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Impact of SARS-CoV2 on a Center for Mechanical Ventilation Weaning and Rehabilitation

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Abstract

Introduction: Since December 2019, the SARS-CoV2 virus has propagated throughout the world at great speed. Multiple studies describe its behavior in Intensive Care Units, but there is little information about its impact on a Critical Care Recovery Center (CCRC).
Objective: To show if the use of a contingency protocol could reduce virus dissemination among patients hospitalized in a CCRC.
Materials and Methods: Observational, retrospective, cross-sectional study. The study included patients older than 18 years on respiratory isolation for being a suspected case of SARS-CoV2, or close contact of a confirmed case or for their admission to the institution, during May 2020.
The values were expressed as median and interquartile range or frequency and percentage, according to the variable. The differences between positive and negative SARS-CoV2 cases were evaluated with the median test and the Fisher' s Exact Test.
Results: During the study period, 30 patients were placed in respiratory isolation (53% suspected cases, 13% close contact and 34% admission to the institution). 5 of them tested positive for SARS-CoV2, with a median of 61 years (18-71), mostly males (4/5), 80% tracheostomized and 33% with invasive mechanical ventilatory assistance. One patient died from complications associated with SARS-CoV2.
No significant differences were found in the number of positive cases according to the isolation cause (p = 0.37) or the clinical-demographic characteristics between positive and negative cases.
Conclusion: The use of a contingency protocol for patients potentially infected with SARS-CoV2 in a CCRC could reduce the virus dissemination inside the institution.

Key words: SARS-CoV2; Tracheostomy; Rehabilitation Center; Patient isolation

Introduction

During December 2019, in Wuhan, China, a virus of unknown etiology, called at that moment 2019-nCov[1] was beginning to disseminate. On February 11, 2020, the coronavirus study group of the International Committee on Taxonomy of Viruses defined it as "severe acute respiratory syndrome coronavirus-2" (SARS-CoV2)[2].

There are multiple publications around the world about the impact of SARS-CoV2 on the Critical Care Units (CCU), where a great percentage of moderate or severe infected patients required invasive mechanical ventilation[3]. The known mortality of this virus is 2.9% up to now, and even higher in the cohort of patients admitted to the CCU, with values close to 50%[4].

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Between May 1 and 31, 2020, an exponential increase in positive cases for SARS-CoV2[5] was observed in the Autonomous City of Buenos Aires (CABA). In our institution, there weren't any patients referred from another Acute Care Center who showed detectable virus, nevertheless we thought it was essential to be able to describe the epidemiological characteristics upon the first registration of a patient with SARS-CoV2 in our institution. We believe that early detection of the cases and their immediate referral to an Acute Care Center, the use of personal protection barriers for attending every patient, and maximal protection in suspected or confirmed cases, together with the decision on the part of our institution to cancel visits, could control virus propagation among hospitalized patients, since they are high-risk subjects due to their critical condition.

The purpose of this study is to show if the use of a contingency protocol could reduce virus dissemination among patients hospitalized in a Critical Care and Rehabilitation Clinic.

Materials and Methods

An observational, retrospective, cross-sectional study was carried out between May 1 and 31, 2020, at the Santa Catalina Neurorehabilitación Clínica, Autonomous City of Buenos Aires, Argentina.

Our institution is a center for neurorehabilitation and management of chronic critically ill patients. Thus, all the patients admitted to our center are referred from Acute Care Centers. We have a maximum availability of 80 beds distributed in rooms shared by up to two patients. We receive an average of 150 patients per year, 35% of which are tracheostomized and 25% have mechanical ventilatory assistance (MVA).

The study has been approved by the Teaching and Research Committee and the Ethics Committee of the institution. Due to the retrospective nature of the study and the fact that information was obtained from clinical records, protecting the personal identification data of the patients, no additional informed consent was required aside from the anticipatory informed consent signed by subjects upon admission to the institution.

Inclusion criteria

- Patients older than 18 years under respiratory isolation for suspected infection with SARS-CoV2.

Procedures

We reviewed the clinical records of patients who required respiratory isolation during their hospitalization, and created a database. Patients' personal information was not included; it was encoded using correlative numbers starting from the day in which they were isolated.

