

Correlation of Renal Failure in Birth Asphyxia with Hypoxic Ischemic Encephalopathy Among Term Neonates

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Abstract

Background: Most important organs commonly affected in the multiple organ dysfunction due to the perinatal asphyxia is kidney. Perinatal asphyxia is the important reason for mortality and neurological morbidity in most of the cases. Regular assessing biochemical parameters like serum creatinine, urea with urine output helps in predicting severity of disease and for early management of disease and good outcome.

Aim and Objectives: In the study we are correlating the severity of renal failure with hypoxic ischemic encephalopathy staging.

Material and Methods: In the prospective observational study, we have collected data of 100 term neonates (38-42 weeks) with APGAR score of less than 7 at one minutes. Study conducted at Gandhi medical college, Secunderabad, Telangana, for the period of one year from June 2016– June 2017. All the neonate with clinical feature of HIE were staged by Sarnat and Sarnat staging. All asphyxiated [as per WHO definition] neonates were selected as cases. Gestational age, birth weight, relevant perinatal history and examination findings were recorded in predesigned, pretested proforma. The post asphyxiated neonates were managed as per the standard guidelines. In Descriptive statistical analysis Qualitative data were presented by frequency and proportion and quantitative data were presented by using mean and standard deviation. Significance is assessed at 5% level of significance. ANOVA was conducted to observe mean difference in HIE staging for quantitative variables.

Results: Male is to female ratio in the study was 13:12. We had 31 patients with HIE-I, 37 patients with HIE-II and 30 patients were with HIE-III. We observed there was significant increased in the serum creatinine level as the HIE progressed, also urine output was decreased as the HIE progressed. Oliguric patients were more in stage III of HIE compared to stage I and stage II.

Conclusion: We concluded that renal dysfunction increases with the severity of HIE. there was good correlation between the renal dysfunction and HIE, means renal dysfunction can be used as early predictor of severity of disease and for early management of disease.

Keywords: Perinatal asphyxia, Hypoxia Ischemic Encephalopathy, Sarnat Staging.

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Introduction

Perinatal asphyxia is a lack of blood flow or gas exchange to or from the fetus in the period immediately before, during or after the birth process. Perinatal asphyxia can result in profound systemic and neurologic sequelae due to decreased blood flow and/or oxygen to a fetus or infant during the peripartum period. When the placental or pulmonary gas exchange is compromised or ceases altogether, there is a partial (hypoxia) or complete (anoxia) lack of oxygen to the vital organs.

The burden of birth asphyxia in neonates is so high that 104 new-borns die every hour, and the situation is particularly grave in India, where between 250,000 and 350,000 infant deaths are reported annually, most of which occur within the first three days of life [1].

Hypoxia and ischemia damage every tissue and organ. Because kidneys are the most vulnerable (50%) to hypoxia, renal insufficiency is the most prevalent manifestation that arises within 24 hours of a hypoxic-ischemic episode. Other organs are affected in the following order CNS (28%), CVS (25%) and respiratory system (23%). [2] Long-term ischemia can result in non-reversible cortical necrosis [3].

Thus, in infants with hypoxia ischemic encephalopathy (HIE), detecting renal failure is crucial in maintaining a stable biochemical environment and initiating appropriate treatment [4]. We have observed very less studies and literature regarding correlation between renal failure and hypoxia ischemic encephalopathy (HIE). It is often difficult to predict which newborn will develop renal perinatal asphyxia lack specificity. [5] So early detection, diagnosis and therapy of disturbed kidney function in the diseased neonates having high risk of acute renal failure may benefited

So, we have undertaken our study to correlate the severity of renal failure with hypoxic ischemic encephalopathy staging

Material and Methods

Present prospective observational study in the tertiary level neonatal intensive care unit in Gandhi hospital, Gandhi medical college, Secunderabad, Telangana, for the period of one year from June 2016– June 2017. After approval of Institutional Ethical committee (IEC) and consent form the parents of the patients who were eligible for the study considered in the study.

❖ Inclusion Criteria:

1. Term babies (38-42 weeks)
2. APGAR score of less than 7 at 1 minute.
3. Intrapartum signs of asphyxia as indicated by nonreassuring non-Stress test

❖ Exclusion Criteria:

1. Neonates with confounding factors believed to alter renal function such as septicaemia, respiratory distress syndrome, necrotizing enterocolitis, major congenital anomalies and administration of IV nephrotoxic drugs.
2. Mothers who received nephrotoxic drugs, antiepileptics, magnesium sulphate and general anesthesia and those with maternal fever (which might lead to intrapartum asphyxia) were excluded from the study.

