SARS-COV-2 SEROPREVALENCE AMONG PATIENTS WITH CANCER AND HEALTHCARE WORKERS FROM AN ONCOLOGY REFERRAL CENTER DURING THE FIRST YEAR OF COVID-19 VACCINATION IN MEXICO

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BACKGROUND

Cancer patients (CPs) with COVID-19 have an increased risk of adverse outcomes. Vaccination is the most effective strategy to decrease the COVID-19 burden, including severe disease, hospitalization, and mortality. However, knowledge gaps remain concerning the effectiveness of different types of vaccines in patients living with cancer. This population seems to have a suboptimal response, which might be related to their immunocompromised status. On the other hand, healthcare workers (HCWs), although mostly healthy, are at increased risk of COVID-19 due to occupational exposure.

In Mexico, by the end of 2021, seven different COVID-19 vaccines had been approved for use in ≥18 years individuals. These included mRNA, viral vector, and inactivated vaccines. The Ministry of Health centralized the national immunization program according to age and high-risk occupational groups. Based on this strategy, HCWs were the first to be vaccinated, followed by those aged ≥60 years. Patients with cancer were not prioritized for vaccine type or early vaccination.

OBJECTIVE

This study aimed to evaluate the humoral response following COVID-19 vaccination in patients living with cancer and HCWs from a referral cancer center in Mexico during the first year of vaccination before booster doses.

METHOD

We conducted a cross-sectional study in November 2021 at the Instituto Nacional de Cancerologia (INCan), a tertiary teaching oncological center in Mexico City. CPs and HCWs with a 2-dose scheme of BNT162b2 or AZD1222 SARS-CoV-2 vaccines were included. All individuals who accepted to participate completed an electronic questionnaire with variables related to the COVID-19 vaccine, comorbidities, and demographic characteristics. For patients, further variables were retrieved through electronic medical records.

SARS-CoV-2 spike antibody (anti-S Abs) titers were quantified by an electrochemiluminescence assay using the Roche Cobas e411 platform. Titers were obtained on units per milliliter (U/mL) on a scale of 0.80 U/mL to 250 U/mL. All samples below the lower detection threshold were considered negative; those exceeding the upper detection threshold were diluted (1:300) to estimate the exact anti-S antibody concentration. A low humoral immunological response was defined as anti-S Abs titers less than 250 U/mL. Chemotherapy use was classified as cytotoxic chemotherapy during the previous month of vaccination. Active cancer was defined as patients with a recent diagnosis or current cancer-related treatment.

A descriptive analysis was conducted. We reported frequencies and proportions for qualitative variables and mean and standard deviation (SD) ranges for continuous variables. Chi2, Fisher exact test or U-Mann Whitney test was used to compare groups, according to the type of variable.

ANALYSIS

We evaluated 1) the impact of a cancer diagnosis on the humoral response in the entire cohort balancing the groups by age, HAS, gender, type of vaccine, and time since immunization and 2) the impact of the type of vaccine on the humoral response in the cancer population balanced by age, gender, time since vaccination, oncological status and chemotherapy use. For this purpose, we performed a propensity 1:1 nearest-neighbor matching algorithm to balance the basal characteristics of interest and calculated SMD (standarized mean difference) to quantify the degree of balance. Then, we performed a multiple logistic regression for a double adjustment to reduce the effect of poor balance variables (SMD> 0.1). Odds ratio with 95% confidence intervals (CI) were calculated. Statistical analysis was performed in the RStudio software.

RESULTS

We included 566 individuals: 127 (22%) CPs and 439 (78%) HCWs. Four hundred ten (72%) were female, and the median age was 45 (SD 13) years. Basal characteristics and propensity score matching are shown in **Table 1**. Only five (1%) individuals had a negative serology: 4 (1%) were HWCs and 1 (1%) CP, After multivariate analysis, AZD1222 was associated with low antibody titers (aOR; 2.90, CI 95%; 1.28-6.85, p-value= 0.011) **(Table 2).**

In the analysis that only included CPs, after group balance in the propensity score matching (**Table 3**), active cancer status was associated to lower anti-S antibody titers (aOR; 2.89, CI 95%; 1.03-8.54, p=0.046) (**Table 4**).

Table 1. Basal characteristics among patients with cancer and healthcare workers and propensity score matching

Variable	Before matching			After matching		
	CPs n=127	HCWs n=439	P-value	CPs n=127	HCWS n=127	SMD
Age in years—mean (SD)	56 (12)	41 (12)	<0.001	56 (12)	53 (9)	0.403
Gender						
Female	91 (72)	319 (73)	0.822	91 (72)	94 (74)	0.053
Male	36 (28)	120 (27)		36 (28)	33 (26)	
Comorbidities						
Diabetes mellitus	10 (8)	22 (5)	0.218	10 (8)	8 (6)	N/A
High blood pressure	19 (15)	34 (8)	0.013	19 (15)	13 (10)	0.143
Vaccine type						
BNT162b2	54 (43)	301 (69)	<0.001	54 (43)	53 (42)	0.016
AZD1222	73 (57)	138 (31)		73 (57)	74 (58)	
Time since vaccination in days-mean (SD)	147 (65)	188 (70)	<0.001	147 (65)	147 (60)	0.003

CPs: cancer patients. HWCs: healthcare workers. SMD: standarized mean difference. SD: Standard deviation. N/A: not applicable.

