

Research Article

Anti COVID-19 immunity developed as assessed in a community-based oncological center

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Abstract

Introduction: Serology (antibody) tests for the SARS-CoV-2 have been proposed as an instrument to inform health authorities about immunization during the COVID-19 pandemic. As there is a significant part of the population that may have some degree of immunity, it is of great interest to communicate the immunization results obtained in the first 500 healthcare workers (HCW), patients and relatives tested in a community-based Oncological Center.

Materials and methods: Between April 9th, 2020 and May 8th, 2020, a group of healthcare workers (HCW), their families, and general public who had had the COVID-19 or had been in close contact with confirmed cases of COVID-19 were screened for IgG SARS-CoV-2 antibodies. The tests were carried out in a rigorous manner, strictly following the guidelines approved by the Spanish Ministry of Health (Ministerio de Sanidad).

Results: The major objective of this study was to determine the proportion of asymptomatic infected individuals and those who had already secreted IgG against SARS-CoV-2 in our cancer treatment center or in the community of Barcelona. Patients were tested with PCR, Rapid diagnostic test (RDT) or enzyme-linked immunoabsorbent assay (ELISA). A total of 521 participants were tested, 206 with RDT and 315 with ELISA, 59 (11,32%) resulted positive to SARS-CoV-2.

Conclusion: RDT and ELISA proved to be effective and sensible enough to determine the extent of SARS-CoV-2 immunization in a community-based oncological center. The degree of immunization reached is nowadays far away from what can be considered desirable for a herd immunization.

Introduction

Serology (antibody) tests for the SARS-CoV-2 have been proposed as an instrument to inform health authorities in order to take appropriate public health decisions during the pandemic [1]. Serology testing for COVID-19 may be used to determine whether an individual has been previously infected by SARS-CoV-2. Serological antibodies are important to

determine, because the polymerase chain reaction (PCR) identify the presence of viral material, which is found only in people who are currently infected. Not everyone who had the disease had the opportunity to be tested before the virus was cleared from their bodies, and estimates show that as many as 25% or more may have been asymptomatic [2,3]. Thus, we can presume that there is a significant part of the population that may have some degree of immunity. Because public

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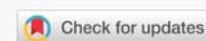
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health decision making relies in part on an understanding of the disease prevalence and the prevalence of immunity, extensive antibody/serology testing is needed to determine the true prevalence of SARS-CoV-2 infection. It is for this reason that we consider of great interest to communicate the immunization results obtained in our cohort.

Materials and methods

Study design

This study was conducted between April 9th, 2020 and May 8th, 2020 in Barcelona, a city of 1,636,762 inhabitants in 2019, the second most populated city of Spain and the capital of Catalonia. Enrollment consisted on a group of HCW, their families, and general public that considered that had had the COVID-19 or had been in close contact with an infected. All participants provided written and informed consent before enrollment to have their data anonymously processed.

Testing was done according to the guidelines approved by the Spanish Ministerio de Sanidad, Instituto de Salud Carlos III [4] and the Conselleria de Salut of the Generalitat de Catalunya [5]. In summary, all HCW (including doctors, physicists, nurses, technicians, administrative and cleaning personnel) that might, to any degree, have been in contact with COVID-19 patients, the patients, their relatives or individuals who have been in contact with other infected patients, could be tested.

Cancer patients have been considered of higher risk of being infected by SARS-CoV-2 as well of having an increased severity of symptoms and higher mortality rate, so a special protocol for prevention of transmission among patients and health care workers was promptly applied in the cancer center in order to minimize risks. This protocol served as basis for the development of the national guidelines for radiation oncology services [6]. This protocol determined the use of extensive PCR and immunodetection exams periodically and as soon as any symptom or contact with infected individuals was suspected.

Procedures

Participants voluntarily contacted the center to be tested. After providing informed consent, participants completed a questionnaire including information about demographics, symptoms, underlying diseases, vaccinations, and medications they were taking. If no symptoms and no contact with possibly infected patients was detected, participants were excluded from the analysis.

