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Original Research Article

Assessment of Renal Function among Term Neonates with Perinatal Asphyxia

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Abstract

Background and Aim: One of the most significant organs frequently affected by the multiple organ dysfunction brought on by prenatal hypoxia is the kidney. Monitoring the serum urea, creatinine, and urine production aids in the early diagnosis of prenatal asphyxia's severity and so improves the result. The goal of the current study was to evaluate renal function and its relationship to the degree of HIE in term infants with HIE.

Materials and Methods: The current study examined the relationship between renal function in term infants with HIE and HIE severity over the course of a year in the neonatal ward of a tertiary care facility in India. The total numbers of patients was 240 divided into cases and control 120 patients each. Neonatal patients in case groups received HIE diagnoses in accordance with WHO guidelines, and age and gender matching of infants was carried out. One baseline and one after 48 hours of life were used to calculate the serum creatinine.

Results: Between cases and controls, there was a statistically significant difference in the Apgar score at 1 and 5 minutes. Serum creatinine, blood urea, urine salt, creatinine clearance, and renal indices showed statistically significant differences across the various stages of HIE. Except for urine potassium and urine specific gravity, all urine parameters exhibited statistically significant differences between patients and controls, including creatinine clearance, urine output, pH, fractional excretion of sodium, renal failure index, and osmolality.

Conclusion: Renal dysfunction is a widespread finding present in subjects of perinatal asphyxia. Renal derangement increases with sternness of disease. Most common form of AKI among neonates with birth asphyxia is prerenal and it responds to fluid resuscitation with 100% recovery.

Keywords: Neonates, Perinatal asphyxia, Renal dysfunction, Serum Urea

Introduction

The condition known as perinatal asphyxia occurs when a foetus or newborn does not receive enough oxygen (hypoxia) or blood flow (ischemia) to cause a variety of organ dysfunction of sufficient magnitude and duration [1]. In India, between 250,000 and 350,000 infant deaths are reported annually, most commonly in the first three days of life [2]. The burden of birth asphyxia in neonates is so high that 104 children pass away from

the illness every hour. Nearly every organ in the body is affected by birth asphyxia, however the kidneys, central nervous system, heart, and lungs are the most frequently damaged [3]. It is quite challenging to identify and classify the hypoxia after birth in the absence of a prenatal record [4,5]. The kidneys, gut, and skin are sacrificed in order to maintain perfusion to more essential organs including the heart, brain, and adrenals. As a result of prenatal hypoxia, the kidney is one of the organs that is frequently damaged. Renal insult may occur within 24 hours of a hypoxic ischemic episode, which if extended, may still cause irreversible cortical necrosis [6]. because kidneys are particularly sensitive to oxygen shortage; it is possible for this to happen [7].

It appears that the severity and presence of prenatal asphyxia are related to the rising incidence of AKI [7,8]. Asphyxia is a substantial contributor to AKI and transient renal injury, both of which have negative outcomes, especially in the first five days after birth [7]. chronic kidney Most critical care and nephrology societies now refer to injury instead of acute renal failure to underline the need of identifying this procedure as soon as harm occurs rather than waiting until complete failure has occurred. It is important to recognize renal damage as soon as possible to maintain fluid and electrolyte equilibrium.

The current diagnostic method for AKI is based on an abrupt fall in GFR, which is manifested by an acute rise in serum creatinine levels and/or a decline in urine output over a specified period of time [9-11] Due to scarcity of such researches, present research was performed with an aim of assessment of renal function among term neonates with HIE and its correlation with degree of HIE.

Material and Methods

The current research of assessment of renal function among term neonates with HIE and its association with degree of HIE was performed in the neo-natal unit of tertiary care institution at India for the period of one year.

Babies who were born at term with perinatal asphyxia, foetal bradycardia, clinical confirmation of hypoxic ischemic encephalopathy using Sarnat and Sarnat staging of HIE, and babies who needed positive pressure ventilation for longer than one minute at birth or mechanical ventilation at birth met the inclusion criteria for the current study.

