

Original article:

Study of renal functions in neonatal asphyxia

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ABSTRACT

Background: Birth asphyxia occurs when a baby does not receive enough oxygen before, during or after birth. This results in lack of oxygen (hypoxia) and /or a lack of perfusion (ischemia) to various organs. Fetus totally depends for its oxygen supply and other nutrients on the blood supplied through placenta. Due to any reason, if blood supplied through placenta is hampered, it leads to asphyxial injury. We performed this study to determine the incidence of renal failure in birth asphyxia by estimating urine output, serum creatinine and blood urea.

Material and methods: This is a prospective observational hospital based study carried out on 152 asphyxiated neonates admitted in NICU of Rural Medical College of Pravara Institute of Medical Sciences, Loni, Ahmednagar, Maharashtra from September 2013 to August 2015.

Result: Renal involvement was noted in 64% asphyxiated neonates. Most common presentation of renal involvement in the present study was found to be in the form of an elevated serum creatinine (64%) followed by oliguria (22%) and elevated urea (17%). We conclude that renal failure is a significant problem in asphyxiated neonates.

Key words: Birth asphyxia, Renal failure, Serum creatinine, Creatinine clearance, Blood urea, Urine output.

INTRODUCTION:

Perinatal asphyxia remains an important cause of neonatal mortality, morbidity and late sequelae especially in a developing country like India. The focus in perinatal asphyxia is mostly on the brain, due to Hypoxic-Ischemic Encephalopathy (HIE) causing mortality or morbidity with sequelae in a large number of cases. Other organ systems also suffer the

consequences of hypoxic ischaemic insult but are often overlooked.

Target organs of perinatal asphyxia are the brain, heart, lungs, kidneys, gut and bone marrow. The most frequent abnormalities involving kidneys (50%) followed by CNS (28%), CVS (25%) and pulmonary system (23%). Thus there is evidence of multiorgan

system dysfunction in the immediate neonatal period.⁽¹⁾ The kidneys are very sensitive and immature at birth and slowly mature as the age increases. Kidneys are very sensitive to oxygen deprivation; prolonged hypoxic ischemic episode can lead to irreversible cortical necrosis with onset of acute renal failure (ARF). Renal failure refers to temporary or permanent damage to the kidneys that result in loss of normal kidney function. It may be acute or

MATERIAL AND METHODS :

This is a prospective observational hospital based study carried out on 152 asphyxiated neonates admitted in NICU of Rural Medical College of Pravara Institute of Medical Sciences, Loni, Ahmednagar, Maharashtra.

Inclusion Criteria:

1. All neonates delivered at Pravara Rural Hospital who had features of birth asphyxia.
 - A. Apgar score of ≤ 7 at 5min.
 - B. Umbilical cord arterial pH of < 7.2 at birth.
 - C. Requirement of more than 1 minute of positive pressure ventilation before sustained respiration occurred or the need for mechanical ventilation at birth.
2. Neonates whose parents were ready to give informed written consent.
3. Neonates of either sex.

Exclusion Criteria:

1. Neonates born before 37 weeks of gestation.
2. Neonates with birth asphyxia but delivered outside our hospital.
3. Neonates with fetal congenital anomalies.

chronic.⁽²⁾ Acute renal failure in the newborn has been defined as urine output less than 0.5 ml/kg/hour, blood urea more than 40 mg and serum Creatinine of more than 1 mg %.⁽³⁻⁴⁾ Diagnosis of renal failure is difficult in neonates as many of the established clinical and biochemical parameters are unreliable in this age group. We performed this study to determine the incidence of renal failure in Birth asphyxia and to correlate renal failure.

4. Neonates with early onset sepsis.

Clinical Examination:

A detailed clinical examination was carried out as soon as the neonates were admitted. Gestational age, birth weight, relevant perinatal history; findings on physical examination were recorded on a pre-designed proforma.

Renal Evaluation:

Criteria adopted for defining acute renal failure is oliguria < 0.5 ml/kg/hr or blood urea more than 40 mg/dl or serum creatinine of more than 2SD above of mean value for gestational age which is more than 1.2 mg/dl.

Laboratory Investigation:

1. Blood urea
2. Serum Creatinine
3. Creatinine clearance

STATISTICAL ANALYSIS:

Values have been expressed as Mean \pm SD. The data were compiled and analyzed using descriptive statistics using student t-test. $P < 0.05$ was considered as significant.

RESULTS:

Total 152 asphyxiated babies were included in the study. In this study out of 152 neonates, 84 were males and 62 females. 55.17% of our patients were delivered by vaginal delivery, while 38% of them were delivered by cesarean section.

Renal involvement was there in 64% asphyxiated neonates. Most common

presentation of renal involvement in the present study was found to be in the form of an elevated serum creatinine (64%) followed by oliguria (22%) and elevated urea (17%).

- In present study we found that on day 1, oliguria was there in higher no. of cases (22%). Even on 3rd day oliguria was there in 17% of case but gradually over 5 to 7 days no. of cases falls down to 1.30%.

