

To Study the Association between Severity of Perinatal Asphyxia and Multiorgan Dysfunction

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Abstract: Background: Perinatal asphyxia is a leading cause of neonatal mortality and survivors are at risk for neuro-developmental sequelae including motor and cognitive disabilities. Many clinical, pathological, biochemical and metabolic changes occur as a result of perinatal asphyxia which affect many organ systems like CNS, CVS, RS, renal, adrenal, GIT, skin and haemopoietic systems. The study was designed to study the association between the severity of perinatal asphyxia and multiorgan dysfunction. Aim and Objectives: To study the association between severity of perinatal asphyxia and multiorgan dysfunction. Methods: This was a hospital based prospective observational study that was carried out at inborn NICU of tertiary care hospital attached to Narayana medical college and hospital during the period of April 2022 - October 2022 (6months). Methodology: Inborn perinatal asphyxia babies were recruited as per study protocol. Immediately after birth of an asphyxiated newborn, 1 mL of blood was collected in heparinised syringe from double clamped segment of umbilical cord for Arterial Blood Gas Analysis (ABG). All the asphyxiated newborns were shifted to neonatal intensive care unit (NICU) after resuscitation for further monitoring and management. Screening and staging of Hypoxic Ischemic Encephalopathy (HIE) was done as per Sarnat and Sarnat staging system. The admitted newborns were observed for immediate outcome during first 24 hours of life and classified as neurologically normal or abnormal based on signs of HIE. All the cases were followed up till the discharge or death for final outcome. The association of severity of perinatal asphyxia and multiorgan dysfunction is evaluated and analysed statistically. Results: Among the 48 babies included in the study, the mean APGAR at 1 minute is 3 and at 5 mins is 4, the mean PH is 7.01. Among the study population, 26 babies are categorised into severe asphyxia, 12 into Moderate asphyxia and 10 into mild asphyxia after correlating with mean APGAR score at 1mins, 5 mins and PH. Incidence of Multiorgan dysfunction was observed in 21asphyxiated babies, various complications were developed in 20babies without multiorgan dysfunction. Relative risk and attributable risk was calculated which showed significant association between severity of perinatal asphyxia and multiorgan dysfunction. Conclusion: There is a significant association between the severity of perinatal asphyxia and multiorgan dysfunction with poor outcome.

Keywords: Birth asphyxia, APGAR score, Hypoxic ischemic encephalopathy, Multiorgan dysfunction

1. Introduction

The World Health Organization (WHO) most recent estimates indicate that 4 million babies die each year before they turn one month old [2]. The data from NATIONAL NEONATOLOGY FORUM NNFDF suggest that almost 20% of newborn deaths occur due to perinatal asphyxia [1]. Together, birth traumas and perinatal asphyxia are responsible for over 29% of these fatalities [1]. Hypoxic ischemia injury to the central nervous system (CNS) has been linked to failure to initiate and maintain breathing right away after delivery, and the clinical signs of this injury are known as Hypoxic Ischemic Encephalopathy (HIE).

In term newborns, asphyxia can occur in the antepartum or intrapartum period as a result of impaired gas exchange across the placenta that leads to the inadequate provision of O₂ and removal of carbon dioxide (CO₂) and hydrogen (H⁺) from the fetus.

Methods

This was a hospital based prospective observational study that was carried out at inborn NICU of tertiary care hospital attached to Narayana medical college and hospital during the period of April 2022 - October 2022 (6months)

2. Methodology

Inclusion Criteria:

Gestational age of 37 - 42weeks born intramurally who fulfilled the following criteria were included in the study. WHO criteria for failure to initiate breathing at birth including high risk pregnancies and infants with prolonged antenatal acidosis, APGAR score less than 3 at 5 minutes, need for positive pressure ventilation or first cry delayed more than 5 minutes were included in the study

Exclusion Criteria:

- Congenital anomalies.
- Known chromosomal/genetic anomalies.
- Twin gestation.
- Infant of diabetic mother

Inborn perinatal asphyxia babies were recruited as per study protocol i. e., pH \leq 7.01, Base deficit more than 16mmols/dL, APGAR less than 3 even after 5 mins, Need of positive pressure ventilation. Immediately after birth of an asphyxiated newborn, 1 mL of blood was collected in heparinised syringe from double clamped segment of umbilical cord for Arterial Blood Gas Analysis (ABG). All

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the asphyxiated newborns were shifted to neonatal intensive care unit (NICU) after resuscitation for further monitoring and management. Screening and staging of Hypoxic Ischemic Encephalopathy (HIE) was done as per Sarnat and Sarnat staging system [4]. The admitted newborns were observed for immediate outcome during first 24 hours of life and classified as neurologically normal or abnormal on the basis of absence or presence of signs of HIE and Asphyxiated Neonates are categorized into Mild, Moderate and Severe Asphyxia. All the cases were followed up till the discharge or death for final outcome. Babies are monitored for further complications and organs involvement. The association of severity of Birth asphyxia and multiorgan dysfunction is evaluated and analysed statistically.

3. Results

In this study, among the 48 neonates recruited in the study, the mean APGAR was 3, 5 at 1 and 5 min respectively, the

mean cord PH was 7.01. Severity of asphyxia was categorized into Mild, Moderate and severe based on mean PH and Mean APGAR score at 5 minutes. 26 babies were categorised into severe asphyxia, 12 as Moderate asphyxia and 10 as mild asphyxia after correlating with mean APGAR score at 1min, 5 mins and PH.

