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Coronavirus Pandemic

Clinical behavior of COVID-19 in a reference public hospital in Mexico City during SARS-CoV-2 epidemiological waves

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Abstract

Introduction: The severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) pandemic presented a unique behavior in each of the epidemiological waves in terms of clinical presentation, severity, and transmissibility; in Mexico, as in the rest of the world. The objective of this study was to describe the clinical severity and risk factors associated with mortality in patients hospitalized with coronavirus disease 2019 (COVID-19), by comparing each epidemiological wave in a reference public hospital in Mexico City.

Methodology: The Kaplan-Meier and logistic regression analyses were performed to determine the mortality and odds ratio of 1,752 patients according to their specific comorbidity and during each epidemiological wave.

Results: The average age of the patients was 54 years. Each patient presented at least one comorbidity; such as, diabetes mellitus (33.3%), systemic arterial hypertension (28.3%), chronic kidney disease (8.67%), chronic obstructive pulmonary disease (1.35%), and cancer (4.82%). The average length of hospital stay was 11.93 days. General mortality was 29%, with the percentage of deaths being higher in the first and second waves of COVID-19. Admission to the intensive care unit and mechanical ventilation were required in 21.6% and 5%, respectively.

Conclusions: Chronic diseases such as diabetes mellitus and arterial hypertension were associated with a higher risk of death in patients hospitalized with COVID-19. This phenomenon was more evident during the first and second epidemiological waves of the pandemic in Mexico.

Key words: SARS-CoV-2; comorbidity; mortality.

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Introduction

The World Health Organization (WHO) defines an epidemiological wave as an exponential increase in cases of a disease in a region, and which impacts the society in various ways. Each subsequent wave must involve the same etiological agent and a sustained increase in cases following a decline. The first coronavirus disease 2019 (COVID-19) case was reported in Mexico in February 2020; and subsequently the hospitals around the country were converted into COVID-19 treatment centers to treat patients infected with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). Since then, the exponential rise in infections marked the onset of epidemiological waves in the country [1,2].

The Mexican government's Ministry of Health issued weekly epidemiological reports on COVID-19, which indicated that the first wave began on 24 February 2020, and ended on 27 September 2020; with 9,556 new cases per day, 47,472 deaths, and a national hospital occupancy rate of 89%. In September 2020, there were 2,917 new cases and 76,246 deaths, marking the end of the first wave of COVID-19.

The second wave of COVID-19 started on 28 September 2020, and was marked by accelerated increase in new cases, reaching 15,000 new cases daily with a total of 733,717 cases and 76,603 deaths. The SARS-CoV-2 vaccination campaign began in December 2020, and led to a significant reduction in infections, hospitalizations, and deaths.

According to the reports from Mexico's Ministry of Health, increasing number of COVID-19 cases were again recorded starting on 6 July 2021, which marked the beginning of the third epidemiological wave. This wave concluded in January 2022, with a total of 1,358,852 confirmed cases and 309,736 confirmed deaths.

The fourth epidemiological wave began on 20 December 2021, with an incidence of 17,655 new daily cases, and the wave ended in the last week of February 2022.

There have been 661,764,982 reported cases of COVID-19 and 6,695,956 deaths worldwide, as of January 2023. In Mexico, these figures correspond to 7,576,695 cases and 345,216 deaths [6]. The variants of the virus exhibited different behaviors throughout the pandemic, leading to distinct patterns regarding clinical presentation, severity, and transmissibility in each epidemiological wave [3–5].

The objective of this study was to describe the clinical and demographic characteristics and risk factors associated with mortality in patients admitted for the treatment of SARS-CoV-2 infection at a reference public hospital in Mexico City, and compare the variables across epidemiological waves.

Methodology

This was an observational, retrospective study. The medical records of 1,752 patients admitted to the Pulmonology Department of the General Hospital of Mexico, in Mexico City, from March 2020 to March 2022 were reviewed. The timings of each epidemiological wave were based on the reports of the Ministry of Health of Mexico. The patients who had tested positive for SARS-CoV-2 by real time reverse transcriptase polymerase chain reaction (RT-PCR) were approved by the Institute of Epidemiological Diagnosis and Reference in Mexico to be included in this study. The criterion for hospital admission of COVID-19 patients was the presence of one or more signs of acute respiratory failure (tachypnea, SpO_2 < 90%, and/or presence of pulmonary infiltrates and dyspnea). The patients were divided into four groups based on the first four epidemiological waves. The data were analyzed with the statistical software R 4.1.2 and Studio. The Kaplan-Meier analysis with Nelson-Aalen adjustment was performed on data on survival/mortality after hospital admission. A logistic regression analysis was performed taking improvement and death as key variables and the odds ratio was obtained.

