ORIGINAL ARTICLE

Neurological Sequalae in Survivors of Perinatal Asphyxia

by

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Abstract

Perinatal asphyxia is the most common cause of either death or severely handicapped survivors. Perinatal asphyxia can be identified by one, five, ten minutes APGAR scores less than 7. Prolonged asphyxia produce hypoxemia, acidosis, hypercapnia, thus diminishing cerebral blood flow, which in turn results in clinical patterns of Hypoxic - Ischemic Enchepalopathy (HIE). The aim of this study was to evaluate the accuracy of clinical observation on newborn asphyxia to predict the presence of neurological deficits connected with blood gas analysis investigation. Thirty eight newborn babies who had APGAR scores of less than 7 as an asphyctic newborn baby group compared with an equal number of normal babies as control group. Physical and neurological examinations were performed immediately after birth and at six months of age. Two of the 38 infants who had perinatal asphyxia died several hours after birth. Two of the 31 of the surviving infants with a historical of perinatal asphyxia had cerebral palsy. One of the two babies with cerebral palsy had epilepsy. Twenty nine of the 31 of the surviving infants with a history of perinatal asphyxia with or without mild HIE showed normal neurological outcomes. All of the normal newborn babies as control showed normal neurological outcome. One infant with cerebral palsy and one infant who had cerebral palsy with epilepsy had a history of a severe degree of HIE and moderate degree of HIE with neonatal convulsion respectively. One of the 2 infants with cerebral palsy had severe hypoxia and none on the infants with normal neurological outcome exhibited PaO_2 less than 50 mmHg. There were no significant differences ($p > 0.05$) of the PaO_2 PH and base deficit between the infants with a history of asphyxia and with a history of a vigorous baby, who had a normal outcome.

We concluded that postasphyxia encephalopathy was more accurate than a low APGAR score in predicting an adverse outcome, and the value of the PaO_2 very important in predicting an encephalopathy.

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Introduction

Several perinatal problems may result in central nervous system injury. Among these is in particular perinatal asphyxia [1]. The effect of asphyxia can be assessed by the measurement of newborn depression as expressed by the APGAR score at one and five minutes [1]. Perinatal asphyxia can be identified by one and five minutes an APGAR score of less than 7. Severe asphyxia will result in a clinical syndrome known as hypoxic-ischemic encephalopathy as the consequence of hypoxia and ischemia occuring simultaneously [2,3]. The diagnosis of hypoxic-ischemic encephalopathy (HIE) is made on the basis of an abnormally neurological examination after one hour of age [4]. According to the severity, HIE is distinguished into three degrees. They are respectively mild, moderate and severe HIE [3,4,5,6,7].

Prolonged asphyxia produces increased brain lactase consentration, impairing vascular autoregulation, inhibiting glycolysis and decreasing cerebral blood flow which in turn cause edema and brain tissue necrosis. Brain tissue necrosis creates risk of neurologic abnormality in later months or years. Post asphyxia encephalopathy is better than a low APGAR score in predicting an adverse outcome. There are no handicapped children who have a low APGAR score with evidence of encephalopathy. The APGAR score is not accurate to predict the severity of acidosis [8,9]. The value of the APGAR score in term of predicting the ultimate neurological outcome is significant only when it is less than 3 and when it remains depressed in more than 10 minutes [3,9,10,11].

Many term newborn babies suffer from some degree of perinatal asphyxia but only few of them have permanent brain damage as a consequence [5]. Perinatal asphyxia with moderate or severe HIE are at much greater risk for becoming handicapped children [5,6,7,9,12,13]. It is important to recognize these clinical syndrome of HIE in order to initiate prompt and appropriate therapy and to formulate a prognosis. The aim of this study is to evaluate the accuracy of clinical observation on newborn infants with asphyxia to predict the presence of the neurological deficit in later months connected with blood gas analysis findings.