Table 1: Urine Output Profile of Neonates in Perinatal Asphyxia

DAYS	MEAN URINE OUTPUT(ml/kg/hr)
Day 1	0.31±0.07
Day 3	0.41±0.08
Day 5	0.51±0.16
Day 7	0.82±0.39
Day 14	1.30±0.10

Blood urea was significantly high on day 1 and 3. It took 3 to 5 days to come down to normal range.

Table 2: Blood Urea Profile of Neonates in Perinatal Asphyxia

DAYS	MEAN BLOOD UREA LEVEL (mg/dl)
Day 1	86.92±16.63
Day 3	63.55±9.36
Day 5	35.20±8.90
Day 7	27.28±7.41
Day 14	24.18±6.95

In present study elevated serum creatinine was present in 69 (45%) asphyxiated neonates. Serum creatinine was significantly high on day 1, 3 and 5. It took 7 to 14 days to come down to normal range.

Table 3: Serum Creatinine Profile of Neonates in Perinatal Asphyxia

DAYS	MEAN SERUM CREATININE LEVEL (mg/dl)
Day 1	1.40±0.78
Day 3	1.60±0.48
Day 5	1.44±0.32
Day 7	0.77±0.31
Day 14	0.55±0.12

In present study creatinine clearance was low on 1st day of life and it falls down significantly over 3rd day of life and it started increasing over 7 to 14 day.

Table 04: Creatinine Clearance Profile of Neonates in Perinatal Asphyxia

DAYS	MEAN CREATININE CLEARANCE (ml/min per 1.73 m²)
Day 1	16.12±1.23
Day 3	13.50±2.12
Day 5	14.59±2.68
Day 7	33.23±3.08
Day 14	39.23±3.42

DISCUSSION :

Renal injury in Birth asphyxia is a potential consequence of adaptive mechanism. Amongst the recognized complications, ARF is commonest and carries a poor prognosis and even may result in permanent renal damage in upto 40% of survivors ⁽⁵⁾. In the present study, out of 152 asphyxiated babies, 64% of infants had ARF. Jayashree et al ⁽⁶⁾ in his study on 30 newborns with severe birth asphyxia observed that 43% of asphyxiated babies developed

ARF. M.Gary Karlowicz et al ⁽⁷⁾ studied 66 neonates and found ARF occurred in 61% of infants with asphyxia.

In the present study, out of 152 asphyxiated babies, 64% of infants had raised serum creatinine. Aggarwal ⁽⁸⁾ in his study observed that 56% of asphyxiated babies had raised creatinine. Hankins Gary D.V. ⁽⁵⁾ found raised creatinine in 61% of infants with asphyxia. The higher incidence of elevated creatinine values in the present study can be accounted for by the

fact that most of the neonates with mild asphyxia were also noted to have renal involvement in the form of elevated serum creatinine. This can be explained on the basis of activation of the 'diving reflex' in the pathophysiology of asphyxia. In present study we also calculated plasma creatinine clearance in cases of raised creatinine. Creatinine clearance is a more accurate parameter for assessing renal function. Creatinine clearance was significantly low in the first day of life (16.12ml/min per 1.73 m²) to 3rd day of life (13.50 ml/min per 1.73 m²). There was a significant and systematic increase by day 7 to 14 days. In a study by Aggarwal et al⁽⁸⁾ mean creatinine clearance in their asphyxiated cases was 21.00±10.9 ml/min per 1.73 m².

Oliguria is seen in 22% neonates in our study but it has been reported in higher numbers of neonates by other authors with figures ranging from 25% to 69.2% babies. Jayashree et al⁽⁶⁾ in their study on 30 newborns with severe birth asphyxia observed that 62.2% babies had oliguric renal failure. M.Gary Karlowicz et al⁽⁷⁾ studied 66 neonates and found that ARF associated with severe asphyxia was predominantly non-oliguric. Gupta B.D. et al⁽⁹⁾ in his study on 70 asphyxiated babies and 28 healthy controls found that blood urea and serum creatinine were significantly higher in asphyxiated babies compared to control group. In the present study, blood urea and serum creatinine were significantly higher in

asphyxiated babies on day 3 to day 5 and significant oliguria was there. This can be explained on the fact that in the first 48 hours of life these levels are reflection of maternal renal functions. In normal babies there is subsequent fall in blood urea and creatinine, whereas in cases with renal damage these levels rise above normal.⁽¹⁰⁾ Our observation is in close approximation to those reported by Aggarwal et al and Gupta B.D. et al.

Thus it can be concluded that birth asphyxia is a significant cause of ARF in asphyxiated neonates. The renal function tests can be useful to establish ARF diagnosis and predict outcome especially on day 3 of life. Despite tremendous advancements in medicine and current supportive techniques of the patient with ARF, death occurs from collapse of other body systems. Birth asphyxia is still common, more so in developing countries like India. Combination of dehydration, sepsis, shock and nephrotoxic drugs is not an uncommon situation in NICU. These lead to high incidences of neonatal failure. They are often reversible if identified and managed in time.

LIST OF ABBREVIATIONS:

HIE -- Hypoxic-Ischemic Encephalopathy

CNS – Central Nervous System

CVS - Cardio Vascular System

ARF – Acute Renal Failure

SD - Standard Deviation

NICU- Neonatal Intensive Care Unit

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