Questionnaire data were recorded on site at the time of obtaining the samples and was introduced into an electronic data base (SPSS v15) by trained personnel for further statistical analysis.

Results

Study design and study population

The main objective of this study was to determine the proportion of individuals infected with the SARS-CoV-2 or with

immunity against it in the general population of Barcelona. The city that had a total of 17.163 positive cases (crude incidence rate of 104,86 cases per 10.000 inhabitants) and 38.241 considered as suspicious, according to the guidelines of the Conselleria de Sanitat of the Government of Catalonia [5]. These numbers approximately represent the 1.05% and 2.33% of the population respectively. Patients with PCR, Rapid diagnostic test (RDT) or enzyme-linked immunoabsorbent assay (ELISA) positive were considered positive meanwhile, patients classified as suspicious were individuals who had symptoms similar to those of confirmed covid-19 patients but who lacked a positive PCR or RDT.

Immunization results

A total of 521 participants were tested, 315 with ELISA and 206 with RDT.

Individuals without symptoms and without IgM or IgG were considered negative for SARS-CoV2. Patients with IgG and without IgM, were considered to have passed the infection. Patients with IgM (with or without IgG) were remitted to a PCR determination as well as patients with symptoms but without immunity (negative for IgM and IgG), as can be observed in table 1.

Of the 521 persons tested, 59 (11,32%) resulted positive to SARS-CoV-2. There were 47 patients who resulted positive for IgG in the group of 315 patients studied with ELISA (13,33%). In the group of 206 tested with RDT, there were a total of 17 patients (8,25%) with IgG positive (Table 2). In this Group, 4 (1,92%) patients probed to be positive for IgM, 2 (0,97%) of them in previously symptomatic patients and 2 (0,97%) in asymptomatic patients. All 4 were tested with PCR, the 2 previously symptomatic were negative and the 2 asymptomatic tested positive, thus considered as new diagnosis of COVID-19.

Table 1: General interpretation summary.

Past Symptoms/Contact with confirmed/possible COVID-19 patient	IgM	IgG	Interpretation
No	-	-	Negative
No	-	+	Past infection. Immune
No	+	-	Possible infection. PCR Mandatory
No	+	+	Possible infection. PCR Mandatory
Yes	-	-	Not immune. Possible infection. PCR Mandatory
Yes	-	+	Past infection. Immune.
Yes	+	-	Possible presence of the infection. PCR Mandatory
Yes	+	+	Past infection. Possible persistente of virus PCR Mandatory

Table 2: Results of the immunity rapid diagnostic tests (RDT) and enzyme-linked immunoabsorbent assay (ELISA).

	N	Positive	%
RDT	206	17	8,76
ELISA	315	42	13,33
TOTAL	521	59	11,32



It is interesting to observe that there were 4 patients with previous positive PCR that tested negative for RDT and ELISA. This suggests that they may have passed the disease, with a variable intensity (none of them required hospitalization), but didn't develop significant immunity, at least at the time of analysis.

Speed of immunization

It is noteworthy that between April 9th and 21st a total of 223 patients were tested and only 5 (2.24%) were positive. After this date, rate of positivity increased and in the remaining 298 patients tested 54 (18,12%) resulted positive.

Discussion

The study followed government guidelines which required a prescription of the test by a doctor following some kind of symptom or indication. It has been run in a hospital environment and it has addressed to HCW or patients and their relatives and close contacts. This population is considered in high risk of being infected or having been in contact with the SARS-CoV2 (or at least with a higher risk than for the normal population), and so they were supposed to have acquired a degree of immunity higher than the one observed in the general population.

In this environment, the 11,32% that developed immunity was far less than expected and much lower than what would have been considered as ideal for the herd-immunity effect [7].

One of the topics of highest public interest nowadays, is the proportion of the citizenship that has developed immunity against SARS-CoV-2. If we would extrapolate the data obtained to the general population of Spain and Barcelona we could obtain an estimate, even only partially approximated, of the numbers of people already immunized. In terms of the whole Spanish population (47.100,396), we could consider that around 5.181.044 citizens would have been in contact with the SARS-CoV-2 and would have developed significant immunity. This, in turn, would mean that 185.281 persons would be immunized in the metropolitan area of Barcelona.