Preterm infants (POG 42 weeks), infants whose mothers had serious illnesses like eclampsia, diabetes mellitus, and renal impairment, infants whose mothers had serious illnesses like sepsis, Rh incompatibility, infants with congenital renal malformation, and infants who died within three days were excluded from the current study. The predesigned Performa was used to record the patient's gestational age, birth weight, pertinent perinatal history, and examination results.

Suitable gestational age term (AGA) neonates delivered during the study's time period matched for hours after birth and sex with one minute. Agar scores of seven or higher were used to enroll controls from the postnatal ward of the same facility. When there was a question, the mother's exact memory of the day of her last menstrual period was used to determine the gestational age. The Expanded New Ballard score was used to determine the newborn's age.

The asphyxiated newborns were primarily divided into two categories: moderate (scoring 4-6) and severe asphyxia based on the APGAR score at 1 minute (score 3 or less). Sarnat and Sarnat scoring were used in the neurological evaluation. Every newborn was watched over in accordance with NICU practice. To measure electrolytes, blood urea, and serum creatinine, two milliliters of venous samples were taken at birth, at 48

hours, and before 72 hours of life. On the Roche completely automated chemistry analyzer, creatinine was estimated. Ion selective electrode theory was applied to the evaluation of serum electrolytes.

Application of a plastic collecting bag or, if necessary, catheterization allowed for the observation of urine production. The infectivity of urine with faeces was avoided with care. Thus, a sample of blood and urine was sent for measurement of sodium, potassium, urea, and creatinine. Additionally, urine osmolality measurements were made after 24 and before 48 hours of life. Proteinuria and urine specific gravity were evaluated in all urine samples between 24 and 48 hours of life. Between 24 and 48 hours of life, RFI and FeNa were measured in all patients and controls. AKI is defined as an abrupt (within 7 days) decline in kidney function, which is now indicated by a complete increase in serum creatinine of more than or equal to 0.3 mg/dl, a percentage increase in serum creatinine of more than or equal to 50%, or a decline in urine output. AKI was classified using a modified KDIGO system. Asphyxiated newborns who met more requirements were identified as having AKI, and they were given a fluid challenge of 20 ml/kg of normal saline while being watched for urine output. If urine output fails to follow despite fluid challenge, intravenous loop diuretics were administered. In spite of these interventions, urine output still<1 ml/kg/hr, neonates were diagnosed to have built-in AKI.

Statistical analysis

The recorded data was compiled and entered in a spreadsheet computer program and then exported to data editor page of SPSS version 15. For all tests, confidence level and level of significance were set at 95% and 5% respectively.

Table 1: Baseline characteristics in asphyxiated and non-asphyxiated babies

Variables	Cases Mean±SD	ControlsMean±SD	P value
Maternal age (years)	25.19±4.50	26.98±4.50	0.02*
Gravida	1.50±0.78	1.57±0.71	0.78
APGAR score at 1 minute	3.56±1.22	7.10±0.0	0.001*
APGAR score at 5 minutes	5.50±1.47	9.1±0.0	0.002*
Length of baby	49.45±1.40	49.70±1.45	0.60
Birth weight (kgs)	2.92±0.32	2.91±0.30	0.12
Gestational age (weeks)	39.05±1.02	38.74±0.10	0.09

* indicates statistically significance at p≤0.05

Table 2: Mode of delivery in asphyxiated and non-asphyxiated babies

Mode of delivery	Cases		Control	
	N	Percentage (%)	N	Percentage (%)
Normal vaginal delivery	56	46.66	86	71.6
Assisted vaginal delivery	14	11.6	10	8.3
Emergency LSCS	50	41.6	20	16.6
Elective LSCS	0	0	4	3.3

Table 3: Renal function tests in asphyxiated and non-asphyxiated babies

Variables	Cases Mean±SD	ControlsMean±SD	P value
Creatinine clearance (ml/min/1.73m^2)	17.40±4.22	24.12±6.10	0.02*
Urine output (ml/kg/hr)	1.15±0.64	1.63±0.24	0.01*
Urine creatinine (mg/dl)	17.25±6.10	15.40±1.74	0.002*

