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CD4⁺ T-Lymphocyte Level as a Predictor of Seroimmunity Strength to Tetanus in Adults Living with HIV

Vaccination is the main healthcare measure to control infectious diseases. People living with HIV (PLHIV) are at greater risk of becoming ill or developing complications from vaccine-preventable infectious diseases. Tetanus is the most striking example of such an infectious pathology.

Objective — to determine the level of seroimmunity against tetanus and assess the impact of the level of CD4⁺ T-lymphocytes on the intensity of anti-tetanus immunity in PLHIV to determine optimal vaccination regimens.

Materials and methods. 90 PLHIV were involved in the study, the average age was (40.1 ± 0.9) years. Determination of the levels of anti-tetanus antibodies was carried out by the enzyme immunoassay method using the RIDASCREEN Tetanus IgG diagnostic test system (R-Biopharm AG, Germany). CD4⁺ quantitative content of T-lymphocytes was determined using the flow cytometry method with monoclonal antibodies. Statistical processing was performed using the Statistica v. 6.1 licensed software.

Results and discussion. The research has shown that the median of anti-tetanus antibodies in PLWH was 0.59 (0.28—1.09) IU/mL. The unprotected cohort of PLHIV encompassed 52.2 % (n = 47). We have seen that restoration of the level of CD4⁺ T-lymphocytes in the context of antiretroviral therapy does not lead to «restoration» of specific antitoxic immunity. A reliable direct correlation was established between nadir of CD4⁺ T-lymphocytes and the degree of intensity of anti-tetanus immunity — $r_s = 0.42$ ($p < 0.001$). According to the results of the ROC analysis, it was found that a high risk of lack of immunity against the specified infectious pathology is predicted in case of the decrease of nadir level of CD4⁺ T-lymphocytes less than 106 cells/μL (test sensitivity — 88.6 %, specificity — 52.9 %, diagnostic efficiency of the criterion — 71.0 %).

Conclusions. The nadir level of CD4⁺ T-lymphocytes ≤ 106 cells/μL according to the result of ROC-analysis indicates the absence of seroimmunity in PLHIV against tetanus, which justifies booster administration of tetanus toxoid. Clinicians and the public health system must organize effective strategies, including effective communication with PLHIV and social services, to effectively implement vaccine prevention goals.

Keywords

HIV infection, seroprevalence, seroimmunity, tetanus, CD4⁺ T-lymphocytes, vaccination, toxoid.

People living with HIV (PLHIV) may have a poorer prognosis for vaccine-preventable diseases [1, 3, 5, 8, 16]. On the other hand, modern treatments using antiretroviral therapy (ART) can ensure that a person will have an undetectable viral load, reducing the possibility of severe immunosuppression, guaranteeing quality of life and life expectancy comparable to that of people not affected by HIV, which results in potentially increased risk of developing infectious diseases [1, 5, 6, 8]. The potential contraindication of attenuated vaccines containing live pathogens in the context of severe immunosuppression may contribute to the uncertainty among medical professionals in administering vaccines to a defined population group [2, 4, 7, 9, 10].

In addition, there is concern about the indications for vaccination of PLHIV given the limited availability of data on immunogenicity and efficacy in this population, which may contribute to hesitancy in vaccination uptake. Despite the theoretical possibility of reduced response, available evidence suggests that vaccination of PLHIV helps reduce hospitalizations and deaths from vaccine-preventable diseases [11, 13, 16, 20].

Vaccination is the main healthcare measure to control infectious diseases. It is a safe and effective strategy that has led to a marked reduction in the mortality rate associated with infectious diseases. In addition, vaccines can prevent disabilities that can impair physical and cognitive development in children. They also protect the health of adults and the elderly, thus allowing them to live longer and healthier lives. In addition, vaccination is globally considered an important strategy to combat emerging infectious diseases by containing or limiting disease outbreaks and preventing the spread of antimicrobial resistance [3, 5, 8, 14, 18, 21].

Although the public health benefits of vaccination are clear, the decline in vaccination adherence and vaccination coverage observed worldwide in recent years is a serious concern. According to the definition of the World Health Organization (WHO), vaccine hesitancy is among the 10 biggest global threats to public health [21].

While childhood vaccination programs in developed countries mostly achieve their goals, adult vaccination often remains significantly below the desired coverage level [1, 12, 13, 19].

