y.A., Rustamov U.Kh., Shodieva N.E., Alieva U.Z., Bobomurodov B.M. Modern Application of Computer Tomography in Urology. Central Asian journal of medical end natural sciences, volume 2 issue 4 Jul-Aug 2021 P.121-125
8. Alimdjanovich, R.J., Obid , K., Javlanovich, Y.D. and ugli, G.S.O. 2022. Advantages of Ultrasound Diagnosis of Pulmonary Pathology in COVID-19 Compared to Computed Tomography. Central Asian Journal of Medical and Natural Science. 3, 5 (Oct. 2022), 531-546.
9. Amandullaevich AY, Danabaevich JK. Ultrasound Diagnosis of Hirschsprung’s Disease in Children. CAJMNS [Internet]. 2022Mar.3 [cited 2022May24];3(2):64-1. Available from: https://cajmns.centralasianstudies.org/index.php/CAJMNS/article/view/623
10. Amandullaevich AY, Zafarjonovich UZ. Possibilities of MRI Diagnostics of Focal Liver Defeats. CAJMNS [Internet]. 2022Mar.3 [cited 2022May24];3(2):35-2. Available from: https://cajmns.centralasianstudies.org/index.php/CAJMNS/article/view/618
11. Amandullaevich, Akhmedov Yakub, Rustamov Umar Khaidarovich, Shodieva Nodira Egamberdievna, Alieva Umida Zairovna, and Bobomurodov Bektosh Mamadiyorovich. 2021. “Modern Application of Computer Tomography in Urology”. CENTRAL ASIAN JOURNAL OF MEDICAL AND NATURAL SCIENCES 2 (4), 121-25. https://doi.org/10.47494/cajmns.v2i4.261.
12. Ametova Alie Servetovna, Saitkulova Shahribonu Rakhmatillevna, Khaidarova Aziza Anvarovna. Early Rheumatoid Arthritis: Possibilities Of Mri Diagnosis. TJMS [Internet]. 2022 Feb. 24 [cited 2022 May 24];5:260-6. Available from: https://zienjournals.com/index.php/tjm/article/view/879
13. Ataeva S.Kh., Ravshanov Z.Kh., Ametova A.S., Yakubov D.Zh. Radiation visualization of chronic joint diseases. Central Asian journal of medical end natural sciences, volume 2 issue 2 March-aprel 2021 P.12-17
14. Is lower extremity vein pathology a risk factor for the development of osteoarthritis of the knee joint? / I. Yu. Khodzhanov, B. M. Mamasoliev, A. N. Tkachenko [et al.] // Ural medical journal. – 2022. – Vol. 21, № 2. – P. 19-25. http://doi.org/10.52420/2071-5943-2022-21-2-19-25.

15. Kadirov J. F. et al. NEUROLOGICAL COMPLICATIONS OF AIDS //Journal of new century innovations. – 2022. – Т. 10. – №. 5. – С. 174-180.
16. Khamidov O. A., Khodzhanov I. Yu., Mamasoliev B.M., Mansurov D.Sh., Davronov A.A., Rakhimov A.M. The Role of Vascular Pathology in the Development and Progression of Deforming Osteoarthritis of the Joints of the Lower Extremities (Literature Review). Annals of the Romanian Society for Cell Biology, Romania,Vol. 25, Issue 1, 2021, Pages. 214 – 225
17. Khamidov O.A., Akhmedov Y.A., Ataeva S.Kh., Ametova A.S., Karshiev B.O. Role of Kidney Ultrasound in the Choice of Tactics for Treatment of Acute Renal Failure. Central Asian journal of medical end natural sciences, volume 2 issue 4 Jul-Aug 2021 P.132-134
18. Khamidov O.A., Akhmedov Y.A., Yakubov D.Zh., Shodieva N.E., Tukhtaev T.I. DIAGNOSTIC POSSIBILITIES OF USES IN POLYKYSTOSIS OFKIDNEYS. Web of scientist: International scientific research journal, volume 2 issue 8 August 2021 P.27-33
19. Khamidov O.A., Ataeva S.Kh., Ametova A.S., Yakubov D.Zh., Khaydarov S.S. A Case of Ultrasound Diagnosis of Necrotizing Papillitis. Central Asian journal of medical end natural sciences, volume 2 issue 4 Jul-Aug 2021 P.103-107
20. Khamidov O.A., Ataeva S.Kh., Yakubov D.Zh., Ametova A.S., Saytkulova Sh.R. ULTRASOUND EXAMINATION IN THE DIAGNOSIS OF FETAL MACROSOMIA. Web of scientist: International scientific research journal, volume 2 issue 8 August 2021 P.49-54
21. Khamidov O.A., Mirzakulov M.M., Ametova A.S., Alieva U.Z. Multispiral computed tomography for prostate diseases. Central Asian journal of medical end natural sciences, volume 2 issue 2 March-aprel 2021 P.9-11
22. Khamidov O.A., Normamatov A.F., Yakubov D.Zh., Bazarova S.A. Respiratory computed tomography. Central Asian journal of medical end natural sciences, volume 2 issue 2 March-aprel 2021 P.1-8
23. Khamidov O.A., Urozov U.B., Shodieva N.E., Akhmedov Y.A. Ultrasound diagnosis of urolithiasis. Central Asian journal of medical end natural sciences, volume 2 issue 2 March-aprel 2021 P.18-24
24. Khamidov O.A., Yakubov D.Zh., Alieva U.Z., Bazarova S.A., Mamaruziev Sh.R. Possibilities of Sonography in Differential Diagnostics of Hematuria. Central Asian journal of medical end natural sciences, volume 2 issue 4 Jul-Aug 2021 P.126-131
25. Khamidov O.A., Yakubov D.Zh., Ametova A.S., Bazarova S.A., Mamatova Sh.T. Application of the Ultrasound Research Method in Otorhinolaryngology and Diseases of

the Head and Neck Organs. International Journal of Development and Public Policy, volume 1 issue 3 August 2021 P.33-37

