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RESEARCH ARTICLE

Changes in Neonatal Intensive Care Unit statistics during the COVID-19 pandemic

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Abstract

Background: *With the identification of COVID-19 disease in China, a pandemic began that affected health-care systems. The Neonatal Intensive Care Unit (NICU) of the Hospital de Ginecobstetricia del Centro Médico Nacional de Occidente experienced an increase in patient flow as part of the COVID-19 strategy of the Instituto Mexicano del Seguro Social (IMSS). This study aimed to analyze the impact of the COVID-19 pandemic on neonatal care and mortality indicators in our unit.* **Methods:** *We conducted a retrospective study to compare the number of hospital births, pre-term newborns (PTNB), NICU admissions, and deaths. Changes in frequencies between 2019 and 2021 were analyzed using Poisson distribution. Changes in PTNB births, proportion of admissions, and deaths/NICU discharges were analyzed by z-test for two proportions.* **Results:** *Between 2019 and 2021, the number of births increased by more than 2-fold. NICU admissions increased from 770 in 2019 to 1045 in 2021 ($p < 0.01$). The ratio of deaths/discharge from the service was 16.9% in 2019 and 13.1% in 2021 ($p = 0.02$).* **Conclusions:** *Mortality indicators in the NICU decreased from 2019 to 2021, even with the increase in the number of patients admitted during the COVID-19 pandemic.*

Keywords: *Newborn. Neonatal intensive care. Statistical distributions. Coronavirus infections.*

Cambios en las estadísticas de una Terapia Intensiva Neonatal durante la pandemia COVID-19

Resumen

Introducción: *Con la identificación de la enfermedad por COVID-19 en China, inició una pandemia que afectó a los sistemas de salud. La Unidad de Cuidados Intensivos Neonatales (UCIN) del Hospital de Ginecobstetricia del Centro Médico Nacional de Occidente del Instituto Mexicano del Seguro Social (IMSS) vio incrementado su flujo de pacientes como parte de la Estrategia COVID-19 del IMSS. El objetivo fue analizar el impacto de la pandemia COVID-19 en los indicadores de atención y mortalidad neonatal en nuestra unidad.* **Métodos:** *Se realizó un estudio retrospectivo para comparar el número de nacimientos en el hospital, nacimientos de recién nacidos prematuros (RNPT), ingresos a UCIN y defunciones. Se analizaron los cambios en frecuencias entre los años 2019 a 2021 mediante la distribución de Poisson. Los cambios en nacimientos de RNPT, proporción de ingresos y defunciones/egreso en UCIN se analizaron mediante prueba Z para dos proporciones.*

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Resultados: *Entre los años 2019 a 2021, el número de nacimientos incrementó más de 2 veces. Los ingresos a UCIN aumentaron de 770 en 2019, a 1045 en 2021 (p < 0.01). La proporción de defunciones/egreso del servicio fue de 16.9% en 2019, y 13.1% en 2021 (p = 0.02).* **Conclusiones:** *Los indicadores de mortalidad en la UCIN disminuyeron de 2019 a 2021, aun con el incremento en el número de pacientes atendidos durante la pandemia COVID-19.*

Palabras clave: *Recién nacido. Cuidado intensivo neonatal. Distribuciones estadísticas. Infecciones por coronavirus.*

Introduction

COVID-19 was first identified in December 2019 in Wuhan, China[1]. The COVID-19 pandemic has pressured health systems and social and economic dynamics globally[2]. As a result, health authorities in various countries have adopted strategies to protect patients and health workers and mitigate the pressure on health systems[3-6].

Neonatal intensive care unit (NICU) services also faced challenges of a different nature. These included changes in patient flow associated with health policy adjustments. Some of the consequences of these changes have been reported as an increase in the frequency of deaths[7] or a lack of necessary supplies for neonatal care[8].

Developed countries have reported reductions in neonatal mortality[9], cesarean births, pre-term births, and NICU admissions[10-15].

The NICU of the Hospital de Ginecobstetricia (HGO) of the Centro Médico Nacional de Occidente (CMNO) of the IMSS cares for patients who, due to associated maternal conditions or characteristics of the product of pregnancy, require management with specialized equipment and personnel. The HGO-CMNO is located in the city of Guadalajara, Jalisco, Mexico. This High Specialty Medical Unit (UMAE) cares for pregnant women who, due to their complex conditions, are referred from different units in the western part of the country.

As an essential part of the IMSS COVID-19 strategy, hospital restructuring was implemented to reorganize hospital infrastructure, medical equipment, and health personnel to face the health emergency. To provide adequate medical care, several types of health units were established, such as 100% COVID hospitals, hybrid hospitals, temporary medical units, expansion medical units, and early opening units. Each of these units had specific dynamics and logistics for their operation, as well as the financial and administrative resources necessary for their operation[16].

The HGO, a highly specialized medical unit for the care of high-risk pregnant women and their critical newborns, adapted its infrastructure and human resources to accept pregnant patients without evidence of COVID-19 disease, thus avoiding their care in pandemic-adapted units. This change resulted in an increased influx of patients with complex pregnancies who had not previously been cared for in pandemic-adapted units. As a result, the number of patients in the NICU also increased. Therefore, it is essential to analyze the behavior of statistical indicators related to neonatal mortality in the NICU to understand the impact of this increase in patient load on these indicators.

