IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 15, Issue 3 Ver. IX (Mar. 2016), PP 45-49
www.iosrjournals.org

A Determination Of The Renal Functions In Perinatal Asphyxia: A Cross-Sectional Comparative Study

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Abstract
Objective: *To describe the renal functions in perinatal asphyxia.*
Methods: *This was cross-sectional comparative study. All the newborns admitted in NICU of the Institute with diagnosis of perinatal asphyxia and fulfilling inclusion criteria were included in the study. A total of 54 gestational neonates were studied. These subjects were divided into two groups according to their ARF status. Group I (n=24) had subjects with ARF while Group II (n=30) has subjects without ARF.*
Results: *There were 23/24 (95.8%) subjects in Group I who had serum creatinine >1.5 units at some point of time during the study. None of the subjects in Group II witnessed such phenomenon. None of the Group II subjects had oliguria while 7 (29.2%) of Group I subjects had oliguria. Abnormal USG KUB was observed in 8 (33.3%) case of Group I only. None of the cases in Group II had abnormal USG KUB finding.*
Conclusion: *Serial monitoring of serum creatinine is a better indicator of ARF than measurement of urine output as non oliguric ranal failure is more common than oliguric renal failure.*
Key words: *Renal functions, Perinatal asphyxia, Serum creatinine*

I. Introduction

Acute renal failure (ARF) is a common problem in the hospitalised newborn at Intensive care unit (ICU). It is the rapid decline in the kidney ability of maintaining homeostasis of water and electrolytes, associated with a reduction of the glomerular filtration rate (Andreoli, 2004). ARF in term newborns within the first few days of life refers to progressive increment in plasma creatinine by higher than 1,5 mg/dl for at least 24–48 h, if a mother has normal kidney function. Serum creatinine concentration in preterm infants in the first few days of life may not be a reflection of the glomerular filtration rate because creatinine rises during the first 36-96 h and then decreases gradually during the first 2 weeks (Andreoli, 2004; Momtaz et al, 2014; Gouyon and Guignard, 2000). Whether pre-renal injury is caused by true volume depletion or decreased effective blood volume, correction of the underlying disturbance will return renal function to normal (Gouyon and Guignard, 2000; Youssef et al, 2015; Kleinman et al, 1992).Birth asphyxia is a common problem in our country and accounts for a major proportion of neonatal mortality, especially in the early neonatal period. To some extent it is a preventable cause of neonatal death. In developing countries, hypoxic ischaemic injury is more common. Reported incidence in India is ranging between 2.2-1.5% (Bhargava et al., 1988; Chandra et al., 1997).

Both asphyxia has global effect on new born and affects every organ system of body but target organs of perinatal asphyxia are brain, heart, lungs, kidney, liver, bowel and bone marrow with most frequently involving the kidney (50%), followed by CNS (28%), CVS (25%), and pulmonary system (23%), Apgar scores at 1 and 5 minutes were the only perinatal factors related to the number of organs involved and severity of involvement (Martin-Ancel et al., 1995) with the 5 minute Apgar score having stronger independent associations. No relationship of organ dysfunction was found with the umbilical cord arterial blood pH, meconium stained amniotic fluid, umbilical cord abnormalities, presentation or type of delivery (Martin-Ancel et al., 1995). During birth asphyxia diving reflex is activated which diverts scarce blood supply to the vital organs of the body, i.e. brain, heart & lung and there is relative reduction in blood supply to abdominal viscera and mesentery.Renal system is the most common system affected in Asphyxia, the adaptive capacities of kidneys are overcome, leading to renal dysfunction. Renal dysfunction due to asphyxia contributed redistribution of blood flow towards the brain, heart and adrenal away from the kidney leading to acute tubular necrosis.The present study was aimed to study the renal function in perinatal asphyxia.

