



A STUDY OF RENAL PARAMETERS AND SERUM ELECTROLYTE PROFILE IN ASPHYXIATED NEWBORNS ADMITTED TO NICU OF A TERTIARY CARE HOSPITAL

KEYWORDS

Perinatal, Intrapartum, Hypoxic-Ischemic Encephalopathy, Acute Kidney Injury(AKI).

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ABSTRACT **ABSTRACT:** Perinatal asphyxia (PA) is a major public health problem. As per the latest estimates, it accounts for millions of neonatal deaths worldwide which occur mainly during intrapartum period, largely owing to asphyxia. This study is carried out To determine the incidence of renal function abnormalities in term asphyxiated newborns, acute kidney injury based on renal parameter changes and its correlation with HIE (hypoxic-ischemic encephalopathy) staging, the electrolyte profile in term asphyxiated new born and its correlation with HIE staging and to study the outcome in term asphyxiated newborns with Acute Kidney Injury.

INTRODUCTION

Asphyxia [as-ffik –se-ah](Greek: a stopping of the pulse) Perinatal asphyxia is an insult to the fetus or the newborn due to lack of oxygen (hypoxia) and/or a lack of perfusion (ischemia) to various organs of sufficient magnitude and duration to produce more than fleeting functional and/or biochemical changes¹ Perinatal asphyxia (PA) is a major public health problem. As per the latest estimates, PA accounts for 9% (i.e. 0.8 million) of total Under-5 mortality (i.e. 8.8 millions) worldwide, being one of the three most common causes of neonatal deaths along with prematurity and bacterial infections² Of a total of 2.7 million stillbirths globally, approximately 1.2 million occur during intrapartum period, largely owing to asphyxia³

INDIAN DATA⁴:

As reported in NNPD (2002-2003)⁵ APGAR scores of <7 were found at 1 minute in 8.4% while 2.4 % had scores of <7 at 5 minutes of life of all intramural births at 18 neonatal units in India. Oxygen was used as most commonly used resuscitative measure in 9.5%, bag and mask ventilation in 6.3% and chest compressions in 0.8% while use of other medications in 0.5%. PA was responsible for 28.8% of all neonatal deaths. Manifestations of hypoxic ischemic encephalopathy (HIE) were seen in approximately 1.4% of all babies.

MATERIAL AND METHODS

This prospective study was conducted in the 60 term asphyxiated babies and 60 term normal babies who were admitted in ASRAM hospital, eluru during the period of Jan 2014 TO July 2015. A thorough and systematic approach to the diagnosis was done.

STUDY DESIGN

A Descriptive retrospective history was taken for all the term babies with perinatal asphyxia admitted from JANUARY 2014 to JULY 2015 at the neonatal ICU of ASRAM hospital, ELURU. Total number of cases 60, were included in the study using the following inclusion and exclusion criteria

INCLUSION CRITERIA

All the term (37-42 wks.) neonates born with Apgar score of ≤7 at 5 minutes after birth were selected as cases and 60 normal term (37-42wks.) neonates were selected as controls by using stratified random sampling.

EXCLUSION CRITERIA

Neonates with confounding factor believed to alter renal functions

such as Septicemia, Respiratory distress syndrome, Necrotizing enterocolitis, Major congenital anomalies, on IV nephrotoxic drugs, H/o maternal drug intake, H/o Maternal fever, gestational age < 37 wks and > 42 wks are excluded from the study.

METHODS

All asphyxiated [as per WHO definition]⁵ neonates were selected as cases, Gestational age, birth weight, relevant perinatal history, examination findings are recorded in predesigned Proforma. The post asphyxiated neonates were managed accordingly.

Initial management:

The initial management of all such neonates consisted of placing the baby under a servo-controlled radiant warmer and nursing them in the thermo-neutral range of temperature. Immediate clinical assessment was made by recording respiratory rate, heart rate, capillary filling time, blood pressure and temperature and oxygen saturation. Intravenous line was secured and IV fluids started. 10% dextrose at 60ml/kg/day on day 1, 75ml/kg/day on day 2, 90 ml/kg /day on day 3, 105 ml/kg/day on day 4, 120 ml/kg/day on day 5, 135 ml/kg/day on day 6, 150 ml/kg /day on day 7 with additional allowance of 20 ml/kg/day for radiant warmer. First 48 hrs fluids given was 10% dextrose and then Isolyte-p was started. Injection vitamin K 1mg was administered to all these babies. A stomach wash was performed if there was meconium staining. All neonates who have suffered asphyxia were closely monitored clinically. This monitoring aims to detect derangements in the clinical, metabolic and hemodynamic milieu so as to ensure prompt management. The respiratory status was monitored by meticulous record of the RR, B/L adequate chest expansion & air entry. The CVS status was assessed by monitoring pulse volume, HR, colour, CFT, Pulse oximetry & temperature. Assessment of the neurologic status should include Sarnat & Sarnat staging for HIE along with assessment of anterior fontanel, tone, seizures, papillary size & reaction every 12hrly. Seizures were treated. Continuous monitoring of vital parameters was done for early detection of derangements and complications and their timely management.

