

Status of Renal Function in Perinatal Asphyxiated Newborn in a Tertiary Care Hospital

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Abstract

Introduction: Perinatal asphyxia is a perennial problem that has come to stay as one of the single most important cause of neonatal mortality and morbidity. The immediate and long term outcome depends to a large extent on the early recognition and appropriate management of complications. The objective of this study was to assess the renal function in newborn suffering from asphyxia in a tertiary care hospital of Bangladesh.

Methods: This cross sectional descriptive study was conducted in Neonatology department of Bangabandhu Sheikh Mujib Medical University from June 2009 to May 2010. Renal function was assessed by urine output, serum creatinine, and fractional excretion of sodium (FENa) in 35 neonates suffering from perinatal asphyxia.

Results: Thirty five asphyxiated newborn were studied to find out renal impairment. Mean age of the study babies was 3±2 days. Male female ratio of the newborn was 4:3. Fetal distress was more observed in those delivered by caesarean delivery (57.1%). The commonest history related to birth was premature rupture of membrane (57.1%) and the commonest manifestation of fetal distress was in the form of respiratory distress (82.9%). In the current study 2 babies presented with oliguria and 6 babies had creatinine level above normal limit. According to FENa level renal function was normal in 26 (74.3%) asphyxiated babies while 6 (17.1%) had pre renal failure and 3 (8.6%) had renal failure. Among 35 cases 34 (97.1%) had moderate asphyxia while 1 (2.9%) had severe asphyxia. Renal failures were observed in 2 out of 34 moderately asphyxiated babies and 1 out of 1 severely asphyxiated baby by FENa level. Among 9 asphyxiated babies having renal impairment by FENa level, 4 presented with higher creatinine level and 2 cases presented with oliguria. Eight asphyxiated babies died during the course of treatment and all who died had renal impairment.

Conclusion: Renal impairment occurs in significant number of asphyxiated neonates. More severely asphyxiated neonates are more likely to experience renal impairment and death than those with moderate asphyxia. FENa can be recommended as more sensitive tests for renal tubular functions like urinary beta-2 microglobulin and N-acetyl glucosaminidase (NAG) and cystatin C.

Key words: Perinatal asphyxia, Renal impairment, Fractional excretion of sodium

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Introduction:

Asphyxia is an important cause of morbidity and mortality among neonates. It can lead to multiorgan dysfunction. In response to stressful condition of perinatal asphyxia there is redistribution of blood away from organs such as the kidney, bowel, lungs, and skeletal muscle to preserve perfusion of vital organs such as the brain, heart, and adrenal glands.¹ As a consequence, the under perfused organs become vulnerable to hypoxic injury.

Perinatal asphyxia is a Greek word which means stopping of pulse. Perinatal asphyxia is defined as delay of more than 1 minute in onset of spontaneous respiration at birth. Perinatal asphyxia is also an oxygen deficit from the 28

week of gestation to the first 7 days following delivery. As a result an insult to the fetus or newborn occur due to lack of oxygen (hypoxia) and/or circulation (ischemia) to various organs.

It is estimated that about 7 million perinatal deaths occur each year, mostly in developing countries.² Nearly 3 -6 million newborn suffer from moderate to severe birth asphyxia with a minimum toll of 800,000 lives and at least equal number develop sequel.³

In Bangladesh, 7 – 8 % of rural and 9 – 10% of urban newborn are born with moderate to severe birth asphyxia and more than 150,000 newborn are born with asphyxia every year.⁴ About 30% – 50% of infants born with moderate to severe asphyxia ultimately suffer from some form of mental and physical disabilities.

Birth asphyxia constitutes 21% of total neonatal deaths in Bangladesh.⁵ But significant data on renal function status in these sick newborn are lacking. Because diagnosis of renal impairment in the neonate and its differentiation from functional oliguria is often difficult and is frequently delayed. Moreover diagnosis of acute renal failure is difficult in neonates as many of the established clinical and biochemical parameters are unreliable in this age group. But it can be assessed by urinary beta-2 microglobulin and N-acetyl glucosaminidase (NAG) and cystatin C.

