

Асфиксия и рН пуповинной крови

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Review

Perinatal asphyxia in the term newborn

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Критерии асфиксии

1996 The American Academy of Pediatrics and American College of Obstetrics and Gynecology published the first statement that included the following criteria:

- a. profound metabolic acidosis ($\text{pH} < 7.0$) in umbilical artery blood;
- b. Apgar score ≤ 3 for longer than 5 minutes;
- c. neonatal encephalopathy;
- d. multi-organ system disfunction.

Committee on Fetus and Newborn, Committee on Obstetric practice.

Use and Abuse of the Apgar Score. Pediatrics. 1996;98:141-2.

Критерии асфиксии

The second Consensus statement was approved by the International Cerebral Palsy Task Force in 1999, and included 3 essential criteria and 5 additional criteria.

The essential criteria were the following:

- a. metabolic acidosis in early neonatal blood sample (pH < 7.0 and base deficit \geq 12 mmol/L);
- b. moderate or severe encephalopathy;
- c. cerebral palsy of spastic quadriplegia, dyskinetic or mixed type.

The 5 additional criteria were:

- a. sentinel event;
- b. severe changes in fetal heart rate;
- c. Apgar score < 6 beyond 5 min;
- d. multi-system involvement;
- e. early imaging evidence [6].

MacLennan A. A template for defining a causal relation between acute intrapartum events and CP: International Consensus Statement.

Критерии асфиксии

The third consensus statement was developed by the American College of Obstetrics and Gynecology in 2002, including 4 essential criteria and 5 additional criteria.

The essential criteria were the following:

- a. metabolic acidosis (pH < 7.0 and base deficit \geq 12 mmol/L) in umbilical artery sample;
- b. moderate or severe encephalopathy;
- c. cerebral palsy of spastic quadriplegia or dyskinetic type;
- d. exclusion of other etiologies.

The 5 additional criteria were:

- a. sentinel event;
- b. abrupt changes in fetal heart rate;
- c. Apgar score \leq 3 beyond 5 min;
- d. multi-system failure within 72 h of life;
- e. early imaging evidence [7].

Task Force American College of Obstetricians and Gynecologists
and The American Academy of Pediatrics. Neonatal encephalopathy
and CP. Defining the pathogenesis and pathophysiology. Washington
DC: ACOG. 2003.

- The cornerstone of all three statements is the presence of severe metabolic acidosis (pH < 7.0 and base deficit ≥ 12 mmol/L) at birth in a newborn exhibiting early signs of moderate or severe encephalopathy.
- Both arterial and venous cord blood should be obtained because the former reflects fetal status more directly while the latter reflects the uteroplacental oxygen exchange [8].

Нормальные значения газового состояния в пуповинной крови

Use of umbilical cord blood gas analysis in the assessment of the newborn

L Armstrong, B J Stenson

.....
Analysis of paired arterial and venous specimens can give insights into the aetiology of acidosis in the newborn

Table 1 Studies reporting umbilical cord values for term and preterm infants

Author	Umbilical artery				Umbilical vein				Number
	pH	Base excess (mmol/l)	PCO ₂ (kPa)	PO ₂ (kPa)	pH	Base excess (mmol/l)	PCO ₂ (kPa)	PO ₂ (kPa)	
Victory <i>et al</i> ¹ 2004	7.24 (0.07)	-5.6 (3.0)			7.33 (0.06)	-4.5 (2.4)			20 456
Helwig <i>et al</i> ² 1996	7.26 (0.07)	-4.0 (3.0)	7.05 (1.33)	2.26 (0.8)	7.34 (0.06)	-3.0 (3.0)	5.45 (0.93)	3.86 (0.93)	15 073
Thorp <i>et al</i> ³ 1989	7.24 (0.07)	-3.6 (2.7)	7.49 (1.14)	2.38 (0.92)	7.32 (0.06)	-2.9 (2.4)	5.83 (0.89)	3.82 (0.97)	1694 _a 1820 _v
Riley and Johnson ²⁰ 1993	7.27 (0.07)	-2.7 (2.8)	6.69 (1.48)	2.45 (1.09)	7.34 (0.06)	-2.4 (2.0)	5.41 (1.05)	3.79 (1.02)	3522
Dickinson <i>et al</i> ²³ 1992	7.26 (0.08)	-3.2 (2.9)	7.05 (1.33)	2.53 (1.05)	7.33 (0.07)	-2.6 (2.5)	5.77 (1.1)	3.88 (1.29)	1393 _a 1526 _v

Data are presented as mean (SD). Arterial (a) and venous (v) sample numbers are given separately where available.
CTG, cardiotocogram; SOL, spontaneous onset of labour; SVD, spontaneous vertex delivery.