In order to protect the safety of all the patients in the institution and taking into account the fact that our admissions come from Acute Care Centers only, we identified three types of patients requiring respiratory isolation:

- *Suspected case:* defined as any patient presenting fever (37.5 °C or higher) or symptoms compatible with respiratory infection or any other symptom of SARS-CoV2, according to the criteria of the Ministry of Health of the Argentine Nation (cough, odynophagia, breathing difficulty, anosmia and dysgeusia)[6].
- *Close contact:* defined as any patient who has been less than 2 meters away from a confirmed case and presented symptoms, during at least 15 minutes. Generally speaking, this criterion was applied to patients who shared room with a suspected case confirmed positive for SARS-CoV2 infection or had contact with a health staff member who had been found to be positive for SARS-CoV2.
- *Admissions:* "Admission" was defined as every patient admitted to our institution and referred from an Acute Care Center. All of those patients were placed under respiratory isolation for 14 days and were then taken a sample for SARS-CoV2 analysis as from the third hospitalization day, since it was impossible to know if they could have got infected in the referral center.

"Positive case" was defined as every patient showing detectable SARS-CoV2 in the Reverse Transcription Polymerase Chain Reaction (RT-PCR) Test from a nasopharyngeal swab sample, in patients without artificial airways (AAW) or from tracheal secretion aspirate in patients with tracheostomy (TQT).

Respiratory isolation consisted in placing the patient in an individual room and with a surgical mask, in the case of patients without AAW, or placing a bacterial/viral filter with more than 99.7% efficacy next to the heat and moist exchanger (HME) in TQT patients. The health staff entering the room to assist the patient had to wear grade 3 personal protection elements (goggles, face shield, N95 respirator, hair net, hydro-repellent gown and latex gloves)[7].

Apart from what has already been described, it was stipulated that all the members of the health staff remained with face shield and mask on (surgical mask in patients without aerosol generating mechanisms or N95 respirator in patients with aerosolization mechanisms)[7]. The purpose of this order was to prevent contagion from and to the staff, due to the possibility of there being asymptomatic cases that do not meet the criteria indicated for performing the nasopharyngeal swab and RT-PCR for SARS-CoV2[6]. No massive testing to the health staff was performed to find asymptomatic patients. On the other hand, in accordance with the social, preventive and mandatory isolation established by Decree 297/2020 of the National Executive Power of our country[8], visits to patients from family members were suspended.

Measurement Variables

Once the patients were placed under respiratory isolation for suspected SARS-CoV2 infection, the following clinical-demographic information was obtained: age; sex; reasons for admission (diagnosis for which the patient was admitted to the CCU of the referring Acute Care Center); respiratory history (defined as the presence or absence of chronic obstructive pulmonary disease, asthma, pneumonia, airway disorder or other), neurologic history (defined as the presence or absence of history of stroke, traumatic brain injury, amyotrophic lateral sclerosis, Parkinson's or other), toxic-metabolic history (defined as the presence or absence of history of diabetes, hypothyroidism, obesity, chronic renal failure, smoking, alcohol/drug abuse or other), cardiovascular history (defined as the presence or absence of history of arterial hypertension, myocardial revascularization surgery, acute myocardial infarction or other) and oncologic history (defined as the presence or absence of cancer history); TQT (defined as the presence of a tracheostomy cannula the moment the patient tests positive for SARS-CoV2); IMVA-P (defined as the requirement for prolonged invasive mechanical ventilatory assistance the moment the patient tests positive for SARS-CoV2); NIMVA-P (defined as the requirement for prolonged non-invasive mechanical ventilatory assistance the moment the patient tests positive for SARS-CoV2); days until positive SARS-CoV2 (defined as the number of days since the patient was considered a suspected case until a positive result was obtained); and death (defined as death within 25 days after testing positive for SARS-CoV2 in our institution).

Statistical Analysis

Descriptive statistics values were expressed as median and interquartile range (IQR) 0.25-0.75 for the quantitative variables and as frequency and percentage for categorical variables. In order to evaluate the differences between both groups, we used the median test for continuous variables and the Fisher's Exact Test for categorical variables. The statistical significance was established in a p value of $p < 0.05$.

Data were analyzed using the R program, version 3.5.2 through the RStudio Interface.

Results

During May, 2020, 30 patients were placed under respiratory isolation in our institution. 53% of those patients were isolated for presenting symptoms compatible with the definition of a suspected case, and 13% were isolated for being close contact of a positive case, whereas the rest of isolated patients were those who had been referred from Acute Care Centers. In total, we found 5 positive cases among all of the patients who were tested for SARS-CoV2 through RT-PCR **(Figure 1)**.