II. Material And Methods

This was cross-sectional comparative study conducted in a tertiary care hospital in north India. The study was approved by the Ethical Committee of the Institute. The consent was taken from guardian before enrolling in the study. All the newborns admitted in NICU of the Institute with diagnosis of perinatal asphyxia and fulfilling inclusion criteria were included in the study. A total of 54 gestational neonates were studied.

These subjects were divided into two groups according to their ARF status. Group I (n=24) had subjects with ARF while Group II (n=30) has subjects without ARF.

Asphyxia: For the purpose of the study, the diagnosis of perinatal asphyxia had been made on the basis of either of the two definitions:-

(i) For hospital deliveries, a baby presenting with APGAR score <7 at one minute of life (NNPD, 2002) in presence of signs and symptoms of hypoxic ischaemic encephalopathy.

Feature	**Score**		
	0	**1**	**2**
Respiratory effort	Nil	Slow/irregular	Good/Crying
Heart rate	Nil	<100/min	>100/min
Muscle time	Limp	Some/lesion of extremities	Fully flexed/active movements
Reflex irritability	No response	Grimare	Cough sneeze
Colour	Pale/blue	Blue extremities	All pink

(ii) For outside dekiveries when apgar score is not authenticated, history of delayed cry and not cried after birth (as per history given by any of the relative present at the time of birth) in presence of signs and symptoms of hypoxic ischaemic encephalopathy.

Acute Renal Failure: ARF was defined as elevation of S. creatinine by 1.5 mg/dl on two separate accasions 24 hours apart or creatinine rising by 0.3 mg/dl/day with or without urine output less than 0.5 ml/kn/hour.

Oligenic Renal Failure: When even after fluid challenge the urine output remained <0.5 ml/kg/hour.

Non-Oligenic Renal Failure: If blood urea, were >40 mg% and creatinine was ≥1.5 mg% as above and urine output was more than 0.5 ml/kg/hour such cases were labile as having non-oliguric and failure.

Inclusion/ Exclusion Criteria

Newborns equal to or more than 36 weeks of gestational age and having asphyxia were included in the study. The newborns with preterm neonates with gestational age less than 36 weeks, neonates with associated major congenital anomaly, product of twin deliveries, presence of sepsis or septic shock, inborn error of metabolism, congenital infections, presence of primary disease of the kidney/urinary tract and parents refused to give written informed consent were excluded from the study.

Methods

In all cases, diagnosis was established as per definitions given those that fulfilled the inclusion criteria were included in the study. All cases were managed on line of standard protocol for perinatal asphyxia. Detailed history with respect to antenatal, natal and postnatal period were taken.

Investigations

Fractional excretion of sodium prior to giving fluid challenge for calculating it we measured: Urinary sodium, Urinary creatinine, Plasma sodium, Urinary sodium
Daily urine, S. creatinine and Blood urea Nitrogen output (till 5-7 days of life) were taken.

Data Analysis

The statistical analysis was done using SPSS 16.0 version (Chicago, Inc., USA). The results are presented in mean and standard deviation. The Chi-square test was used to compare the categorical variables between the groups. The Unpaired t-test was used to compare the continuous variables between the groups. The p-value<0.05 was considered significant.

III. Results

Table-1 shows the comparison of various study parameters between the groups. In both the groups majority of subjects had birth weight <2500 gm. There were only 8 (33.3%) subjects in Group I and 13 (43.3%) subjects in group II who were ≥2500 gm of weight at the time of birth. Statistically, there was no significant difference between the two groups. In Group I, there were 16 (66.7%) LSCS deliveries while in Group II there were 11 (36.7) LSCS deliveries. On comparing the data statistically, Group I showed significantly higher proportion of LSCS deliveries as compared to Group II (p=0.02).In Group I, majority of subjects had Apgar score ≤5 at 5 minutes while in Group II, majority of subjects had Apgar score >5 at 5 minute. However, statistically this difference was not significant (p>0.05). Majority of subjects in Group II were in Stage I (63.3%) while maximum number of subjects in Group I (50%) were HIE Stage III. None of the Group II

subjects were HIE Stage III. Statistically, there was a significant difference between two groups ($p<0.001$). There were 23/24 (95.8%) subjects in Group I who had serum creatinine >1.5 units at some point of time during the study. None of the subjects in Group II witnessed such phenomenon. None of the Group II subjects had oliguria while 7 (29.2%) of Group I subjects had oliguria. Abnormal USG KUB was observed in 8 (33.3%) case of Group I only. None of the cases in Group II had abnormal USG KUB finding.