У каждого второго
ребенка рН меньше
7,0, почему этот
ребенок умер?

Once severe acidosis is present, the likelihood of adverse sequelae rises sharply with worsening acidosis. Goodwin *et al* found that hypoxic-ischaemic encephalopathy occurred in 12% of infants with cord pH <7.0, 33% with cord pH <6.9, 60% with cord pH <6.8, and 80% with cord pH <6.7.³⁵ In a study of 69 000 term deliveries with cord blood gas measurements, no infant was live born with pH <6.6.³⁵ Increasing morbidity with worsening acidosis, once severe acidosis is present, has also been noted in several other studies.^{59–61} Collectively these data suggest that permanent neurologic injury from intrapartum asphyxia occurs late in the course of the asphyxial insult in most of the cases, once the fetus is close to death.

Вероятность развития ГИЭ при различных уровнях пуповинной крови:

pH <7,0 12%

pH <6,9 33%

pH <6,8 60%

pH <6,7 80%

При исследовании газового состояния пуповинной крови у 69000 доношенных детей, при уровне pH <6,6 выживших не было!!!

SUMMARY

Umbilical cord blood gas analysis is recommended in all high-risk deliveries and is performed after all deliveries in some centres. For optimal interpretation paired umbilical arterial and venous samples should be taken soon after birth from a segment of cord that has been doubly clamped to isolate it from the placenta. Low cord pH in infants who are vigorous at birth and free of cardiopulmonary compromise does not indicate an increased risk of adverse outcome. Infants with pH <7.0 at birth who are not vigorous are at high risk of adverse outcome. Identification of infants at risk of encephalopathy is especially important now that early intervention is being considered. Analysis of paired arterial and venous specimens can give insights into the aetiology of the acidosis. In combination with other clinical information, normal paired arterial and venous cord blood gas results can usually provide a robust defence against a suggestion that an infant had an intrapartum hypoxic-ischaemic event.

Анализ газового состояния пуповинной крови рекомендуется проводить при родах с высоким риском и выполняется после родов некоторых центрах. Для оптимальной интерпретации, следует проводить забор как артериальной, так и венозной пуповинной крови сразу же после родов, путем накладывания зажима с двух сторон пуповины.

Не активные новорожденные с низким рН имеют высокий риск нежелательного исхода.

Анализ газового состояния артериальной и венозной пуповинной крови поможет раскрыть причину ацидоза.

Анализ газового состояния пуповинной крови ребенка

pH – 6,6

pCO₂ 113 мм.рт.ст.

pO₂ 21 мм.рт.ст.

BE – (-22)

HCO₃ – 4,8

Артериальной/венозной ???

Выводы:

Отрицательные моменты:

В данном случае, на неонатальном этапе, вероятность предотвращения смерти была очень низкой

Положительные моменты:

В центре проводится анализ газового состояния пуповинной крови

Предложения:

Необходимо проводить забор артериальной и венозной пуповинной крови для анализа газового состояния

Клинический случай

A mother presented at term for induction of labor. Fetal heart monitoring demonstrated variable and late decelerations during the labor. The mother received Stadol (butorphand tartrate) 3 hours prior to the birth. A male infant was born depressed with Apgar scores of 1 and 4.

