Экспериментальная и профилактическая медицина

Assessment of Humoral Immune Response to SARS CoV-2 Virus among Work Staff

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It should be recognized the significant impact of SARS CoV2-2019 not only on the development of healthcare, but also on the welfare and social protection of the world population [11]. By September 2022 the number of infected exceeded 612 million, meanwhile the number of deaths amounted to more than 6 million [12].

Note that until 2002 human coronaviruses were regarded as seasonal acute respiratory viral infections not causing serious complications.

The earliest identified cases of the disease have been found in Guangdong Province since November 2002. The disease is currently referred to as severe acute respiratory syndrome (SARS) with mortality at the level of 11%, caused by coronavirus infection. SARS CoV was later placed in the genus Betacoronavirus, (subgenius Sarbecovirus) [4].

Afterwards, in the Middle East (Saudi Arabia, Oman) with the subsequent drifts among with otherwise countries, began to record the cases of severe respiratory disease with mortality of 30% [4],which has been named Middle East respiratory syndrome coronavirus under the genus Betacoronavirus, (subgenius Merbecovirus) [11].

As far as the last reported outbreaks of the respiratory disease were caused by unknown coronavirus (at the end of November, 2019, city Wuhan, Hubei Province) which was later named COVID-19 (Coronavirus infectious disease) [4, 15].

The first case of COVID-19 infection was confirmed on March 1, 2020 in

the Republic of Armenia in a citizen of Armenia who arrived from Iran, which led to the declaration of a state of emergency by the government of the country.

It should be emphasized that the dynamics of the incidence of COVID-19 infection has been characterized by fluctuations with periods of ups and downs in Armenia as well as in other countries. It should be pointed out that as of September 20, 2022, 443785 cases of COVID-19 infection were recorded, while the total number of deaths were amounted to 8691 cases [1, 19].

As is known, coronaviruses stimulate humeral and cellular immune responses. Similar to the other viral infections, they generate typical dynamics of IgM and IgG production. In addition, immunoglobulin M antibodies (IgM), appearing earlier, produced by immune system in response to SARS CoV-2 infection, are detected within 1-2 weeks since contact with causative agents. However, general period of the potential detection of IgM primarily ranges at least 2-3 months when IgM antibodies are gradually replaced by IgG antibodies.

Nevertheless, detection of IgM indicating the recent infection with SARS CoV-2, cannot be basis for diagnostic reports, since the level of antibodies and dynamics of antibodies response can vary individually.

It is considered that immunoglobulin G (IgG) began to generate within 21-28 days after the exposure to the virus. Their levels grow slowly meanwhile it can persist for quite a long time, sometimes several years. By the presence and level of IgG antibodies in the bloodstream, one can judge on the fact of incidence in the past and define the presence of specific immune response: body's ability to recognize virus on the subsequent exposure to it.

Undoubtedly, depending on levels and dynamics of antibodies in the bloodstream, humeral immune response can vary in relation to individuals and severity of the diseases. It is established that the first 5 days from the onset of the symptoms, the PCR-tests aimed to identify RNA from swabs of nasal and oropharyngeal sites are clinically more sensitive. However, throughout subsequent periods of the disease, the importance of identifying specific antibodies increases.

The highest sensitivity of laboratory examination can be achieved by using the complex of those tests. It is common knowledge that immunogenic proteins (inducing active immune response) of SARS CoV-2 are spike (S) and nucleocapsid (N) proteins.

Antibody-based tests against N protein of SARS CoV-2 by some estimates can possess higher sensitivity in early infection in comparison to antibody –based tests against S protein. The detection of IgG against N protein allows to judge the presence of specific immune response throughout SARS CoV-2 infection, which forms after the transmitted disease in the presence of conditionally healthy virus carriers.

Investigation of the levels of specific IgG antibodies against SARS CoV-2 is pivotal in the evaluation of epidemiological prevalence. In addition, it can

presumably serve as predictive tool to detect the immune protective reactions in the matter of transmitted diseases.

Regrettably, the duration of persistence of SARS CoV-2 S IgG after various forms of infection has not yet been established [3, 5].

Undoubted scientific interest posed surveys, which have been implemented to determine the relationship between the ABO blood group system and various diseases. The effect of the ABO blood group system on susceptibility to COVID-19 was first reported by Zhao J. et al. [16]. Some researchers associate the susceptibility and outcome of many diseases with ABO blood group polymorphism, including cancer, coronary heart disease, viral hepatitis B, diseases caused by Helicobacter pylori infection, etc.