Materials and methods

Seventy six newborn babies who were born at Kariadi Hospital Semarang were included in this observations. They consisted of thirty eight newborn babies who had APGAR scores less than 7 as the asphyxia newborn baby group and we compared it with an equal of normal babies. APGAR score were recorded at one, five and ten minutes by a senior pediatric resident. The criteria for the diagnosis of perinatal asphyxia was newborn babies who had APGAR scores of less than 7 and persisted until 10 minutes recording. At birth all babies were given routine care and recuscitated when necessary by a senior pediatric resident. All babies were investigated about the gestational age which was calculated from menstrual dates, birth weight, birth length, blood gas analysis, blood sugar level and electrocardiography. Blood gas analysis and blood sugar level were from umbilical cord blood specimens.

General physical and neurological examination was performed by pediatrician at approximately less than 12 hours after birth and was repeated at 48 hours of life. The follow up was performed at six months of age. Neurological evaluation consisted of consciousness, muscle, stretch reflexes, primary reflexes (graps, palmar and plantar relfexes, tonic neck reflex, automatic walking reflex and placing reflex). According to neurological findings the newborn babies who had aspyxia were differentiated into three degrees of hypoxicischemic encephalopathy (HIE).

Mild degree of HIE : Conciousness was not to impaired; there were only brief intervals of lethargy or hyperalertness. Normal or mild disturbances of muscle tone was present; muscle stretch reflexes were normal or sligthly hyperactive.

Moderate degree HIE : Conciousness was impaired as lethargy or obtuted. Pronounced abnormalities of muscle tone. Muscle stretch reflexes were increased or depressed. Primitive reflexes were mildly depressed.

Severe degree HIE : Conciousness was severely impaired as stupor or coma immediately after birth, failure to maintain adequate ventilation. Profound hypotonia. Muscle stretch reflexes and primitive reflexes were absent. Congenital anomalies, traumatic cerebral injury, perinatal infection, gestational age less than 28 weeks were excluded from further study. Physical (head circumference, heart, lungs) and milestone development (language, fine motor adaptive, gross motor and personal social) examination were performed at six months of age. Milestone development screening was performed the Denver Development Screening Test (DDST). In infants who had been suspected of having delayed development, immediately afterwards a detailed neurological examination was done. The statistical test done was the chi square analysis method.

Results

During the study period, there were thirty eight newborn babies who had perinatal asphyxia and thirty eight vigorous babies as control group arranged to be followed up at six months of age. The follow up information was obtained from thirty one of the 38 infants who had perinatal asphyxia history, five of the thirty eight infants could not be followed up six months later because they moved to other houses.

Two of the 38 infants who had perinatal asphyxia died several hours after birth. They were low birth weight babies. Twenty nine of the 31 surviving infants with a history of perinatal asphyxia showed normal neurological outcomes at six months of age follow up. Two of the 31 surviving infants with history of perinatal asphyxia had cerebral palsy. One of the 2 infants with cerebral palsy had epilepsy. Both infants who had cerebral palsy and cerebral palsy with epilepsy at six months of age respectively had a history of severe degree of HIE and moderate degree of HIE with neonatal convulsion. Microcephaly, necrosis and atrophy of the brain were seen on computerized tomography examination in both infants with cerebral palsy. Twenty nine of the 31 surviving infants who had a history of perinatal asphyxia without or with mild HIE had no neurological abnormalities at six month of age. Two of the 38 infants with a history of normal APGAR score as control groups could not be followed up. they moved to other houses. All of the 36 infants as a control group had neither neurological abnormalities nor died at follow up six months of age later.

The data of the blood gas analysis investigation, birth weight and history of delivery of the perinatal asphyxia group and normal babies as control group, were summarised in tables (Appendix A, B, C, D). None on the infants with normal neurological develop-

ment at the follow up six months of age had had PaO_2 less than 50 mmHg. One of the 2 infants with cerebral palsy had had severe hypoxia (PaO_2 28 mmHg) the other one had had mild hypoxia (PaO_2 50 mmHg) but suffered from convulsion of a more than 10 minutes duration several hours after birth.

