Epidemiology of hospitalized patients with COVID-19 in a tertiary care hospital

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Abstract

Introduction: COVID-19, caused by the betacoronavirus SARS-CoV-2, has overwhelmed the world's health systems. **Objective:** To describe the epidemiological characteristics of patients treated in a tertiary care hospital. **Methods:** A retrospective cohort study of patients diagnosed with or suspected of having COVID-19 from March 23 to July 31, 2020 was conducted. **Results:** 4,401 patients were hospitalized at Central Military Hospital, out of which 35 % were beneficiaries, 26 % civilians, 28 % active military personnel, and only 11 %, retired military personnel. Male gender predominated, both in hospitalized patients and in those who died, as well as the O+ group and absence of comorbidities; among the observed comorbidities, the main ones were overweight and diabetes. Hospitalized patients' median age was 49 years, while median age of those who died was 62 years; women older than 51 years had a higher risk of dying. Adjusted case fatality rate was 18.5 %; 50 % died within the first six days. **Conclusions:** In this study, the epidemiological characteristics and main comorbidities in Mexican patients with SARS-CoV-2 infection were identified.

KEY WORDS: Epidemiology. COVID-19. Tertiary care hospital.

Epidemiología de los pacientes hospitalizados con COVID-19 en un hospital de tercer nivel

Resumen

Introducción: COVID-19, causada por el betacoronavirus SARS-CoV-2, ha saturado los sistemas de salud del mundo. **Objetivo:** Describir las características epidemiológicas de los pacientes atendidos en un hospital de tercer nivel. **Métodos:** Se realizó una cohorte retrospectiva de pacientes con diagnóstico o sospecha de COVID-19, del 23 de marzo al 31 de julio de 2020. **Resultados:** En el Hospital Central Militar se hospitalizaron 4401 pacientes, 35 % derechohabientes, 26 % civiles, 28 % militares en activo y solo 11 %, militares retirados. Predominó el sexo masculino, tanto en los pacientes hospitalizados como en los que fallecieron, el grupo O+ y la ausencia de comorbilidades; entre las comorbilidades que se observaron, las principales fueron el sobrepeso y la diabetes. La mediana de edad de los pacientes hospitalizados fue de 49 años, mientras que 62 años

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fue la edad de quienes fallecieron; las mujeres mayores de 51 años tuvieron mayor riesgo de fallecer. La tasa de letalidad ajustada fue de 18.5 %; 50 % falleció durante los primeros seis días. **Conclusiones:** En este estudio se lograron identificar las características epidemiológicas y se destacaron las principales comorbilidades en pacientes mexicanos con infección por SARS-CoV-2.

PALABRAS CLAVE: Epidemiología. COVID-19. Hospital de tercer nivel.

Introduction

In December 2019, coronavirus disease 2019 (COVID-19) emerged in Wuhan, China, and generated a public health emergency of international concern due to its rapid spread, overburdening health systems. Its clinical presentation varies from asymptomatic cases to the development of severe pneumonia.¹

In Mexico, the first case was recorded on February 28, 2020; by September 11, 2020, 652,364 cases and 69,649 deaths had been reported.² The General Directorate of Epidemiology generated various strategies and guidelines for epidemiological surveillance, which include identification of cases, contact tracing, timely notification to the National System of Epidemiological Surveillance (SINAVE – *Sistema Nacional de Vigilancia Epidemiológica*), as well as aspects for adequate collection, handling and shipment of samples and analytical control available for the confirmation of cases. COVID-19 diagnosis is established with the performance of the reverse transcriptase-polymerase chain reaction (RT-PCR) assay together with clinical and radiological findings.³

The purpose of this work was to describe the demographic and epidemiological characteristics of patients hospitalized at Central Military Hospital from March 23 to July 31, 2020.

Methods

The medical records of patients hospitalized for COVID-19 were reviewed according to the criteria established by SINAVE, between March 23 and July 31, 2020 in a tertiary care hospital, in compliance with the guidelines of the Declaration of Helsinki.³

The comorbidities that were considered were those known and reported by the patients. The frequency of overweight and obesity was determined according to the body mass index (BMI) in a sample of 656 confirmed patients.

Categorical variables were reported as frequencies and percentages; continuous variables were described in medians and interquartile ranges (IQR).

