



## CORRELATION OF UMBILICAL CORD BLOOD PARAMETERS WITH ABGAR SCORE IN HYPOXIC ISCHEMIC ENCEPHALOPATHY FOLLOWING BIRTH ASPHYXIA

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### ABSTRACT

**Background and objectives:** Hypoxic ischemic encephalopathy as a result of severe birth asphyxia in neonates remains one of the important causes of neurological disability in children. This study identifies the neurological outcome in term neonates with Hypoxic ischemic encephalopathy that appear following severe birth asphyxia and correlation of conventional umbilical cord blood parameters with APGAR score among controls and cases.

**Materials and Method of study:** A prospective case control study was conducted in term babies from which 60 cases of birth asphyxia and 30 cases of normal newborn delivered in Rajah Muthiah Medical college, Chidambaram over a period of 1 year. Immediately after birth, blood was drawn from clamped umbilical cord, and sent for ABG analysis and parameters like pH, PCO<sub>2</sub>, PO<sub>2</sub>, HCO<sub>3</sub>, Base excess and oxygen saturation were observed.

**Results:** Increased risk of low APGAR score was associated with severe birth asphyxia with decreased umbilical arterial pH. Compare to PO value, difference in PCO<sub>2</sub> and base excess values between cases and controls was associated with increased risk of low APGAR score.

**Conclusion:** pH < 7, high PCO<sub>2</sub>, base excess values were significantly associated with low APGAR. Umbilical cord, PCO<sub>2</sub>, base excess are better indicators of neonatal mortality and morbidity than PO<sub>2</sub> level.

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### INTRODUCTION

Hypoxic-ischemic encephalopathy is the brain injury caused by oxygen deprivation to the brain. The newborn's body can compensate for brief periods of depleted oxygen, but if the asphyxia lasts too long, brain tissue is destroyed. Impairment can include epilepsy, developmental delay, motor impairment, neurodevelopmental delay, and cognitive impairment.

Perinatal depression leads to diminished exchange of oxygen and carbon dioxide and severe lactic acidosis<sup>[1]</sup>. If an episode of Hypoxic ischemia is severe enough to damage the brain, it leads within 12 to 36 hours to a neonatal encephalopathy known as hypoxic-ischemic encephalopathy. The APGAR score predicts cerebral damage but may be influenced by maternal sedation, trauma, cardiac conditions or other neurological diseases. During the past decade, umbilical blood gas analysis has increasingly been recognized as the most

reliable indicator of the fetal oxygenation and acid base condition at birth. The diagnosis of asphyxia mandates the presence of severe cord blood acidemia and normal values refute the diagnosis. As it can provide important information about the past, present and possibly the future condition of the infant it is considered as the gold standard objective for the assessment of intrauterine asphyxia.<sup>[1][2]</sup>. This study is done to correlate umbilical artery blood gas parameters with APGAR score with Hypoxic ischemic encephalopathy due to hypoxia near or at the time of birth.

### MATERIALS AND METHOD OF STUDY

A prospective case control study was conducted in term babies from which 60 cases of birth asphyxia and 30 cases of normal newborn delivered in Rajah Muthiah Medical college, Chidambaram over a period of 1 year. Immediately after birth, blood was drawn from clamped umbilical cord, and sent for ABG analysis and parameters

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like pH, PCO<sub>2</sub>, PO<sub>2</sub>, HCO<sub>3</sub>, Base excess and oxygen saturation were observed.

**Inclusion criteria**

Controls -- Singleton, live born neonates of Gestational age > 37 weeks without evidence of fetal distress and HIE. Cases - Singleton, live born neonates of Gestational age > 37 weeks with

1. Evidence of fetal distress and delayed cry after birth presenting with signs and symptoms of HIE.
2. Those needing resuscitation at birth
3. Low APGAR score <5 after 1 minute or 5 minutes after delivery or well defined episode of fetal distress like,
4. Fetal bradycardia/tachycardia (HR <110 bpm/>150 bpm respectively)

Reduced baseline variability Decelerations and absence of accelerations on cardiocotogram

**Exclusion criteria**

1. Evidence of congenital heart disease, traumatic cerebral injuries, hydrocephalus or infection.
2. Those neonates born with major congenital anomaly.
3. All these infants were graded clinically into stages of hypoxic ischemic encephalopathy based on Sarnat and Sarnat classification without the electro-encephalographic criteria.

