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CLÍNICA

Perinatal factors associated with umbilical cord blood pH values

Factores perinatales asociados con los valores de pH de sangre de cordón umbilical

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Palabras clave: pH; cordón umbilical; factores perinatales.

ABSTRACT

Objective: Perinatal asphyxia is the mayor cause of neonatal morbidity and mortality. The analysis of umbilical arterial cord blood pH remains an objective criterion used to determine the metabolic state of the newborn after birth, and therefore of fetal wellbeing.The aim was to identify the perinatal factors associated with umbilical arterial cord blood pH values.

Materials and methods: A descriptive and analytical study was conduced between January 2010 and January 2013 at a tertiary hospital in the Southern Spain. The inclusion criteria were: Uncomplicated pregnancy and vaginal single delivery at term with vertex presentation. Independent variables with greater significance after the univariate analysis were: Age, parity, gestational age, epidural analgesia, birth plan, episiotomy, duration of first labor stage and oxytocin use. It was considered as a dependent variable the umbilical arterial blood pH values (< = 7.24; > 7.24). The total number of women was 165. Statistical analysis was performed using logistic regression.

Results: epidural analgesia and gestational age more than or equal to 41 weeks have negatively influence the neonatal umbilical cord pH, while having presented a birth plan could have a protective influence.

Conclusions: findings of this study provide to the professionals more evidence on the elements that may influence neonatal wellbeing, in order to act accordingly, anticipating risk situations and applying more effective care.

RESUMEN

Objetivo: El análisis del pH de sangre arterial de cordón umbilical sigue siendo un criterio objetivo usado para determinar el estado metabólico del recién nacido tras el parto, y por tanto del bienestar

fetal. El objetivo de este estudio fue identificar los factores perinatales asociados con los valores de sangre arterial de cordón umbilical.

Material y métodos: Se realizó un estudio descriptivo y analítico entre Enero de 2010 y Enero de 2013 en un hospital de tercer nivel en el sur de España, con mujeres atendidas por parto. Los criterios de inclusión fueron: embarazo sin complicaciones y parto vaginal único, a término, con presentación cefálica. Las variables independientes con gran significación tras un análisis univariante fueron: edad, paridad, edad gestacional, analgesia epidural, plan de parto, episiotomía, duración de la primera fase del parto, y uso de oxitocina. Como variable dependiente se consideró: los valores de pH de sangre arterial de cordón umbilical (< = 7.24; > 7.24). El número total de mujeres fue de 165. El análisis estadístico se realizó mediante regresión logística múltiple.

Resultados: La analgesia epidural y la edad gestacional mayor o igual a 41 semanas influyeron negativamente en el pH de cordón umbilical neonatal, mientras que haber presentado un plan de parto tuvo una influencia protectora.

Conclusiones: Los hallazgos de este estudio proporcionan a los profesionales más evidencias sobre los elementos que pueden influenciar en el bienestar neonatal, con el fin de actuar en consecuencia, anticipándose a las situaciones de riesgo y aplicando una atención más eficaz.

INTRODUCTION

Perinatal asphyxia is the mayor cause of neonatal morbidity and mortality. James et al. found that analysis of umbilical cord pH may reveal if there was fetal hypoxia during labor.[1] Also, the analysis of umbilical cord pH value is currently measured in high-risk birth and neonates with asphyxia risk.[2] The analysis of the acid-base status of umbilical cord blood remains an objective criterion used to determine the metabolic state of the fetus at birth.[2, 3]

Although there is no consensus under which birth conditions the test should be performed, for many hospitals in Spain it is systematically performed for births. Some studies suggest it should be done only if there is risk of hypoxia, [2-4] but there are many authors who recommend its implementation at all births.[5]