The comparison of comorbidities, type of comorbidity, gender and age groups between suspected and confirmed cases was carried out using Fisher's exact test and Mann-Whitney's U-test for continuous variables. Median survival was determined by Kaplan-Meier analysis. A p-value < 0.05 was considered to be statistically significant; the analysis was carried out with the SPSS program, version 27.

Results

Four-thousand four hundred and one patients were admitted to the Central Military Hospital, in Mexico City, between March 23 and July 31, 2020. The highest admission peak was between May 27 and June 24 (Fig. 1); the day with the highest number of admissions was May 29 (106 patients).

The hospital was reconverted into a COVID hospital; it complied with the guidelines established on April 5, 2020 and allowed the care of non-beneficiary patients; 26 % of hospitalized patients were civilians (Table 1).⁴

Among the patients admitted for COVID-19, male gender and blood group O+ predominated; median age was 49 years (Table 1). The age range that predominated was 41 to 50 years (Table 2).

Most admitted patients had no known comorbidities. The predominant comorbidity was diabetes, followed by hypertension and obesity (Table 1); however, in 656 confirmed patients, median BMI was recorded to be 27.1 kg/m², which indicates that 76.1 % had overweight or obesity (Table 3).

Table 4 shows the characteristics of the patients who died (n = 1,059), with a crude case fatality rate of 24 % and an adjusted case fatality rate of 18.5 %. The period with the highest case fatality rate was between May 20 and June 24, as shown in figure 2, with a new increase from July 15 on.

Overall, the male gender and blood group O+ predominated; the rate of deceased males/hospitalized males was higher than the rate of deceased females/hospitalized females (Tables 4 and 5).

Median age of the patients who died was 62 years (Table 4). The case fatality rate percentage was

Figure 1. Frequency of COVID-19-diagnosed patients admissions per day at Central Military Hospital, Mexico City. Total admissions are shown, as well as admissions of patients with suspected COVID-19 (patients who meet clinical criteria with no RT-PCR test) or RT-PCR-confirmed patients.

Figure 2. Frequency of admissions and deaths of patients diagnosed with or suspicious of having COVID-19 per day at Central Military Hospital, Mexico City. Total hospitalizations are shown, as well as patients who died from COVID-19.

Table 1. Patients with COVID-19 hospitalized at Central Military Hospital, Mexico City

Variable	Total (n = 4,401)		Suspected (n = 3,553, 81 %)		Confirmed (n = 848, 21 %)		p
	Median	IQR	Median	IQR	Median	IQR	
Age	49	38, 72	49	38, 62	49	39.5, 62	0.5**
	n	%	n	%	n	%	
Situation							
Active military personnel	1,225	28	908	26	317	37	
Retired military personnel	491	11	392	11	99	12	
Beneficiary	1,538	35	1,305	37	233	27	
Civilian	1,147	26	948	27	199	23	
Gender							< 0.001*
Males	2,666	61	2,089	59	577	68	
Females	1,735	39	1,464	41	271	32	
Blood group							
O+	3,561	83	2,838	80	723	85	0.001
A+	494	12	402	11	92	10.9	0.72
B+	130	3	99	2.8	31	3.6	0.1
O-	52	1	45	1.3	7	8	0.2
A-	5	0.1	3	0.08	2	0.2	0.2
B-	5	0.1	4	0.1	1	0.1	0.6
AB+	28	1	24	0.6	4	0.4	0.3
No record	131	—	119	—	12	—	—
No known comorbidities	3,509	80	2,941	83	568	67	< 0.001*
Comorbidities	892	20	612	17	280	33	< 0.001
Diabetes	392	9	286	8	106	12.5	< 0.001
Hypertension	345	8	249	7	96	11.3	0.11
Obesity	272	6	203	5	69	8.1	0.21
Chronic kidney disease	60	1.4	41	1	19	2.2	0.001
Cancer	22	0.5	11	0.3	11	1.3	0.007
Heart disease	23	0.5	13	0.4	10	1.2	0.5
Autoimmune disease	20	0.5	15	0.4	5	0.6	0.2
Hypothyroidism	21	0.5	15	0.0	6	0.7	0.5
Asthma	15	0.3	12	0.3	3	0.4	0.6
HIV	11	0.2	9	0.2	2	0.2	

IQR = interquartile range.