Results

The study included data from 1,752 patients hospitalized with acute respiratory failure caused by SARS-CoV-2 infection, with a range age of 52–56 years. A total of 519, 743, 360, and 130 patients were included during the first, second, third, and fourth epidemiological waves, respectively. There were no differences in the survival rate between the four epidemiological waves. The overall mortality rate was 29%. 71% of the patients survived, and all were discharged from the hospital due to improvement. The male gender predominated (60%) among all patients, with ages between 50 and 60 years. The comorbidities present were diabetes mellitus in 33.3%, systemic arterial hypertension in 28.3%, chronic kidney disease in 8.67%, chronic obstructive pulmonary disease in 1.35%, and cancer in 4.82%. The average length of hospital stay was 12 days. The percentage of patients who required admission to the intensive care unit was 21.6%, of which 5%, required mechanical ventilation.

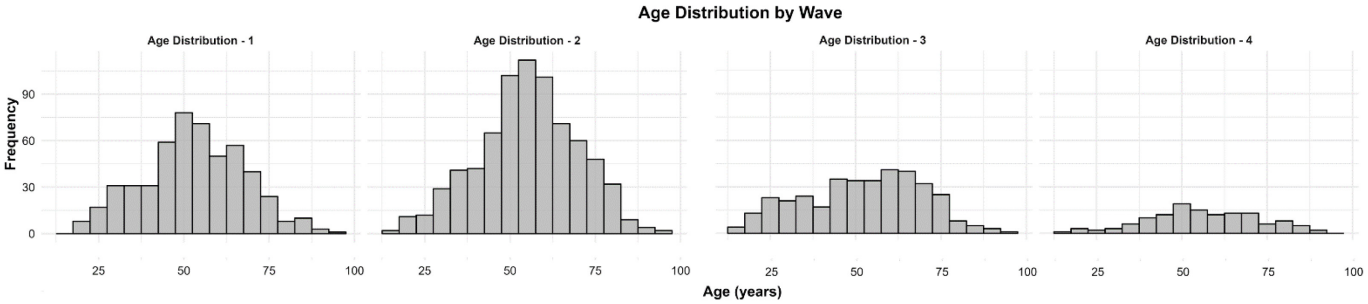
The odds ratios for the most relevant risk factors during the first epidemiological wave were 1.27 for diabetes mellitus, 1.13 for systemic arterial hypertension, 2.12 for chronic kidney disease, and 0.29 for liver disease. During the second wave the odds ratios were 1.42 for diabetes mellitus, 1.21 for systemic arterial hypertension, 2.35 for chronic kidney disease, and 4.41 for liver disease. During the third wave the odds ratios were 1.60 for diabetes mellitus, 1.47 for systemic arterial hypertension, 1.72 for chronic kidney

Table 1. Age distribution according to the epidemiological waves of coronavirus disease 2019 (COVID-19).

Age (yrs)	First wave (n = 519)			Second wave (n = 743)			Third wave (n = 360)			Fourth wave (n = 130)		
	Deceased	Survivors	95% CI	Deceased	Survivors	95% CI	Deceased	Survivors	95% CI	Deceased	Survivors	95% CI
0–19	1	3	–	1	7	–	0	6	–	1	0	NA
20–24	2	7	0.008–20.29	1	6	0.007–67.12	0	16	0	0	5	0.02
25–29	4	18	0.02–25.30	4	20	0.01–9.15	4	27	0–8.6	0	1	0.02
30–34	4	27	0.03–36.91	7	21	0.008–4.54	1	15	0–103.8	1	2	0.02
35–39	3	33	0.05–65.67	5	41	0.02–13.09	3	21	0–10.41	0	5	0.12
40–44	9	30	0.01–15.91	6	47	0.02–11.74	4	17	0–5.61	0	14	0.35
45–49	15	47	0.01–14.15	14	60	0.01–5.46	6	30	0–5.59	2	14	0.11
50–54	15	64	0.02–19.10	30	78	0.007–3.11	4	25	0–8.01	6	13	0.04
55–59	28	38	0.008-6.04	27	90	0.01–3.99	18	26	0–1.41	2	10	0.08
60–64	18	35	0.01–8.81	31	49	0.004–1.92	15	24	0–1.59	0	11	0.28
65–69	17	27	0.009–7.31	34	35	0.003–1.26	16	22	0–1.37	2	11	0.09
70–74	25	15	0.003–2.85	32	25	0.002–0.98	10	19	0–2.01	1	9	0.11
75–79	4	9	0.01–13.67	17	22	0.003–1.71	7	9	0–1.58	4	3	0.01
+ 80	12	9	0.004–3.92	17	16	0.002–1.29	8	7	0–1.10	7	6	0.01
Total	157	362		226	517		96	264		26	104	

CI: confidence interval.

