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Perinatal asphyxia: antepartum and intrapartum characteristics in a second-level hospital in northwestern Mexico.

Asfixia perinatal: características anteparto e intraparto

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Abstract

OBJECTIVE: To describe the characteristics of mothers before and during delivery, and their newborns diagnosed with perinatal asphyxia.

MATERIALS AND METHODS: Retrospective, observational and descriptive study conducted on newborns consecutively admitted to the Intensive Care Unit of the Children Hospital of the State of Sonora between January 1 and December 31, 2023, for a diagnosis of perinatal asphyxia. The main characteristics of the mothers and the modes of pregnancy termination considered risk factors for asphyxia were identified.

RESULTS: Sixty-four cases with a diagnosis of perinatal asphyxia were identified. The mean gestational age was 38.3 weeks with a mean birth weight of 3209 grams. The most common maternal comorbidities were obesity (n = 29), gestational diabetes (n = 21), and pre-eclampsia (n = 16). The most common route of pregnancy termination was vaginal delivery, 45 of the 64 patients had a history of labor induction, which was the most common factor in this study.

CONCLUSIONS: Antepartum and intrapartum factors associated with perinatal asphyxia at the Children Hospital of the State of Sonora are consistent with those in the literature. Early detection is crucial to prevent the occurrence of neonatal asphyxia, however complex this is, given the heterogeneity of the condition, in which multiple maternal and fetal factors are involved. Improving the quality of prenatal care allows the identification of high-risk patients, strengthening collaboration between obstetricians and neonatologists to make personalized decisions, and optimize obstetric and perinatal care.

KEYWORDS: Neonates; Perinatal asphyxia; Risk factors; Gestational age; Birth weight; Obesity; Induction of labor; Gestational diabetes; Prenatal care.

Resumen

OBJETIVO: Describir las características de las madres, antes y durante el parto, y de sus recién nacidos con diagnóstico de asfixia perinatal.

MATERIALES Y MÉTODOS: Estudio retrospectivo, observacional y descriptivo efectuado en los neonatos ingresados entre el 1 de enero y el 31 de diciembre de 2023, en forma consecutiva, a la unidad de cuidados intensivos del Hospital Infantil del Estado de Sonora por diagnóstico de asfixia perinatal. Se identificaron las principales características de las madres y de las modalidades de finalización del embarazo consideradas factores de riesgo de asfixia.

RESULTADOS: Se identificaron 64 casos con diagnóstico de asfixia perinatal. La media de semanas de gestación fue de 38.3, con un peso medio al nacer de 3209 gramos. Las principales comorbilidades de las madres fueron: obesidad (n = 28), diabetes gestacional (n = 20) y preeclampsia (n = 16). La vía de finalización del embarazo más común fue el parto, 45 de las 64 pacientes tenían antecedente de inducción del parto, lo que resultó en el factor más prevalente en este estudio.

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CONCLUSIONES: Los factores anteparto e intraparto asociados con la asfixia perinatal en el Hospital Infantil del Estado de Sonora coinciden con los de la bibliografía. En virtud de la heterogeneidad de esta afección, donde intervienen múltiples factores maternos y fetales, la detección temprana es decisiva para prevenir su incidencia. Mejorar la calidad de la atención prenatal permite identificar a las pacientes de alto riesgo, fortalecer la colaboración entre obstetras y neonatólogos para tomar decisiones personalizadas y optimizar la atención obstétrica y perinatal.

PALABRAS CLAVE: Neonatos; asfixia perinatal; factores de riesgo; semanas de gestación; peso al nacer; obesidad; inducción del parto; diabetes gestacional; cuidados prenatales.