80% of patients who tested positive for SARS-CoV2 were male, with a median of age of 61 years (range 18-71 years). 80% were TQT and 33% had IMVA. One patient was in the process of changing interface from IMVA through TQT to non-invasive ventilation (NIV) with oronasal mask (**Table 1**).

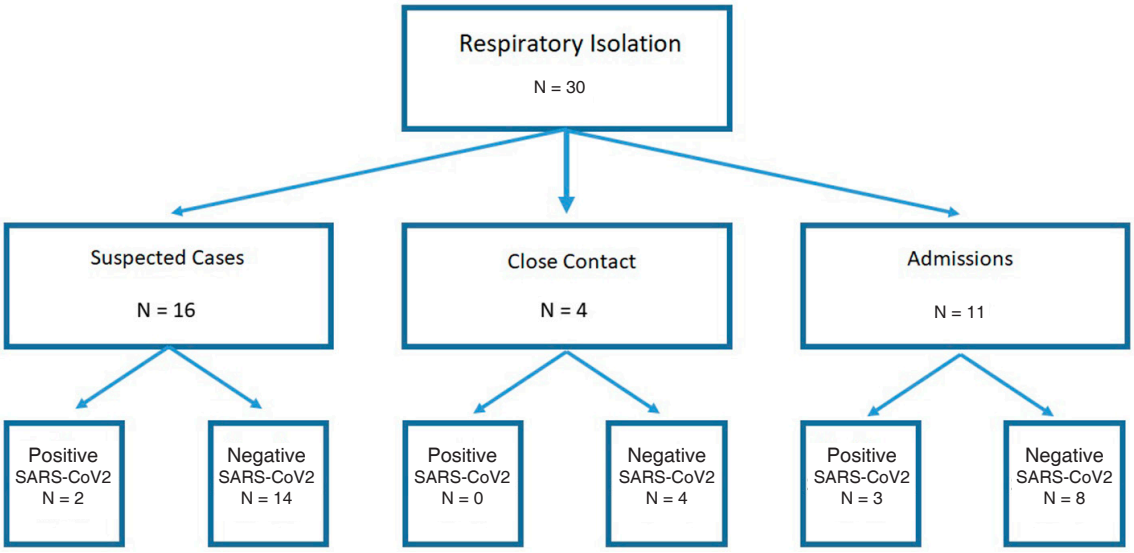

Figure 2. Flow diagram of patients under respiratory isolation. SARS-CoV2: severe acute respiratory syndrome coronavirus type 2

TABLE 1. Characteristics of patients positive for SARS-COV2

Age	Sexo	Admission diagnosis	TQT	AVMi	VMNI	Respiratory history	Cardiovascular history	Neurological history	Metabolic history	Oncologic history	Reason for suspicion	Days until positive SARS-Cov2	Death
56	M	Neurological	Yes	No	No	Asthma	AHT	STROKE	No	No	Fever	1	Yes
71	M	Respiratory	Yes	Yes	No	COPD	AHT	NO	No	Tongue cancer	Admission	7	No
69	M	Neurological	No	No	No	No	AHT	Meningoencephalitis	DBT	No	Admission	12	No
61	M	Respiratory	Yes	No	Yes	COPD	AHT	NO	Obese	No	Fever	2	No
18	F	Neurological	Yes	Yes	No	No	No	Neurodegenerative disease	No	No	Admission	4	No

SARS-CoV2: severe acute respiratory syndrome coronavirus type 2; TQT: tracheostomy; IMVA-P: prolonged invasive mechanical ventilatory assistance; NIMV: non-invasive mechanical ventilation; AHT: arterial hypertension; COPD: chronic obstructive pulmonary disease; DBT: diabetes.

No statistically significant differences were found in the number of positive cases between the different causes for isolation ($p = 0.37$). No significant differences were found, either, between the patients who tested positive and negative for SARS-CoV2 regarding reason for admission to the ICU, personal history, presence of TQT and the need for mechanical ventilatory assistance, both invasive and non-invasive (**Table 2**).

