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SARS-CoV-2 seroprevalence among cancer patients and household caregivers in a cancer hospital: Cross-sectional survey after the second COVID-19 wave in Thailand

Teerapat Ungtrakul [a,*], Gaidganok Sornsamdang [b], Kamonwan Soonklang [c], Siriporn Saeloo [c], Kasiruck Wittayasak [c], Ornpreya Suptawiwat [a], Rojjanaporn Pulmanausahakul [a], Nanthida Phattraprayoon [a], Chirayu Auewarakul [a], Nithi Mahanonda [b]

[a] Princess Srisavangavadhana College of Medicine, Chulabhorn Royal Academy, Bangkok, Thailand
[b] Chulabhorn Hospital, Chulabhorn Royal Academy, Bangkok, Thailand
[c] Chulabhorn Learning and Research Center, Chulabhorn Royal Academy, Bangkok, Thailand

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ABSTRACT

Objectives: Patients with cancer may be at an increased risk of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection and experience more severe outcomes. Low vaccine coverage in the early phase of the coronavirus disease 2019 (COVID-19) pandemic meant that personal and social measures to reduce viral spread were the only methods of lowering the risk of infection among cancer patients. This study explored the prevalence of SARS-CoV-2 antibodies in cancer patients and caregivers in a cancer hospital after the second COVID-19 outbreak in Thailand.

Study design: Cross-sectional study.

Methods: A SARS-CoV-2 seroprevalence cross-sectional survey was conducted among 200 cancer patients and 200 household caregivers in a tertiary cancer care hospital in Bangkok, Thailand. The survey took place between 4 March and May 31, 2021 - a time period covering the end of the second COVID-19 wave and the early phase of the third wave in Thailand.

Results: Rigorous personal and social measures to reduce viral spread among cancer patients and caregivers lead to an extremely low prevalence of SARS-CoV2 infection (0% among cancer patients and 1% among household caregivers).

Conclusion: This study demonstrates the importance of social distancing and personal hygiene measures for the prevention of SARS-CoV-2 infection, even when vaccine coverage is low.

1. Introduction

Cancer patients are more likely to develop serious illnesses after severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection [1]. Previous reports indicate differences in the prevalence of SARS-CoV-2 antibodies among cancer populations [2,3]. During the early phase of the coronavirus disease 2019 (COVID-19) pandemic, social distancing and personal hygiene were the only measures to reduce the risk of infection among cancer patients. Household caregivers have a significant role in cancer care in Thailand, where many people live in large, multigenerational households. Household caregivers may contribute to the transmission of SARS-CoV-2 to cancer patients, potentially leading to high morbidity and death.

This study explored the prevalence of SARS-CoV-2 antibodies in cancer patients and caregivers in a cancer hospital after the second COVID-19 outbreak in Thailand.

2. Methods

2.1. COVID-19 pandemic in Thailand

On January 13, 2020, Thailand was the first country outside China to report SARS-CoV-2 infection among travellers. The first and second waves (i.e. with the original Wuhan strain) of the COVID-19 outbreak

* Corresponding author. Princess Srisavangavadhana College of Medicine, Chulabhorn Royal Academy, 906 Kampangphet 6, Laksi, Bangkok, 10210, Thailand.
E-mail address: Teerapat.ung@cra.ac.th (T. Ungtrakul).

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occurred in March–April 2020 and January–February 2021, respectively. Public health measures, including a nationwide curfew, mandatory state quarantine for all inbound travellers, promotion of personal hygiene behaviours (e.g. mask-wearing, awareness of handwashing) and social distancing, were implemented [4]. In Thailand, the COVID-19 vaccination programme commenced in late February 2021. The third COVD-19 wave (with the Alpha [B.1.1.7] variants) started in April 2021 across the country.

2.2. Study design and patients

This was a cross-sectional study conducted between 4 March and May 31, 2021 - a time period covering the end of the second COVID-19 wave and the early phase of the third wave in Thailand.