Discussion

Birth is the most important cause of preventable mortality and morbidity in infants. Several published reports had shown that perinatal asphyxia increased the risk of handicapped children such as cerebral palsy, mental retardation, epilepsy, learning disabilities [1,14]. In our study, asphyxia in neonates had caused 5,26% death and 6,45% of the surviving infants had neurologic sequals as cerebral palsy (spastic type) at six months of age follow up. Asphyxia was identified by at one APGAR score of 6 and five minutes APGAR score was considered as an accurate predictor of neurologic sequels [2]. Unless its score was less than 3 which persist for more than 20 minutes [3,8].

The study of Synkes showed that 73% of neonates with severe acidosis had a one minute APGAR score of 7 or higher and only 21% of the infants with a one minute APGAR score of < 7 had severe acidosis (pH $\leq$ 7 and base deficit 13 mmol/l) [9]. In our study neonates with a history of a 10 minutes APGAR score less than 7 had respectively PH less than 7 and base deficit more than 7 were 3,2% and 83,3% . On the contrary neonates without a history of asphyxia had respectively pH less than 7 and base deficit more than 7 were 11,1% and 88,9% . The authors suggested that 20% of the 1200 babies with APGAR scores less than 7 had acidosis (PH $\leq$ 7.10).

Prolonged asphyxia produced hypoxemia, acidosis, hypercapnia, diminished cerebral blood flow which in turn resulted in clinical patterns of hypoxic-ischemic encephalopathy (HIE) [8,13]. According to the severity of asphyxia, the HIE was differentiated into three degrees, respectively mild HIE, moderate and severe HIE [5,6,7]. In our study 9,09% of the newborns with asphyxia had severe HIE. Some of the newborns with moderate HIE become neurologically impaired and all newborns who had severe HIE died or survived with severely neurological disabilities. No neurological disabilities were found in the newborns with a history asphyxia (without HIE or with mild HIE) [6,7,9]. In our study two of the three newborn babies who had severe HIE died and the other one survived with severely neurological disabilities as cerebral palsy (spastic type). One of the two infants who had cerebral palsy had had severe hypoxemia and acidosis (PH 6,97 , PaO_2 28 mmHg with base deficit of 20).

One of the two infants who had cerebral palsy, had a history of moderate HIE and she suffered from seizures more than 10 minutes duration after birth. The incidence of neurological sequalae in infants with seizures was two to five folds greater than in those without [3]. Moderate HIE with seizure made a worse prognosis [4]. While 50 % of the newborn babies who had moderate HIE with seizures had neurological disability [10]. In our study, all of the infants with a history of mild HIE who had no neurological abnormality had had mild hypoxia (PaO_2 50 mmHg or more) and infants with a history of severe HIE who had severely neurological abnormality (cerebral palsy) had had severe hypoxemia (PaO_2 less than 30 mmHg). They were no differences in the value of the PCO_2 , pH and base dificit. There was also no significant difference ($P > 0.05$) of the PaO_2 , pH and base dificit between infants with a history of asphyxia (APGAR score < 7) without HIE or with mild HIE and infants with a history of normal babies; both had normal children outcome at six months of age follow up.

Normal blood gas value in the newborn babies after several minutes of life were lower than the normal values. It was caused by the delivery processing [15]. Both blood gas values of the normal newborns and asphyctic newborns with mild encephalopathy or without encephalopathy which resulted in normal children outcome, changed toward normal values. So it perhaps made their significant difference in both values on blood gas analysis investigation in asphyctic and normal newborns. Perinatal asphyxia leading to neurological and behavioral abnormalities were exhibited in early newborn babies.