Management:

After obtaining informed written consent from the parents, under aseptic precautions 3 ml blood is drawn and is evaluated for blood urea (Berthelot method), serum creatinine (Jaffe's test), and Serum electrolytes (Calorimetric method) after 72 hrs and before 96 hrs of birth 24 hr. urine output is monitored by applying plastic collection

bag (minicom) and clinical condition of the baby was monitored .Criteria adopted for defining Acute Kidney Injury in neonates is oliguria <0.5ml/Kg/hr or serum creatinine of more than 2SD above of mean value for gestational age, which is more than 1.19 mg/dl. Those neonates which fulfilled the above criteria were diagnosed as AKI, and were first given a fluid challenge 20 ml/kg of normal saline, monitored for urine output and clinical parameters. If U/O< 1ml/kg/hr it was followed by diuretic Inj. Lasix 1mg/kg and still if urine output< 1ml/kg/hr were diagnosed as intrinsic renal AKI. The results were analyzed using following statistical methods: Descriptive statistical analysis has been carried out in the present study. Results on continuous measurements are presented on Mean ± SD (Min-Max) and results on categorical measurements are presented in Number (%). Significance is assessed at 5% level of significance. Student t test (two tailed, independent) has been used to find the significance of study parameters on continuous scale between two groups. Chi-square/ Fisher Exact test has been used to find the significance of study parameters on categorical scale between two or more groups. Student t test has been used to find the homogeneity of parameters on continuous scale and Chi-square/Fisher exact test has been used to find the homogeneity of samples on categorical scale.

RESULTS

This prospective case control study is to determine the incidence of renal failure based on renal parameters (Blood urea, Serum creatinine) and serum electrolyte(Na⁺, k⁺, Cl⁻) changes in term asphyxiated newborn and there correlation with severity of HIE staging conducted in the NICU.

Gender distribution of neonates are statically similar in both the group with p=0.633.

Age distribution and Birth weight : Birth age of sample collection in the neonates is statically similar in both the groups with p=0.496(age) and p=0.498 (weight).

Age in hours of the neonates studied: Birth age of sample collection in the neonates is statically similar in both the groups with p=0.496

Birth weight of neonates studied: Birth weight is statically similar in both the group with p=0.498.

Table 1: Perinatal risk factors for birth asphyxia

Maternal Risk factors	Cases	
	No	%
MSAF(meconium stained amniotic fluid)	29	48.3
Prolonged second stage	21	35
LOC(loop of cord around the neck)	13	21.6
MSAF+ LOC+ Prolonged stage	4	6.6
Assisted breach	1	1.6
APH	1	1.6
Cord prolapse	1	1.6
Difficult extraction by LSCS	3	5
Obstructed labor	1	1.6
PIH	12	20
Oligohydramnios	7	11.6

Most common predisposing factors observed were meconium stained amniotic fluid (48.3%), prolonged second stage (35%),loop of cord around neck(21.6%),maternal PIH(20%), Oligohydramnios (11.6%).More than one risk factor is found in 6.6% cases.

Distribution of cases and control based on urine output: - Among the controls all were non-oliguric and among the cases 25%were oliguric and 75%were non oliguric.

Distribution of cases based on urine output and AKI: Among 60 2 ❖ INDIAN JOURNAL OF APPLIED RESEARCH

birth asphyxia cases, 15 (25%) were oliguric, 45 (75%) were non oliguric. All oliguric cases have AKI, among non-oliguric cases, 28 (62.2%) cases have AKI.

Table 2: Comparison of blood chemistry in controls and cases.

Blood chemistry	Control	Cases	P value
Blood urea	35.26±3.6	66.96±16.56	<0.001**
S creatinine	0.69±0.20	1.4±0.52	<0.001**
Na ⁺	141.98±2.16	136.78±4.27	<0.001**
K ⁺	4.09±.23	4.13±.60	0.462
Cl ⁻	102.76±3.47	101.36±3.48	0.062

There is significant differences in the level of blood urea and serum creatinine between the cases and controls on Day 3, with value p <0.001 showing their importance in diagnosing renal failure even in the presence of influence of maternal value. There is statistically significant (p<0.001) correlation between birth asphyxia and serum sodium levels. Serum sodium levels were low in birth asphyxia cases. There is no difference between serum potassium and chloride levels between cases and controls.