Table 2. Multivariable logistic regression analysis for associated variables with <250 U/mL anti-S in cancer patients and healthcare workers after propensity score matching

Variable	High response n=208	Low response n=46	aOR (95% IC)	P-value
Age (years) – median (SD)	54 (11)	58 (10)	1.03 (0.99-1.07)	0.129
Gender				
Female	155 (75)	30 (65)	reference	0.178
Male	53 (25)	16 (35)	1.63 (0.78-3.30)	
Cancer diagnosis	98 (47)	29 (63)	1.61 (0.80-3.29)	0.180
Comorbidities				
Diabetes mellitus	14 (7)	4 (9)	0.87 (0.20-3.12)	0.846
High blood pressure	23 (11)	9 (20)	1.50 (0.53-3.94)	0.420
Vaccine type				
BNT162b2	94 (45)	13 (28)	reference	0.011
AZD1222	114 (54)	33 (72)	2.90 (1.28-6.85)	
Time since vaccination (days) – median (SD)	147 (63)	150 (64)	1.00 (0.99-1.00)	0.662

aOR: adjusted odds ratio. SD: Standard deviatio

Table 3. Basal characteristics in cancer patients vaccinated against SARS-CoV-2 and propensitiy score matching

Variable	Before matching			After matching		
	BNT162b2 vaccine n= 54	AZD1222 vaccine n= 73	P-value	BNT162b2 vaccine n= 54	AZD1222 vaccine n=54	SMD
Age in years, mean (SD)	59 (11)	55 (12)	0.065	59 (11)	55 (12)	0.273
Gender						
Female	36 (67)	55 (75)	0.283	36 (67)	39 (72)	0.121
Male	18 (33)	18 (25)		18 (33)	15 (28)	
Chemotherapy use	10 (19)	16 (22)	0.638	10 (19)	13 (24)	0.136
Active cancer status	25 (46)	25 (34)	0.169	25 (46)	21 (39)	0.150
Hematologic neoplasms	5 (9)	4 (5)	0.412	5 (9)	4 (7)	0.067
Comorbidities						
Diabetes mellitus	4 (7)	6 (8)	1.000	4 (7)	5 (1)	N/A
High blood pressure	8 (15)	11 (15)	0.968	8 (15)	9 (17)	N/A
Time since vaccination (days), mean (SD)	175 (56)	126 (64)	<0.001	175 (56)	145 (63)	0.509

SMD: standarized mean difference. SD: Standard deviatio. N/A: not applicable.

RESULTS (Continuation)

Table 4. Multivariable logistic regression analysis for associated variables with <250 U/mL anti-S in cancer patients after propensity score matching

Variable	High response n=82	Low response n=26	aOR (95% IC)	P-value
Age (years) – median (SD)	56 (12)	61 (10)	1.03 (0.97-1.09)	0.262
Gender				
Female	58 (71)	17 (65)	reference	0.435
Male	24 (29)	9 (35)	1.52 (0.51-4.36)	
Comorbidities				
Diabetes mellitus	2 (2)	7 (3)	0.46 (0.04-3.28)	0.467
High blood pressure	12 (15)	5 (19)	1.16 (0.24-4.93)	0.842
Chemotherapy use	17 (21)	6 (23)	0.85 (0.22-2.93)	0.810
Active cancer status	31 (38)	15 (58)	2.89 (1.03-8.54)	0.046
Hematologic neoplasm	8 (1)	1 (0)	0.31 (0.01-2.00)	0.299
Vaccine type				
BNT162b2	44 (54)	10 (38)	reference	0.064
AZD1222	38 (46)	16 (62)	2.6 (0.97-7.81)	
Time since vaccination (days) – median (SD)	158 (64)	168 (51)	1.00 (0.99-1.01)	0.673

aOR: adjusted odds ratio. SD: Standard deviatio

CONCLUSION

In this study, CPs and HCWs had a high seroconversion rate (>99%) after SARS-CoV-2 vaccination. After the propensity score analysis, cancer was not associated with low (<250U/ml) antibody response; nevertheless, the BNT162b2 vaccine was associated with higher antibody titers within the entire cohort. In addition, when the sub-analysis in the cancer population was conducted, we observed a lower response in patients with active cancer. Even though a relationship between BNT162b2 and a high humoral response was observed in the cancer subgroup analysis, this was not statistically significant. This might be related to the difference in the time since vaccination between both groups, caused by the stepped vaccination program in our country, as well as the small number of patients after the propensity score matching. Overall, and based on previous reports in cancer and non-cancer populations, RNA vaccines showed a potential benefit for immunocompromised patients. Cancer patients should be prioritized in COVID-19 vaccination programs with mRNA-based vaccines.

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