Mean electrolyte levels in Group I were found to be significantly higher as compared to that of Group II ($p=0.0001$) (Table-2).

Comparison of S. creatinine levels in two groups at different time intervals showed that Group I subjects had significantly higher mean S. creatinine levels as compared to that of Group II at all time intervals ($p=0.0001$) (Fig.1).Comparison of BUN levels in two groups at different time intervals showed that Group I subjects had significantly higher mean BUN levels as compared to that of Group II at all time intervals ($p=0.0001$) (Fig.2).At all the time intervals, the mean urine output level was fount do be significantly higher in Group II as compared to Group I ($p=0.0001$) (Fig.3).

IV. Discussion

In this study, all the neonates in the study had gestational age ≤36 weeks as the nephrogenesis is completed by 35 weeks of gestational age.Out of 54 cases of perinatal asphyxia, 24 had renal failure i.e. 44.4% as compared to study done by Gupta et al. in which the incidence of ARF was 47.1%. Birth weight in two the groups showed no significant difference in the present study.

Present study indicates mode of delivery to be significantly associated with asphyxia cases. Godambe et al. also reported increased incidence of severe asphyxia following LSCS (64%) as compared to normal vaginal delivery (31%).21% of babies with perinatal asphyxia had history of prolonged labor in this study which was in close proximity of 24% seen in the study by Mazeed et al (2007). Prolonged labor has also been reported as an independent risk factor for asphysia by Chandra et al. (1997) and has been corroborated by other authors (Nathoo et al., 1990 and Bhalerao et al., 1987). We found higher HIE grading was found and prolonged labor was present. In Group I, majority of subjects with ARF had APGAR score≤5 (54.2%) in this study.

We found mean S.creatinine, BUN and urine output level was significantly higher in Group I compared to Group II at all the time intervals. These findings are similar a study conducted by Gupta et al. In Group I, non-oliguric ARE was more common (70.8%). The mean serum Na^+ level was lower in Group I compared to Group II in this study. Gupta et al. (2005) also reported hyponatreamia in ARF in asphyxiated newborns.

Griffin et al. (1976) reported an incidence of hyponatremia in 56.8% cases. Perlman et al. (1989) reported the incidence in 60% cases which was comparable to results in our study. In the present study, none of the subjects in Group II showed abnormal USG KUB. Gupta et al. (2005) also reported similar finding.

V. Conclusion

Serial monitoring of serum creatinine is a better indicator of ARF than measurement of urine output as non oliguric ranal failure is more common than oliguric renal failure.

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Table-1: Comparison of various study parameters between the groups

Study parameters	Group I(n=24)		Group II(n=30)		p-value
	No.	%	No.	%	
Birth weight					
<2500 gm	16	66.7	17	56.7	0.45
≥2500 gm	8	33.3	13	43.3	
Made of delivery					
LSCS	16	66.7	11	36.7	0.02*
Vaginal	8	33.3	19	63.3	
Apgar Score at 5 min					
≤5	15	54.2	14	46.7	0.06
> 5	9	45.8	16	53.3	
HIE stage					
I	2	8.3	19	63.3	0.0001*
II	10	41.7	11	36.7	
III	12	50	0	0.0	
S. Creatinine status >1.5					
Yes	23	95.8	0	0.0	-
No	1	4.2	30	100	
Oliguria					
Yes	7	29.2	0	0.0	-
No	17	70.8	30	100	
USG KUB Findings					
Normal	16	66.7	30	100	-
Abnormal	8	33.3	0	0.0	