BACKGROUND

Perinatal asphyxia is still a global challenge, it is one of the main neonatal morbidity and mortality causes. The perinatal asphyxia incidence is determined by different factors which contribute to the decrease of oxygen supply during birth. According to the World Health Organization (WHO), between 4 and 9 million newborns suffer some kind of asphyxia every year. Approximately 1.2 million of the aforementioned babies die in their first days of life, while the rest will have some affectation to neurologic development.[1] Despite the measures established by the WHO to improve birth care quality, the perinatal asphyxia incidence is estimated to be around 1.6 in every 1,000 births in industrialized countries, and 4.6 in every 1,000 births in developing countries.[2] An observational study conducted in Mexico in 2018 at a tertiary hospital identified extreme preterm birth as the most frequent cause of neonatal mortality, followed by perinatal asphyxia, which is responsible for 13% of deaths.[3]

Perinatal asphyxia is a state which is characterized by the privation of oxygen during birth, with a multifactor origin. Uterine activity is one of the conditioning factors which affect gas exchange.[4] Determining a specific cause for perinatal asphyxia is a challenge because there are multiple conditions that can interfere with the gas exchange by affecting uteroplacental flow. The diagnosis criteria for perinatal asphyxia established together by the American College of Obstetricians and Gynecologists and the American Academy of Pediatrics, include an Apgar score under 5 at 5 minutes, evidence of metabolic acidosis in arterial blood (with a pH lower than 7.0, or a base deficit over -12 mmol/L), a neuroimaging study with evidence of acute lesion, and multiple organ failure.[5]

The severity of the lesion is correlated with the length and severity of the oxygen deprivation which starts with a pathological cascade of hypoxemia, then hypoxia, hypercapnia, and ends in fetal metabolic acidosis.[4] Currently, international guidelines have established that early detection of the factors that predispose to a defective gas exchange is decisive to prevent neurological damage associated with asphyxia.[6] Because of the multifactorial nature of this condition, the present study had the goal of describing the characteristics of mothers before and during birth, and of their newborns with perinatal asphyxia diagnosis.

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MATERIALS AND METHODS

Retrospective, observational, and descriptive study conducted with newborns admitted consecutively in the intensive care unit with diagnosis of perinatal asphyxia (according to the ACOG and AAP criteria),[5] between January 1 and December 31, 2023. The study was approved by the hospital's Research Ethics Committee. The relevant clinical records from the Obstetrics and Neonatology service were retrieved, with the help of physicians of the Epidemiology service. The data of the mothers and newborns was organized in an Excel database for its analysis. *Inclusion criteria*: singleton pregnancies, newborns with perinatal asphyxia diagnosis, asphyxia criteria (Apgar under 6 at 5 minutes, pH under 7.0, base deficit over -12 mmol/L, neurologic manifestations, and multiorgan failure), delivery care at the institution, and gestation over 35 weeks at the time of birth. *Exclusion criteria*: multiple pregnancy, under 35 weeks of gestation at the time of birth, newborns delivered at another facility, and incomplete records. *Study variables*: Age of the mothers, parity, previous diseases or diseases diagnosed during pregnancy, prenatal control visits, gestation weeks and weight at birth, newborn sex, Apgar at 5 minutes, route of birth, and intrapartum factors: labor induction, time of membrane rupture, meconium, non-reassuring fetal heart rate, and comorbidities recorded in the clinical record notes.

Descriptive statistics were used for the demographic information. Categorical variables (qualitative) were expressed in percentages and frequencies, and for quantitative variables (non-categorical) central tendency measures and standard deviation were used. Microsoft Excel® was used for the database and the R software version 4.3.3 for the analysis.

RESULTS

Sixty-nine admittances to the intensive care unit due to perinatal asphyxia were recorded, but 5 were excluded because of not meeting the inclusion criteria. Sixty-four newborns were finally studied, with a mean gestation week of 38.3, and standard deviation of 1.55 (range 35.2 – 42.0 weeks). Most of the newborns were male (36 of 64), and the mean gestational weight was 3109 g, with a standard deviation of ± 473 g (range 2079 – 3960). An Apgar score under 6 at 5 minutes was found in 30 of the 64 newborns (**Table 1**). As for the temporality distribution of the cases, the highest proportion was observed in the month of April (12 cases), followed by June and May, as shown in **Figure 1**. According to the data of births in the unit during 2023, the prevalence of perinatal asphyxia was of 1.8 cases for every 100 newborns.

Mother's characteristics

The mother's mean age was 23.6 years, with a standard deviation of ± 5.8 years. The age range was from 13 (3.1%) to 41 (1.5%) years. Twenty-eight patients had a poor prenatal control, with under 5 consultations, and 15 patients did not attend any consultation during their pregnancy.

