



INCIDENCE OF ACUTE KIDNEY INJURY IN BIRTH ASPHYXIA AND ITS CORRELATION WITH HYPOXIC ISCHEMIC ENCEPHALOPATHY (HIE) STAGING

Neonatology

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ABSTRACT

Background: Acute Kidney Injury (AKI) is a recognized complication of birth asphyxia and may result in renal damage. Early recognition of AKI is important.

Objectives and Design: In this case control study, we determined the incidence of AKI in birth asphyxia and correlated the severity of acute kidney injury with HIE staging. Duration from February 2013 to August 2014.

Setting: Tertiary care neonatal unit in eastern India.

Material and Methods: 100 term (37-42wks) neonates with Apgar score of 7/<7 at 1 minutes were selected as cases and 50 normal term (37-42 wks) neonates were as controls. All asphyxiated neonates (WHO definition) were staged by Sarnat and Sarnat staging. Between 72 hrs to 96 hrs of life blood was collected for relevant investigations.

Results: Incidence of AKI was more in cases (75.0% vs 4.0%). Among 75 cases of AKI 64 had pre-renal and 11 had intrinsic AKI and based on urine output 24 had oliguric and 51 had non-oliguric AKI, among 50 controls, 2 neonates had pre-renal and non-oliguric type of AKI. Among 75 cases, 64 improved after fluid therapy and 11 did not. 9 neonates died, among them 7 had associated morbidities and refused Peritoneal Dialysis(PD), 2 underwent PD and died and 2 went LAMA(Leave Against Medical Advice).Among 9 neonates who died 4 had oliguric and 5 had non oliguric AKI.

Conclusion: AKI in birth asphyxia is predominantly pre-renal and non oliguric type and correlates well with HIE staging.

KEYWORDS

Neonates, Birth asphyxia, Hypoxic Ischemic Encephalopathy, Acute Kidney Injury.

INTRODUCTION

Birth asphyxia is an eventuality having far reaching consequences in the neonatal period. Overall incidence of asphyxia is reported to vary from 1 to 1.5% at various centers and is related to birth weight and gestational age of the baby¹.

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% cases². 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 necrosis³. The essential criteria for diagnosing perinatal asphyxia⁴:

- Prolonged metabolic or mixed acidemia (pH <7.0 on cord arterial blood sample).
- Persistence of an Apgar score of <3 for 5 minutes or longer.
- Evidence of fetal hypoxia/distress.

The WHO has defined birth asphyxia "Failure to initiate and sustain breathing at birth" and based on Apgar score as an Apgar score of <7 at 1 minute of life⁵.

In the absence of a standard definition of Acute Renal Failure, the term Acute Kidney Injury (AKI) is proposed to reflect entire spectrum of disorder. Patients are diagnosed to have AKI if there is abrupt (within 48 hours) reduction in kidney function, defined as absolute increase in serum creatinine of more than or equal to 0.3mg/dl, or a percentage increase of more than or equal to 50% from baseline, or (ii) reduction in urine output (< 0.5ml/kg/hr for >6 hours). We performed this study to determine the incidence of Acute Kidney Injury in birth asphyxia and to correlate the severity of kidney injury with HIE grading of asphyxiated neonates to mainly emphasize on early diagnosis of disturbed neonatal kidney function and also on therapeutical aspects which may be of particular benefit for asphyxiated newborns at high risk for developing acute kidney injury.

AIMS & OBJECTIVES

To determine the incidence of acute kidney injury in term asphyxiated neonates.

To correlate severity of acute kidney injury with hypoxic ischemic encephalopathy staging of asphyxiated neonates.

MATERIALS AND METHODS

SOURCE OF DATA-All term asphyxiated neonates admitted in NICU in Department of Pediatrics and 50 term normal neonates born in Nalanda Medical College and Hospital, Patna during study period of Feb 2013 to Aug 2014.

STUDY DESIGN-Prospective study

INCLUSION CRITERIA-

All term(37-42wks)neonates born with Apgar score of 7 or <7 at 1mins after birth were selected as cases and 50 normal term 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 weeks/> 42 weeks are excluded from study.

METHODS:

All asphyxiated (as per WHO definition) neonates were selected as cases, gestational age, birth weight, relevant perinatal history, examination findings were recorded in predesigned proforma, the post asphyxiated neonates were managed according to protocols.Criteria adopted for defining acute kidney injury in neonates is oliguria <1 ml/kg/hr or serum creatinine of more than 2 SD above of mean value for gestational age(0.75±0.2mg/dl)¹.Descriptive statistical analysis was used in calculating and analyzing results.

OBSERVATIONS

TABLE-1 INCIDENCE OF AKI

AKI	Controls(n=50)		Cases(n=100)	
	No.	%	No.	%
Present	2	4.0	75	75.0
Absent	48	96.0	25	25.0

Incidence of AKI significantly more in cases (75.0% v/s 4.0%) 18.4 times more likely when compared to with $\chi^2 = 50.049$; p value<0.001.

TABLE2-INCIDENCE OF AKI AND TYPE OF AKI AND ITS CORRELATION AMONG DIFFERENT STAGES OF HIE.