As a result of above-mentioned studies of COVID-19 infected people in 3 different hospitals in China, the protective role of O blood type against infection was revealed, meanwhile the A blood type increases the risk of getting infected with COVID-19. Moreover, the studies conducted in the USA, Spain, Denmark, Turkey, Lebanon, and Iraq similarly demonstrated the highest prevalence rates among people with blood type A, and the lowest among group O [2, 7, 9, 10, 17].

Currently, immunity, which is achieved when a large proportion of the population becomes immune, can work against the spread of some diseases, probably with COVID-19 too. Hence, the investigation of immunity throughout COVID-19 pandemic can provide an illustration regarding defensive mechanisms against widespread disease.

The goal of this work was to assess the seroprevalence to SARS CoV-2 N protein among the personnel of one institution.

Material and Methods

The material for the study was venous blood taken in the amount of 3-5 ml in vacutainers with a separating gel. After 30 minutes of settling, the blood was centrifuged for 10 minutes at 40,000 rpm, then the plasma was transferred into special tubes in an amount of 10 μl and placed in a Cobas e 411 analyzer from «Roche» Diagnostics. Quantitative determination of high-affinity specific total (IgM + IgG) antibodies to SARS CoV-2 nucleocapsid N protein based on the formation of a "sandwich" complex with antibodies present in human blood was carried out by immunochromatographic method.

Quantification of the antibody response can be used to determine the titer of specific antibodies and to monitor the dynamics of the antibody response in individuals. Results were considered positive if the cut-off index (COI) was ≥1. It was believed that a combined test for antibodies to both classes increased the efficiency of the analysis [8].

Results and Discussion

Since the early days of the pandemic, the prevalence of COVID-19 cases increased drastically in the Republic of Armenia.

In order to identify total antibodies to the N protein of the SARS CoV-2 virus, 89 employees of one institution in Yerevan were examined. Among the surveyed, the ratio of women and men was almost the same (47,7% and 46,7%, respectively). The confidence interval (hereinafter referred to as CI) was calculated - in both cases with 95% reliability (for women - CI 46,5-48,9, for men - CI 45,0-48,4) (Please refer to Table).

People aged 24 to 73 years were examined (average age 44,3). Age structure analysis revealed the following: 17,0% (n=15) - 20-29 years old; 29,2% (n=26) - 30-39 years old; 18,0% (n=16) - 40-49 years old; 18,0% (n=16) -50-59 years old; 13,5% (n=12) - 60-69 years old; 5,0% (n=4) - 70 years and older (Fig. 1).
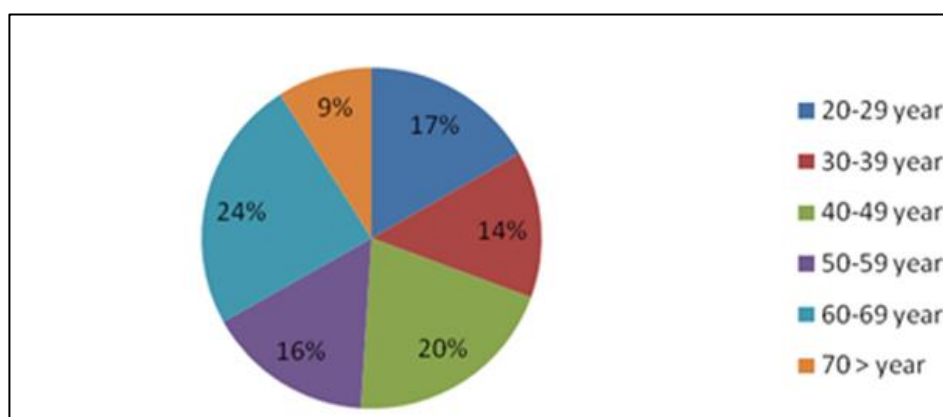

Fig. 1. Age Structure of Examined Individuals

The overall seroprevalence (presence of total antibodies) to SARS CoV-2 among examined was 47,2% (95% CI 46,5-47,98), antibodies were absent in 52,8% of cases (95% CI 52,2- 53,4). The COI level of positive results ranged from 1,35 to 171,8. There was no difference in antibodies detection frequency among both sexes (table).

Table

Seroprevalence of total antibodies to SARS CoV-2 N protein

Researched personnel	Absolute number	Positive result	
		absolute number	%±m
Females	44	21	47,7±5,3
Males	45	21	46,7± 5,28
Total	89	42	47,2±5,3

It is worth mentioning that 16 (38,1%) of 42 seroprevalent individuals had previously undergone PCR test for the presence of SARS CoV-2 virus in nasopharyngeal swab, among which 12 had positive results. COI level of PCR test positive results ranged from 1,35 to 139,5.

