Assessment of antibody levels in a population vaccinated with Sputnik V

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Abstract: Objectives — The objective of our study was to assess humoral response in a population of health workers after vaccination with the first and second doses of Sputnik V. Methods — SARS-CoV-2 total antibodies (IgG and IgM) were measured, using the Centaur XPT autoanalyzer, Siemens*, in 530 serum samples taken from health workers in Buenos Aires vaccinated with Sputnik V. Results — After 21 days of the first dose application, 10 individuals (1.9%) presented antibody levels <1.0 (non-reactive), while 520 subjects (98.1%) responded with antibody values >1.0 (reactive). The results, obtained 21 days after the second dose, show that only 2 individuals (0.38%) had antibody levels <1.0 (non-reactive) and 528 (99.6%) responded with antibody values >1.0 (reactive). Conclusion — This study results implied that two doses of Sputnik V vaccine generated a proper antibody response in virtually the entire studied population.

Keywords: SARS-CoV-2, COVID-19, vaccination, Sputnik V, antibodies.

Introduction

In Wuhan, China, in December 2019, cases of severe atypical viral pneumonia infection emerged, spreading swiftly and causing a significant number of deaths [1]. Subsequently, the virus genome was sequenced, determining that it was a new coronavirus called SARS-CoV-2 [2]. On March 11, 2020 the World Health Organization declared COVID-19 a pandemic, affecting more than 180 countries around the world [3]. By now, it has caused over 114,518 deaths worldwide, and more than 5.2 million people have been infected in our country (https://coronavirus.jhu.edu/map.html). This disease is considered at present an international public health emergency. This has forced countries to adopt various policies with the goal of fighting the pandemic. According to recent reports, most COVID-19 patients have an incubation period of 3 to 7 days [4]. Fever, cough, and fatigue are the most common symptoms, while nasal congestion, discharge, and diarrhea are only seen in a small portion of patients [5]. Severe cases can rapidly progress to acute respiratory distress syndrome (ARDS), septic shock, metabolic acidosis, and bleeding due to coagulation dysfunction [6]. Health care community is making every effort to provide adequate treatment to patients, limit the spread of the virus and overcome this pandemic; hence, a well-timed and accurate diagnosis of SARS-CoV-2 infection is essential [7]. In this sense, detection of viral RNA based on RT-PCR is the gold-standard to confirm the diagnosis of SARS-CoV-2 infection. Regarding prophylaxis, at present, more than 187 vaccines against COVID-19 are being developed, 44 of which are in various stages of human clinical trial testing (8). Recently, the first results of early phase clinical trials, which have tested 9 candidate vaccines, have been published. Tested vaccines represent a wide range of platform technologies including mRNA vaccines, such as Moderna [9] and Pfizer/BioNTech [10], adenoviral vector-based vaccines as per CanSino [11], Oxford [12], Gamaleya Research Institute of Russia [13] and Janssen/Beth Israel [14]; and a recombinant protein vaccine with Novavax adjuvant [15] and two inactivated virus vaccines [16, 17]. Recombinant adenosivirus (rAd)-based vaccines, such as Sputnik V, are suitable candidates for the long-term protection of people at high risk of COVID-19 since they stimulate the rapid onset of protective immunity. Gam-COVID-Vac (Sputnik V) is a combined vector vaccine, based on rAd type 26 (rAd26) and rAd type 5 (rAd5), both carriers of the full-length SARS-CoV-2 glycoprotein S gene (rAd26-S and rAd5-S). rAd26-S and rAd5-S are administered intramuscularly separately with an interval of at least 21 days. Overall, trial results suggested that vaccination was relatively safe and reasonably well tolerated. Importantly, all vaccination modalities induced detectable antibody titers by ELISA, as well as variable neutralizing antibody (nAb) titers levels. The vast majority of these vaccines were developed with the aim of inducing nAb. However, there is still no evidence of the nAb magnitude required for protection or the durability of nAb responses. The goal of our study was to assess the humoral
response (antibody levels) in a health worker population after being vaccinated with the first and second doses of Sputnik V.

Material and Methods

Studied population
This study included 530 health workers in the city of Buenos Aires vaccinated with Sputnik V. Within this population, 25% (n=133) had already suffered from Covid infection prior to their vaccination. This vaccine is based on heterologous recombinant adenovirus (rAd), Gam-COVID-Vac (Sputnik V) [18]. Our study used a longitudinal observational design.

Measuring total SARS-CoV-2 antibodies
SARS-CoV-2 total antibodies (IgG and IgM) were measured in serum samples, using a semi-quantitative chemiluminescent assay in the Centaur XPT autoanalyzer, Siemens®. This system reports assay results by index values with a measurement range from 0.05 to 10. The outcome is considered negative for SARS-CoV-2 antibodies when the index is <1.0 (non-reactive), and positive when the index is >1.0 (reactive). Antibody levels were measured after the first dose and after the second dose of Sputnik V vaccine.

Statistical analyses
The distribution of variables was identified using normality tests (kurtosis and skewness). Results were expressed as mean ± standard deviation (SD) or median (range), depending on the data distribution. Mean and median differences were evaluated by t-test or Mann-Whitney test, respectively. Statistical analyses were performed using the SPSS 19.0 program (Chicago, IL).