In addition, the Russian invasion of Ukraine seriously impaired access to vaccines and the implementation of routine vaccinations due to the destruction of infrastructure, facilities, equipment, disruption of supply chains, lack of heat and electricity, thus increasing the risks of outbreaks of infectious diseases. The materials of the Public Health Center of the Ministry of Health of Ukraine showed that among the adult population, the vaccination coverage rate for diphtheria and tetanus in 2024 — 80.7 %, in 2023 — 52.0 %, in 2022 — 40,2 %, in 2021 — 45.5 % [15].

Despite the existing health risks (especially since war in the country always poses a high risk of injury and, as a result, the risk of *Clostridium tetani* infection increases proportionally), a study of the antitetanus serological profile among adult PLHIV in Ukraine has not been conducted before, which underscores the relevance of the chosen topic.

Objective — to determine the level of seroimmunity against tetanus and assess the impact of the level of $CD4^+$ T-lymphocytes on the intensity of anti-tetanus immunity in PLHIV to determine optimal vaccination regimens.

Materials and methods

90 PLHIV who are registered in the municipal Centre for HIV Prevention and Control were involved in the study. There were 51 (56.7 %) women, 39 (43.3 %) men, aged from 22 to 60 years, the average age (M ± m (SD)) was (40.1 ± 0.9) (8.8) years. None of the participants had a history of tetanus. Regarding vaccination history: all subjects received a course of vaccination against tetanus in childhood, namely: 3 doses of vaccination and 3 doses of revaccination (the last one at age 14 — according to the previous national vaccination calendar). 69 examinees (76.7 %) received ART and 21 (23.3 %) did not receive therapy. The median level of T-helpers ($CD3^+CD4^+$, $CD4^+$ T-lymphocytes) at the time of examination was 364.5 (164—510) (range: 16— 1230) cl/μL, the lowest level (before the appointment of ART) T-helpers was 67 (43—126) (range: 5—245) cells/μL.

Determination of the level of antitetanus antibodies was performed by the method of enzyme immunoassay using the RIDASCREEN Tetanus IgG diagnostic test system (R-Biopharm AG, Germany). The study was conducted according to the manufacturer's instructions. The state of immunity against tetanus was assessed by determining the concentration of antibodies in IU/mL. The intensity of anti-tetanus immunity was assessed as follows: up to 0.1 IU/mL — no protection; 0.1—0.5 IU/mL is the minimum level of protection; 0.6—1.0 IU/mL — average level of protection; 1.1 IU/ml and above — high level of protection. Table 1 presents vaccination recommendations against tetanus based on antitoxic antibody levels, in accordance with the manufacturer's instructions.

Table 1. **Ranking of the intensity of antitoxic immunity against**

The level of anti-tetanus IgG antibodies (IU/mL)	Protection level	Vaccination recommendations
< 0.1	No protection	Basic immunization
0.1—0.5	Minimum level of protection	Booster immunization
0.6—1.0	Average level of protection	Control after 2 years
≥ 1.1	High level of protection	Control after 5—10 years

Table 2. **Distribution of PLHIV depending on the intensity of anti-tetanus immunity**

Immunity	Antibody level (IU/mL)	Group	Number of persons (n = 90)		Median antibodies Me (LQ—HQ), IU/mL
			n	%	
Against tetanus	0.0—0.5 (no and minimal protection)	I	47	52.2	0.28 (0.10—0.39) *
	≥ 0.6 (medium and high levels)	II	43	47.8	1.48 (1.00—2.50) *

Note. * pU < 0.001.

The quantitative count of T-helpers was determined by flow cytometry using monoclonal antibodies.

Verification of the diagnosis of HIV infection was carried out through the detection of HIV-specific antibodies using ELISA. HIV viral load was determined in 1 mL of blood plasma using PCR. The stage of HIV infection was determined according to the WHO clinical classification.

All examined persons were fully informed about the scope of diagnostic procedures and gave informed consent to participate in the scientific research being conducted in accordance with bioethical norms.