Table 1: Correlation of clinical and biochemical factors with severity of perinatal asphyxia

	(n) =48	Mean PH	Mean APGAR at 5 mins	Need of Ventilation
Mild Asphyxia	10	7.1+/- 0.05	4	Not needed
Moderate Asphyxia	16	7.0+/- 0.04	3	Needed
Severe Asphyxia	22	6.9+/- 0.05	3	Needed

Table 2: Incidence of multiorgan dysfunction and other complications in relation to severity of Perinatal asphyxia

	Incidence of MODS	Complications	Opted Out of Study/ Death	Discharged Without Complications
Severe Perinatal Asphyxia	19	06	01	-
Moderate Perinatal Asphyxia	02	10	-	-
Mild Perinatal Asphyxia	NIL	04	-	06

Incidence of Multiorgan dysfunction was observed in 21 asphyxiated babies and complications were developed in 20 babies without multiorgan dysfunction, 6 babies discharged without complications, one opted out of study.

Relative risk or Risk ratio: 4.7 (p value 0.001) was calculated which showed significant association between severity of perinatal asphyxia and multiorgan dysfunction. Attributable risk of 0.78 percent was observed with severe perinatal asphyxia in the incidence of multiorgan dysfunction.

Table 3: Association between severity of perinatal asphyxia and multiorgan dysfunction

Neonatal variable	Incidence of multiorgan dysfunction	Other complications	Risk ratio (CI 95%)	P value
Severe perinatal asphyxia (n=26)	19	06	4.5	0.001

4. Discussion

Birth asphyxia is one of the serious causes of mortality and morbidity in newborns. The severity of perinatal asphyxia is assessed by cord blood pH [7] and APGAR SCORE at 1 minute and at 5 minutes [5]. In a minority of cases (<15%), the brain may be the only organ exhibiting dysfunction following asphyxia. In most cases, multiorgan dysfunction occurs as a result of systemic hypoxia - ischemia. This study was carried out to study the association between the severity of perinatal asphyxia and multiorgan dysfunction.

a) Renal system is most commonly effected in perinatal asphyxia. Reduced perfusion affects the proximal tubule of the kidney, causing acute tubular necrosis (ATN), which causes oliguria and an increase in blood creatinine [8].

- b) Transient myocardial ischemia is the root cause of cardiac dysfunction. Decreased left ventricular contractility, particularly in the posterior wall; higher ventricular end - diastolic pressures are among the echocardiographic findings. Cardiogenic shock and pulmonary hypertension are other major findings. A significant brainstem injury may be indicated by a fixed HR [8, 9].
- c) The effects on the lungs include pulmonary bleeding, pulmonary edema from cardiac failure, and increased pulmonary vascular resistance leading to PPHN [8].
- d) Hematologic consequences include disseminated intravascular coagulation (DIC), poor liver function - related synthesis of clotting components, and poor bone marrow production of platelets [8].
- e) Isolated increase of hepatocellular enzymes may be a sign of liver dysfunction. More hypoglycemia, DIC and decreased metabolism are major clinical problems seen [8].

Table 4: Various effects of Perinatal asphyxia on different organ systems.

System	Effect
Central Nervous System	Hypoxic Ischemic Encephalopathy, Infarction, Intra Cranial Hemorrhage, Seizures, Cerebral Edema, Hypotonia and Hypertonia
Cardiovascular System	Cardiogenic Shock, Myocardial Ischemia, Poor Contractility, Tricuspid Insufficiency, Hypotension
Pulmonary	Pulmonary Hypertension, Pulmonary Hemorrhage, Respiratory Distress Syndrome
Renal	Acute Tubular Or Cortical Necrosis
Adrenal	Adrenal Hemorrhage
Gastrointestinal	Perforation, Ulceration With Hemorrhage And Necrosis
Metabolic	Inappropriate Secretion Of Anti - Diuretic Hormone. Hyponatremia, Hypoglycemia, Hypocalcemia, Myoglobinuria

Hematology	Disseminated Intravascular Coagulation
Integument	Subcutaneous Fat Necrosis

5. Conclusion

Perinatal asphyxia affects almost every possible organ system in the body. Depending on the severity, there is sequential involvement of organ systems. In our study we have monitored newborns and categorized as neurologically normal or abnormal in the first 24 hours. Sequential involvement of other organ systems was observed and based on severity involvement of organ system include: CVS (76%), Renal (71%), Pulmonary (66%), Liver (57%), Hematologic (52%). With this study we noticed that mortality and morbidity increased proportionately in babies with involvement of cardiovascular system followed by respiratory and renal system involvement. In contrast presence of dysfunction of GIT, liver dysfunction and haematological abnormalities did not correlate directly with poor outcome [9]. There is a significant association between the severity of perinatal asphyxia and multiorgan dysfunction as multiorgan dysfunction was observed in many babies with severe perinatal asphyxia with poor outcome. Many other studies found correlation between individual organ involvement and outcome. Study by Shah P et al. did not find any relation between multiorgan dysfunction and outcome [9]. There was no evidence of multiorgan dysfunction in case of mild perinatal asphyxia [13]. Similar studies on incidence of multiorgan dysfunction in babies with perinatal asphyxia did not study the relation between number of organs involved and outcome [10, 11, 12].

Conflicts of interest: None declared

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Ethical approval: The study was approved by the Institutional Ethical committee on 22/10/2022

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