Urine pH	5.15±0.22	6.10±0.40	0.005*
Urine specific gravity	1.02±0.001	1.03±0.005	0.03*
Urine K^+ (m mol/l)	16.19±3.12	17.48±3.22	0.10
Urine Na+ (m mol/l)	47.10.±14.33	18.64±2.65	0.003*
FeNa (%)	2.20±0.9	1.30±0.21	0.02*
RFI	3.2±1.40	1.64±0.24	0.008*
Urine osmolality	425.10±103.40	601.80±39.20	0.05*

* indicates statistically significance at $p \leq 0.05$

Results and Discussion

120 perinatal asphyxia cases and 120 matched controls were present. Regarding gestational age, weight, sex, mother age, and parity, there were no notable differences among the analyzed groups. According to Table 1, there were statistically significant differences between cases and controls' Apgar scores at 1 and 5 minutes.

Compared to controls, cases experienced more assisted vaginal births and emergency caesarean sections. 20% of cases had severe perinatal asphyxia, while 80% of cases had moderate birth asphyxia. Bag and mask ventilation was the most popular method of recovery among cases (61%). In the cases, 25 newborns had HIE-stage III, 57 babies developed HIE-stage II, and 26 babies did not develop HIE at all.

Serum creatinine, blood urea, urine sodium, creatinine clearance, and renal indices like FeNa and RFI were included among cases where there was statistically significant differentiation between various stages of HIE. 75 out of 120 infants (62.5%) had AKI, and of those, 47 (62.6%) had prerenal AKI and 37.33% (28/31) had intrinsic AKI. With the exception of urine potassium and urine specific gravity, all urine measures, including creatinine clearance, urine output, urinary creatinine, Ph, renal failure index, and osmolality, exhibited statistically significant differences between patients and controls (Table 3).

Our study nearly exactly matched other research by Aggarwal A *et al* [11]. that discovered impaired renal function in 56% of asphyxiated infants. Similar relationships between metabolic markers and the severity of HIE were discovered in other investigations as well. According to Jayshree G *et al* [12]. stage 2 and stage 3 patients were substantially more likely to have ARF than stage 0 and stage 1 patients. In 40 neonates with varying HIE stages, the kidney functions evaluated by Jayaswal A *et al* on days 3 and 5 of age revealed a substantial difference. As the HIE stage progressed, metabolic derangement also increased, which is similar to our discovery in their study [13].

As HIE progressed from stage I to stage III in the current study, there was an increase in blood urea, serum creatinine, urine sodium, FeNa, and RFI levels as well as a decrease in creatinine clearance. This difference was statistically significant.

It is well recognized that many organ dysfunctions can be brought on by neonatal birth asphyxia. In the current investigation, asphyxiated newborns' biochemical markers that may indicate renal dysfunction, urine production, and hemodynamic state were tracked and shown to differ significantly from other HIE phases. It is crucial to understand that non-oliguric neonates can also sustain serious acute kidney injury (AKI). Due to the kidneys' high sensitivity to oxygen deprivation, renal insufficiency can develop within 24 hours of a hypoxic ischemic insult and, if left untreated, can result in irreversible cortical damage.[7] The

most common organ affected by ischemia is the kidney, and information gleaned from past studies places AKI in the range of 50–72% [7-9].

Limitations of present research were Long term follow up of babies with AKI was not performed to look for any remaining renal damage on follow up.

Conclusion

Renal dysfunction is a common finding present in patients of perinatal asphyxia. Renal derangement increases with severity of disease. Prerenal AKI, which affects infants with birth asphyxia most frequently, responds to fluid resuscitation with a 100% recovery rate.

Monitoring of urine production as well as serum and urinary parameters are crucial for the early detection of AKI in newborns that have had birth asphyxia but are still not oliguric.

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