Blood samples from 200 cancer patients at the Chulabhorn Hospital, a tertiary cancer hospital in Bangkok, Thailand, and 200 matched caregivers who had lived in the same households as patients for the past month were tested. All participants were asymptomatic at the time of blood collection. Survey questionnaires included baseline information, clinical and treatment data, personal hygiene and social behaviours, COVID-19 symptoms in the past 14 days and history of COVID-19 vaccination.

2.3. Laboratory testing

All tests were performed at the central laboratory unit (ISO 15189 accreditation) at the Chulabhorn Hospital according to standard operating procedures. Findings from an anti-SARS-CoV-2 nucleocapsid immunoassay (Elecys®, Roche Diagnostics GmbH, Mannheim, Germany) were measured using Cobas 8000 e602 analyzer. A cut-off index of 1.0 indicated a reactive result.

2.4. Statistical analyses

The overall prevalence of SARS-CoV-2 antibodies was estimated. Categorical variables were represented as counts and percentages, while continuous variables were represented as medians and ranges. The multivariate logistic regression model was used to determine predictors of positive SARS-CoV-2 antibodies. Furthermore, the correlation of SARS-CoV-2 antibody levels between cancer patients and caregivers was analysed using the Cramer's V test. Statistical analysis was performed using SPSS software version 16.1 (IBM Corp., Armonk, NY, USA).

3. Results

Of the 200 cancer patients, 70% were female and 45% were aged ≥60 years. The most frequent diagnosis was breast cancer (25%), followed by gynaecological cancer (23%). The majority of patients were diagnosed with advanced-stage cancer (68%) and 66% of patients were receiving active chemotherapy (Table 1).

Most patients (99.5%) lived in households with more than two people. Mask-wearing, hand hygiene and social distancing were observed in 97%, 87% and 87% of patients, respectively. Only four patients had received COVID-19 vaccination (Three received the Oxford-AstraZeneca vaccine and one received the CoronaVac vaccine). All patients tested negative for SARS-CoV-2 antibodies.

Household caregivers also exhibited rigorous personal hygiene: 97% wore masks, 84% had good hand hygiene and 85% practiced social distancing. Seven caregivers had received COVID-19 vaccination (one received the Oxford-AstraZeneca vaccine and six received the CoronaVac vaccine). Two caregivers tested positive for SARS-CoV-2 antibodies, but both denied any history of COVID-19 infection or symptoms potentially related to COVID-19 infection during the 14 days prior to SARS-CoV-2 antibody testing.

The overall prevalence of SARS-CoV-2 antibodies was exceptionally low in cancer patients (0%) and caregivers (1%). Owing to the low prevalence of SARS-CoV-2 antibodies, predictors of SARS-CoV-2 seropositivity could not be identified. Furthermore, no correlation in antibody prevalence was noted between cancer patients and caregivers.

Table 1
Characteristics of cancer patients (n = 200) and caregivers (n = 200).

Characteristics	Cancer patients (n = 200) [n (%)]	Caregivers (n = 200) [n (%)]
Male gender	60 (30)	76 (38)
Age ≥60 years	90 (45)	37 (19)
BMI ≥25 kg/m^2	62 (31)	89 (45)
ECOG performance status 0-2	200 (100)	
Household structure		
Living alone	1 (0.5)	
Living with >2 people	199 (99.5)	
Cancer type		
Breast cancer	50 (25)	–
Gynaecological cancer	46 (23)	
Colorectal cancer	40 (20)	
Lung cancer	23 (12)	
Primary liver cancer	10 (5)	
Other cancer	31 (15)	
Stage of cancer		
Early stage	65 (32)	–
Locally advanced/metastasis stage	135 (68)	
Cancer treatment duration before the study (year)		
<1	40 (20)	
1-3	105 (52)	
>3	55 (28)	
Active chemotherapy	131 (66)	–
Personal and social measures		
Mask-wearing	193 (97)	194 (97)
Hand hygiene	173 (87)	167 (84)
Social distancing	174 (87)	169 (85)
Received COVID-19 vaccine		
CoronaVac	1 (0.5)	6 (3)
Oxford-AstraZeneca	3 (1.5)	1 (0.5)
Reactive anti SARS-CoV-2 nucleocapsid protein	0 (0)	2 (1)

