

Incidence of acute kidney injury in birth asphyxia and its correlation with severity of hypoxic ischemic encephalopathy (HIE) in newborns with perinatal asphyxia in SNCU at DR. BRAM Hospital, Raipur (CG)

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Abstract

Introduction: Perinatal asphyxia is an important contributor of neonatal morbidity, mortality and adverse outcome in India. Due to any reason, if blood supplied through placenta is hampered, it leads to asphyxial injury. Renal involvement is frequent in perinatal asphyxia. The severity of renal involvement and adverse outcome are correlated with severity of asphyxia and HIE stage. We performed this study to determine the incidence of renal failure in birth asphyxia by estimating urine output, serum creatinine and blood urea. **Aim and Objective:** To study incidence of Acute Kidney Injury (AKI) in Hypoxic Ischemic Encephalopathy (HIE) and its association with severity of HIE in Newborns. **Material Methods:** Cross-sectional observational hospital based study was conducted over a period of six months from March 2018 to August 2018 in Special Newborn Care Unit (SNCU) of Dr. BRAM hospital, Raipur. Sarnat and Sarnat staging was used to classify HIE. Statistical analyses were performed by using SPSS21.0 software. Chi square test, P- value and likelihood ratio were calculated using appropriate tests. **Result:** Total 1318 newborns were admitted in SNCU during study period. 415 newborns were admitted with HIE following perinatal asphyxia. Out of these 52 (12.5%) were HIE-I cases, 242(58.3%) were HIE-II and 121(29.1%) were HIE-III. Total 70(16.9%) newborns developed AKI. None of newborn in HIE I developed AKI. 20(8.2%) newborns with HIE II developed AKI while in HIE III 50 (41.3%) newborns had AKI. There was significant correlation between HIE III and AKI (P value- 0.157). **Conclusion:** There is significant correlation of HIE with AKI. As severity of HIE progresses from stage-I to stage-III, there is increased risk of developing AKI.

Key words: Acute Kidney Injury (AKI), Hypoxic Ischemic Encephalopathy (HIE), Special Newborn Care Unit (SNCU).

Introduction

Hypoxia-ischemia in the perinatal period is an important cause of cerebral palsy and associated disabilities in children [1]. Perinatal asphyxia is one of the most common causes of neonatal mortality and morbidity in developing countries [2]. Out of 1000 births about 1 to 10 newborns develop HIE due to various reasons [3].

Perinatal asphyxia is a condition characterized by an impairment of exchange of the respiratory gases (oxygen and carbon dioxide) resulting in hypoxemia and hypercapnia, accompanied by metabolic acidosis [4]. WHO has defined perinatal asphyxia as a “failure to

initiate and sustain breathing at birth” [5]. The National Neonatal Perinatal Database (NNPD), 2000 used a similar definition for perinatal asphyxia [6]. It defined moderate asphyxia as slow gasping breathing or an Apgar score of 4-6 at 1 minute of age. Severe asphyxia was defined as no breathing or an Apgar score of 0-3 at 1 minute of age.

As per the AAP (American academy of Pediatrics) and ACOG (American college of Obstetrics and Gynecology), all the following must be present for designation of asphyxia Viz (a) Profound metabolic or mixed acidemia (pH< 7.00) in cord. (b) Persistence of Apgar scores 0-3 for longer than 5 minutes. (c) Neonatal neurologic sequelae (eg, seizures, coma, Hypotonia). (d) Multiple organ involvement (eg, of the

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kidney, lungs, liver, heart, intestine). Apgar scores are also useful for predicting long term outcome in infants with perinatal asphyxia. Metabolic derangements after asphyxia alters hemodynamics of newborn and a redistribution of cardiac output occur to maintain cerebral, cardiac, and adrenal perfusion while potentially compromising renal, gastrointestinal, and skin perfusion resulting in multiple organ dysfunctions [7-9]. In term neonates with asphyxia Renal, CNS, cardiac and lung dysfunction occur in 50%, 28%, 25% and 25% respectively [7]. AKI may occur within 24 hours of hypoxic– ischemic events resulting from decreased renal flow and deprived oxygen. If this is prolonged then it may result in cortical necrosis and irreversible damage.

High serum creatinine and high blood urea had 100 per cent sensitivity and negative predictive value to predict adverse outcome while serum creatinine >1.5 mg/dl alone had the best specificity and positive predictive value [10]. According to the Acute Kidney Injury Network (AKIN), AKI is an absolute increase in serum creatinine of $\geq 26.4\mu\text{mol/l}$ (or a percentage increase in serum creatinine of at least 50%) over two consecutive days [11].