The limits used to determine when a result of umbilical cord pH is low, and therefore may be a risk of fetal acidemia, are varied. A precise definition of what is considered significant fetal acidemia cannot be clearly determined from the literature.[6] There are studies that consider a cord blood pH values of 7 as a limit below which quite important pathological and neurological neonatal mortality risk should be considered.[7] Many studies considered an arterial blood pH < 7.20 as pathological while others set the limit at 7.24. The Working Group on Assistance to Normal Childbirth and Puerperium of the Perinatal Medicine Section of the Spanish Society of Gynecology and Obstetrics (SEGO): "*If the fetal pH is between 7.20 to 7.24, excluding expulsive period, it should be repeated in about 15 minutes. In the case of persistence these figures, the fetus should be extracted in a maximum of one hour*. *If the fetal pH is less than 7.20 we should proceed immediately to the termination of labor";* however, they refer to intrapartum fetal scalp values. Moreover, SEGO sets the fetal acidosis (metabolic, respiratory, or mixed) in a result of pH < 7.25.[8]

Recently, in the systematic review and meta-analysis conducted by Malin et at, considering a threshold ranging from pH = 7 to values lower than 7.24, found a strong association between umbilical cord arterial pH and a number of clinically important neonatal outcomes such as neonatal mortality, hypoxic-ischemic encephalopathy, intraventricular haemorrhage, and cerebral paralysis. The same authors considered that the determination of pH is justified as an important outcome measure, and should

not be limited only to the population at risk; they suggested that a larger prospective study must be performed to assess its prognostic capacity and profitability.[9]

Most authors who have studied the factors that may affect the umbilical cord blood pH of term infants, found a significant association with parity, mode of delivery and the use of epidural anesthesia, among others.[10-12]

Meanwhile, any others authors did not find significant association between the use of epidural anesthesia and neonatal pH;[13-15] or Greenwell et al., who say that the rate of newborns with adverse outcomes increased with epidural anesthesia in the presence of elevated maternal temperature, although they did not consider pH values.[16]

Some studies consider that the gestational age is an important factor and has influence in umbilical cord pH values. Helwig et al., showed that the umbilical artery pH was stretched with increasing gestational age, showing better results in premature babies because these newborns were subject to less labor;[17] but Weiner et al., showed the same trend in preterm infants that were not subjected to labor.[18] They concluded that there was a higher oxygen consumption by the placenta with increasing gestational age.

The hospital where the research was performed, umbilical cord pH determinations are systematically being made for about 15 years. Researchers think that are needed studies to identify the factors during the perinatal period before delivery that can influence the pH values of umbilical cord blood; so the main objective of present study was to identify perinatal factors that can influence at the umbilical cord blood pH values in neonates.

MATERIAL AND METHODS

Study design and participants

A descriptive and analytical study conducted at a tertiary hospital, in the Autonomous Community of Andalucia (Spain). Participants were women attended for birth between January 2010 and January 2013. The hospital provides care to women of the city and the central region of the province.

The inclusion criteria were: Uncomplicated pregnancy and vaginal single delivery at term with head presentation. Exclusion criteria were: high-risk delivery and cesarean birth.

Sample

56 women who presented with a birth plan during this period were included, and also we included 2 to 3 women without a birth plan for each of the above by simple random sampling and in the same time period. Total sample was N = 165. A birth plan is a way for women to communicate their wishes to the midwives and doctors who care for them in labour. It tells them about the type of labour and birth they´d like to have, what they want to happen, and what they want to avoid.

Variables

Independent variables considered were: Age (years): parity (primiparous/multiparous); gestational age (37-39 weeks + 6 days/40 – 40 weeks + 6 days/ > or = 41 weeks); start of labour (spontaneous/induction of labour); type of birth (eutocic/instrumented); epidural analgesia (yes/no); episiotomy (yes/no); duration of the active phase of labor (hours); duration of the expulsive phase (minutes); use of oxytocin (yes/no); have presented a birth plan (yes/no); and newborn weight (grams). It was considered as a dependent variable the umbilical cord arterial blood pH values: normal (> 7.24); pathologic (< = 7.24).

Material and Procedure

Data we collected from medical records of women included in the sample. Women´s records were stored in the hospital´s delivery unit database, from here, the data were retrieved. Umbilical cord arterial blood pH were routinely collected according to a standardized protocol. Extraction is performed from the arteries immediately after birth, and after a double cord clamping. This analysis is performed in the same unit and is carried out by the midwife or auxiliary nurses.