BMI; Body Mass Index, ECOG; Eastern Cooperative Oncology Group, COVID-19; Coronavirus disease 2019, SAR-CoV-2; Severe Acute Respiratory Syndrome Coronavirus 2.

4. Discussion

The prevalence of SARS-CoV-2 antibodies was low among cancer patients and caregivers after the second COVID-19 outbreak in Thailand. Previous studies have shown differences in the prevalence of SARS-CoV-2 antibodies, specifically among cancer populations. For example, the prevalence of SARS-CoV-2 antibodies was highest in cancer outpatients in Spain (31.4%) [3], while only a 3.6% prevalence was reported among cancer patients in a tertiary care centre in Austria [2]. Lerdsamran et al. reported 1.5–7.5% SARS-CoV-2 seropositivity among 1856 participants who shared or lived in communities with reported COVID-19 cases in Bangkok during Thailand's second and third epidemic waves [5]. This variance might be due to selection bias in the different studies. In addition, national public health policies specific to lockdown, school and business closure, travel restrictions, quarantine and border closure are also likely to have influenced the incidence of COVID-19 [6].

SARS-CoV-2 is highly transmissible via respiratory droplets. The low vaccination rates at the time of the present study meant that personal hygiene and public health interventions were the only methods to reduce the risk of infection. Evidence suggests that personal and social measures, including handwashing, mask-wearing and physical distancing, effectively reduce the incidence of COVID-19 infection [7]. As a result of the rigorous public health interventions, none of the cancer patients in the current study showed SARS-CoV-2 infection.

Household caregivers showed a similar rate of adherence to public health measures; however, two caregivers tested positive for SARS-CoV-2 antibodies. Although anti-nucleocapsid antibodies are highly specific

markers of previous SARS-CoV-2 infection, these individuals denied any history of COVID-19 infection. Notably, both individuals had received the CoronaVac vaccine in the previous 3 months. CoronaVac is an inactivated whole virus that can trigger a positive antibody response to nucleocapsid protein [8].

The elderly, health workers and immunocompromised individuals, including cancer patients, are the highest priority candidates for COVID-19 vaccination because of the risk of severe disease and death in these population groups [9]. To prevent household transmission, caregivers to cancer patients could be considered another priority group for COVID-19 vaccination.

The current study had some limitations. First, it was conducted during an early phase of the pandemic when only the original Wuhan strain was prevalent. The evolution of the SARS-CoV-2 genome has led to several variances of concern, including Alpha (B.1.1.7), Delta (B.1.617.2) and Omicron (B.1.1.529), all with higher transmissibility compared with the original strain [10,11]. Second, the study was conducted in one cancer centre. The hospital's policies, including those regulating systematic surveillance testing for SARS-CoV-2 infection among health care workers and cancer patients, may differ from those of other cancer centres.

Overall, the present study showed that social distancing and personal hygiene measures prevented SARS-CoV-2 infection in vulnerable cancer patients and their caregivers, even when vaccine coverage was low.

Ethical approval

This study was approved by Chulabhorn Research Institute Ethic Committee (no.0020/2564).

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CRediT authorship contribution statement

TU: Conceptualization, methodology, investigation, and writing (original draft, review, and editing). **GS:** Data curation. **KS**: Formal analysis. **SS:** Project administration. **KW:** Conceptualization. **OS:** Conceptualization. **RP:** Conceptualization, writing (review and editing). **NP:** writing (review and editing). **CA:** Supervision. **NM:** Supervision. All authors have approved the final manuscript.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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