**METHODOLOGY**

Umbilical artery is identified on the cut section of the cord which is doubly clamped. A syringe of 2ml, flushed with 1/1000 of heparin solution is advanced into the artery and 1ml of blood is collected. Sample is kept air free and transported for analysis in ice packs within thirty minutes of collection. Analysis is done by AVL Compact 3 analyzer.

**Statistical analysis**

Data was analysed by Student t test, Chi square test and p value of <0.05 was considered significant

**RESULT**

**Table 1** APGAR score of cases and controls at 1 minutes

APGAR 1Min	Case		Control	
	N	%	N	%
0-2	25	41.7	0	0.0
3-5	35	58.3	0	0.0
6-10	0	0.0	30	100.0
Total	60	100.0	30	100.0

**Chi-Square Tests**

	Value	df	Sig.
Pearson Chi-Square	90.000	2	0.000

Majority of cases one minute APGAR score is 3-5,5 minute APGAR is 3-5 or,6-10

**Table 2** APGAR score of cases and controls at 5 Minutes

APGAR 5 Min	Case		Control	
	N	%	N	%
0-2	0	0	0	0
3-5	30	50.0	0	.0
6-10	30	50.0	30	100.0
Total	60	100.0	30	100.0

**Chi-Square Tests**

	Value	df	Sig.
Pearson Chi-Square	22.500	1	0.000

**Table 3** One minute APGAR score and umbilical arterial pH among cases and controls

	APGAR 1Min level (Case)	pH level	pH level						Total	
			<6.80	6.81-6.90	6.91-7.00	7.01-7.10	7.11-7.20	7.21-7.30		>7.31
APGAR 1Min level (Case)	0-2	Count	3	4	8	4	4	2	0	25
		%	25.0	28.6	53.3	30	50	66.7	0	41.7
	3-5	Count	9	10	7	4	4	1	0	35
	%	75.0	71.4	46.7	50.0	50.0	33.3	0	0	58.3
	6-10	Count	0	0	0	0	0	0	0	0
	%	0	0	0	0	0	0	0	0	0
Total	0-2	Count	12	14	15	8	8	3	0	60
		%	100.0	100.0	100.0	100.0	100	100	0	100.0
	3-5	Count	0	0	0	0	0	0	0	0
	%	0	0	0	0	0	0	0	0	0
APGAR 1Min level (Control)	0-2	Count	0	0	0	0	0	0	0	0
		%	0	0	0	0	0	0	0	0
	3-5	Count	0	0	0	0	0	0	0	0
	%	0	0	0	0	0	0	0	0	0
	6-10	Count	0	0	0	0	3	23	4	30
	%	0	0	0	0	100.0	100.0	100.0	100.0	100.0
	6-10	Count	0	0	0	0	23	4	30	30
	%	0	0	0	0	0	100.0	100.0	100.0	100.0
Total	0-2	Count	0	0	0	0	0	0	0	0
		%	0	0	0	0	0	0	0	0
	3-5	Count	0	0	0	0	3	23	4	30
	%	0	0	0	0	100.0	100.0	100.0	100.0	100.0

X2 value – 4.428, p=0.490

The decrease in umbilical arterial ph of cases was directly proportional to the decrease in the APGAR score at 1 minute.

**Table 4** Five minute APGAR score and umbilical arterial pH among cases and controls

Group	APGAR 5 Min level	pH level	pH level						Total	
			<6.80	6.81-6.90	6.91-7.00	7.01-7.10	7.11-7.20	7.21-7.30		>7.31
Case	0-2	Count	0	0	0	0	0	0	0	0
		% within pH level	0	0	0	0	0	0	0	0
	5-Min	Count	6	7	11	3	2	1	0	30
	% within pH level	50.00%	50.00%	73.30%	37.50%	25.00%	33.30%	0	50.00%	50.00%
	10-Min	Count	6	7	4	5	6	2	0	30
	% within pH level	50.00%	50.00%	26.70%	62.50%	75.00%	66.70%	0	50.00%	50.00%
Total	0-2	Count	12	14	15	8	8	3	0	60
		% within pH level	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	0	100.00%
	5-Min	Count	0	0	0	0	0	0	0	0
	% within pH level	0	0	0	0	0	0	0	0	0
Control	0-2	Count	0	0	0	0	0	0	0	0
		% within pH level	0	0	0	0	0	0	0	0
	5-Min	Count	0	0	0	0	0	0	0	0
	% within pH level	0	0	0	0	0	0	0	0	0
	10-Min	Count	0	0	0	0	3	23	4	30
	% within pH level	0	0	0	0	100.00%	100.00%	100.00%	100.00%	100.00%
	10-Min	Count	0	0	0	0	23	4	30	30
	% within pH level	0	0	0	0	100.00%	100.00%	100.00%	100.00%	100.00%
Total	0-2	Count	0	0	0	0	0	0	0	0
		% within pH level	0	0	0	0	0	0	0	0
	5-Min	Count	0	0	0	0	3	23	4	30
	% within pH level	0	0	0	0	100.00%	100.00%	100.00%	100.00%	100.00%

