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Clinical Significance of Cord Blood Lactate in Neonates with Asphyxia

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Abstract: Objective It is clinically insufficient to assess the severity and prognosis of neonatal asphyxia only according to Apgar score and blood gas measurement. In order to find more sensitive and specific indexes, the clinical significance of cord blood lactate in neonates with asphyxia was studied. **Methods** The lactate level and the pH value of cord arterial blood were determined in 31 term infants with perinatal asphyxia (further divided into the mild and the severe asphyxia groups) and 30 normal neonates (the control group). At the 14th day after birth, 20-item neonatal behavioral neurological assessment (NBNA) was taken for each subject. **Results** The levels of cord blood lactate in the mild and severe asphyxia groups [(6.42 ±0.14) and (10.77 ±0.12) mmol/L] were significantly higher than that in the control group [(4.20 ±0.15) mmol/L] ($P < 0.01$). The pH values in the mild and severe asphyxsia groups were markedly lower than that of the control group [(7.16 ±0.07) vs (7.18 ±0.11); (7.04 ±0.09) vs (7.18 ±0.11)] ($P < 0.01$). There were significant differences in the lactate level and pH value between the mild and severe asphyxia groups ($P < 0.01$). The lactate level was negatively correlated with the pH value and the score of NBNA ($r = -0.76$ and -0.85, respectively, both $P < 0.01$). **Conclusions** Cord blood lactate may be a useful index in evaluating the severity and short-term prognosis in neonates with perinatal asphyxia.

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Key words: Asphyxia; Lactate; Neonatal Behavioral Neurological Assessment; Newborn

窒息新生儿脐血乳酸值的临床意义

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[**摘 要**] **目的** Apgar 评分和血气分析作为判断新生儿窒息程度和预后的指标有一定的局限性,为寻找更具敏感性和特异性的指标,该研究探讨脐血乳酸值在新生儿窒息中的临床意义。**方法** 对 31 例足月窒息新生儿(分为轻度窒息组 22 例和重度窒息组 9 例)和 30 例正常新生儿(对照组)的脐动脉血进行乳酸测定及微量血液气体分析,并在第 14 天进行新生儿 20 项行为神经测定(NBNA)。**结果** 轻、重度窒息组脐动脉血乳酸值[(6.42 ±0.14) mmol/L,(10.77 ±0.12) mmol/L]较对照组[(4.20 ±0.15) mmol/L]显著升高($P < 0.01$),pH 值[(7.16 ±0.07),(7.04 ±0.09)]较对照组(7.18 ±0.11)明显降低($P < 0.01$);其中重度窒息组的乳酸值高于轻度窒息组,pH 值低于轻度窒息组,差异均有显著性($P < 0.01$)。脐血乳酸值与 pH 值及第 14 天 NBNA 评分呈显著负相关($r = -0.76, -0.85$, $P < 0.01$)。**结论** 脐血乳酸值可作为判断新生儿窒息程度和近期预后的指标。

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[**关 键 词**] 窒息;乳酸;新生儿行为神经测定;新生儿

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To find a sensitive and specific index for assessing the severity of perinatal asphyxia will attract the attention of obstetricians and pediatricians. So far, the severity of perinatal asphyxia is mainly identified

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by the Apgar score, clinical observation and blood gas measurement. It has been reported that the cord blood lactate level was a better marker than the pH or base excess (BE) value for diagnosis and prognosis evaluation of asphyxia[1]. Neonatal behavioral neurological assessment (NBNA), as a general behavioral and neurological assessment, is better than the Apgar scoring. This study aims at exploring the relationship between lactate level and neonatal asphyxia by a combined measurement of cord blood lactate level and NBNA.

Materials and methods

Materials

Thirth-one term neonates with perinatal asphyxia born in the Department of Obstetrics of the Third Xiangya Hospital, Central South University were enrolled in this study. Of the 31 cases, there were 22 cases of mild asphyxia (13 boys and 9 girls) with 1 minute Apgar score of 4 - 7, a gestational age of (39.66 ±0.52) weeks and a birth weight of (3.34 ± 0.14) kg. The others were severe asphyxia cases (6 boys and 3 girls) with 1 minute Apgar score of 0 - 3, a gestational age of (39.36 ±0.23) weeks and a birth weight of (3.25 ±0.25) kg. Thirty normal neonates (19 boys and 11 girls) born in the same period were used as the control group. They had a gestational age of (40.01 ±0.35) weeks and a birth weight of (3.37 ±0.12) kg. There were no significant differences in the gestational age, gender and birth weight among the 3 groups.