*Fisher's exact test. **Mann-Whitney's U-test.

Table 2. Age of patients hospitalized at Central Military Hospital, Mexico City

Age range (years)	Total (n = 4,401)		Males (n = 2,666)		Females (n = 1,735)	
	n	%	n	%	n	%
< 20	67	1.5	27	1	40	2.3
21-30	442	10	216	8	226	13
31-40	776	17.6	501	19	275	16
41-50	1,009	23	703	26	306	17.6
51-60	856	19.5	519	19.5	337	19.4
61-70	656	15	394	15	262	15
71-80	418	9.5	210	8	208	12
81-90	161	3.7	89	3.3	72	4
91-100	16	0.4	7	0.3	9	0.5

doubled between the second, third, fourth and fifth decades of life, and between the latter and the 61 to 70 group, it increased by 14.6 %; in turn, between this group and the next one, it only increased by 1.8 % and subsequently it only increased by 6.6 % (Table 4).

In patients younger than 51 years of age, the crude case fatality rate in men was 11.8 % (172/1,447), while in women it was 6.1 % (52/847), which represented a male:female ratio of 1.98:1. On the other hand, in those older than 51 years of age, the crude case fatality rate in male patients was 44.3 % (541/1,219), and in female patients, 33.1 % (294/888); this represented a male:female ratio of 1.33:1 (Table 4).

Most deceased patients did not have any comorbidity; among the 390 patients with comorbidities, the

Table 3. Nutritional status of COVID-19-confirmed patients hospitalized at Central Military Hospital, Mexico City

BMI (kg/m ²)	Global		Recovered		Deceased		p
Median (IQR)	27.1 (25.2, 29.4)		27 (25, 29)		27.2 (25.7, 29.7)		0.03
Category	Rate*	%	Rate*	%	Rate*	%	
< 25, normal	151/656	23	108/418	25.8	43/238	18	0.02
25-29.9, overweight	372/656	56	235/418	56.2	137/238	57.5	0.74
30-34.9, grade I obesity	93/656	14.1	50/418	11.9	43/238	18.0	0.03
35-39.9, grade II obesity	29/656	4.4	18/418	4.1	11/238	4.6	0.84
≥ 40, grade III obesity	11/656	1.6	7/418	1.6	4/238	1.6	0.61

IQR = interquartile range.

*Rate of patients/hospitalized patients.

Table 4. COVID-19 deaths at Central Military Hospital, Mexico City

(N = 4,401)	Total (n = 1,059, 24 %)		Suspected (827 = 23)		Confirmed (232 = 27)		p
Median age, years (IQR)	62 (53, 71)		62 (53, 72)		61 (51, 71)		< 0.001*
	n	Crude case fatality rate %	n	Crude case fatality rate %	n	Crude case fatality rate %	
Gender							
Males	713	67	541	65	172	74	0.01**
Females	346	33	286	35	60	26	
Blood group							
O+	930	88	719	87	211	91	0.04**
A+	90	9	77	9	13	5.6	
B+	22	2	16	1.9	6	2.5	
O-	10	1	8	0.9	2	0.8	
A-	1	0.1	1	0.1			
B-	2	0.2	2	0.2			
AB+	4	0.4	4	0.4			
No known comorbidities	669	63	552	67	117	50	
Comorbidities							
Diabetes	90	37	275	33	115	50	0.4
Hypertension	219	21	165	20	54	23	
Obesity	193	18	147	17	46	20	0.4
Chronic kidney disease	123	12	90	10	33	14	0.1
Cancer	30	3	24	2.9	6	2.5	1
Heart disease	7	1	3	3	4	1.7	0.04
Autoimmune disease	12	1	8	9	4	1.7	0.3
Hypothyroidism	6	0.6	3	0.3	3	1.3	0.1
Asthma	4	0.4	1	0.1	3	1.3	0.03
	6	0.6	4	0.4	2	0.8	0.6

IQR = interquartile range.

*Mann-Whitney's U-test.

**Fisher's exact test.

main one was diabetes, followed by hypertension and obesity (Table 4).