Processing of the study data was carried out with the help of software products Statistica v. 6.1 (StatSoftInc., serial No. AGAR909E415822FA) and MedCalc Version 23.02 free trial version (https://www.medcalc.org/download.php, 2024). Taking into account the distribution law of quantitative data, evaluated according to the Shapiro—Wilk test, parametric and non-parametric characteristics and methods of analysis were used: for a normal distribution, the arithmetic mean (M), standard error (m), standard deviation (SD), Student's test (t), in other cases — median (Me), interquartile range (LQ—HQ), Mann—Whitney test (U), non-parametric variance analysis of Kruskal—Wallis (H); for comparison of relative values — Pearson's Chi-square test (χ^2). The relationship between traits was assessed by Spearman's rank correlation coefficient (r_s). To compare indicators in groups of patients with different levels of antibodies, the odds ratio (OR) with a 95 % confidence interval (CI) was determined. ROC analysis was used to assess the prognostic significance of nadir CD4⁺ T-lymphocytes. The critical level of statistical significance (p) when testing all hypotheses was taken to be < 0.05 [12].

Results and discussion

The study showed that the median level of anti-tetanus antibodies in PLHIV was 0.59 (0.28—1.09) IU/mL. A more detailed study of the indicators of seroprevalence of anti-tetanus antibodies revealed that the percentage of protected PLHIV (moderate and high level of protection) was quite low and amounted to 47.8 % (n = 43). The median of anti-tetanus IgG in groups with high and moderate protection was 1.48 (1.00—2.50) IU/mL.

The unprotected cohort of PLHIV (seronegative and persons with a minimum level of protection) was 52.2 % (n = 47). The median anti-tetanus IgG in the group with no and minimal level of protection (group I) was 0.28 (0.10—0.39) IU/mL, which is 5.3 times lower than in the group with medium and high levels of anti-tetanus IgG (group II) — 1.48 (1.00—2.50) IU/ml ($p_U < 0.001$) (Table 2).

The indicated groups did not differ among themselves in the age of patients — (39.9 ± 1.4) and (40.5 ± 1.2) years, respectively, in the I and II groups ($p_t = 0.742$). At the same time, significant differences in gender composition were established ($p_{\chi 2} = 0.022$), namely: the number of men prevailed among the II group — 24 (55.8 %) versus 15 (31.9 %) patients in the I group. That is, the risk of low/absent tetanus immunity in male PLHIV is low (OR = 0.37; 95 % CI 0.16—0.88). This fact can be explained by such a phenomenon as «natural boosting» (that is, men more often receive injuries in everyday life with a violation of the integrity of the skin and, accordingly, receive minor doses of tetanus toxin).

The study showed that taking ART does not affect the level of anti-tetanus IgG. So, 35 (74.5 %) patients of the I group and 34 (79.1 %) of the II group received ART ($p_{\chi 2} = 0.606$). The ART duration was (3.09 ± 0.34) years and (2.85 ± 0.34) years, respectively, in groups I and II ($p_t = 0.631$). The duration of follow-up in the patient registry ranged ranged from 1 to 15 years and was on average (5.13 ± 0.55) years for the patients of the I group versus (5.33 ± 0.59) years for the patients of the II group ($p_t = 0.806$). Similarly, the level of viral load (40 (40—10 405) copies/mL and 40 (40—1452 copies/mL) cannot be considered a determinant of tetanus seroprotection ($p_U = 0.326$).

No significant correlations were found between the levels of anti-tetanus antitoxic antibodies and the number of CD4⁺ T-lymphocytes (measured at the time of the study), as evidenced by the data in Fig. 1.

Thus, the average levels of tetanus antibody seroprevalence ranged from 0.79 (0.31—1.08) IU/mL at a concentration of CD4⁺ T-lymphocytes below 200 cells/μL (n = 25; 27.8 %) to 0.64 (0.25—

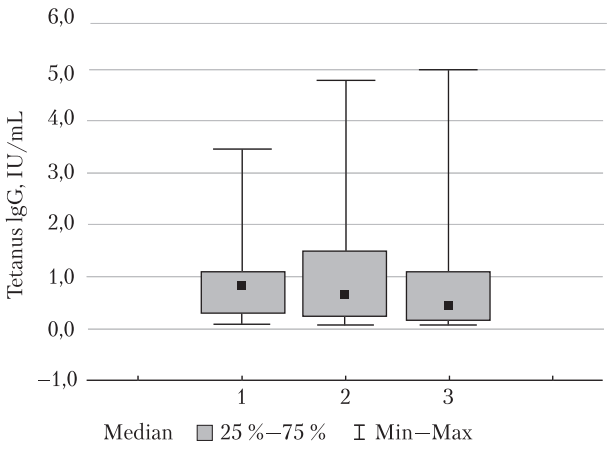

Fig. 1. **Levels of antitoxic antibodies against tetanus depending on the degree of immunosuppression**

1 — CD4⁺ < 200 cells/μL; 2 — CD4⁺ 200—500 cells/μL; 3 — CD4⁺ > 500 cells/μL.

