

Postnatal Lactate As An Early Predictor of Short-Term Outcome in Term Neonates with Birth Asphyxia: Prospective Case Series Study

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Abstract

Background: Perinatal Asphyxia is a multi-system disorder and its effects are not limited to central nervous System. It is lack of blood flow or gas exchange to or from the fetus in the period immediately before, during period or after the birth process. Perinatal asphyxia remains one of the commonest causes of newborn admissions in some centers. This study was done to know the role of lactate as an early predictor of severity of perinatal asphyxia and to assess the short-term outcome which help in assessing the prognosis and parent counselling.

Methodology: A hospital based prospective analytical study performed in 53 asphyxiated term neonates admitted in our NICU from January 2019 to June 2020. Biochemical parameters like Serum Lactate and Base deficit were evaluated for sensitivity, specificity and diagnostic accuracy in comparison with clinical diagnosis HIE insult and predicting the outcome of baby were correlated with results from EEG, MRI/CT, anticonvulsants, duration of inotrope, severity of shock and outcome.

Results: In our study among 53 term asphyxiated neonates. We had 13 neonates (25%) with stage 3 HIE while 24 babies (45%) were stage 2 HIE and 16 babies (30%) were stage 1 HIE. The serum lactate within 6 hours, 10 neonates (19%) had lactate >15mmol/l, 14 neonates (26.4%) had between 10-14.9mmol/l, 29 babies (54.7%) had lactate 20mmol/l in 25 babies (47.2%), between 15-20 in 23 babies (43.4%) and between 12-15 in 5 babies (9.4%). The outcome of the study showing 8 babies (15%) death whose having persisting hyperlactemia, 12 babies (23%) recovered with neurological sequelae followed by 25 babies (47%) recovered normally without sequelae, 15% of them went DAMA. The sensitivity and specificity of lactate within 6 hours birth showing 92.3% was 100% respectively. Also, the value of serum lactate and base deficit had strong statistical significance with severity of HIE ($p < 0.001$).

Conclusion: Serum Lactate and Base deficit are valuable tool in resource limited settings for early detection of outcome of perinatal asphyxia. The early detection and prompt treatment of condition will help in improving prognosis and also help in parental counselling of these asphyxiated newborns.

Keywords: Perinatal Asphyxia, Serum Lactate, Base-Deficit, Hypoxic-Ischemic Encephalopathy.

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Introduction

The term asphyxia is derived from the Greek and means "stopping of the pulse". Perinatal asphyxia is a condition characterized by an impairment of exchange of respiratory gases resulting in hypoxemia and hypercarbia, accompanied by metabolic acidosis.

Of the 130 million infants born every year globally, about four million die in the first four weeks of life - the newborn period.

According to the World Health Organization (WHO), between four and nine million newborns develop birth asphyxia each year. Of these, an estimated 1.2 million die and at least the same

number develop severe consequences such as cerebral palsy, epilepsy, and developmental delay (The World Health Report, 2003).

Birth asphyxia remains one of the commonest causes of newborn admissions in some centers.

Factors influencing the success of illness management include: place of birth, level of prenatal care, cause of birth asphyxia, gestational age, maternal ill health and events during pregnancy/delivery, and availability of specialized personnel/resources.

Caregivers of sick neonates seek predictors of outcome to facilitate parental counseling and

provide appropriate levels of care, including withdrawal of therapy or initiation of neuroprotective strategies.[7-9]

Based on animal studies and preliminary clinical experience, the therapeutic window in human neonates seems to be within 1 to 6 hours after birth.

It is important to look for useful predictors of severity and prognosis early in the course of disease, preferably within the first 6 hours after birth.

Biomarkers are essential topics in HIE research. As an early predictor within blood biochemistry, blood lactate concentration was used to predict severity and outcome of neonatal hypoxic ischemic encephalopathy.

Blood lactate concentration in critically ill babies can detect tissue hypoxia at an early stage, assess illness severity, and predict outcome.

There is a relative paucity of studies evaluating the role of lactate measurements in neonates with isolated asphyxia. Hence, this study was undertaken to determine the role of lactate as an early predictor of perinatal asphyxia and its immediate prognosis.

Objectives

To study the role of lactate level as an early predictor of severity of perinatal asphyxia and to assess the short-term outcome.

Methods & Methodology

Study Design: Prospective Case Series Study.

Sample Size: Sample Size Estimation: Done using Open Epi software v2.3.1

at 95% confidence level and 80% power of the study.

$$\text{Formula used: } \frac{2(z_{\alpha} + z_{\beta})^2 \sigma^2}{d^2}$$

Drop-out Rate: 10%.

Total Sample Size: 48~50.

Inclusion Criteria: Term neonates with birth asphyxia (37 weeks to 42 weeks) Parent consenting for the neonate to be part of the study.

Exclusion Criteria: Preterm and post-term babies Neonates with life-threatening congenital malformations Neonates with chromosomal abnormalities Parents not consenting for the study.

Ethical clearance was obtained from the "Institutional Ethical Committee" of S. N. Medical College, Bagalkot.