Perinatal asphyxia that caused neurological disturbances in newborns but that immediately changed to normal neurological exhibition resulted normal infant outcome. In our study all of asphyctic newborn babies (APGAR score <7) who had normal infant outcome, the abnormalities of the neurological examination immediately changed to the normal pattern in less than 24 hours. A previous study had shown that the abnormality on neurological examination and computerized tomography of brain following a HIE insult were associated with neuro developmental disability [1,4].

In our study infants who had had perinatal asphyxia resulting in cerebral palsy on six months of age follow up showed atrophy and cerebral necrosis on computerized tomography investigation. We concluded that post asphyctic enchepalopathy to be more accurate than a low APGAR score in predicting an adverse outcome. We had not found any handicapped children who had a low APGAR score either in infants without evidence of the encephalopathy or infants with mild neurological disturbance who recoverred in less than 24 hours. The value of the PaO_2 was important factor in the development of encephalopathy with handicapped outcome. Severe encephalopthy or moderte encephalopthy with seizure was at much greater risk of death or surviving with severe handicap.

Summary

Perinatal asphyxia was expressed by a lowering APGAR score. Prolongged asphyxia produced hypoxic-ischemic encepholopathy (HIE). Post asphyxial encephalopathy was more accurate than low APGAR score in predicting an adverse outcome. No handicap at all were found on the newborns who had low APGAR scores either with mild encephalopathy or without evidence of encephalopathy. Moderate HIE with seizure or severe HIE produced cerebral palsy at six months of age. Asphyxia with mild hypoxia ($PaO_2 \geq$ 50mmHg) result in mild HIE, had normal infant outcome and asphyxia with severe hypoxia ($PaO_2 \leq$ 30 mmHg) resulting in severe HIE had cerebral palsy outcome. The value of the PaO_2 was important in producing impaired neurological outcome.

APPENDIX A.

Tables of blood gas analysis investigation

BLOOD GAS ANALYSIS IN ASPHYXIATED NEWBORNS

1. PH

	< 7	7,1 - 7,35	7,35 - 7,45
N	1	27	3
Mean ± SD	6,97	7,28 ± 0,087	7,39 ± 0,033

2. PaO2

	< 50	50 - 80	80 - 100	> 100
N	1	4	4	22
Mean ± SD	28	63 ± 8.992	90 + 5,633	158,28+46,237

3. PaCO2

	< 30	30 - 50	≥ 50
N	22	8	1
Mean ± SD	24,87 ± 4,114	34,73 ± 3,165	50

4. BE

	+2 to -2	-2 to -7	> -7
N	-	5	26
Mean ± SD	-	-5,36 ± 1,798	-13,13 ± 4,635

APPENDIK B

BLOOD GAS ANALYSIS IN CONTROLS

1. PH

	< 7	7,1 - 7,35	7,35 - 7,45
N	4	27	5
Mean ± SD	6,92 ± 0,025	7,25 ± 0,082	7,39 ± 0,033

2. PaO2

	<50	50 - 80	80 - 100	> 100
N	-	10	10	16
Mean ± SD	-	66,90 ± 7,498	89,47 ± 5,979	130,34 ± 22,808

3. PaCO2

	< 30	30 - 50	> 50
N	12	23	1
Mean ± SD	25,958 ± 2,907	37,270 ± 4,423	51,20

4. BE

	+ 2 to -2	-2 to -7	> -7
N	2	2	32
Mean ± SD	1,350 ± 0,354	-6,75 ± 0,288	-13,98 ± 5,462

APPENDIX C

Type of delivery	Number of the patients	
	Asphyxiated newborn	Normal newborn
Per vaginam	10 (30,3%)	13 (36,1%)
Vacuum ectration	16 (48,5%)	11 (30,5%)
Cesarian section	7 (21,2%)	12 (33,3%)

APPENDIX D

Birth Weight	Number of the patients	
	Asphyxiated newborn	Normal newborn
Low birth weight	2 (6,06%)	3 (8,33%)
Normal birth weight	31 (93,93%)	33 (91,67%)

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