Methods:

All asphyxiated [as per WHO definition] neonates were selected as cases. Gestational age, birth weight, relevant perinatal history and examination findings were recorded in predesigned, pretested proforma.

The post asphyxiated neonates were managed as per the standard guidelines.

- All neonates who have suffered asphyxia were closely monitored clinically. This monitoring aims to detect derangements in the clinical, metabolic and hemodynamic milieu so as to ensure prompt management.

- The respiratory status was monitored by meticulous record of the RR, bilateral adequate chest expansion and air entry.
- The CVS status was assessed by monitoring pulse volume, HR, Color, CFT, Pulse oximetry and temperature.
- Assessment of the neurologic status should include Sarnat and Sarnat staging for HIE along with assessment of anterior fontanel, tone, seizures, pupillary size & reaction every 12th hourly.
- After 72 hours of birth and before 96 hours of birth after obtaining informed written consent from the parents, under aseptic precautions 3 ml blood was drawn and was evaluated for serum creatinine (Jaffe's test), Serum electrolytes (Colorimetric method) and urine output was monitored by applying plastic collection bag (minicom) and clinical condition of the baby was monitored.
- Criteria adopted for defining acute renal failure (ARF) in neonates is oliguria < 1ml/kg/hr or serum creatinine of more than 2 SD above of mean value for gestational age 11 which is more than 0.95 mg/dl.
- Those neonates which fulfilled the above criteria were diagnosed as ARF and were first given a fluid challenge 20 ml/kg of normal saline and then monitored for urine output and clinical parameters. If urine output < 1 ml/kg/hr it was followed by diuretic Inj lasix 1 mg/kg and still if urine output < 1

ml/kg/hr, they were diagnosed as having intrinsic renal ARF and peritoneal dialysis was planned when there was indication.

- The cases were categorised according to Sarnat-Sarnat staging into HIE-1, HIE-2 and HIE-3 stages, so that the parameters can be compared.

Sample Size:

A sample size of 100 cases were chosen and the study was conducted. Chetty et al, observed prevalence of ARF was 76% among the cases, so the sample size was 73 and 30% more sample we calculated final sample size was 100

Statistical Analysis:

Collected data were entered in the Microsoft Excel 2007, for further statistical analysis. In Descriptive statistical analysis Qualitative data were presented by frequency and proportion and quantitative data were presented by using mean and standard deviation. Significance is assessed at 5% level of significance.

Analysis of variance was used to find the difference between the mean among HIE Staging of study samples and P value < 0.05 has been taken as significant.

Results:

A total 100 cases were selected. The following tables and figures illustrate the results in detail. The results obtained were analyzed.

Table 1 : Gender distribution of the patients among HIE.

	Males	Female	Total
HIE - 1	13(39%)	20(61%)	33(33%)
HIE - 2	19(51%)	18(51%)	37(37%)
HIE - 3	20(66%)	10(34%)	30(30%)
Total	52(52%)	48(48%)	100(100%)

Table showed gender distribution among staging, we observed that we had 52% of male and 48% of the patients were female. Also, we observed 37% of the patients were from grade 2 staging of HIE followed by grade 1 and Grade 3.

Table 2: Distribution of Risk factors among patients.

Risk factors	Cases	
	Frequency	Percentage
MSAF (meconium-stained amniotic fluid)	33	33%
Prolonged Second stage	12	12%
LOC (loop of cord around the neck)	8	8%
MSAF+LOC+ Prolonged stage	22	22%
Assisted breech	5	5%
APH	4	4%
Cord prolapsed	2	2%
Difficult extraction by Iscs	4	4%

Table 3: Urine output distribution among the staging of patients.

Urine Output	<1ml/kg/hr	>1ml/kg/hr	Total	Urine Output
HIE - 1	0(0%)	33(100%)	33(33%)	1.59±0.24
HIE - 2	2(5%)	35(95%)	37(37%)	1.45±0.48
HIE - 3	11(36%)	19(64%)	30(30%)	1.08±0.59
Total	13(13%)	87(87%)	100(100%)	P-value<0.01

We have observed from above table that in first staging of HIE urine out was more compared to grade 2 and grade 3 and this difference in the mean urine output among the staging were statistically significant.

Table 4: Mean distribution of lab parameters the staging of patients.

PARAMETERS	HIE-1	HIE-2	HIE-3	P - VALUE
Serum creatinine	0.68±0.16	0.95±0.20	1.43±0.46	<0.001
Serum sodium	137.4±3.0	136.5±4.88	132.9±5.79	<0.001
Serum potassium	3.78±0.32	3.98±0.48	4.60±0.83	<0.001

We observed serum creatinine level, serum sodium and serum potassium were not comparable among the staging of the a(HIE)

Table 5: Acute renal failure among the staging of patients.