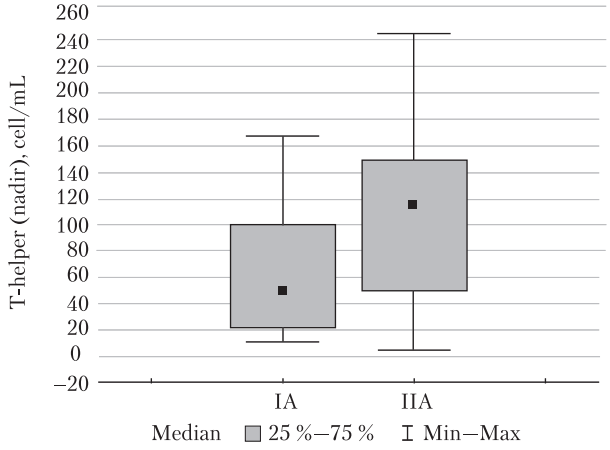

Fig. 2. **Nadir levels CD4⁺ T -lymphocytes depending on the tension anti-tetanus immunity**

Table 3. **Distribution of PLHIV receiving ART, depending on antitetanus serological profile**

Immunity	Antibody level (IU/mL)	Subgroup	Number of persons (n = 69)		Median antibodies
			n	%	Me (LQ—HQ)
Against tetanus	0.0—0.5 (no and minimal protection)	IA	35	50.7	0.28 (0.13—0.39)*
	≥ 0.6 (medium and high level)	IIA	34	47.3	1.51 (1.0—2.80)*

Note. * pU < 0.001.

1.50) IU/mL and 0.42 (0.15—1.09) IU/mL at levels of CD4⁺ cells 200—500 cells/μL (n = 42; 46.7 %) and above 500 cells/μL (n = 23; 25.5 %), respectively (according to the Kruskal—Wallis test (H = 0.476; pH = 0.788).

Subsequently, it was established that the presence of immunological protection against tetanus in PLHIV is associated with a potentially higher number of T-helpers at the start of ART compared to the indicator in the group of persons with no/low level of protection. This is confirmed by a reliable direct correlation between nadir CD4⁺ T-lymphocytes and the degree of intensity of anti-tetanus immunity, $r_s = 0.42$ ($p < 0.001$).

In order to study the nadir of CD4⁺ T-lymphocytes as a prognostic factor for the duration of post-vaccination immunity against tetanus among PLHIV receiving ART (n = 69), the defined sample was similarly divided into 2 subgroups depending on the level of the anti-tetanus serological profile (Table 3).

In the IA subgroup with absent and low anti-tetanus immunity (n = 35; 50.7 %), the median of antibodies was 0.28 (0.13—0.39) IU/mL. In the IIA subgroup with a sufficient level of protection (n = 34; 47.3 %), the median anti-tetanus IgG was 1.51 (1.0—2.80) IU/mL.

Considering the nadir levels of T-helpers in the specified subgroups, the following results were obtained: the average number of cells in patients of the IA group (50.0 (23.0—100.0) cells/μL) was 2.3 times less compared to patients of the IIA group (114.5 (50.0—150.0) cells/μL, $p_U < 0.001$) (Fig. 2).

In order to predict the risk of immunological vulnerability of PLHIV against tetanus, ROC analysis was performed. According to the result of which it was established that a high risk of lack of immunity against the specified infectious pathology is predicted when the nadir level of T-helpers decreases to less than 106 cells/μL (AUC area = = 0.741 (0.622—0.839), p < 0.001, which provides test sensitivity of 88.6 %, specificity of 52.9 %, diagnostic efficiency of the criterion of 71.0 %. (Fig. 3).

Therefore, the levels of anti-tetanus IgG antibodies among adult PLHIV are far from optimal; this is due to the fact that tetanus toxoid is an antigen that induces a strong T-cell specific immune response. That is why both the immune response and the duration of adaptive immunity directly depend on the state of the T-cell line. Also, we saw that the restoration of the level of CD4⁺ T-lymphocytes on the background of ART does not lead to «restoration» of specific antitoxic immunity.