There are only a few studies done on renal function in newborn with perinatal asphyxia in Bangladesh. The objective of this study was to assess the renal function in newborn suffering from asphyxia in a tertiary care hospital of Bangladesh. The study findings may help to increase awareness of the possibility of renal insufficiency in asphyxiated newborn and thereby progressive increase in diagnosis of acute renal failure.

Methods:

This cross sectional study was conducted in the Neonatology department of Bangabandhu Sheikh Mujib Medical University after obtaining ethical clearance from the institute from June 2009 to May 2010. Thirty five diagnosed cases of perinatal asphyxia with given consent were included in the study. Babies were excluded if he or she was premature or post mature, large or small for gestational age, malformed, had significant illness, receiving renal suppressant drugs or whose mothers had significant illness.

A preformed history sheet filled up at enrollment into study containing relevant information such as age of the child, sex of the child, maternal age, maternal antenatal history etc. A careful physical examination was performed. On the

basis of apgar score at 5 minutes the asphyxiated babies were further grouped into moderate (score 4-6) and severe asphyxia (score ≤ 3). Then 2ml of venous blood sample was collected for the estimation of creatinine level and electrolytes. Urine samples were simultaneously collected using commercially available pediatric urine bags. Care was taken to prevent leakage and contamination of urine with stool. The blood and urine sample thus collected were sent for estimation of creatinine, sodium and potassium using computerized auto-analyzer.

Following renal indices was calculated:

$$\text{Fractional excretion of Na (\%)} = \frac{U_{\text{Na}}/S_{\text{Na}}}{U_{\text{Cr}}/S_{\text{Cr}}} \times 100$$

Where U_{Na} = Urine Sodium (mmol/L), S_{Na} = Serum Sodium (mmol/L), U_{Cr} = Urine creatinine ($\mu\text{mol/L}$), S_{Cr} = Serum Creatinine ($\mu\text{mol/L}$).

An asphyxiated neonate was considered to have renal impairment if any of the following criteria was noted: urine output < 0.5 ml/kg/h, serum creatinine > 0.9 mg/dl. Acute renal failure was considered if FENa > 0.72 . Statistical analysis was carried out manually.⁶

Results:

Thirty five asphyxiated newborn were studied to see renal impairment. Mean age of the study babies was 3 days with a standard deviation of ± 2 days. Male female ratio of the newborn was 4:3. More than half (52%) of the mothers were primigravida and median age of the mothers was 23 years. Fetal distress was more observed in caesarean delivery (57.1%).

The commonest history related to birth was premature rupture of membrane (57.1%) (Table I) and the commonest manifestation of fetal distress was in the form of respiratory distress (82.9%) (Table II).

Table I

Distribution of asphyxiated babies according to their history related to birth

History related to birth	Frequency	Percentage
Premature rupture of membrane	20	57.1
Prolong delivery	6	17.2
Obstructed labor	6	17.1
Knotted of umbilical cord around the neck	1	2.9
Respiratory failure of mother	2	5.7
Total	35	100

Table II

Distribution of asphyxiated babies according to their clinical features

Clinical features	Frequency	Percentage
Respiratory distress	29	82.9
Poor feeding	17	48.6
Cyanosis	11	31.4

* Multiple response presents

Oliguria was found in 2 (5.7%) of the study children. Serum creatinine level above 0.9 mg/dl was present in 6 (17.1%) of the newborn. The current study observed 33 asphyxiated babies were not suffered from renal impairment according to presence of oliguria, out of which 4 were suffered from renal impairment according to serum creatinine level (Table III).

Table III

Distribution of asphyxiated babies according to presence of oliguria and levels of serum creatinine

Serum creatinine	Oliguria	Oliguria	Total
	present	absent	
Up to 0.9 mg/dl	0 (00.0%)	29 (82.9%)	29 (82.9%)
Above 0.9 mg/dl	2 (5.7%)	4 (11.4%)	6 (17.1%)
Total	2 (5.7%)	33 (94.3%)	35 (100%)

But about 25.7% of the asphyxiated newborn had some sorts of renal impairment according to FENa (Table IV).