Table 1. Characteristics of newborns with perinatal asphyxia

	Total (n = 64)
Gestation weeks (mean and SD)	38.3 ± 1.55
35-36.6 gestation weeks	10
37-40.0 gestation weeks	42
More than 40.1 gestation weeks	12
Weight at birth (mean and SD)	(3109 ± 473 grams)
Under 2500 g	13
2500-3500 g	40
More than 3500 g	11
Sex	
Feminine	28
Masculine	36
Apgar score of 6 or less at 5 minutes	
Yes	30
No	34

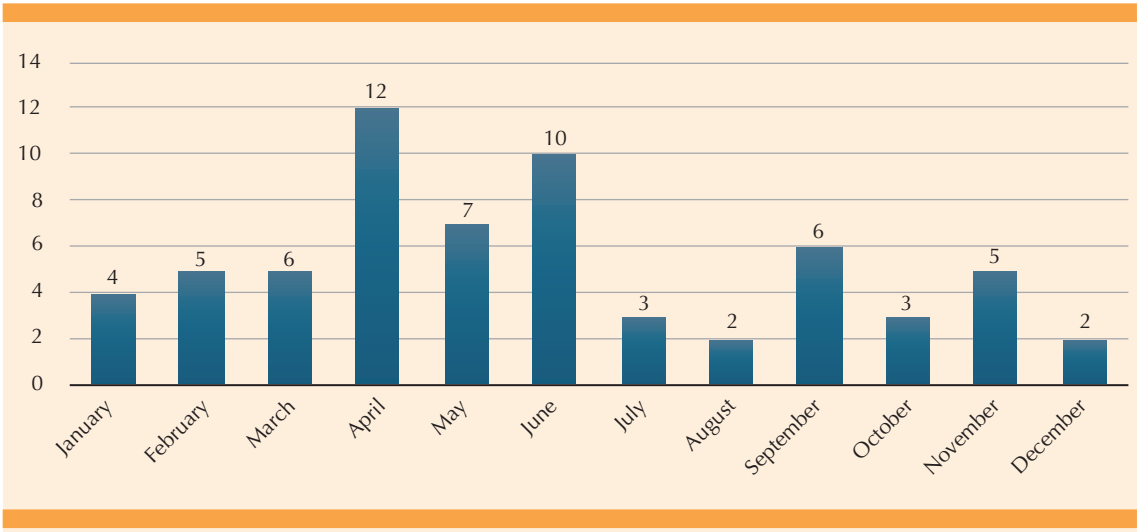


Figure 1. Monthly distribution of cases diagnosed with perinatal asphyxia.

Thirty-seven of the 64 cases had their prenatal control consultations at rural health centers, and only 6 patients received care at the Children Hospital of the State of Sonora.

Regarding comorbidities, 29 mothers had a diagnosis of obesity (BMI ≥ 30 kg/m^2) and the rest had normal weight. Gestational diabetes was diagnosed in 21 patients, preeclampsia in 16, intrauterine growth restriction in 14, and oligohydramnios in 8. The mother's characteristics, their morbidities before pregnancy, and complications are described in **Table 2**.

Characteristics of the route of birth

The most common birth route was vaginal (34 of 64); 46 patients required labor induction, and 18 were admitted with spontaneous labor. Also, 30 patients underwent a C-section birth. The main indications of the latter were risk of fetal well-being loss (n = 13), placental abruption (n = 6), preeclampsia (n = 4), and other causes (n = 7). Other characteristics of birth care, their details, and findings in medical records are shown in **Table 3**.

