Determining an Umbilical Cord pH Cutoff Value for Predicting Neonatal Morbidity Related to Intrapartum Hypoxia

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Intrapartum hypoxia can lead to perinatal asphyxia, acidosis, neuronal injury, long-term morbidity or even death. Intrapartum asphyxia and hypoxia can be predicted by fetal acidosis. Umbilical cord gases are used to evaluate a newborn’s acid-base status and the presence of hypoxia. Depending on what references are used, normal values for umbilical cord gases can widely vary. Although most papers set a pH threshold of < 7.2 for fetal acidosis / acidemia, some studies suggest that neonatal morbidity and mortality is increased only when the pH threshold is set below / cut-off value is 7.0. We did a retrospective study and evaluated all newborns from singleton term births in INSMC Alessandrescu Ruseescu between 2010 - 2012. We found 83 cases of intrapartum asphyxia (IA) and 25 cases of hypoxic ischemic encephalopathy (HIE). Also a control group of 100 normal term newborns were randomly selected. The IA and HIE showed significant lower mean umbilical cord pH values compared to the control group (7.19, respectively 7.12 compared to 7.28). Using the Youden index we calculated pH a cutoff value of 7.25 for the prediction of IA and of 7.16 for the prediction of HIE. While a low Apgar score can be a predictor of neonatal outcome and may be determined by fetal hypoxia, it remains a subjective evaluation with variable intra-observer reliability. Thus it is important to have an objective test able to accurately diagnose perinatal asphyxia and predict the neonatal outcome.

Keywords: intrapartum asphyxia, hypoxic ischemic encephalopathy, umbilical cord gases

Intrapartum hypoxia can lead to perinatal asphyxia, acidosis, neuronal injury, long-term morbidity or even death [1-4]. An objective measurement of intrapartum hypoxia may predict those neonates at risk for morbidity and mortality [5, 6]. Intrapartum asphyxia and hypoxia can be predicted by fetal acidosis [7-9].

The presence of hypoxia during labor results in fetal asphyxia that in turn, is characterized by fetal acidosis, depression of vital functions, long term morbidity and mortality [10]. Intrapartum hypoxia can have multiple causes starting with prematurity and dystocic labor going to serious accidents such as retroplacental hematomata [11, 12]. Umbilical cord gases are used to evaluate a newborn’s acid-base status and the presence of hypoxia in acute and chronic fetal distress various etiologies [13].

Umbilical cord pH is often used as an indicator if fetal oxygenation before birth and the Apgar score reflects newborn adaptation. Depending on what references are used, normal values for umbilical cord gases can wildly vary. Although most papers set a pH cut-off value of 7.2 for fetal acidosis / acidemia, some studies suggest that neonatal morbidity and mortality is increased only when the pH cut-off value is 7.0 [6, 7, 14]. On the other hand other studies suggest a higher pH cut-off value of 7.25 as being optimal for predicting neonatal morbidity [15]. Because there is no consensus as to what the threshold for pH should be considered abnormal, there still uncertainty regarding the below what values should the pH be considered to be predictive for an unfavorable neonatal outcome.

We conducted a retrospective study to evaluate if umbilical cord blood pH can be a mean of predicting morbidity and mortality due to asphyxia in term neonates.

Experimental part

Method

The study was retrospective and evaluated 10356 newborns that were registered between 2010 and 2012 in INSMC Alessandrescu Ruseescu, Bucharest, Romania. The information was collected form the archived patient medical record and included: gestation age, fetal heart rate monitoring during labor, birth weight, Apgar score, umbilical blood gases (pH) performed on ABL800 FLEX blood gas analyzer, neonatal treatment and outcome.

All newborns from term singleton births with markers of a severe hypoxic event during labor defined as the presence of at least one of the following: severe changes in fetal heart rate (<100, >160) or meconium staining and in the presence of at least one of the following: low Apgar score (≤ 3 in the first minute or ≤ 5 after five minutes); respiratory failure (defined/characterized as absence of spontaneous breathing after more than 5 min or mechanical ventilation for more than 10 min); the need for intensive care unit admission for more than 24 h; were included in the intrapartum asphyxia group (IA). Those with at least one of the following: hypotonia; seizures; hypoxia; depression of reflexes; subnormal level of consciousness; were included in the hypoxic ischemic encephalopathy (HIE) group.

The exclusion criteria for both IA and HIE groups were: encephalopathy determined by causes other than IA, congenital malformations, congenital metabolic diseases, viral infection, septic shock, major organ failure, fetal trauma during birth.

A control group of 100 healthy newborns from term singleton births, that did not meet any of the above criteria (IA, HIE, exclusion), and that had information regarding umbilical cord gases, was randomly selected from the 10356 newborn that were registered between 2010 and 2012.

Term pregnancy was defined as a gestational age of 37 weeks or greater.

Receiver operating characteristics (ROC) curves were constructed to assess the accuracy and predictive value of umbilical cord pH for IA and HIE [16]. To estimate the
optimal pH cutoff value for diagnostic effectiveness, the maximal Youden index was used [17].

The data was collected using Office - Excel and the statistical analysis was made using NCSS 12 - Descriptive statistics; Two sample t test; ROC curve and cutoff analysis.

Results and discussions

From the total of 10356 births that occurred between 2010 - 2012, we found 83 cases that met our criteria for IA, of which 25 cases also met our criteria for HIE.

The 83 cases of IA, presented increased morbidity, including: low Apgar score, respiratory failure, complications due to the mechanical ventilation, signs of neurological damage, infection. Out of the 25 cases of HIE there were 7 deaths, while in total there were 91 newborn deaths in the period 2010-2012. Thus there is a 28 fold increase in death rate in the HIE group, compared with the total mortality which is 1.1%.

The umbilical cord pH was significantly lower in the IA and EHI groups, compared to the Control group as shown in Table 1 and figure 1. In the IA group pH values ranged between X-y with a mean of 7.19 ± 0.07, while in the EHI group the pH values ranged between 7.09-7.20 with a mean of 7.12 ± 0.03.

The ROC curves of pH for predicting IA and EHI are shown in figure 2. Using the ROC curves we analyzed the predictive value for IA and EHI of different umbilical cord


References


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