Table 1. Distribution of the total population included in the study and antibody levels

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Study group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>45±14</td>
</tr>
<tr>
<td>Gender % (n)</td>
<td>F: 58,7 (313) M: 41,3 (220)</td>
</tr>
<tr>
<td>Covid (n)</td>
<td>133</td>
</tr>
<tr>
<td>Sputnik V (n)</td>
<td>530</td>
</tr>
<tr>
<td>Covid+Sputnik (n, %)</td>
<td>133 (25%)</td>
</tr>
<tr>
<td>Days since 1st dose</td>
<td>38±21</td>
</tr>
<tr>
<td>Total antibodies after the 1st dose</td>
<td>4.4 (0.18–10)</td>
</tr>
<tr>
<td>Days since 2nd dose</td>
<td>24±16</td>
</tr>
<tr>
<td>Total antibodies after the 2nd dose</td>
<td>&gt;10 (1.3–10)</td>
</tr>
</tbody>
</table>

F, Female; M, male.

Table 2. Antibody levels after the first and second dose

<table>
<thead>
<tr>
<th>Days since 1st dose</th>
<th>Total antibodies</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-20</td>
<td>1.5 (0.13–10)*</td>
</tr>
<tr>
<td>≥21</td>
<td>5.67 (0.05–10)**</td>
</tr>
<tr>
<td>Days since 2nd dose</td>
<td></td>
</tr>
<tr>
<td>0-20</td>
<td>&gt;10 (1.3–10)+</td>
</tr>
<tr>
<td>≥21</td>
<td>&gt;10 (&lt;1.0–10)**</td>
</tr>
</tbody>
</table>

Mann Whitney Test *vs** p=0.040; +vs++ p=0.012.

Table 3. Post-vaccination antibody levels in the population with and without COVID-19 infection

<table>
<thead>
<tr>
<th>Post</th>
<th>Days since 1st</th>
<th>Days since 2nd</th>
<th>Total antibodies</th>
<th>Total antibodies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sputnik V</td>
<td>39±20</td>
<td>23±15</td>
<td>2.76 (0.3-8.3)²</td>
<td>&gt;10 (1.4–10)²</td>
</tr>
<tr>
<td>COVID-19</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>+Sputnik V</td>
<td>34±18</td>
<td>25±14</td>
<td>&gt;10 (1.1–10)²</td>
<td>&gt;10 (5.8–10)²</td>
</tr>
</tbody>
</table>

Mann Whitney Test ‘vs’ p<0.0001.

Results
From a total of 530 individuals vaccinated with Sputnik V, 25% were infected with COVID-19 (n = 133), confirmed by the real-time PCR (Table 1). Table 2 demonstrates the levels of antibodies obtained after the application of the first and second doses of Sputnik V, according to the elapsed days. Table 3, along with Figures 1 and 2, show the antibody levels in vaccinated individuals who did not have COVID-19 and in individuals who received the vaccine after being infected with the virus. After 21 days of the first dose application, 10 subjects (1.9%) exhibited antibody levels <1.0 (non-reactive) and 520 subjects (98.1%) had a reactive humoral response (>1.0). The results 21 days after the second dose showed that only 2 individuals (0.38%) had antibody levels <1.0 (non-reactive), while 528 subjects (99.6%) responded with antibody values >1.0 (reactive).

Discussion
Our results demonstrated that the two-component Gam-COVID-Vac (Sputnik V) vaccine was able to induce a humoral
response in the individuals included in this study. Previous studies showed that this vaccine had an efficacy of 91.6% (95% CI 85.6-95.2) against COVID-19 in vaccinated patients, starting 21 days after the application of the first dose.

In our research, we observed that after the first dose, 98.1% of individuals generated antibodies, while after the second dose, such effect was detected in 99.6% of cases. Logunov et al [12] found that the vaccine induced strong humoral responses in all age ranges; however, in a few cases, no response was observed (6 of 342). There is strong evidence that many factors influence the immune response to vaccination. Among them, we should mention intrinsic factors (genetics, gender, age at time of vaccination, and comorbidities); extrinsic factors (infections, microbiota and antibiotics); behavioral factors (smoking, exercise, alcohol consumption, stress, and sleep quality); nutritional factors (body mass index, nutrition status, micronutrients, enteropathy); and environmental factors (geographic location, season, toxins, family size). Also, vaccine-related aspects are involved, such as choice of vaccine products, adjuvants, and vaccination schedule [19].

The lack of antibody rise in this small group could be due to immunosenescence in the elderly, individual characteristics of the immune response, or concomitant immune disorders.

In a study carried out in Argentina by the Ministerio de Salud de la Provincia de Buenos Aires, in which 288 individuals vaccinated with Sputnik V were included, the results suggested that after 21 days of the vaccine first dose application, 94% of subjects developed specific IgG antibodies against spike protein, whereas 21 days after the second dose, 100% of them have developed such antibodies. In our study, we also observed that previously infected individuals with COVID-19 showed a more pronounced increase in antibodies after the first dose than those who were not previously infected: >10 (1.1→10) vs. 2.76 (0.3–8.3). On the other hand, after the second dose, in both groups, the levels of antibodies were >10 (5.8→10) vs. >10 (1.1→10). These results are in agreement with recent studies carried out with the Pfizer and Moderna vaccines, which showed that the increase in the levels of antibodies after the first dose in people who had a previous exposure to the virus were very high and that the second dose did not generate further increase [16].

Conclusion

Our results demonstrated that Sputnik V vaccine was able to induce a humoral response against the spike protein of SARS-CoV-2 in 99.6% of the individuals studied 21 days after the application of the second dose. This study suggested that two doses of Sputnik V vaccine triggered a proper antibody response in virtually the entire studied population. The second Sputnik V dose had no impact on IgG response for those who had previous exposure to SARS-CoV-2.

Limitations of the study

There are some limitations in our study. One limitation is that demographic data from volunteers was not available, such as height, weight, or BMI. Another limitation is related to the fact that our antibody level results were reported as an index that had a maximum of 10, which could be slightly constrained; however, this is an inherent limitation of the method available at the time.

Conflict of interest

None declared.

References


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