DISCUSSION

The identification of a specific cause for perinatal asphyxia represents a challenge because of the multiple diseases that can affect the uteroplacental flow, which can occur before, during birth, or even in the immediate postpartum, especially in newborns with difficulty to adapt to extrauterine life.[7] The main risk factors include labor induction, nulliparity, poor prenatal control, hypertensive states, C-section, and assisted birth, among others.[8]

Perinatal asphyxia predominated in term pregnancies (37.0 to 40.0 gestation weeks), which is in line with other studies' findings. Alemu et al. found that 61.3% of the cases happened in term newborns.[9] Several studies point out that the newborn's weight can be a determining factor in perinatal asphyxia.[10-11] The mean weight in the present study was similar to the one published by Locatelli et al., who recorded an average weight of 3216 ± 435 grams, in a four-year cohort.[12] Similarly, a study conducted in Ethiopia found that 73.1% of perinatal asphyxia cases occurred in newborns with weights between 2500 and

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Table 2. Characteristics and complications of mothers of newborns with perinatal asphyxia

Variables	Total (n = 64)
Mothers' age (mean and SD)	(23.6 ± 5.8 years)
< 15 years	11
16 - 20 years	20
20 - 34 years	26
>35 years	7
Parity	
Primigravidas	45
Multiparous (1 or more births)	19
Prenatal control	
Adequate (5 or more consultations)	21
Inadequate (less than 5 consultations)	28
Without prenatal control	15
Place of prenatal control	
Our institution	6
Rural center	37
Not specified	21
Chronic arterial hypertension	
Yes	5
No	59
Pregestational diabetes	
Yes	3
No	61
Maternal weight at birth	
Normal (BMI 18.5 - 24.9 kg/m^2)	17
Overweight (BMI 25 - 29.9 kg/m^2)	18
Obesity (BMI >30 kg/m^2)	29
Preeclampsia	
Yes	16
No	48
Gestational diabetes	
Yes	21
No	43
Intrauterine growth restriction	
Yes	14
No	50
Oligohydramnios	
Yes	8
No	56

Table 3. Birth characteristics and intrapartum findings

Variables	Total (n = 64)
Route of birth	
Vaginal birth	34
Assisted	0
C-section	30
Labor start	
Spontaneous	18
Induction	46
C-section indication	n=30
Risk of fetal well-being loss	13
Premature placental abruption	6
Preeclampsia	4
Chorioamnionitis	3
Pelvic presentation	2
Not specified	2
Membrane rupture (time)	
0 to 12 hours	40
12 to 24 hours	11
More than 24 hours	13
Chorioamnionitis	
Yes	10
No	54
Amniotic fluid with meconium	
Yes	18
No	46

3999 grams, without an epidemiologic significant association.[13]

The maternal age group with a higher incidence of asphyxia cases in the present study was between 21 and 34 years, which is in contrast with Abdo et al.'s findings, who showed that women older than 35 have a sixfold risk.[14] A widely studied factor in medical literature is parity, which in our study, most mothers were primigravidas (45 of 64), which coincides with what Rincón Socha published.[15] In a study conducted in Cuba, 62.22% of the patients were primigravidas, and a significant association was found (p = < 0.01).[16] Therefore,

the results published here coincide with much of what has been published before. Prenatal control was one of the variables we analyzed, and according to the WHO, a minimum of 5 consultations are considered optimal. A large number of mothers in the present study (n = 28) had a poor prenatal control, with less than 5 consultations, which suggests that a suboptimal prenatal control increases the risk of intrapartum complications. An essay conducted in Peru, supports this affirmation by pointing out that an adequate control reduces the risk of perinatal asphyxia, with an OR of 0.32 (95%CI: 0.14-0.76).[17]

AlMuqbil, in a retrospective study conducted in 2023, highlighted that the mother's previous diseases doubled the risk of perinatal complications.[18] In the present study, the most common maternal morbidities were obesity, gestational diabetes, and pregnancy hypertensive disorders. A study carried out by Lavanya Ravichandran[19] showed a significant association between pregnancy hypertensive disorders and perinatal asphyxia, finding which is supported by another study conducted in Peru, where they found that preeclampsia increased the risk of asphyxia up to fivefold (OR 5.07; CI95%: 2.28-11.28).[17] Also, the Peruvian study showed that pregestational diseases, such as diabetes mellitus type 2, and arterial hypertension, increase the risk as well, although to a lesser degree.[17] In our study, patients with chronic arterial hypertension and diabetes mellitus type 2 were a minority.