26. Khamidov O.A., Yakubov D.Zh., Ametova A.S., Turdumatov Zh.A., Mamatov R.M. Magnetic Resonance Tomography in Diagnostics and Differential Diagnostics of Focal Liver Lesions. Central Asian journal of medical end natural sciences, volume 2 issue 4 Jul-Aug 2021 P.115-120
27. Khodzhibekov M.X., Khamidov O.A., Mardieva G.M. Verification of radiation methods in diagnostics of injuries of the knee joint intra-articular structures. International Journal of Pharmaceutical Research. 2020:13(1), p. 302-308.
28. Khurshedovna AS, Danabaevich JK. Ultrasound Diagnosis of Fetoplacental Insufficiency. CAJMNS [Internet]. 2022Mar.3 [cited 2022May24];3(2):53-7. Available from: https://cajmns.centralasianstudies.org/index.php/CAJMNS/article/view/621
29. Khurshedovna AS, Zafarjonovich UZ. Ultrasound Examination for the Diagnosis of Acute Appendicitis. CAJMNS [Internet]. 2022Mar.3 [cited 2022May24];3(2):72-7. Available from: https://cajmns.centralasianstudies.org/index.php/CAJMNS/article/view/624
30. Rustamov U.Kh., Shodieva N.E., Ametova A.S., Alieva U.Z., Rabbimova M.U. US-DIAGNOSTICS FOR INFERTILITY. Web of scientist: International scientific research journal, volume 2 issue 8 August 2021 P.55-61
31. Rustamov U.Kh., Urinboev Sh.B., Ametova A.S. Ultrasound diagnostics of ectopic pregnancy. Central Asian journal of medical end natural sciences, volume 2 issue 2 March-aprel 2021 P.25-28
32. Yakubov , J., Karimov , B., Gaybullaev , O., and Mirzakulov , M. 2022. Ultrasonic and radiological picture in the combination of chronic venous insufficiency and osteoarthritis of the knee joints. Academic Research in Educational Sciences. 5(3), pp.945–956.
33. Yakubov D. Z., Gaybullaev S. O. The diagnostic importance of radiation diagnostic methods in determining the degree of expression of gonarthrosis //UZBEK JOURNAL OF CASE REPORTS. – С. 36.
34. Yakubov Doniyor Javlanovich, Juraev Kamoliddin Danabaevich, Gaybullaev Sherzod Obid ugli, and Samiev Azamat Ulmas ugli. 2022. “INFLUENCE OF GONARTHROSIS ON THE COURSE AND EFFECTIVENESS OF TREATMENT OF VARICOSE VEINS”. Yosh Tadqiqotchi Jurnali 1 (4):347-57.
35. Zhavlanovich YD, Servetovna AA. Ultrasonography and its Role in Clinical Diagnosis. CAJMNS [Internet]. 2022Mar.3 [cited 2022May24];3(2):48-2. Available from: https://cajmns.centralasianstudies.org/index.php/CAJMNS/article/view/620

36. Кадиров Ж. Ф. и др. МАГНИТНО-РЕЗОНАНСНАЯ ТОМОГРАФИЧЕСКАЯ ОЦЕНКА ПОРАЖЕНИЙ ЦЕНТРАЛЬНОЙ НЕРВНОЙ СИСТЕМЫ У БОЛЬНЫХ, ИНФИЦИРОВАННЫХ ВИРУСОМ ИММУНОДЕФИЦИТА ЧЕЛОВЕКА //Journal of new century innovations. – 2022. – Т. 10. – №. 5. – С. 157-173.
37. Hamidov Obid Abdurahmanovich. "DIAGNOSTICS OF INJURIES OF THE SOFT TISSUE STRUCTURES OF THE KNEE JOINT AND THEIR COMPLICATIONS" European research, no. 1 (37), 2020, pp. 33-35.
38. Xamidov Obid Abduraxmanovich, Optimization of Radiological Diagnostics of Injuries of the Soft Tissue Structures of the Knee Joint and Their Complications, American Journal of Medicine and Medical Sciences, Vol. 10 No. 11, 2020, pp. 881-884. doi: 10.5923/j.ajmms.20201011.10.
39. Хамидов О. А., Гайбуллаев Ш. О., Хакимов М. Б. ОБЗОР МЕТОДОВ ОБРАБОТКИ ИЗОБРАЖЕНИЙ ДЛЯ ДИАГНОСТИКИ ПАТОЛОГИИ ГОЛОВНОГО МОЗГА: ПРОБЛЕМЫ И ВОЗМОЖНОСТИ //Journal of new century innovations. – 2022. – Т. 10. – №. 5. – С. 181-195.
40. Ходжибеков М.Х., Хамидов О.А. Обоснование ультразвуковой диагностики повреждений внутрисуставных структур коленного сустава и их осложнений. №3 (31), 2020. С.526-529.
41. Якубов Д. Ж., Гайбуллаев Ш. О. Влияние посттравматической хондропатии на функциональное состояние коленных суставов у спортсменов. Uzbek journal of case reports. 2022; 2 (1): 36-40. – 2022.