	Total Cases	With ARF	Oliguric	Non-Oliguric
HIE - 1	33(33%)	4(12.12%)	0(0%)	4(100%)
HIE - 2	37(37%)	19(51.35%)	2(10.5%)	17(89.5%)
HIE - 3	30(30%)	23(76.67%)	11(47.8%)	12(52.2%)
Total	100(100%)	46(46%)	13(28.26%)	33(71.74%)

Among all the patients we had 33% of the patients were HIE stage I, out of that 12% of the patients were with acute renal failure, in HIE stage II 51.35% of the patients were

with ARF and at stage 3 76.67% of the patients were with ARF. Among all Acute renal failure patients 28.26% were oliguric and 71.74% patients were non-oliguric.

Discussion:

We know that neonatal birth asphyxia is well known cause to multiple organ dysfunctions. It is an insult during the intrauterine or immediate extrauterine period to the fetus or the newborn due to hypoxic and/or ischemic damage to various organs of sufficient magnitude which leads to transitory functional and biochemical changes.

Hypoxia and ischemia can cause damage to almost every tissue and organ of the body. 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 necrosis. In Our study observations, biochemical parameters were suggestive of renal dysfunction, we have monitored urine out of asphyxiated neonates and found significant difference compared with different staging of HIE.

Our study observed that male is to female ratio was 13:12, male dominance over female. It was observed that 33% of the patients were with Grade I HIE, 37% were with grade II HIE and 30 % were with grade III HIE, so maximum patients were observed in grade II of HIE. Study conducted by Chetty et al[6] found, that 20% of the patients were with Grade I, 25% were with Grade II and 5% were with grade III of HIE, these results were nearly similar to our observations. Hadzimuratovic Emina et al[7], Dinesh Kumar et al[8], Gupta BD et al[9], observed maximum patients with grade II of HIE.

Study observed serum creatinine level in the staging of HIE were statistically significant mean difference, raised creatinine level in stage III of HIE compared to stage II and I was observed. Chetty et al observed raised creatinine level in stage III of HIE and also significant mean difference in creatinine level of HIE staging (P-value<0.01), supported to our study Gupta BD et al and Dinesh Kumar et al,

found raised creatinine level in stage III of HIE also they found significant difference in the mean creatinine level in HIE staging. Other than serum creatinine level other biochemical parameters also observed that as the HIE stage increased biochemical derangement increased. Also Bhatnagar et al, reported that concentration of blood urea and creatinine level were significantly higher in their hypoxic ischemic patients when compared to the control group[10].

We correlated renal function in HIE staging, observed that mean urine output in stage III of HIE were less compared to the stage II and I and this difference were found statistically significant in our study. Out of all 13% of the patients had urine output were less than 1ml/kg/hr, of them 11 patients out of 13 were belonged to the stage III of HIE and 2 patients were of stage II of HIE. Chetty et al and Dinesh Kumar et al showed decreased Mean urine output in stage III of HIE compared to Stage II and I.

Out of total 46 cases with acute renal failure, of them 4 cases were belonged to HIE -I, 19 cases were with HIE-II and 23 were with HIE-III among, of them in HIE-III, 11 cases were with urine output less than 1ml/Kg/hr means oliguric and In HIE-II only 2 cases were oliguric observed in the study. Gupta BD et al. showed that oliguric ARF was more common in their study, they found 12 cases with oliguric ARF and 2 of them succumbed and 6 cases with non-oliguric. Study conducted by Mohan PV and Pai MP also found, 72% of the neonates suffering from asphyxia had either oliguric or non-oliguric renal failure [11].

From overall observation of present study and comparison with other conducted studies on renal dysfunction because of asphyxia effects, it was highlighted good correlation between renal dysfunction and hypoxic ischemic encephalopathy, but still many questions were unanswered on this topic. Long term side effect of asphyxia on renal function and effect of medication during management its complication of the

asphyxia and outcomes were unanswered in the study, furthermore studies needed for the solution.

Conclusion:

In perinatal asphyxia renal dysfunction observed as most common findings, in the study we can conclude that renal dysfunction increases with the severity of HIE. In the HIE stages, stage III had maximum renal dysfunction compared to other stages. Also, biochemical derangement progresses with the severity of disease. Finally, there was good correlation between the renal dysfunction and HIE, means renal dysfunction can be used as early predictor of severity of disease and for early management of disease.

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