HIE staging	Total no.of neonates	No. of AKI	No. of cases of pre-renal AKI	No. of cases of intrinsic AKI	No. of oliguric	No. of non oliguric
HIE1	40	21 (52.5%)	21 (100%)	0 (0.0%)	7 (33.3%)	14 (66.6%)
HIE2	50	44 (88.0%)	43 (97.7%)	1 (2.2%)	13 (29.4%)	31 (70.4%)
HIE3	10	10 (100%)	0 (0.0%)	10 (100%)	4 (40.0%)	6 (60.0%)
TOTAL	100	75 (75.0%)	64 (85.4%)	11 (14.6%)	24 (32.0%)	51 (68.0%)
p-value	<0.001					

21(52.5%) HIE1 cases had AKI, 44(88.0%) HIE2 cases had AKI and 10 cases of HIE3, all 10(100%) had AKI. Incidence of AKI has a strong correlation with the staging of HIE. Distribution of type of AKI shows all cases of HIE1 had pre renal AKI and 14(66.6%) of non oliguric type of AKI, 43(97.72%) cases of HIE2 had pre renal and 31(70.45%) of non oliguric type of AKI, all 10 cases of HIE3 had intrinsic AKI and 6(60.0%) of non oliguric AKI.

TABLE 3- DISTRIBUTION OF RENAL PARAMETERS AMONG DIFFERENT STAGES OF HIE

Hie Staging	Mean Creatinine	Mean Blood Urea	Mean Creatinine Clearance
HIE1	1.04	41.15	21.65
HIE2	1.37	52.38	16.44
HIE3	1.73	65.21	12.75
MEAN	1.38	52.91	16.94
p-value	<0.001	<0.001	<0.001

There was a significant increase in mean values of blood urea and serum creatinine as the HIE staging progressed. Creatinine clearance significantly decreased as the HIE staging progressed.

TABLE4-OUTCOME AMONG THE CASES

Outcome of Cases With AKI	Number of Neonates	Percentage (%)
Clinically improved after fluid therapy(PRE RENAL)	64	85.4%
Clinically did not improve after fluid therapy(INTRINSIC KIDNEY INJURY)	11	14.6%
Neonates underwent peritoneal dialysis and died	02	2.6%
Neonates in whom peritoneal dialysis was planned but went LAMA(Leave Against Medical Advice)	02	2.6%
Number of neonates who had associated morbidities and refused peritoneal dialysis and who died	07	9.33%
Total number of neonates who died	09	12.0%

64(85.3%) had pre renal AKI, 11(14.6%) had intrinsic AKI, 9 neonates died in which 2 underwent peritoneal dialysis and 7 neonates died with associated morbidities and refused peritoneal dialysis.

TABLE-5 MORTALITY PATTERN AMONG THE CASES WITH AKI

	Oliguric kidney injury	Non oliguric kidney injury	Total
Number of neonates died with AKI	04(44.4%)	05(55.6%)	09

Mortality was 9(12.0%), 5(55.6%) had non oliguric AKI and 4(44.4%) had oliguric AKI.

DISCUSSION

The incidence of AKI among the cases in our study was 75% and among them 32% were oliguric and 68% were non-oliguric. Gupta et al⁶ in his study showed that incidence of AKI in asphyxiated neonates was 47.14% as he had studied 70 asphyxiated neonates of them 32

cases had no HIE. Non oliguric kidney injury was more common. Agrawal et al⁷ studied 25 cases and showed that incidence of AKI was 56%, less as compared to our study, this is because those neonates who died within 4 days were excluded from study and these are the neonates who might have suffered severe asphyxia and logically should have had AKI, and also he did not mentioned about distribution of neonates according to HIE staging. Non oliguric AKI was more common in his study.

Jayashree et al⁸ showed in her study the mean value of blood urea was 94±32.7, as she studied 30 neonates among them 55.5% were HIE3. However in our study the mean value of blood urea among cases was 52.91±9.66 as we studied 100 cases among them 10% were HIE3. Gupta et al⁶ studied 70 asphyxiated neonates of them 32 cases had no HIE features so the mean value was only 1.08±0.49 among the cases. In our study the mean value of serum creatinine was 1.38±0.28.

The results of our study were compared to studies of Pammi V Mohan⁹ who showed the mortality was 36.1% as most of them had associated morbidity and among them 46.15% non oliguric type. In our study mortality was 12.0%, all cases of HIE3 and one case of HIE2 i.e. total 11 cases did not improve with fluid therapy and had intrinsic AKI.9 neonates died among them in which 2 neonates died inspite of peritoneal dialysis. Also in our study we had 24 cases who were oliguric, all(100.0%) had AKI, 4(16.6%) of them succumbed and 76 cases who were non oliguric 51(68.0%) had AKI.

CONCLUSION

Perinatal asphyxia is an important cause of neonatal kidney injury. Monitoring of blood levels of blood urea, serum creatinine and urine output helps in the early diagnosis and management of kidney injury. 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.

FUTURE SCOPE

Early non invasive biomarkers like serum and urinary neutrophil gelatinase associated lipocalin(NGAL)¹⁰, Urinary interleukin – 18(IL-18)¹¹, Kidney injury molecule-1(KIM-1)¹² were not done. Urinary indices were not done. CVP monitoring, NIBP, EEG, ECG, ABG and imaging studies were not done.

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