TABLE 2. Characteristics of patients with respiratory isolation for SARS-COV2

		Positive SARS-COV2	Negative SARS-COV2	p Value
Age		61 (18-71)	65 (27-80)	0.81
Sex (M)		4	20	1
Reason for admission	Respiratory	2	3	0,18
	Neurological	3	18	0,53
	Clinical	0	3	1
	Trauma	0	2	1
Personal history	Respiratory	3	6	0,14
	Cardiovascular	3	18	0,62
	Neurological	3	10	0,63
	Toxic-metabolic	2	8	1
	Oncologic	0	3	1
NAW		1	13	0,36
TQT		4	12	0,34
IMVA-P		2	2	0,12
VMNI		1	1	0,31

SARS-CoV2: severe acute respiratory syndrome coronavirus type 2; TQT: tracheostomy; IMVA-P: prolonged invasive mechanical ventilatory assistance; NIMV: non-invasive mechanical ventilation

After 25 days of follow-up, only patient 1, who showed multiple risk factors associated with a worse prognosis, died from complications related to his infection by SARS-CoV2 in an Acute Care Center.

Discussion

In order to protect the integrity both of the patients and the staff, since the beginning of the social, preventive and mandatory isolation stated by the national government[8], it was determined that all visits to our institution should be prohibited and all the staff members should wear face shield and mask (surgical mask or N95 respirator, according to the exposure to aerosol generating mechanisms) for assisting patients and while they were in common areas. On the other hand, during the month of May, 2020, CABA suffered an increase in SARS-CoV2 positive cases[5].

On May 5, 2020, the first confirmed case of SARS-CoV2 in our institution was registered. The person had been infected from a member of the health staff who started having symptoms. After this situation, we proceeded to isolate more than 40% of hospitalized patients, and found only one positive case. This is different from what was published in Washington by Temet et al, where after the first positive case, there were in consequence 54% of infected patients and 33.7 %[9] mortality. Our sample was way below those values, with only 16.7% of positive cases during the month after the first detected case and only one death among those patients after 25 days of follow-up. We believe those results have to do with the early recognition of suspected SARS-CoV2 cases and taking the appropriate measures, as well as the early use of personal protection elements on the part of the institution's professionals. This could explain the fact that there were no positive cases among patients who had been isolated for being close contact of a patient infected with SARS-CoV2. Another aspect to highlight is the possible importance

of health staff multitasking, which would seem to be an important factor for the dissemination of the virus among different institutions.

Both the age and sex of patients with positive RT-PCR are in line with the information published so far[3, 4, 9, 10]. It is worth mentioning that the only patient who died was within the age range found in the multivariate analysis about mortality risk factors of the study of Zhou et al[11].

The necessary steps were taken regarding the management of tracheostomized patients, taking into account the different guides for this pandemic[12-14]. However, we observed that 80% of infected patients showed AAW. The reason for this could be that TQT patients require extra assistance from the healthcare staff.

It is important to mention that, although NIV placement is under discussion due to the aerosolization risk[15, 16], our first case occurred in a patient who was changing the mechanical ventilation interface, from invasive to non-invasive. However, this situation did not cause him to infect his roommate or the members of the institution's healthcare staff who were in contact with him (every close contact spent 14 isolation days and underwent swab sampling, according to the national protocols)[17]. The patient was using NIV as provided under the treatment protocol, but the moment he was considered a suspected case, we decided to inflate the endotracheal tube cuff of the TQT and place IMVA with closed-circuit aspiration, HME and bacterial/viral filter for better control of aerosols, according to the published recommendations[12-14].

Some limitations of this study are the short study period (31 days) and follow-up period (25 days) of patients positive for SARS-CoV2. It is possible that some patients were infected during the study period, but started having symptoms after it was closed. Also, we can't exclude the possibility that some of the four infected patients who were still alive after 25 days of follow-up died due to the consequences of the infection. On the other hand, the limited size of our sample, specially of positive cases, determined the use of the nonparametric hypothesis test with lower statistical power to detect differences among groups. Finally, we can't exclude the presence of asymptomatic cases within the study period, since no SARS-CoV2 sample collection or test were done with RT-PCR in patients not requiring respiratory isolation for being a suspected case, a close contact or for being admitted to our institution.

Conclusion

The use of a protocol with respiratory isolation criteria and analysis of patients potentially infected with SARS-CoV2 in a Neurorehabilitation and Critical Care Center could reduce the rate of SARS-CoV2 infections within the institution.

The authors declare they don't have any external funding sources or conflict of interest.

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