Data analysis

Data analysis was performed using the PASW Statistic program (version 18). First, we performed a descriptive study of variables. Quantitative variables were described based on a standard deviation and mean value. Qualitative variables were described with frequencies and percentages in each one of the categories. Statistical analysis was performed using logistic regression.

For statistical analysis it was firstly performed a univariate logistic regression analysis with each one of the independent variables. Afterwards, the variables that had a greater significance were included in the multiple logistic regression (MLR) model. Using the Wald statistic, variables with a p > or = 0.15 (methodical selection procedure backwards), were, one to one, eliminated. The comparison with the reduced model that includes the variables eliminated was performed using the likelihood ratio test. The scale of the continuous variables was evaluated by Tidwell Box testing. We studied the possible interactions among the variables. Variables with a significance greater than 0.05 were studied as potential confounders, considering them as such if the percentage of change of the coefficients was higher than 15%. As extreme cases diagnostic test was used Cook's distance. The Hosmer-Lemeshow statistic was used to assess goodness of fit.

Ethical considerations: The project for this study was approved by the Ethical Committee of Clinical Research.

RESULTS

Among the 214 pregnant women included initially in the study sample, 49 were excluded: 41 were caesarean sections; another 5 for having less than 37 weeks gestation, 2 were twin births and one for extra hospital birth. The final sample was 165 women (N = 165). The descriptive analysis showed that the average age was 30 (4.78) years (minimum 16 years, maximum 41 years), 56% were primiparous, 44% were multiparous, and 5.5% had a previous caesarean. As for the type of delivery 16%

had an instrumental delivery, 39% received oxytocin, 21% of women had induction of labor. Concerning the use of epidural analgesia, 73% of the sample had an epidural. The women who presented with a birth plan were the 29% (n = 48).

Umbilical Cord Blood pH values: The mean of cord blood pH values was 7.29 (0.08). A pH value < 7.24 appeared in the twenty-six percent of newborns.

Obstetrical characteristics of participants are listed in table 1.

Table 1. **Obstetric characteristics** (n = 165)

Variable	n	%
Age (years) Mean (SD)	0,43	(4,78)
Parity		
Primiparous	93	(56,4)
Multiparous	72	(43,6)
Gestational age		
37 - 39+6 s	78	(43,3)
40 - 40+6 s	56	(33,9)
> = 41 s	31	(18,8)
Type of delivery		
Non-instrumented	138	(83,6)
Instrumented	27	(16,4)
Start of labor		
Spontaneous	130	(78,8)
Induction of labor	35	(21,2)
Previous Caesarean		
Yes	9	(5,5)
No	156	(94,5)
Epidural analgesia		
Yes	121	(73,3)
No	44	(26,7)
Episiotomy		
Yes	74	(44,8)
No	91	(55,2)
Use of oxytocin		
Yes	64	(39)
No	101	(61)
Birth plan		
Yes	48	(29)
No	117	(71)
Umbilical cord pH[a]		
> 7,24	119	(74,4)
7,21-7,24	15	(9,4)
< = 7,20	26	(16,3)

[a] Data available for 160 participants

The univariate logistic regression analysis showed that the variables with greater significance, and therefore to be considered for the MLR analysis, were: age (p =

0.15), parity (p = 0.15), anesthesia epidural (p = 0.009), episiotomy (p = 0.05), duration of the expansion phase (p = 0.01), gestational age (p = 0.02), use of oxytocin (p = 0.02) and had presented a birth plan (p = 0.03).

Multiple logistic regression analysis determined the variables that significantly influence the outcome of the umbilical cord blood pH were: epidural anesthesia (OR: 4.07, p = 0.015), gestational age > or = 41 weeks (OR: 2.84, p = 0.034), and birth plan (OR: 0, 31, p = 0.021). Possible interactions were evaluated and none were significant. No subject had a Cook's distance greater than one.

Table II summarizes the results of MLR analysis.