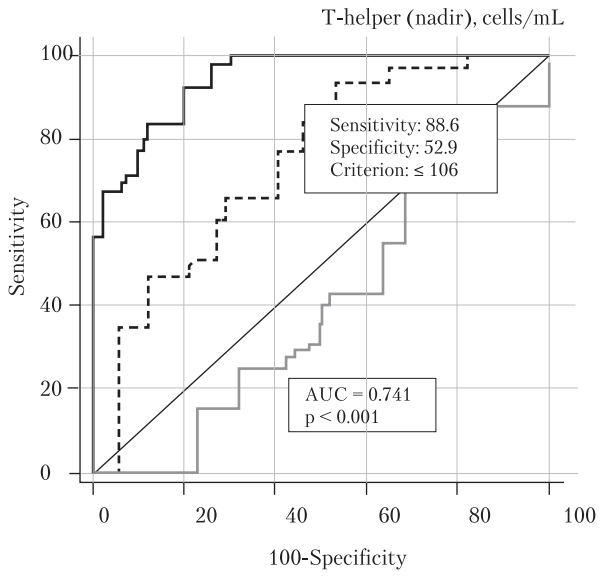

Fig. 3. **ROC curve of the nadir CD4⁺ T-lymphocyte levels in determining the risk of immunity against tetanus in PLHIV receiving ART**

The study showed that a significant part of PLHIV is vulnerable to infectious pathology that can only be prevented by immunoprophylaxis. It provides a complete picture of the low level of tetanus seroimmunity among the risk group.

The obtained results demonstrated that PLHIV with impaired humoral immunity require booster administration of tetanus toxoid to achieve adequate and sustainable protection against tetanus.

Understanding the barriers and prospects for routine vaccination of PLHIV is vitally important for this population group. A comprehensive assessment of population immunity against tetanus will help inform the public health system about the effectiveness of immunoprevention programs, as the current approach has shown ineffectiveness in achieving immunization goals. Therefore, it is necessary to make efforts for careful monitoring of the vaccination status of vulnerable population groups.

Conclusions

The nadir level of CD4⁺ T-lymphocytes ≤ 106 cells/μL according to the result of ROC-analysis indicates the absence of seroimmunity in PLHIV against tetanus, which justifies booster administration of tetanus toxoid.

The low level of anti-tetanus immunity among PLHIV who are under regular medical control indicates deficiencies in the implementation of immunoprophylaxis, which causes the strengthening of vaccination advocacy among this category of patients.

Clinicians and the public health system must organize effective strategies, including effective communication with PLHIV and social services, to effectively implement vaccine prevention goals.

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Authors' participation: research concept and design, material processing, statistical data processing, writing text — V.V. Mavrutenkov, H.O. Revenko; collection of material — H.O. Revenko; text editing — V.V. Mavrutenkov.