Methods

The cord blood lactate levels and the blood gas results were measured immediately after birth with an i-STAT micro-quantity blood gas analyzer (Abbott Ltd., USA). All the reagents needed were supplied by the same company. NBNA was taken by a specialist on the 14th day after birth.

Statistical analysis

SPSS 10.0 software was used for data statistical analysis. A two-two comparison among multiple samples was done by the q test. The relationship between indexes was expressed by linear correlation analysis. The results were expressed with $\bar{x} \pm s$.

Results

Comparison of the blood lactate levels and the pH values among the asphyxia groups and the control group

The cord blood lactate levels in the mild and severe asphyxia groups were higher than that of the control group respectively ($P < 0.01$) and the pH values were lower than that of the control group, respectively ($P < 0.01$). The differences of the lactate levels and the pH values between the mild and severe asphyxia group were significant ($P < 0.01$). See Table 1.

Table 1 Lactate levels and pH values in the asphyxia groups and the control group ($\bar{x} \pm s$)

Groups	n	lactate (mmol/L)	pH
Control	30	4.20 ±0.15	7.18 ±0.11
Mild asphyxia group	22	6.42 ±0.14[a]	7.16 ±0.07[a]
Severe asphyxia group	9	10.77 ±0.12[a,b]	7.04 ±0.09[a,b]

Note: a vs the control group $P < 0.01$; b vs the mild asphyxia group $P < 0.01$

Relationship between the lactate level, pH value and NBNA score

The cord blood lactate level was significantly negatively correlated to the NBNA score and the pH value ($r = -0.85$, $r = -0.76$ respectively, both $P < 0.01$) (See Figure 1). The pH value was significantly positively correlated to the NBNA score ($r = 0.71$, $P < 0.01$).

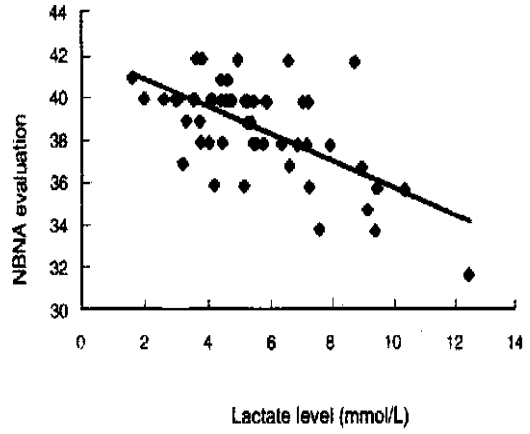

Figure 1 Correlation between the cord blood lactate level and the NBNA score

Discussion

Neonatal asphyxia is a continuous process with a basis of metabolic, functional and structural disorders induced by the decrease of blood supply and blood oxygen concentration. The metabolic disorders include aerobic metabolic reduction, anaerobic metabolic enhancement, decrease of pH value, increase of blood lactate concentration and elevation of BE value. Blood gas, a more commonly used accessory examination, is useful for assessing neonatal asphyxial severity. But it is commonly thought that both the sensitivity and the specificity of blood gas are insufficiently high in evaluating the prognosis of asphyxia only by acidosis severity. This is because of the difference of individual adaptability, the redistribution of blood flow and the complementary action of by-pass pathway energy metabolism[2]. In addition, the over-decreased pH value in neonates with asphyxia may increase by the body fluid buffering and respiratory compensation after birth, which blur the severity of acidosis. Lactate is the main composition of organic acid and anion gap in anaerobic zymolysis. The increase of lactate level was detected earlier and disappeared later than the decrease of pH value[3], and therefore is more continuable than the unstable pH value. Lactate has a direct toxicity on the brain and has a closer relationship with neurological damage than the pH value[4,5].

Similarly, the Apgar score used for identifying the clinical severity of asphyxia is inaccurate and unbalanced. The reason why the NBNA method was used to evaluate the neonatal post-asphyxial brain damage rather than the Apgar score or Sarnat method is because the NBNA method, which is widely used in China, has been proved to be more accurate and sensitive and has closer relationship with the prognosis of asphyxia[6]. In this study, it was found that the changes of the lactate levels were even more closely related to the NBNA score changes than the pH value. Some acute asphyxial neonates with low pH value and high lactate level may recover soon, while the persistent severe perinatal asphyxial neonates may develop apparent neurological and behavioral changes due to lactate accumulation even though the acidosis is compensated to some extent. The results in this study matched with the above speculation. Therefore, lactate is possibly a useful marker for evaluating the severity of neonatal asphyxial damage. The relationship between the lactate level and the long-term prognosis of asphyxia and the determination of threshold value of lactate need larger samples and further statistical analysis.

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