Recently, the Spanish Ministerio de Ciencia e Innovación, the Ministerio de Sanidad, the Consejo Interterritorial sistema nacional de salud and the Instituto de salud Carlos III released the preliminary results of the first round of the National study

of sero-epidemiology of the SARS-CoV-2 infection in Spain [8]. A total of 60.983 patients were recruited. The estimated prevalence of IgG antibodies in front of the SARS-CoV-2 in Spain was 5,0% and for Barcelona of 7.1%. This data, are about half of the obtained in the present study. This can be considered normal due to the fact that one is obtained in the general population and our study is in a high-risk population.

The amount of prevalence studies is very scarce. Streeck, et al. [9] published data on 919 individuals of a small German town which was exposed to a super-spreading event. They reported a 15,5% infection rate, that was significantly higher than the 3.1% officially reported cases for this community. Another study from Uppsala's university, lead by Lundkvist [10], examined 6,000 individuals and found a 7.5% of immunity rate. He studied independently 1,000 care workers and found that 23% of them had been infected, this is an infection rate much higher than the one described in the present study. Data coming from England [11] showed around a 6.78% of the people who provided blood samples tested positive for antibodies to COVID-19. Finally, Garcia-Basteiro, et al. [12], reporting data from a large reference hospital at Barcelona found a 9.3% for IgM, IgG or IgA in a sample of 578 HCW.

Folgueira, et al. [13] reported that 2085 HCW in Madrid were tested by PCR and found that 38% resulted positive for SARS-CoV-2. Tests were done during 1st and 29th of March 2020. No immunization data has been published. The high infection rate could be a result of the early moment in time in which the study was carried out, when no effective protective garment was provided to HCW by this time. In our series, no transmission was detected between patients and HCW, or vice versa, what probably meant that the protocol was successfully implemented. A summary of immunization results is shown in table 3.

The increasing detection rate of IgG between the first 2 weeks and the last 2 weeks of the study could be due for two reasons: one is the delayed detection of IgG after being in contact with the SARS-CoV-2 and the other could be the fact that after releasing the isolation measures a higher degree of herd immunization was taking place. Probably, both factors had some influence. To determine to which degree both of them contributed, a deep analysis of the epidemiology questionnaires would have to be carried out, that will be the subject of further study.

Table 3: Summary of sero-prevalence studies.

Study	Dates	Location	Sample	Immunization Results
Guix, et al.	April 9 th – May 8 th	Barcelona, Spain	521 (HCW, and patients with symptoms)	11,32%
Ministerio de Sanidad	April 27 th – May 11 th	Spain	60.983 (general population)	5%
Streeck, et al.	March 30 th – April 6 th	Gangelt, Germany	919 (general population)	15.5%
Lundkvist, A		Uppsala, Sweden	6.000 (general population of which 1.000 HCW)	7.5% and 23% respectively
Office for National Statistics	May 24 th	England	17.176 (general population)	6.78%
Garcia-Basteiro, et al.	March 9 th	Barcelona, Spain	578 (HCW)	9.3%
Folgueira, et al.	March 1 st – 29 th March	Madrid, Spain	2085 (HCW)	38%



In summary, RDT and ELISA probed to be effective and sensible enough to determine the extent of SARS-CoV-2 immunization in a community-based oncological center. The degree of immunization reached is nowadays far away from what can be considered desirable for a herd immunization that has been estimated to be extremely variable by country, with 69.6% in the United States and 56,1% in Iceland [7].

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Declarations

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Ethics approval: Not required due to strict adherence to national guidelines

Consent to participate: All participants gave written consent.

Consent for publication: All authors agreed to publish the study

Availability of data and material: All acquired data is disposable online, conveniently anonymized upon request.

Authors' contribution: All authors reviewed the manuscript and collaborated in the study's conception, the obtention of blood samples and data collection, processing and analysis.

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