The main objective of this study was to analyze the impact of the COVID-19 pandemic on neonatal care and mortality indicators in our unit.

Methods

With the approval of the IMSS Local Health Research Committee No. 1310, a retrospective, observational, and analytical time series analysis was performed. The objective was to evaluate the difference in the number of patients seen at the HGO before the onset of the COVID-19 pandemic and during the period of support to the reconverted units. Changes in mortality indicators were also analyzed. All live newborns in the unit were included in birth statistics, regardless of gestational age and diagnosis at birth. For the analysis of neonatal mortality, all patients who died in the NICU were included, regardless of birth weight, extrauterine life, or gestational age at birth as well as those with congenital malformations.

The pre-pandemic period was defined as the period from December 26, 2018, to December 25, 2019. During the pandemic, two periods of care for the eligible population were identified from December 26, 2019, to December 25, 2020, and from December 26, 2020, to December 25, 2021.

To determine whether there were significant differences between these periods, we employed Poisson regression to analyze frequencies and the z-test to compare proportions. We also measured the risk of death in patients admitted to the NICU using the odds ratio, presenting the results with 95% confidence intervals.

The statistics collected and analyzed in this unit are routinely published for annual surveillance, so the study was not submitted to the local health research committee.

Table 1. Distribution of indicators in NICU from 2019 to 2021

Indicator	Year 2019	2020	2021
Births per year	3402	6272	7589
Average weight at admission (SD)	1960 (± 763)	2050 (± 854)	2101 (± 852)
Maximum and minimum weight at admission (g)	351-4425	359-5484	385-5335
Average gestational age at admission (SD)	32.9 (± 5.7)	33.4 (± 3.7)	33.8 (± 3.6)
Maximum and minimum gestational age at admission (weeks)	22-41	24-42	24-41
Pre-term newborns (PNB) (%)	1307 (38.3)	1514 (24.1)	1422 (18.7)
NICU admissions per year (%)	770 (22.6)	1005 (16.0)	1045 (13.8)
NICU discharges per year (%)	732 (21.5)	993 (15.8)	1043 (13.7)
Deaths	124	153	137
Other deaths	85	110	100
PTNB deaths (%)	102/1307 (7.8)	125/1514 (8.2)	96/1422 (6.7)
Deaths per discharge (%)	124/732 (16.9)	153/993 (15.4)	137/1043 (13.1)

NICU: neonatal intensive care unit; PTNB: pre-term newborns; SD: standard deviation.

Results

During the period from 2019 to 2021, a total of 17,263 live newborn births were registered in the HGO-CMNO UMAE. Table 1 shows the distribution and characteristics of these births during the study period. It also shows the distribution of pre-term births and NICU admissions and discharges. In addition, the frequency of deaths is detailed, and the indicators of PTNB deaths in relation to total deaths and deaths in relation to discharges are calculated. Other deaths are described, which include cases with severe congenital malformations, gestational age < 28 weeks, or birth weight < 1000 g.

In 2020, there was an 84% increase in the number of births compared to 2019, which is considered the pre-pandemic period. By 2021, this increase was 120% compared to 2019 and 21% compared to 2020.

The number of PTNB births increased in 2020 compared to 2019 but experienced a decrease in 2021, although it remained at a higher level compared to 2019.

Although the number of deaths increased from 2019 to 2020, a significant decrease was observed in 2021, although at a lower level than in 2019. In the NICU, the ratio of deaths to discharges decreased each year.

Poisson regression analysis was used to assess whether increases or decreases in incidence were due to chance. The results showed that the increase in the number of births between 2019, 2020, and 2021 was statistically significant.

NICU admissions and PTNB births increased significantly from 2019 to 2020 and from 2019 to 2021, although no significant change was observed between 2020 and 2021 (Table 2).

In the NICU, a significant increase in the number of deaths overall, particularly PTNB deaths, was observed from 2019 to 2020. Although there was no significant change in the overall frequency of deaths from 2020 to 2021, a significant decrease in PTNB deaths was observed during this period. Notably, the incidence of deaths in 2021 was similar to that in 2019, as shown in Table 3.

Table 4 shows the comparison of the proportions of NICU admissions, births, and deaths (unrefined) between 2019, 2020, and 2021. The comparison between each of these years is detailed.

Despite the increase in the frequency of PTNB births, their proportion decreased significantly between 2019 and 2020.

A non-significant decrease in the ratio of deaths to NICU discharges was observed in 2020 compared to 2019. In 2021, despite the significant increase in births, NICU admissions, and discharges, the ratio of deaths to discharges also decreased significantly.

Table 5 shows the magnitude of the risk of death by year of admission. The risk of death for patients admitted to the NICU decreased from 1.16 (0.93-1.46) in 2019 to 0.82 (0.65-1.02) in 2021.