Figure 1. Age distribution by epidemiological waves of COVID-19 in Mexico.



disease, and 0.86 for liver disease. During the fourth wave the odds ratios were 1.53 for diabetes mellitus, 2.1 for systemic arterial hypertension, 0.88 for chronic kidney disease, and 6.13 for liver disease. These values identified the comorbidities that implied greater risk and their impact on the course of the disease of the patients included in this study.

Table 1 shows the distribution of patients by the epidemiological waves of COVID-19. No significant difference in age distribution was observed when comparing the different waves (Figure 1). Figure 2 shows the survival function in the Kaplan-Meier plot. The mean hospital stay from admission to death was 46, 38, 50, and 42 days in the first, second, third, and fourth waves, respectively, indicating that an earlier mortality was observed during the second wave.

The Kaplan-Meier graphs in Figures 3 and 4 show the survival function in relation to the most frequent comorbidities found. In the case of patients with diabetes mellitus, the average hospital stay until death was 38, 33, and 44 days for the first, second and third waves. Diabetes mellitus did not represent a risk factor for mortality during the fourth wave. The average time to death for patients with systemic arterial hypertension was 36, 34, 35 and 42 days; and was statistically different in the fourth wave.

During the first COVID-19 wave there were 30% deaths, and the majority who died were in age group 55–59 years (95% CI: 0.008–6.04). The male gender predominated (75%) among those who died and the males had an average of two comorbidities. The mortality during the second wave was also 30%. The majority were between 65 and 69 years old (95% CI: 0.003–1.26) and had three comorbidities on average. During the third wave, admissions decreased substantially, and the group aged 55 to 59 years predominated among the deaths (95% CI: 0-1.41). In the fourth wave, there were only 130 hospitalized

Figure 2. Kaplan-Meier graph of adjusted survival of COVID-19 patients during the epidemiological waves in Mexico.

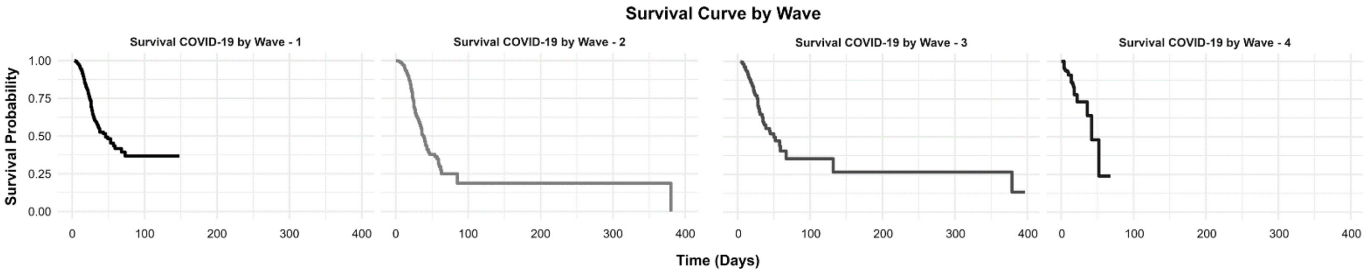


Figure 3. Kaplan-Meier plot of adjusted survival of COVID-19 patients with diabetes mellitus (DM).