Table II. Factors associated with neonatal pH values

Variable	Coeficient	Standard Error	p	OR	CI(95%)
Epidural	1,404	0 ,575	0 ,015	4,07	(1,31 - 12,56)
Gestational Age[a]	1´044	0,493	0.034	2,83	(1,08 – 7.45)
Birth plan	-1,174	0,509	0,021	0,30	(0,11 – 0,83)

Test of likelihood ratio = 18.631, p = 0.001, df = 4
Hosmer-Lemeshow: p = 0.908
Area under the ROC curve = 0.799 (95% CI = .708 to .891)
[a] Data for gestational age > or = 41 weeks.

DISCUSSION

The gestational age variable behaved as influential in our study in accordance with certain authors[17,18] thus, in our study the gestational age greater than or equal to 41 weeks was associated with lower umbilical cord pH values. In this sense, Bailit et al., demostrated that some neonatal outcomes improved until 39 weeks and babies born with elective induction are associated with better neonatal outcomes compared to spontaneous labor.[19]

The use of epidural anesthesia during labor is another variable related to low pH results in our study, In this sense, Pennell et al., reported that the preferences of analgesia is one of the most important requests in birth plans, the 50% of women requested epidural analgesia, and the 65% ended up receiving this analgesia.[20] In accordance with them, in our study about 70% received epidural analgesia in both groups, with and without birth plan. In the Cochrane review by Anim-Somuah et al., the Apgar test results were not affected by the use of epidural analgesia, but it was mentioned an increased risk of caesarean due to an increased risk of fetal distress.[21] Greenwell et al., concluded that neonatal welfare is affected when using epidural analgesia during labor in the presence of high maternal intrapartum temperature.[16]

Only a few studies were found that took into account the pH value of umbilical cord blood to determine if there was any changing of neonatal state after application of epidural analgesia, and although most of them showed no significant involvement pH,[12,13] there is some controversy on the subject.[22] Iglesias et al., are in agreement with our study at this point and found a relation between epidural analgesia during labor and lowest values of pH.[23]

Note the positive relation between the variable using birth plan with results of umbilical cord pH. In reviewing the literature, there were not many studies directly linking the use of birth plan and neonatal outcomes; [24, 25] they didn´t find significant associations where found. In this way we note that the main demands of women with a birth plan are aimed at preventing routine interventional techniques such as early amniotomy, routine oxytocin use during labor, or the Valsalva pushing technique used routinely in the second stage of labor, among other. Thus birth plans could contribute to a more natural birthing process and low-intervention, and in this way there are studies linking the use of oxytocin and uterine hyperactivity with the risk of fetal acidemia.[26] Yildirim et al., for example, concluded that providing support for spontaneous pushing in the second stage result in a shorter second stage without interventions and improved newborn outcomes.[27] Also, Romano and Lothian proposed six evidence-based care practices to promote physiological birth as avoiding medically unnecessary induction of labor, avoiding routine interventions and restrictions, etc…[28]

However, there was no relation between the umbilical cord pH results and factors that, in principle, might seem closely related and are even referred to by some authors as influential. This happened with the variable type of delivery. Contag et al., for example, found no significant difference between pH values in three groups: births assisted by vacuum, by forceps and by cesarean birth,[29] while De Franco et al., concluded that the only factor associated with a low pH value was birth instrumentation, and more specifically with the use of vacuum.[30] In this sense, Benedetto et al., concluded that the birth instrumentation was associated with an increased risk of neonatal complications.[31] Parity variable, regarded as influential in some studies, [10-12] was one of the variables that came out soon from our regression model.

As limitations of this study we have to mention that this is a study carried out in a single hospital, although this hospital attends pregnant women in both, the city and the central area of the province. Secondly, the sample may be limited and restricted.

CONCLUSION

The results of our study allow us to conclude that the perinatal factors that may negatively influence the neonatal umbilical cord pH were: The application of epidural analgesia and gestational age greater than or equal to 41 weeks, while having presented a birth plan could have a protective influence.

Implications

Knowledge of these results provides professionals that serve this area, and especially midwives, more evidence of the elements that may influence neonatal well-being, and thus being able to act accordingly, anticipating risks, applying more effective care, favoring the more active role of women in the birthing process, showing interest in the birth plan requests, and providing more accurate information to pregnant women to give them greater capacity in making decisions.

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