References

1. Boey L, Bosmans E, Ferreira LB, et al. Seroprevalence of antibodies against diphtheria, tetanus and pertussis in adult at-risk patients. Vaccines (Basel). 2021 Jan 4;9(1):18. doi: 10.3390/vaccines9010018. PMID: 33406698; PMCID: PMC7824683.
2. Candevir A, Kuşcu F, Yıldırım F, et al. Low immunity against vaccine preventable diseases in Turkish HIV cohort. Turk J Med Sci. 2021 Oct 21;51(5):2311-7. doi: 10.3906/sag-2102-14. PMID: 33984893; PMCID: PMC8742493.
3. Cunha GH, Galvão MT, Medeiros CM, Rocha RP, Lima MA, Fechine FV. Vaccination status of people living with HIV/AIDS in outpatient care in Fortaleza, Ceará, Brazil. Braz J Infect Dis. 2016 Sep-Oct;20(5):487-93. doi: 10.1016/j.bjid.2016.07.006. Epub 2016 Aug 16. PMID: 27542868; PMCID: PMC9425449.
4. Dauby N, Gobert C, Benslimane A, et al. Durability of tetanus seroprotection in people living with HIV. AIDS. 2022 Jul 1;36(8):1135-9. doi: 10.1097/QAD.0000000000003206. Epub 2022 Feb 24. PMID: 35212671.
5. De Vito A, Colpani A, Trunfio M, et al. Living with HIV and getting vaccinated: a narrative review. Vaccines (Basel). 2023 Apr 25;11(5):896. doi: 10.3390/vaccines11050896. PMID: 37243000; PMCID: PMC10220625.
6. De Vito A, Ricci E, Menzaghi B, et al. Causes of HIV treatment interruption during the last 20 years: a multi-cohort real-life study. Viruses. 2023 Mar 10;15(3):720. doi: 10.3390/v15030720. PMID: 36992429; PMCID: PMC10055812.
7. El Chaer F, El Sahly HM. Vaccination in the adult patient infected with HIV: a review of vaccine efficacy and immunogenicity. Am J Med. 2019 Apr;132(4):437-46. doi: 10.1016/j.amjmed.2018.12.011. Epub 2019 Jan 3. PMID: 30611828.
8. Gerin L, Pedroso AO, Antonini M, Gir E, Spire B, Reis RK. Factors associated with vaccination adequacy in people living with HIV: a cross-sectional study. Vaccines (Basel). 2024 Sep 1; 12(9):1003. doi: 10.3390/vaccines12091003. PMID: 39340033; PMCID: PMC11435921.
9. Gobert C, Van Hauwermeiren C, Quoidbach C, et al. Tetanus seroprotection in people living with HIV: Risk factors for seronegativity, evaluation of medical history and a rapid dipstick test. Vaccine. 2021 Apr 1;39(14):1963-7. https://www.sciencedirect.com/science/article/abs/pii/S0264410X21002425.
10. Hernando V, Suárez L, Gutiérrez G, López JC, Navarro-Soler R, Cabello A, Sanz J, et al; Hospital Survey Working Group. Vaccination trends in people with HIV infection participating in the hospital-based survey of patients infected with HIV, 2006-2021. Enferm Infecc Microbiol Clin (Engl Ed). 2023 Aug 10: S2529-993X(23)00246-0. doi: 10.1016/j.eimce.2023.07.006. Epub ahead of print. PMID: 37573244.
11. Mullaert J, Abgrall S, Lele N, Batteux F, Slama LB, Meritet JF, et al; ANRS HIVVO Study Group. Diphtheria, tetanus, poliomyelitis, yellow fever and hepatitis B seroprevalence among HIV1-infected migrants. Results from the ANRS VIHVO vaccine sub-study. Vaccine. 2015 Sep 11;33(38):4938-44. doi: 10.1016/j.vaccine.2015.07.036. PMID: 26209841.
12. Nunes MC, Tamblyn A, Jose L, et al. Immunogenicity of tetanus,

diphtheria and acellular pertussis vaccination among pregnant women living with and without HIV. AIDS. 2023 Sep 29. doi: 10.1097/QAD.0000000000003731. Epub ahead of print. PMID: 37773052 .

13. Petráš M, Oleár V. Predictors of the immune response to booster immunization against tetanus in Czech healthy adults. Epidemiol Infect. 2018 Dec;146(16):2079-85. doi: 10.1017/S095026881800242X. PMID: 30136643; PMCID: PMC6453010.
14. Pinto Neto LFDS, Vieira JV, Ronchi NR. Vaccination coverage in a cohort of HIV-infected patients receiving care at an AIDS outpatient clinic in Espírito Santo, Brazil. Braz J Infect Dis. 2017 Sep-Oct;21(5):515-9 . doi: 10.1016/j.bjid.2017.03.021.
15. Public Health Center of Ukraine Ministry of Health [Internet]. [cited October 10 2024]. Available from: https://www.phc.org.ua/.
16. Revenko HO, Mavrutenkov VV, Chykarenko ZO. Clinical and laboratory predictors of antitoxic immunity against diphtheria and tetanus in adults with HIV infection. Medical perspectives. 2020;25(3):117-24. doi: 10.26641/2307-0404.2020.3.214846.
17. Riffenburgh RH. Statistics in Medicine. 3rd ed. Elsevier; 2012. 738 p.
18. Simani OE, Izu A, Nunes MC, et al. Effect of HIV exposure and timing of antiretroviral therapy initiation on immune memory responses to diphtheria, tetanus, whole cell pertussis and hepatitis B vaccines. Expert Rev Vaccines. 2019 Jan;18(1):95-104. doi: 10.1080/14760584.2019.1547195. Epub 2018 Nov 19. PMID: 30417710; PMCID: PMC6842654.
19. Tortellini E, Fosso Ngangue YC, Dominelli F, et al. Immunogenicity and efficacy of vaccination in people living with human immunodeficiency virus. Viruses. 2023 Aug 30; 15(9):1844. doi: 10.3390/v15091844. PMID: 37766251; PMCID: PMC10534440.
20. Trickey A, Zhang L, Sabin CA, Sterne JAC. Life expectancy of people with HIV on long-term antiretroviral therapy in Europe and North America: A cohort study. Lancet Healthy Longev. 2022;3:S2. doi: 10.1016/S2666-7568(22)00063-0.
21. World Health Organization [Internet]. Immunization Agenda 2030: A Global Strategy to Leave No One Behind; [cited October 12 2024]. Available from: https://www.who.int/teams/immunization-vaccines-and-biologicals/strategies/ia2030 (accessed on 20 May 2024).