Methodology: Prospective hospital-based study. On admission, detailed history was recorded, thorough physical examination carried out, and newborns classified using Sarnat & Sarnat staging for birth asphyxia. 2 mL of arterial blood sample was collected within 6 hours after birth following informed parental consent.[10-12]

Results

Total neonates included: 53 (16 female, 37 male; 18 inborn, 35 outborn). Apgar scores were noted at 1 minute and 5 minutes. Babies were classified into mild, moderate, and severe HIE based on Sarnat & Sarnat staging.

Table 1: Apgar Score at 1 Minute

APGAR Score at 1 Min	Number of Babies (n=53)	Percent (%)
Severe	10	18.87
Moderate	29	54.72
Mild	10	18.87
Not recorded	4	7.55
Total	53	100.0

Table 2: Apgar Score at 5 Minutes

APGAR Score at 5 Min	Number of Babies (n=53)	Percent (%)
Severe	1	1.89
Moderate	14	26.42
Mild	34	64.15
Not recorded	4	7.55
Total	53	100.0

Table 3: Sarnat and Sarnat Staging of Babies

Sarnat and Sarnat Staging	Number of Babies (n=53)	Percent (%)
Mild (Stage 1)	16	30.2
Moderate (Stage 2)	24	45.3
Severe (Stage 3)	13	24.5
Total	53	100.0

Table 4: Lactate Levels Within 6 Hours

Lactate Within 6 Hrs	Number of Babies (n=53)	Percent (%)
> 15	10	18.9
10–14.9	14	26.4
5–9.9	24	45.3
< 5	5	9.4
Total	53	100.0

Table 5: Lactate Levels at 12 Hours

Lactate at 12 Hrs	Number of Babies (n=53)	Percent (%)
10–14.9	11	20.8
5–9.9	16	30.2
< 5	26	49.1
Total	53	100.0

Table 6: Comparison: Lactate Within 6 Hrs vs Lactate at 12 Hrs

Lactate Within 6 Hrs	10–14.9 (Count / %)	5–9.9 (Count / %)	< 5 (Count / %)
> 15	9 (90.0%)	1 (10.0%)	0 (0.0%)
10–14.9	1 (7.1%)	13 (92.9%)	0 (0.0%)
5–9.9	0 (0.0%)	1 (4.2%)	23 (95.8%)
< 5	1 (20.0%)	1 (20.0%)	3 (60.0%)
Total	11 (20.8%)	16 (30.2%)	26 (49.1%)

Table 7: Outcome relative to Lactate at 12 Hours (\$P < 0.001\$)

Lactate at 12 Hrs	Normal	Recovered with Neurological Sequelae	Death	DAMA
10–14.9	0 (0.0%)	0 (0.0%)	8 (72.7%)	3 (27.3%)
5–9.9	1 (6.3%)	11 (68.8%)	0 (0.0%)	4 (25.0%)
< 5	24 (92.3%)	1 (3.8%)	0 (0.0%)	1 (3.8%)
Total	25 (47.2%)	12 (22.6%)	8 (15.1%)	8 (15.1%)

Summary of Key Findings: 10 babies had serum lactate >15 mmol/L within 6 hours of birth, 14 babies were between 10–14.9 mmol/L, and 29 babies were <10 mmol/L. Babies with serum lactate >15 mmol/L at 6 hours maintained high levels at 12 hours (90%), with a mortality rate of 72%. For serum lactate between 10–14.9 mmol/L within 6 hours, recovery rate with neurological sequelae was 68%. For serum lactate <5 mmol/L within 6 hours, 92% survived without neurological deficits.

Discussion

Hypoxic ischemic encephalopathy is one of the commonest complications in infants after perinatal birth asphyxia.

Perinatal asphyxia ("gasping or ineffective breathing or lack of breathing at one minute after birth") leads to significant mortality and morbidity.

Strong association found between lactate levels and neonatal neurological evolution. Lactate levels were significantly higher in moderate-to-severe HIE compared to mild or no HIE, and took longer to normalize.[13-15]

According to Sarnat & Sarnat staging: 16 had Stage 1 (mild), 24 had Stage 2 (moderate), and 13 had Stage 3 (severe).

Sachin Shah et al.: Showed initial lactate levels were higher in mod-severe HIE. Highest recorded lactate in the first hour and serial measurements are key predictors.

S da Silva et al.: Lactacidaemia <5 mmol/L had no neurological complications; serum lactate >9 mmol/L was associated with moderate/severe encephalopathy (sensitivity 84%, specificity 67%).

PY Cheung et al.: Plasma lactate values for survivors vs non-survivors were 10.0 ± 6.35 mmol/L vs 24.9 ± 9.90 mmol/L on admission. Non-survivors had persistent hyperlactatemia.

Conclusion

Birth asphyxia remains a leading cause of morbidity and mortality in developing countries.

Birth asphyxia with hyperlactatemia at admission to NICU is associated with high mortality.

Serum lactate values above 15 mmol/L predicted death and unfavorable neuro-developmental outcomes.

Serum lactate levels are useful predictors of severity of disease within the first 6 hours after birth.

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