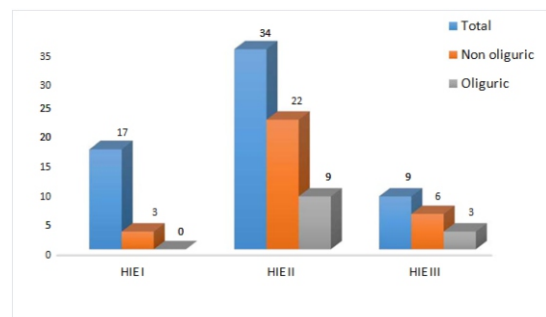
Incidence of AKI among cases and controls: Incidence of AKI is significantly more in cases(71.6% vs 3.4%) 21 times more likely when compare to control with x²=50.049; p<0.001**

Distribution of cases and controls based on type AKI: Among the 43 cases of AKI in birth asphyxia, 34 cases (79%) belong to pre-renal and 9 cases (20.9%) belong to intrinsic renal failure. All AKI cases in controls belong to pre-renal type.

Distribution of cases and controls with AKI based on urine output: Among the 43 cases of AKI in birth asphyxia 15(34.8%) cases were oliguric, 28(65.1%) cases were non oliguric. All controls belongs to non oliguric type of AKI. Non oliguric type of AKI is the most common type among cases and controls.

Comparison of blood parameters with and without AKI in cases: Blood urea and serum creatinine were significantly higher (p<0.001) in cases with AKI compared to cases without AKI. There is no significant difference in Serum electrolytes (Na⁺,K⁺,Cl⁻) between cases with AKI and without AKI.

Fig 1:-Incidence of AKI and type of AKI among different stages of HIE



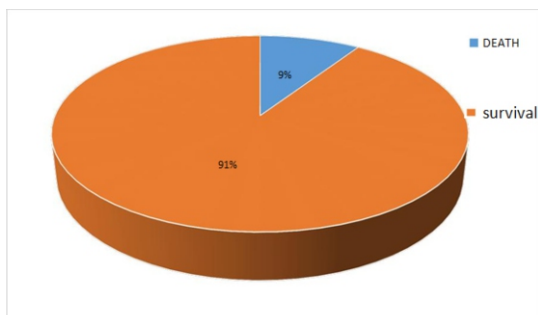
3 (17.6%) HIE I cases, 31 (91.1%) HIE II cases and all cases of HIE III (i.e.100%) had AKI (100%). Incidence of AKI has a strong correlation with the staging of HIE. Distribution of type of AKI Shows all cases of HIE I had pre-renal AKI and 100% were non-oliguric. 27 (87%) cases of HIEII had pre-renal type and 22 (70.9%) of non-oliguric type of AKI. Among 9 cases of HIE III, 2

(22.2%) were pre-renal type and 7(77.8%) were intrinsic type. In HIE III, 6 (66.6%) were non oliguric.

Distribution of renal parameters and duration of stay in the

hospital among different stages of HIE: There was a significant increase in mean values of blood urea and serum creatinine as the HIE Staging progressed. There is no significant relation between HIE staging and serum electrolytes. Duration of stay showed HIE III stayed for longer duration 22±2 days, most deaths among HIE III occur in first week of life. HIE II cases stayed for 20±2 days and HIE I for 15±2 days The Case fatality rate among AKI was 9.3%.

Fig 2:- outcome of cases with AKI



Mortality among the cases based on type of AKI and urine output : All deaths (4) have intrinsic type of AKI, out of them 3 cases (75%) have oliguria.

DISCUSSION

Perinatal asphyxia is an insult to the fetus or the newborn due to lack of oxygen (hypoxia) and/or a lack of perfusion (ischemia) to various organs of sufficient magnitude and duration to produce more than fleeting functional and or biochemical changes. Hypoxia and ischemia can cause damage to almost every tissue and organ of the body and various target organs involved have been reported to be kidneys in 50% followed by CNS in 28%, CVS in 25% and lungs in 23% cases. As kidneys are very sensitive to oxygen deprivation, renal insufficiency may occur within 24 hours of a hypoxic ischemic episode, which if prolonged, may even lead to irreversible cortical necrosis. This study was conducted in our hospital Over a one and half year. 60 term (37-42 wks) neonates born with APGAR score of ≤7 at 5 minutes after birth were selected as cases and 60 normal term (37-42 wks) neonates were selected as controls by using stratified random sampling. In present study we determined the incidence of renal failure, renal parameters and electrolyte changes type of AKI in birth asphyxia and correlated the severity of renal failure with HIE grading of asphyxiated neonates. The results obtained in present study were compared with other studies and discussed as follows.