Table 2. Probability of occurrence of births and NICU admissions from 2019 to 2021 (Poisson)

Variable	2019	2020	2021
Hospital births 2019 2020	(n = 3409) NA NA	(n = 6272) p < 0.0001 NA	(n = 7589) p < 0.0001 p < 0.0001
NICU admissions 2019 2020	(n = 770) NA NA	(n = 1005) p < 0.0001 NA	(n = 1045) p < 0.0001 p = 0.11
PTNB births 2019 2020	(n = 1307) NA NA	(n = 1514) p < 0.0001 NA	(n = 1422) p < 0.001 p = 0.01

NICU: neonatal intensive care unit; PTNB: pre-term newborns.

Table 3. Probability of occurrence of NICU deaths from 2019 to 2021 (Poisson)

Variable	2019	2020	2021
NICU deaths 2019 2020	(n = 124) NA NA	(n = 153) p < 0.01 NA	(n = 137) p = 0.13 p = 0.10
NICU PTNB deaths 2019 2020	(n = 102) NA NA	n = 125 p = 0.02 NA	(n = 96) p = 0.30 p < 0.01

NICU: neonatal intensive care unit; PTNB: pre-term newborns.

Table 4. The difference in proportions (z-test) of NICU indicators from 2019 to 2021

Variable	2019	2020	2021
% Admissions to NICU 2019 2020	22.6% (770) NA NA	16.0% (1005) p ≤ 0.001 NA	13.8% (1045) p ≤ 0.001 p ≤ 0.001
% PTNB births 2019 2020	38.3% (n = 1307) NA NA	24.1% (n = 1514) p = < 0.001 NA	18.7% (n = 1422) p ≤ 0.001 p ≤ 0.01
% of deaths/NICU discharges 2019 2020	16.9% (124/732) NA NA	15.4% (153/993) p = 0.40 NA	13.1% (137/1043) p = 0.02 p = 0.14

NICU: neonatal intensive care unit; PTNB: pre-term newborns.

Table 5. Distribution of the risk of death among patients admitted to the NICU between 2019 and 2021

Year	Deaths	Alive discharge	OR (95% CI)
2019	124	646	1.16 (0.93-1.46)
2020	153	852	1.07 (0.86-1.33)
2021	137	908	0.82 (0.65-1.02)

CI: confidence interval; NICU: neonatal intensive care unit; OR: odds ratio.

Discussion

In our unit, the number of births increased by more than 100% between 2019 and 2021. This increase is attributed to the increase in the flow of obstetric patients seeking care at the HGO UMAE, which represents an important support for the converted hospital units as part of the IMSS COVID-19 strategy.

Contrary to what has been reported by other authors[10,17-20], it was observed that the number of pre-term births increased from 2019 to 2020 but decreased in 2021. Even though the total number of births increased significantly and more were attended at term and without additional pathology, the percentage of PTNBs increased significantly from 2019 to 2020 and then decreased in 2021 to even lower levels than in 2019. This decrease in the proportion of pre-term births was probably due to mothers working from home, which reduced the stress and chances of complications due to lack of rest, as has also been suggested by some authors in Israel[21].

From 2019 to 2020, there was an increase in the frequency of NICU admissions, although it decreased as a proportion of the total number of births. This was due to the increased number of term patients seen at birth. Although the number of deaths increased from 2019 to 2020, the number of patients dying in the NICU decreased in 2021, even to a lower level than in 2019. The decrease in mortality from 2020 to 2021 was statistically significant.

The ratio of deaths to NICU discharges showed a steady decrease from 2019 to 2021. Although the decrease was not statistically significant from 2019 to 2020, it was statistically significant from 2019 to 2021 and 2020 to 2021.

During the COVID-19 pandemic, there was an expectation that NICU mortality might increase due to increased patient flow, and some authors were concerned about a lack of supplies in the NICU[8] or possible difficulties in staff collaboration due to increased patient flow[22,23]. Despite monthly occupancy rates consistently exceeding 100% during the pandemic, the mortality rate relative to discharges decreased significantly. This finding contrasts with other authors who reported no change in neonatal mortality[24] or even an increase in neonatal mortality[25].

We attribute this success to the dedicated efforts of the health-care staff, including physicians, nurses, biomedical engineers, social workers, assistants, laboratory personnel, cabinet staff, hygiene and cleaning teams, utilities, and general services, among others. It is also important to highlight the work of the administrative staff who managed the increase in NICU staffing and ensured that despite the support provided by the health system to the ICUs and units converted to COVID-19, there was no shortage of supplies and resources for the care of critical newborns in our NICU.

The IMSS HGO-CMNO UMAE showed a significant increase in the number of births and the number and frequency of PTNBs cared for as part of the COVID-19 strategy implemented by the IMSS. However, the frequency of deaths remained constant, and the ratio of deaths to NICU discharges decreased in 2019, 2020, and 2021.

Ethical disclosures

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

Confidentiality of data. The authors declare that they have followed the protocols of their work center on the publication of patient data.

Right to privacy and informed consent. The authors have obtained the written informed consent of the patients or subjects mentioned in the article. The corresponding author has this document.

Conflicts of interest

The authors declare no conflicts of interest.

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