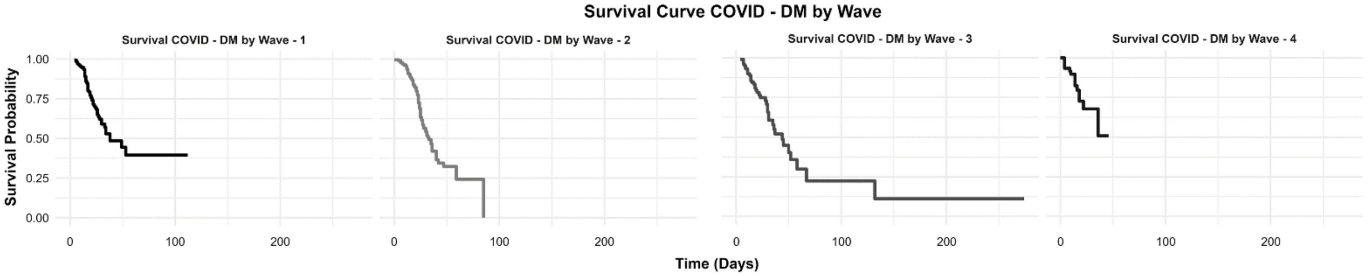
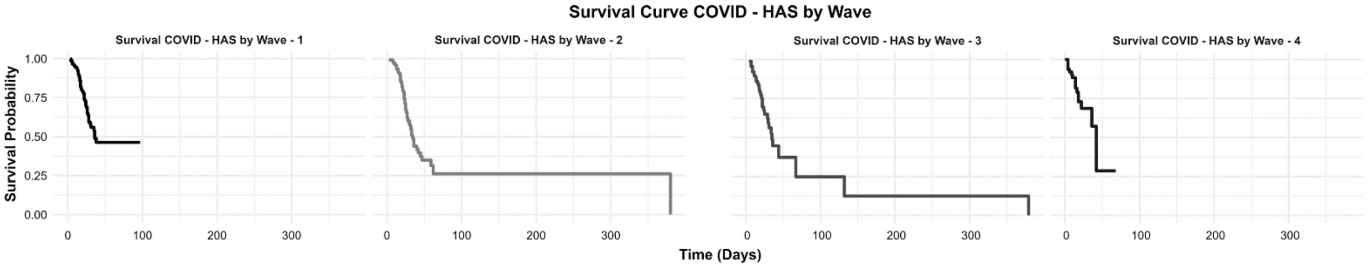


Figure 4. Kaplan-Meier plot of adjusted survival of COVID-19 patients with systemic arterial hypertension (HAS).



patients. A total of 122 patients died in the third and fourth waves.

Discussion

In this study of patients hospitalized with SARS-CoV-2 during the pandemic, we observed a predominance of the male gender with ages between 50 and 60 years, unlike other epidemiological studies on COVID-19 in which age > 65 years was associated with higher rates of hospitalization, complications, and mortality [7].

In Mexico, 10.3% of the population has diabetes mellitus, and the prevalence of systemic arterial hypertension is 49.2% [8] These conditions accounted for 80% of the comorbidities among hospitalized patients with COVID-19 in this study. Diabetes mellitus was the most frequent comorbidity among hospitalized patients (33.3%) and among those who required mechanical ventilation. Furthermore, these patients had an average value of glycosylated hemoglobin > 13%. These data coincide with studies that describe that the greater the lack of glycemic control in patients infected with SARS-CoV-2, the greater the complications and mortality. On the other hand, patients with systemic arterial hypertension (28.3%) had a higher risk of being admitted to the intensive care unit and dying [9–12]. Chronic kidney disease was associated with higher rates of hospitalization, complications, and clinical severity (8.67%), as has been reported in other studies [13].

Aging accompanied by a state of frailty and chronic degenerative diseases can lead to accelerated functional deterioration, disability, and death due to COVID-19. There is a 5 times greater risk of dying from COVID-19 in people over 60 years of age in Mexico; and the mortality can reach 80% if there is a comorbidity present. [13].

According to previous studies, vaccination against COVID-19 can protect from future variants, and can increase immunity by up to 95.5% [14]. The hospitalization rates, deaths, and COVID-19 positive cases in Mexico reduced after the population > 60 years of age were vaccinated, starting in February 2021; thus, highlighting the importance of adding immunization to existing preventive measures [15]. Currently, COVID-19 cases have decreased substantially; and the states with the most active cases are Baja California Sur, Sinaloa, and Mexico City, with a hospital occupancy of less than 3% [16].

Advances in the medical treatment of COVID-19, including the disuse of certain drugs that did not show usefulness, occurred progressively throughout the epidemiological waves; which, together with the lesser hospital occupation and a lower workload for healthcare providers, could have influenced the lowest mortality observed during the later waves compared to the initial ones.

A limitation of the present study was the use of clinical data from a single hospital in Mexico City (one of the first to admit COVID-19 patients); therefore, the results cannot be generalized to the entire country. The inclusion criteria allowed us to use data from patients with respiratory deterioration and uncontrolled chronic diseases who were admitted to the hospital; patients who could have been cared for by medical personnel at home were excluded.

Conclusions

The highest number of hospitalizations due to SARS-CoV-2 in our center occurred during the first and second epidemiological waves, which were those with the highest mortality rates. The most affected were men of age between 50 and 60 years, and carrying at least one risk factor; which is why it is very important to create public health strategies aimed at prevention, timely diagnosis, and control of chronic conditions to reduce hospital admission and death.

Data availability

The data used to support the findings of this study are available upon request from the corresponding author.

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Conflict of interests

No conflict of interests is declared.

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