In a sample of 656 confirmed patients, median BMI was similar between recovered patients and those who died; only 23 % had normal weight, which was

predominant in recovered patients vs. deceased patients. No significant difference was found in patients with grade II and III overweight or obesity between those who recovered and those who died, but a significant difference was observed in patients with

Table 5. Age range of patients who died from COVID-19 at Central Military Hospital, Mexico City

Age range (years)	Total		Males		Females		p
	Rate*	%	Rate*	%	Rate*	%	
< 20	2/67	2.99	0/27	0	2/40	5	0.5
21-30	12/442	2.71	7/216	3.24	5/226	2.21	0.5
31-40	57/776	7.35	39/501	7.78	18/275	6.55	0.4
41-50	153/1,009	15.16	126/703	17.92	27/306	8.82	0.001
51-60	255/856	29.79	180/519	34.68	75/337	22.26	0.004
61-70	291/656	44.36	198/394	50.25	93/262	35.50	0.02
71-80	193/418	46.17	105/210	50	88/208	42.31	0.3
81-90	85/161	52.8	52/89	58.43	33/72	45.83	0.4
91-100	11/16	68.75	6/7	85.7	5/9	55.56	0.7
Total	1,059/4,401	24	713/2,666	26.7	346/1,735	19.9	

*Rate of deceased patients/hospitalized patients.

Figure 3. Kaplan-Meier analysis of COVID-19 deaths at Central Military Hospital, Mexico City.

grade I obesity (Table 3). These data identify overweight as the main comorbidity in those patients who died.

Hospital stay analysis in those patients who died showed a median of six days (95 % CI = 5.5, 6.4), as shown in figure 3.

Discussion

This study describes the epidemiological characteristics of 4,401 patients with COVID-19 at Central Military Hospital, where more patients were admitted during the analyzed period in comparison with 1300 patients cared for from May to the second week of July in the COVID hospital at Mexico City's racetrack.⁵

At the national level, confirmed cases exponentially increased from May 12 on; at Central Military Hospital, the highest number of hospitalized patients occurred between May and June, with a maximum peak on May 29.²

Male gender predominated, similar to the reports in Mexico by Ortiz Brizuela et al., by Wei-Jie Guan et al. in Chinese population, Jaime Berumen et al. in a case-control study based on the reports of the Mexican Ministry of Health, and another involving 12 hospitals of the Northwell health system, in New York, USA.⁶⁻¹⁰ This is consistent with the reports on the predisposition of men for developing viral infections related to the inhibitory effect of testosterone on T-helper cells (Th1) differentiation, with a consequent decrease in the production of IFN- α .¹¹

At "Salvador Zubirán" National Institute of Medical Sciences and Nutrition, median age was found to be 49 years, as in our study and similar to that reported in the Chinese population. In the Central Military Hospital population, > 80 % of hospitalized subjects were between 30 and 80 years of age; in the New York study, median age was 63 years.^{6,8,12-13} Distribution by age group in our research was similar to that recorded by Jaime Berumen et al., who identified that most patients were between 51 and 60 years of age, while at Central Military Hospital, most patients were aged between 41 and 50 years, which is consistent with the observation that risk is higher as age increases.¹⁰

In those patients with COVID-19 from the hospital where we conducted our research, blood group O+

predominated, followed by A+, similar to that reported for the general population in 2018.¹⁴ Positive Rh factor also predominated. In the New York study on Hispanic population with COVID-19, blood group O+ also predominated, followed by the A+ group, even when group O has been reported to be a protective factor against SARS-CoV-1.¹⁵

As for comorbidities, at Central Military Hospital we found that only 20 % of patients had comorbidities, similar to that reported in China (25.1 %).¹⁶ In contrast, in New York all patients had at least one comorbidity.⁸

The order of comorbidities was diabetes, hypertension and obesity, which differs from other reports in Mexico, although in the studies by Jaime Berumen et al. and Ortiz Brizuela et al., these are indicated to be the main comorbidities.^{2,6,10}

In 656 confirmed patients, 56 % were found to be overweight, which turns overweight into the main comorbidity and is consistent with the results obtained by Ortiz Brizuela et al., although median BMI in our study was lower.⁶