Table IV

Distribution of asphyxiated babies according to renal impairment by level of Fractional Excretion of Sodium (FENa)

FENa level	Frequency	Percentage
Normal (up to 0.72%)	26	74.3
Pre renal failure (>0.72% - <2.5%)	6	17.1
Renal failure (>2.5%)	3	8.6
Total	35	100

Among 35 cases 34 (97.1%) had moderate hypoxia while 1 (2.9%) had severe asphyxia. Renal function was normal in 26 (74.3%) asphyxiated babies while 6 (17.1%) develop pre renal failure and 3 (8.6%) developed renal failure. Renal failures were observed in 2 out of 34 moderately asphyxiated babies and 1 out of 1 severely asphyxiated baby (Table V).

Among 9 asphyxiated babies having renal impairment by FENa level 4 presented with higher creatinine level and 2 cases presented with oliguria.

Twenty seven cases were discharged while 8 died during the course of treatment. All the babies who died had renal impairment (Table VI).

Table V

Distribution of asphyxiated babies according to renal impairment in grades of asphyxia

Grading of asphyxia (apgar score)	Normal (%)	Renal impairment (%)			Total (%)
		Pre renal (%)	Renal (%)	Total (%)	
Moderate asphyxia (4 - 6)	26 (74.3)	6 (17.1)	2 (5.7)	8 (22.8)	34 (97.1)
Severe asphyxia (3 or less)	0 (00.0)	0 (00.0)	1 (2.9)	1 (2.9)	1 (2.9)
Total	26 (74.3)	6 (17.1)	3 (8.6)	9 (25.7)	35 (100)

Table VI

Distribution of the asphyxiated babies according to their outcome at discharge

Outcome at discharge	Frequency	Percentage
Alive	27	77.1
Dead	8	22.9
Total	35	100

Discussion:

This descriptive study was carried out with an objective to assess the impairment of renal function in newborns suffering from perinatal asphyxia by doing fractional excretion of sodium (FENa), in addition to serum electrolytes and serum creatinine. A total of 35 newborn were included in the study.

The present study found male female ratio in the newborn suffering from perinatal asphyxia was almost 4:3. In a study found that male was predominant and male female ratio was 3.3:1.⁷

The current study observed 33 asphyxiated babies were not suffered from renal impairment according to presence of oliguria out of which 4 were suffered from renal impairment according to serum creatinine level (Table III). In a study it was observed that 28 neonates presented with Oliguria > 24 hours, out of which 8 had renal impairment according to serum creatinine level which was different from present study.⁸

Among cases 34 (97.1%) had moderate hypoxia while 1 (2.9%) had severe asphyxia according to level of FENa. Renal function was normal in 26 (74.3%) asphyxiated babies while 6 (17.1%) develop pre renal failure and 3 (8.6%) developed renal failure. Renal failure were observed in 2 out of 34 moderately asphyxiated babies and 1 out of 1 severely asphyxiated baby (Table V). Impairment of renal function as noted in 25.7% of the cases correlates well with the observation by Goodwin⁹ and Nouri¹⁰ but much lower when compared to studies by Perlman¹¹ and Aldana¹².

In the present study, 8 died during the course of treatment and all the babies who died had renal impairment (Table VI).

The presence of multiorgan dysfunction certainly seems to predict a worse outcome in infants with acute renal failure from any cause, including those of perinatal asphyxia.

Conclusion:

Renal impairment occurs in significant number of asphyxiated newborns. More severely asphyxiated newborns are more likely to experience renal failure than those with moderate asphyxia. Renal failure can be anticipated in perinatal asphyxia if present with increased fractional excretion of sodium in addition to oliguria or

increased serum creatinine level. FENa can be recommended as more sensitive tests for renal tubular functions like urinary beta-2 microglobulin and N-acetyl glucosaminidase (NAG) and cystatin C.

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