AKI can be of two types based on urine output Oligoanuric and Non oliguric [12]. It can be of 3 types based on the site of origin: Pre renal (75- 80%), Intrinsic renal (10-15%) and Post renal (5%) [13]. Early identification and intervention in AKI can prevent dangerous complications. Intrinsic AKI can result in disturbed fluid, electrolyte and acid-base balance [14]. Hence prompt management is important in AKI in ill newborns.

Since HIE is considered as one of the common and dreadful complication of birth asphyxia we performed this study to determine the incidence of AKI in birth

Result

A total of 1318 neonates were admitted in SNCU for various problems, out of which 415 newborns had perinatal asphyxia. They were 241(58.1%) males and 174(41.9%) females. Out of these 52 (12.5%) were HIE-I cases, 242(58.3%) were HIE-II and 121(29.1%) were HIE-III.

Table-1: Staging of HIE in neonates with perinatal asphyxia

Staging of HIE	Number of newborns	Percentage
HIE I	52	12.5
HIE II	242	58.3
HIE III	121	29.2
Total	415	100

Total cases admitted with HIE 415. Majority 242(58.3%) had HIE II.

asphyxia and to correlate the AKI with severity of HIE grading of asphyxiated neonates.

Material and Methods

Study design: Cross-sectional observational study

Setting: Hospital based study at Special Newborn Care Unit (SNCU) of Dr. BRAM hospital, Raipur (Chhattisgarh)

Inclusion criteria: Newborns admitted in SNCU with perinatal asphyxia.

Exclusion criteria: Neonates with perinatal history of maternal azotemia or kidney disorders, congenital anomalies of kidney or urinary tract (as detected by antenatal or postnatal ultrasonography) and neonates with other factor which may change kidney function tests such as septicemia, respiratory distress syndrome (RDS), necrotizing enterocolitis (NEC), major congenital anomalies.

Participants: Newborns admitted with perinatal asphyxia.

Variables: Gestational age, birth weight, sex, HIE, AKI

Data Source: A predesigned and pretested proforma was used to collect data

Bias: Reporting bias, observation bias

Study size: 415 newborns with HIE out of 1318 newborns admitted in SNCU

Statistical methods: Statistical analyses were performed by using SPSS21.0 software. Chi square test, P- value and likelihood ratio were calculated using appropriate tests.

Ethical approval: The study was conducted after taking ethical approval from the Institute's Ethical Committee.

Table-2: Gender wise distribution of study population.

Sex	Staging of HIE						Total	%
	I	%	II	%	III	%		
Female	24	46.2	111	45.9	39	32.2	174	41.9
Male	28	53.8	131	54.1	82	67.8	241	58.1
Total	52	100	242	100	121	100	415	100

Out of 415 neonates 241(58.1%) were males and 174 (41.9%) were females. In HIE III category 67.8% neonates were males.

Table-3: Distribution of neonates as per birth weight.

Birth Weight	Staging of HIE						Total	%
	I	%	II	%	III	%		
Extremely low birth weight	0	0	1	0.4	0	0	1	0.2
Very low birth weight	1	1.9	5	2.1	5	4.1	11	2.7
Low birth weight	21	40.4	110	45.5	45	37.2	176	42.4
Normal birth weight	30	57.7	126	52.1	71	58.7	227	54.7
Total	52	100	242	100	121	100	415	100

As per birth weight, Most of the HIE around 54.7% were of normal birth weight followed by low birth weight 42.4

Table-4: Incidence of AKI.

AKI	HIE						Total	%
	I	%	II	%	III	%		
NO	52	100	222	91.7	71	58.7	345	83.1
YES	0	0	20	8.3	50	41.3	70	16.9
Total	52	100	242	100	121	100	415	100

None of newborn in HIE I developed AKI. 20(8.2%) newborns with HIE II developed AKI while in HIE III 50 (41.3%) newborns had AKI.

Table-5: Distribution of Types of AKI.

HIE	Type of AKI				Total	%
	Perinatal	%	Intrinsic	%		
I	0	0	0	0	0	0
II	18	90	2	10	20	100
III	47	94	3	6	50	100
Total	65	92.85	5	7.15	70	100

Out of 84 neonatal cases of AKI, 65(92.85%) neonates had pre-renal Azotemia and only 5(7.15%) neonates had intrinsic renal failure.

Table-6: Incidence of Oliguric AKI:

HIE	Urine output				Total	%
	Nonoliguric	%	Oliganuric	%		
I	0	0	0	0	0	0
II	20	100	0	0	20	100
III	39	78	11	22	50	100
Total	59	84.3	11	15.7	70	100

Of all AKI cases, 11(15.7%) babies developed Oliganuric renal failure (urine output <0.5ml/kg/hr) and 59(84.3%) had Non oliguric renal failure (urine output >0.5/kg/hr).