If overweight is regarded as the main comorbidity in confirmed patients, followed by diabetes and hypertension, the results would agree with those obtained by Hernández Garduño, who identified obesity as the main risk factor for infection, followed by diabetes and hypertension. This is probably due to the increased levels of angiotensin-converting enzyme-2 (ACE-2) receptors in adipose tissue, which constitute the entry mechanism for SARS-CoV-2.¹⁷⁻¹⁹

At General Hospital of Mexico, a crude case fatality rate of 46.8 % was recorded²⁰, whereas at Central Military Hospital it was 24 %, which is similar to the crude fatality rate recorded at Pemex (29 %)²¹ and to those reported in New York (21 %) and China (28 %).⁸

In our study, male patient deaths predominated, which is similar to information in national reports (52.24 %);² however, in China and New York, the male:female ratio was 1:1.^{8,22}

The finding that the rate of deceased males/hospitalized males was higher than the rate of deceased females/hospitalized females is consistent with reports of other series and meta-analyses, where the male gender was found to have a higher risk of infection, clinical deterioration and death.^{10,11,23} This is probably due to the predisposition men have for acquiring viral infections and experiencing more complications due to a lower production of INF- α in response to TLR7, as well as to IL-10 elevated levels in response to TLR8 and TLR9 activation; in contrast, women have

the protective role of estrogens, such as 17 β -estradiol, which stimulate cellular and humoral immunity to viral infections.^{11,24}

Regarding the age of those patients who died, the median was 62 years; in China, a similar age was reported (57 years). According to analyses from China, Italy, Spain, New York, and the United Kingdom, an age older than 50 is associated with COVID-19 case fatality rate; the risk is even higher in patients older than 60 years.²²

Comparing the case fatality rates by age groups, they were higher in all age groups in comparison with those of the New York study and were only similar in the 81-90 years group.⁸ In the reports from China, Italy, Spain, New York and the United Kingdom, crude case fatality rate by age group was < 30 % in those younger than 70 years; in our study, the 51-60 years age group had a crude fatality rate of 29.79 %, and of 34.68 % in male patients.²²

In addition to the fact that before 51 years of age the male:female ratio is higher than after that age, these results agree with observations in postmenopausal women (aged > 45 years), who had more symptoms and longer hospitalization time, probably because they lose the protection conferred by estrogens.^{11,25}

Regarding the blood group, the O+ group predominated in those patients who died, unlike the observations reported by Zietz et al.¹⁵

In our study, diabetes prevailed in those patients who died, followed by hypertension and obesity, which have been pointed at as predisposing factors for infection and severity.²⁶ However, according to the BMI, the main comorbidity was overweight.

Various studies consider overweight and obesity to be factors of poor prognosis, severity, admission to intensive care unit requirement, and mortality, due to an increase in ACE-2 receptors in adipose tissue,^{17-18,23,27} coupled with the fact that adipose tissue promotes the production of pro-inflammatory cytokines and induces chronic systemic inflammation. Patients with obesity and COVID-19 exhibit a higher inflammatory response and risk for developing cytokine storm.¹⁸ Another proposed mechanism is associated with regulatory T cells, particularly Th17 cells, related to IL-6, IL-24/IL-17, as well as to other cytokines such as TNF- α or TGF.²⁷

Median hospital stay in those patients who died was longer in our study than in the study conducted in New York (4.1 days).⁸

Conclusion

The age of patients hospitalized at Central Military Hospital with a COVID-19 diagnosis was similar to that reported at the national level, as well as to that recorded in Pemex, but lower when compared to that referred in other tertiary care centers in Mexico. The predominant blood group was O+. Most hospitalized patients who died from COVID-19 were older than 60 years, as it has been reported in other countries. In those patients who died, the male gender was observed to predominate, although in the group older than 51 years, the frequency of female patients did increase. On the other hand, more than 40 % of those patients who died had no comorbidities; among these, the most prevalent were overweight and diabetes, which have already been referred to as risk factors for higher severity and complications. In 50 % of those patients who died, death occurred within the first six days after hospital admission.

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Conflict of interests

The authors declare that they have no conflicts of interest.

Ethical disclosures

Protection of human and animal subjects. The authors declare that no experiments were performed on humans or animals for this research.

Confidentiality of data. The authors declare that no patient data appear in this article.

Right to privacy and informed consent. The authors declare that no patient data appear in this article.

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