Regarding birth, 18 patients were admitted to the labor and delivery area with spontaneous labor, while the rest required pharmacological methods for induction.[17] The relationship between route of birth and perinatal asphyxia has been discussed in several studies. Berhe et al. didn't find a significant association in the route of birth in a cohort study.[20] Berglund et al. showed (2010) that labor induction increased the risk of perinatal asphyxia (OR 2.5; CI95%: 1.7-3.6),[21] opposed to what was found in a Colombian study, where they reported that labor induction is not associated with a risk of asphyxia (OR 0.07; 95%CI: 0.03-0.15).[22] Heimstad found that there is an increased risk of fetal distress in a study about labor induction in term pregnancies, although the risk of asphyxia, or its degree were not assessed.[23] The disagreement in labor induction and asphyxia outcomes can be due to the coexistence of maternal comorbidities, the route of administration, the dosage, and the medication administration interval. In the present study, we found that labor induction was the most prevalent factor, in 46 of the 64 cases, which highlighted the importance of evaluating, carefully, the induction method.

There was no predominant route of birth in the incidence of perinatal asphyxia in the present study (34 vaginal and 30 C-section). The main indications for C-section in our institution are aligned with international studies.[24-27] The most common causes for indication of C-section were risk of fetal well-being loss (13 of 30), premature abruption of normal placenta (6 of 30), and preeclampsia (4 of 30). Much of the literature states that C-sections do not imply an additional risk of asphyxia for the newborn, while still assessing the need for its indication, as it could be the determining factor in oxygen deprivation.

The rupture of membranes is another identified risk factor for perinatal asphyxia, as a meta-analysis by Rossi et al. shows, where the clinical diagnosis of chorioamnionitis significantly increased the risk of asphyxia.[28] In our study, most newborns with asphyxia had membrane rupture, with a length of less than 12 hours, and only 10 of the 64 had clinical suspicion of chorioamnionitis. Milson et al.[29] conducted a study in Sweden for 7 years, and they found that meconium in amniotic fluid was a significant factor associated with asphyxia (OR = 4.1; 95%CI: 1.8-9.8), which is a finding in line with other authors' findings.[20,26] Cases with meconium staining were a minority (n = 18) in our study, unlike what is reported in the literature. An

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Apgar score of 6 or less at 5 minutes was found in 30 of the 64 cases. According to what Yeshaneh et al.[30] reported, the Apgar score can be affected by several factors that happen before and during the pregnancy, including physical and emotional support during labor and delivery, a low or inexistent prenatal control, prepartum hemorrhage, pregnancy induced hypertension, meconium-stained amniotic fluid, a prolonged second period of labor, the route of birth, anemia, the sex of the fetus, among other factors significantly associated with a low Apgar score.

Limitations of the study: The main one is that the study was conducted at a second level hospital, where most of the patients are referred to from other centers at the end of their pregnancy or beginning labor. Also, there is a lack of resources to use diagnostic tools for asphyxia, such as cord blood tests, which is why they were not analyzed, as only in two cases was cardiotocography performed for the diagnosis of fetal distress during birth. This could influence the delay in the detection of gestational conditions or risk factors for perinatal asphyxia. The most common factor in our study was labor induction, but the dosage and the routes could not be evaluated because they were not adequately registered in the medical records. Thus, the conditions under which this practice is being performed, and the patient selection criteria, should be assessed, as this would allow to establish a clear relationship between labor induction and perinatal asphyxia, to better understand the repercussions on obstetric outcomes.

CONCLUSIONS

The incidence of perinatal asphyxia at the Children Hospital of the State of Sonora reflects what has been documented in previous literature. Its coexistence is multifactorial, and prenatal control plays a decisive role in the early detection of associated risk factors. Given that most of the patients arrive to this center during the third trimester or at the beginning of labor, it is fundamental to strengthen prenatal control at the first level of care, with early detection and referral of patients with maternal or fetal risk factors. Accomplishments before and during birth will have a repercussion in neonatal morbidity and mortality, using the tools for fetal well-being, applying preventive and therapeutic guidelines for the control of high-risk cases. The identification of high-risk patients, strengthening communication between obstetricians and neonatology specialists, and implementing timely preventive measures, are decisive in the successful medical care of these patients. Thus, decision making must be personalized, with a careful evaluation of the risks and benefits to optimize perinatal, and neonatal outcomes.

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