In 21,4% of cases, the presence of low values of COI of total antibodies does not exclude new contamination and asymptomatic carriage, as evidenced by the absence of any indication of the fact of disease confirmation or the presence of coronavirus infection symptoms in anamnesis.

Investigation of IgM + IgG antibodies to the SARS CoV-2 virus in various age groups showed the highest COI values among the age groups of 30-39 – 23,8% (95% CI 7,7-39,9) and 40-49 – 21,4% (95% CI 3,0-39,8) years, as well as the smallest values in group over 70 – 2,4% (Fig. 2).
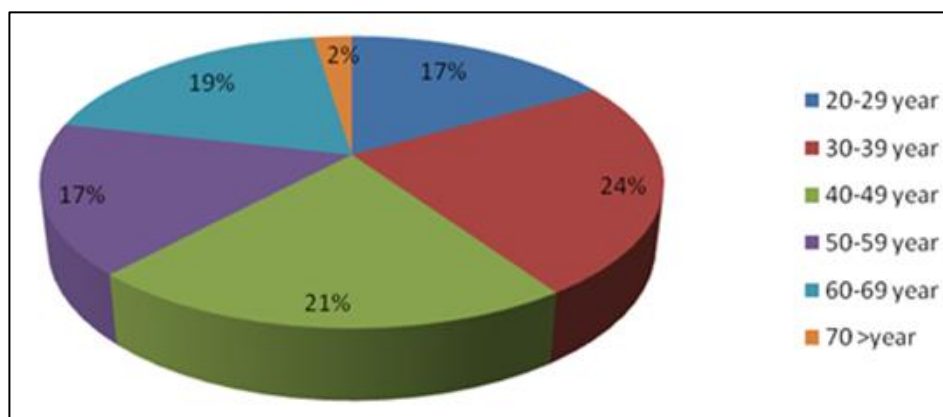

Fig. 2. The Presence of Antibodies of the SAR Virus among Different Age Groups

A comparative analysis of antibodies frequency detection and blood type was carried among 77 participants (42 females and 35 males). The owners of blood type I (O) were 14 people (18.2%), group II (A) - 36 (46.8%), III (B) - 13 (16.9%), and IV (AB) -14(18.2%). Total antibodies to the N protein of the

SARS CoV-2 virus were detected among individuals with blood groups O(I), A(II), B(III), AB(IV) at 15.7%; 44.7%; 21.1%; 18.4%, respectively (Fig.3). This may indicate that A(II) blood type individuals are most susceptible to infection with SARS CoV-2 virus, and those with O(I) blood group are the least susceptible, which correlates with the results of studies by foreign authors [4, 7, 8, 10, 18] (Fig. 3).
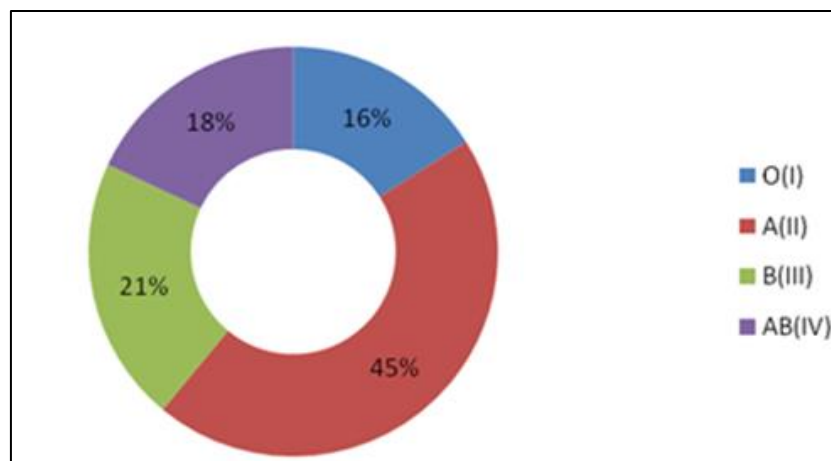

Fig. 3. The Frequency of Detection of Antibodies to the SARS CoV-2 Virus among Individuals with Different Blood Groups

Conclusion

Based on scientific literature, viral agents can primarily be transmitted by animals. The COVID-19 pandemic, as well as otherwise pandemics, is a vivid example of zoonotic disease. To safeguard the public health from zoonotic infections the appropriate proceedings are crucial, since they can emerge epidemiological disasters with severe consequences.

Within this framework, the obtained results revealed insufficient level of collective immunity among the personnel during the examination period amounting to 47.2% (95% CI 46.5-47.9), in accordance with the detection of antibodies to the N protein of the SARS CoV-2 virus. Insufficient immunity can contribute to a spread of a new coronavirus infection.