Discussion

In this study we determined the incidence of AKI and its correlation with place of delivery, birth weight and severity of HIE. AKI were classified according to site of origin and urine output.

A total of 1318 neonates were admitted in SNCU for various problems, among them a total of 415 neonates were admitted for management of perinatal asphyxia. Percentage of male babies was higher (58.1% males versus 41.9% females) which was statistically significant (p- value 0.03). Majority (66%) of neonates were out born (p- value 0.001).

In our study majority of neonates had presented with HIE II 242 (58.3%) followed by 121 (29.1%) had HIE-III and only 52 (12.5%) had HIE-I. In 38.6% cases fetal distress resulting in passage of meconium in utero was cause of asphyxia in neonates. Other causes of birth asphyxia were eclampsia, preeclampsia, obstructed labor, cord around neck etc.

In our study 41.3% babies in HIE III developed AKI while in HIE II 8.3% babies and HIE I none developed AKI. As HIE stage progressed, more renal dysfunction was seen in asphyxiated babies. This difference in incidence was found statistically significant (p value <0.05 done by Chi-square test). In a prospective cohort study in Kenya there was 15 fold increased risk of developing AKI in HIE III as compared to HIE I [18].

In a prospective hospital based study in Sudan most of the babies with AKI had HIE II [15]. In an Indian study conducted at a teaching hospital out of 70 asphyxiated babies 33(47.1%) had renal failure majority of which Nonoliguric type (78%) [16]. A similar observation was noted as Non oliguric AKI was much more common (84.3%). In a Tunisian study out of 15 neonates with renal failure 10 had HIE stage II according to sarnat staging [17].

In our study around 93% newborn had Prerenal type of AKI. Even in HIE III category 94% had Prerenal AKI while only 6% had intrinsic AKI. In this study overall 84% newborn had Nonoliguric renal failure out of all AKI. Even in HIE III category 78% newborn had Nonoliguric renal failure while in HIE II category all newborn had Nonoliguric renal failure. Karlowicz et al found acute renal failure in 61% neonates with severe asphyxia predominantly of which Nonoliguric type (60%) [19]. In contrasts a study by Jayashree et al 1 found oliguric renal failure was more common in birth asphyxia [20]. Majority of research finding were suggestive of predominantly Nonoliguric renal failure in birth asphyxia [21-23].

In this study overall mortality rate is 27.5% while most of neonates belong to HIE III (p- value 0.000). In our study Total 32 newborns had shock out of which all newborn had renal failure. This is highly significant (p-value 0.000). 90% newborns in HIE III ultimately developed shock. This means low organ perfusion is also responsible for renal dysfunction irrespective of HIE. As HIE worsen, there is multiorgan dysfunction which also involve renal system. Thus intensive hemodynamic monitoring is necessary for early recognition of shock and appropriate management to prevent renal dysfunction. This finding is similar to previous studies [24-25].

Conclusion

The current study demonstrates frequency of perinatal asphyxia-31%%. Out born neonates were found to have higher measurably huge frequency of perinatal asphyxia. The most common perinatal danger component was MSAF (40%). In our study the commonest type of ARF in every one of the three phases of HIE was non-oliguric sort. The frequency of characteristic renal disappointment in our study was 9.4%. Monitoring of blood urea, serum creatinine and

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urine yield helps in the early conclusion and administration of renal disappointment. In birth asphyxia, even non-oliguric neonates had ARF. Hence, checking just urine yield does not help in the conclusion of ARF, renal biochemical parameters ought to be observed. ARF in suffocated neonates is dominantly pre-renal and reacts to liquid revival with 100% recuperation.

Shock was observed to be a critical inclining variable and a clinical marker connected with ARF in birth asphyxia. ARF in birth asphyxia demonstrates a solid positive relationship with HIE arranging.

What this study adds to existing knowledge/practice:

This study help in early detection of renal dysfunction in asphyxiated babies can help to prepare guidelines for management of these patients. An early intervention can prevent intrinsic renal failure and thus improve survival of these babies and early establishment the best approach to reduce mortality due to renal failure in asphyxiated neonate is to identify high risk cases for perinatal asphyxia in antepartum and intrapartum stage itself, and prevent this unfortunate event.

Contributions by authors: Phuljhele S conceived and supervised the study and helped in finalizing manuscript writing. Dewangan S helped in protocol writing and conceptualization, analyzed data, prepared and finalized the manuscript; will be the principal corresponding author. Rathi Y wrote the protocol, recruited patients and helped in data analysis and manuscript writing. The final manuscript was approved by all authors.

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