X2 value = 6.100, p=0.297

Most of the cases had APGAR score in the range of 3-5 at 5 minute. In controls decrease in umbilical arterial ph both at 1 minute 5 minutes were not significantly associated with decrease in APGAR scores.

**DISCUSSION**

**Demographic data of study population**

In present study, among cases mean maternal age was 24.8 ±3.6, mean birth weight was 2.67±1.2, mean gestational age was 39.2 ± 1.4. Twenty two (53.3%) were males and 28 (46.7%) were females. Among controls mean maternal age was 24.93±2.8, mean birth weight was 2.73±1, mean gestational age was 38.8±2.4. Fourteen (53.3%) were males and Fourteen (46.7%) were females.

In other prospective studies, Sarnat & Sarnat et al observed that 52% were male and 48% were female babies.

In the study by N. N. Finner and CM Robertson et al there were 56 out of 95 cases i.e. 58% were male infants and 42% were female infants. In the study by Ana Martin Ancel et al also noted male predominance in their study.

**APGAR Scoring**

**APGAR score and umbilical arterial pH**

Studies	One minute		Five minute	
	pH <7.00	pH >7.00	pH <7.00	pH >7.00
Our study	68%	32%	68%	32%
APGAR <7				
Goldaber <sup>63</sup> APGAR <7	27.6%	15%	10.3%	1.5%
Vanderberg <sup>73</sup> APGAR <3	28%	-	30%	-
Naegel <sup>74</sup> APGAR <7	-	-	23.3%	-

Decrease in umbilical arterial pH was significantly associated with low APGAR scores in our study which

was consistent with results of other studies. On the contrary Naegel and co-workers<sup>12</sup> found that 7 out of 30 neonates had APGAR score of <7 at 5 minutes showing a weak correlation between umbilical arterial blood pH and 5 minutes APGAR score with  $p=0.45$ .

#### **APGAR score and umbilical arterial PCO<sub>2</sub>, PO<sub>2</sub> and base excess levels**

Umbilical arterial blood gas parameters like PCO<sub>2</sub>, PO<sub>2</sub> and base excess among cases were not significant in predicting low APGAR scores in our study as also suggested by Belai and co-workers<sup>8</sup>, Winkler and co-workers<sup>9</sup>

Among cases and controls, there was significant association between PO<sub>2</sub> and low APGAR score which was similar to the results contributed by Goldaber and co-workers. However in few studies<sup>7,13</sup> base excess of >16mmol/l was found to be significant. Hence, Low and colleagues<sup>7</sup> proposed that instead of pH alone, consideration of base excess increases the specificity of predicting low APGAR scores. This observation in our study could be explained for by the fact that, in our study base excess of >10mmol/l was defined as acidosis whereas in other studies base excess of >16mmol/l was considered

#### **CONCLUSION**

Hypoxic Ischemic encephalopathy is probably the most important single cause of neurological disability in newborn infants. It is responsible for many neurological changes, mortality and morbidity in infants. Antepartum and intrapartum factors leading to fetal distress contribute significantly for the manifestation of Hypoxic ischemic encephalopathy in neonates, these risk factors should be diagnosed before hand and if possible treated accordingly. Umbilical cord blood parameters like pH <7.00, high PCO<sub>2</sub> and Base excess are significantly associated with low APGAR score. Significant alteration of fetal ABG measurements particularly combined with low APGAR score are effective predictors of neurological condition of infants with HIE at birth.

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