Our preliminary results can provide a basis on the necessity of implementation of anti-epidemic measures to prevent the spread of infection.

Оценка гуморального иммунитета к вирусу SARS CoV-2 среди сотрудников трудового коллектива

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Целью статьи является определение наличия антител (IgG+IgM) к нуклео-капсидному (N) белку вируса SARS CoV-2 у обследованных 89 сотрудников коллектива отдельно взятой организации города Еревана. Вместе с этим отмечается, что соотношение обследованных женщин и мужчин составило 44 (47,7%) и 45 (46,7%) соответственно, а средний возраст составил 44,3 года (наивысший возраст 73 года, наименьший 24 года). Авторы приходят к выводу, что общая серопревалентность (наличие комбинированных антител IgG + IgM) к антигенам SARS CoV-2 у обследованных сотрудников составила 47,2% (95% ДИ 45,6-48,8), в то время как антитела отсутствовали у 47 сотрудников 52,8% (95% ДИ 52,2-53,4). На основании изучения наличия антител к вирусу SARS CoV-2 в разных возрастных группах установлено, что самые высокие уровни антител обнаружены среди возрастных групп 30-39 лет (23,8%) и 40-49 лет (21,4%), наименьший – в группе лиц старше 70 лет (2,4%).

В качестве исследовательской задачи авторами выяснена зависимость инфицированности лиц от группы крови. Известны были группы крови 77 из 89 сотрудников организации (42 женщины и 35 мужчин). В результате исследования выяснено, что по группам крови распределение уровня антител имеет следующее соотношение: 0(I), A(II), B(III), AB(IV) – 15,7; 44,7; 21,2; 18,4% соответственно.

Авторы приходят к выводу, что у лиц с группой крови A(II) инфицированность COVID-19 была выше, более чем в 2 раза, а наименьшая инфицированность отмечена у лиц с 0(I) группой крови, что коррелирует с результатами исследований зарубежных коллег.

Աշխատանքային անձնակազմի հումորալ իմունիտետի գնահատումը SARS CoV-2 վիրուսի նկատմամբ

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Հոդվածի նպատակն է պարզել Երևան քաղաքի կազմակերպություն-ներից մեկում հետազոտված 89 աշխատակիցների SARS CoV-2 վիրուսի նուկլեոկապսիդ (N) սպիտակուցի նկատմամբ հակամարմինների (IgG+IgM) առկայությունը:

Հետազոտված տղամարդկանց և կանանց հարաբերակցությունը կազմել է համապատասխանաբար՝ 47,7% (44 տղամարդ) և 46,7% (45 կին), իսկ միջին տարիքը՝ 44,3 տարեկան (առավելագույնը՝ 73 տարեկան, նվա-զագույնը՝ 24 տարեկան):

Իրականացված ուսումնասիրության արդյունքները վկայում են, որ զննված աշխատակիցների ընդհանուր հակածինների SARS CoV-2 նկատմամբ համակցված IgG + IgM հակամարմիններ առկա են հետազոտվածների 47,2%-ում (95% Հ�Գ 45,6-48,8):

Ավելին, հակամարմինների ամենաբարձր մակարդակ դիտվել է 30-39 և 40-49 տարիքային խմբերում՝ համապատասխանաբար 23,8% և 21,4%, իսկ ամենացածր մակարդակ՝ 70 տարեկանից բարձր մարդկանց խմբում՝ 2,4%:

Մեր խմբի գիտական հետաքրքրությունների շրջանակում է եղել նաև վերլուծել արյան խմբերի և հակամարմինների մակարդակների միջև առկա կապը արյան խմբերի պատկանելությունը հայտնի 77 (42 կին և 35 տղամարդ) աշխատակիցների դեպքում:

Հետազոտության արդյունքում պարզվել է, որ հակամարմինների մա-կարդակի բաշխումը, ըստ արյան խմբերի, ունի հետևյալ հարաբերակ-ցությունը՝ 0(I), A(II), B(III), AB(IV) խմբերում համապատասխանաբար՝ 15,7; 44,7; 21,2; 18,4%:

Կատարված վերլուծության արդյունքները փաստում են, որ արյան A(II) խումբ ունեցող մարդկանց COVID-19-ով վարակվածությունը այլ արյան խմբերի համեմատ եղել է ավելի քան 2 անգամ բարձր: Ամենացածր վարակվածություն գրանցվել է 0(I) արյան խումբ ունեցող աշխատակիցների շրջանում, ինչն էլ հարաբերակցվում է միջազգային գիտական գրականության մեջ բերված օտարերկրյա հետազոտողների կողմից իրականացված ուսում-նասիրությունների արդյունքների հետ:

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