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Рівень CD4⁺ Т-лімфоцитів як предиктор напруженості сероімунітету до правця в дорослих людей, які живуть із ВІЛ

Вакцинація є основним заходом охорони здоров'я для контролю інфекційних захворювань. Люди, які живуть із вірусом імунодефіциту людини (ЛЖВ), мають більший ризик захворіти на інфекційні захворювання, яким можна запобігти за допомогою вакцин, або їхнього ускладненого перебігу. Правець — найяскравіший приклад такої інфекційної патології.

Мета роботи — установити рівень сероімунітету проти правця та оцінити вплив вмісту CD4⁺ Т-лімфоцитів на напруженість протиправцевого імунітету в ЛЖВ для визначення оптимальних схем вакцинації.

Матеріали та методи. У дослідження було залучено 90 ЛЖВ, середній вік яких становив (40,1 ± 0,9) року. Визначення рівня протиправцевих антитіл проводили методом імуноферментного аналізу з використанням діагностичної тест-системи RIDASCREEN Tetanus IgG (R-Biopharm AG, Німеччина). Кількісний вміст CD4⁺ Т-лімфоцитів визначали за допомогою методу проточної цитометрії з використанням моноклональних антитіл. Статистичну обробку проводили за допомогою ліцензійної програми Statistica v. 6.1.

Результати та обговорення. Установлено, що медіана протиправцевих антитіл у ЛЖВ становила 0,59 (0,28—1,09) МО/мл. Незахищена когорта ЛЖВ — 52,2 % (n = 47). Відновлення рівня CD4⁺ Т-лімфоцитів на тлі антиретровірусної терапії не спричиняло «відновлення» специфічного антитоксичного імунітету. Виявлено статистично значущий прямо пропорційний зв'язок між nadir CD4⁺ Т-лімфоцитів і ступенем напруженості протиправцевого імунітету (r_s = 0,42; p < 0,001). За результатом ROC-аналізу з'ясовано, що високий ризик відсутності імунітету проти зазначеної інфекційної патології прогнозується при зниженні рівня nadir CD4⁺ Т-лімфоцитів < 106 кл/мкл (чутливість тесту — 88,6 %, специфічність — 52,9 %, діагностична ефективність критерію — 71,0 %).

Висновки. Рівень nadir CD4⁺ Т-лімфоцитів ≤ 106 кл/мкл за результатом ROC-аналізу свідчить про відсутність сероімунітету проти правця в ЛЖВ, що обґрунтовує бустерне введення правцевого анатоксину. Клініцисти та система громадського здоров'я мають організувати ефективні стратегії, зокрема плідну комунікацію з ЛЖВ та соціальними службами, для реалізації цілей, пов'язаних із вакцинопрофілактикою.

Ключові слова: ВІЛ-інфекція, серопревалентність, сероімунітет, правець, CD4⁺ Т-лімфоцити, вакцинація, анатоксин.

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ДЛЯ ЦИТУВАННЯ

- Mavrutenkov VV, Revenko HO. CD4⁺ T-Lymphocyte Level as a Predictor of Seroimmunity Strength to Tetanus in Adults Living with HIV. Туберкульоз, легеневі хвороби, ВІЛ-інфекція.33 2025;2:42-48. doi: 10.30978/TB2025-2-42.
- Mavrutenkov VV, Revenko HO. CD4⁺ T-Lymphocyte Level as a Predictor of Seroimmunity Strength to Tetanus in Adults Living with HIV. Tuberculosis, Lung Diseases, HIV Infection (Ukraine). 2025;2:42-48.http://doi.org/10.30978/TB2025-2-42.