Table-2: Comparison of Electrolyte levels in two groups

Electrolyte	Group I(n=24)		Group II(n=30)		p-value[1]
	Mean	SD	Mean	SD	
S. Na	128.04	8.69	139.53	4.35	0.0001*
S. Fe	5.99	0.75	4.04	0.62	0.0001*
Fe/ Na prior to giving fluid challenge	2.20	0.82	0.603	0.201	0.0001*

[1]Unpaired t-test, *Significant

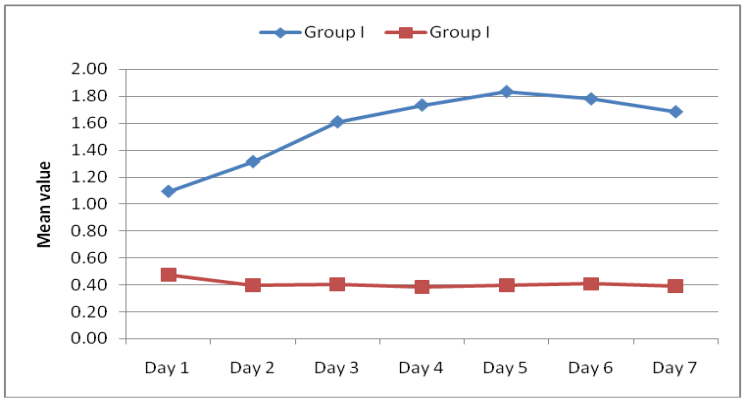

Fig. 1: Comparison of S. Creatinine levels in two groups at different time intervals

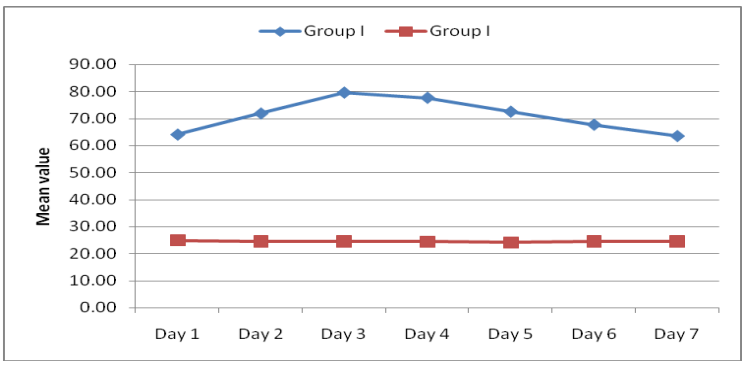

Fig.2: Comparison of BUN levels in two groups at different time intervals

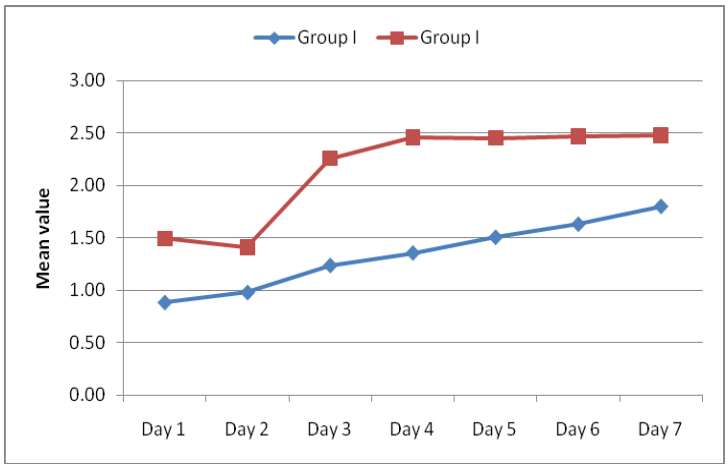

Fig.3: Comparison of Urine output levels in two groups at different time intervals