Table 3: Comparative study showing the gender distribution among cases with birth asphyxia and controls

study	year	sex			
		cases		control	
		Males	females	Male	female
Varma vandana Etal ⁷	2011	24	21	18	12
Roy B etal ⁸	2013	18	14	21	11
Present study	2015	36	24	39	21

In the present study 36 male babies (60%) and 24 female babies (40%) were present in cases and 39 male babies (65%) and 21 female babies (33%) were present in controls Sex is statistically similar among cases and controls in both comparative study and present study.

Table 4: Comparative study showing birth weight distribution among cases and controls with birth asphyxia.

Study	year	Mean birth weight	
		cases	control
Varma vandana Etal ⁷	2011	2.38±0.42	2.41±0.47
Roy b etal ⁸	2013	2.58±0.45	2.60±0.30
Present study	2015	2.88±0.25	2.89±0.24

Birth weight is statistically similar among cases and control in both comparative study and present study. There is no significant correlation between sex and birth weight in incidence of birth asphyxia.

Comparative studies showing the incidence of AKI among the cases by Jayshree etal⁹, Karłowicz et al¹⁰, Pammi v mohan¹¹, Aggarwal etal¹², Gupta etal¹³, Girish gopal¹⁴ The incidence of AKI among the cases in this study was 71.6% (43) and among them 34. 8%(15) were oliguric and 65.1% (28) were non-oliguric

In present study the incidence of AKI in asphyxiated neonates was found to be 71.6% and is higher compared to other studies because first, all asphyxiated neonates with features of HIE in all 3 stages were studied, second the criteria adopted for defining Acute kidney injury in neonates is oliguria <0.5ml/Kg/hr Or serum creatinine of more than 2 SD above of mean value for gestational age¹¹ which is more than 1.19mg/dl, which helped in the management of the neonates at the early stages.

Comparative studies showing the mean blood urea value among the cases and controls: Varma vandana⁷, Gupta et al¹³, Aggarwal et al¹², Roy B et al⁸, Girish gopal¹⁴ The present study showed mean blood urea levels among the cases in present study was 66.96±16.56 and among the controls it was 35.26±3.6. comparative study with the same authors with creatinine the present study showed mean serum creatinine level among the cases in present study is 1.4±0.52 and among the control it is 0.69±0.16.

Serum sodium and serum potassium values among the cases and controls In present study the mean serum sodium levels among the cases was 136.78±4.27 and among the controls it was 138.98±2.16., mean serum potassium levels among the cases was 4.13±0.60 and among the controls it was 4.09±0.23.

Creatinine values in various stages of HIE : In present study of correlation incidence of AKI with HIE staging, it was found that the incidence of AKI increased as the HIE staging progressed, and those all neonates with HIE I and 87% HIE II had pre-renal failure and responded well to fluid challenge, whereas in remaining 11 cases, 7 cases of HIE III and 4 case of HIE II did not respond to fluid challenge and had intrinsic AKI, out of them 4 cases succumbed to death as they had associated multi organ failure.

Mortality pattern among the cases with AKI:

The result of present study were compared to studies of Girish Gopal et al who showed the mortality was 12% as most of them had associated morbidity. Mortality was higher in neonates who had oliguric AKI (83.66%) as compared to neonates with non-oliguric AKI (16.67%). Pammi V Mohan showed the mortality was 36.1% among the total cases of AKI and among them 46.15% cases were non-oliguric type. Gupta et al showed that deaths were common in oliguric AKI. Jayashree et al study showed that the mortality was 61.5% and most of them (87.5%) were oliguric and deaths were attributed to HIE, shock and renal failure. In present study mortality was 9.3%, 7 cases of HIE III and 4 case of HIE II i.e., total 11 cases did not improve with fluid therapy and had intrinsic AKI. 4 neonates died among them as they also had associated co morbid condition, shock, MODS. The asphyxiated neonates has to be screened for AKI at the earliest so that they can be managed at the pre renal failure stage only without letting them to progress to intrinsic renal failure as they have high mortality. Also in present study we had 15 cases who were oliguric, all of them (100 %) had AKI, out of them 3(20%) of them succumbed to death. Out of 45 non-oliguric cases 28(62.2%) had AKI, out of them 1 died(2.2%), thus highlighting that though urine output is good till they can have AKI which should not be missed.

CONCLUSION:

- Perinatal asphyxia is an important cause of neonatal renal failure.

- Monitoring of blood levels of blood urea, serum creatinine and urine output helps in the early diagnosis and management of renal failure.
- In birth asphyxia even non-oliguric neonates had AKI hence monitoring only urine output does not help in the diagnosis of AKI, renal biochemical parameters should be monitored.
- AKI in asphyxiated neonates is predominantly pre renal and responds to fluid resuscitation with 100% recovery.
- AKI in birth asphyxia shows a strong positive correlation with HIE staging.
- In HIE prevention of intrinsic AKI must be given greater importance as it is associated with MODS and has significant mortality and morbidity.

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