Cord blood gases (all given as pH/pCO₂/pO₂/HCO₃⁻ /Base excess) were as follows

Umbilical vein: 6.85/101/24/17/- 21.3

Umbilical artery: 6.71/141/13/18/- 26.8

Клинический случай

The infant was resuscitated with endotracheal intubation and positive pressure ventilation. Narcan was administered at 20 minutes of age. At 1 hour of age, a blood gas revealed 7.19/73/36/13.6/-13.6. The infant began seizing within the first 24 hours of life and there were persistent abnormalities of the muscle tone. He had elevated liver enzymes with an SGOT of 129 IU/l at 5 hours of age. A head CT scan revealed a large subarachnoid hemorrhage. His condition stabilized and he was discharged home at 8 days of age. The child is now 5 years old and has spastic cerebral palsy.

Выберите правильный ответ

- (a) This represents a respiratory acidemia arising in the fetus due to respiratory depression from Stadd. The HCO_3^- values of 17 and 18 indicates that there is little, if any, metabolic acidemia present.
- (b) A low arterial pH with a base excess of -26.8 indicates that this is a metabolic acidemia. A metabolic acidemia can explain all the values. This may have occurred because of problems with either the placenta or the umbilical cord.
- (c) The infant has a mixed acidemia; there is evidence of both uteroplacental insufficiency and cord compression. The elevated pCO_2 demonstrates a severe respiratory acidemia and the base excess of -26.8 indicates a severe metabolic acidemia. It is best to ignore the HCO_3^- value in this case.
- (d) There is a laboratory error in the calculated values. AHCO_3^- of 18 indicates very mild metabolic acidemia, while a base excess of $-24/-25$ indicates a severe metabolic acidemia. The two values are inconsistent and one or the other is in error.



Помогает ли
электронный
мониторинг плода
предупредить
ацидоз у плода?

Electronic Fetal Monitoring

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Randomized Trials regarding EFM – Part 1

- 1986 – Leveno publication in NEJM comparing intrapartum monitoring in low-risk vs. high-risk pregnancies
 - 34,995 pregnancies assessed
 - No difference in rate of stillbirth, low Apgar scores, need for fetal ventilation, fetal seizures or NICU admission; however there was an increase in cesarean delivery for fetal distress
- Follow-up studies including one by Vinzileos in 1993 randomized patients to continuous fetal monitoring versus intermittent fetal monitoring
 - No difference in Apgar scores, fetal acidosis at birth, neonatal resuscitation or other neonatal complications
 - Increased rate of cesarean delivery and assisted vaginal birth
- 2006 – Cochrane metanalysis comparing continuous EFM vs. intermittent EFM
 - Increased risk of cesarean delivery (RR 1.66; 95% confidence interval [CI], 1.30–2.13)
 - Increased the risk of Vacuum and forceps operative vaginal delivery (RR, 1.16; 95% CI, 1.01–1.32).
 - No reduction in perinatal mortality (RR, 0.85; 95% CI, 0.59–1.23).
 - Reduced risk of neonatal seizures (RR, 0.50; 95% CI, 0.31–0.80).
 - No reduction in the risk of cerebral palsy (RR, 1.74; 95% CI, 0.97–3.11).

Can EFM predict fetal acidemia?

- Many studies have evaluated this question in an attempt to link EFM with low umbilical cord gases at birth and EFM with the later onset of cerebral palsy
- Various components of EFM during labor such as presence of decelerations, fetal tachycardia, reduced variability and/or fetal bradycardia have been evaluated for a possible link with neonatal encephalopathy
- Studies from 2003-2007 note that there may be an association between EFM patterns and umbilical artery pH; however there are no clear EFM patterns specifically associated with fetal acidemia

Can EFM predict fetal acidemia?

- HOWEVER ... fetal variability and/or fetal accelerations are reliably depressed with degrees of metabolic acidemia significant to cause neonatal CNS injury
- THEREFORE, in a fetus with moderate variability and/or fetal accelerations on EFM, hypoxic-induced metabolic ischemia can be reliably excluded
- To date, NO evidence proving that electronic EFM reduces the rate of neonatal encephalopathy!
- No evidence in the current literature that supports the ability of practitioners to predict neonatal neurologic injury, cerebral palsy or stillbirth using EFM.

– Neonatal Encephalopathy & Neurologic Outcome, 2nd Edition, 2014

Назарларыңызға көп рахмет!