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Original Research Article

Perinatal asphyxia and acute renal failure in neonates: presentation and outcomes

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ABSTRACT

Background: Perinatal asphyxia (PNA) is described by the world health organization as a "failure to begin and sustain breathing at delivery." Acute renal failure (ARF), a well-known consequence of birth asphyxia, has a poor immediate prognosis and can leave survivors with lasting renal impairment. The goal of this study was to find out how often ARF is in cases of PNA and how it relates to the severity of the Apgar score and the grading of hypoxic ischemic encephalopathy.
Methods: This study was based on APGAR scores and a renal function evaluation done on day 3 of life on neonates with a gestational age of >34 weeks and signs of birth asphyxia.
Results: According to the APGAR score, 46 percent of the 75 infants investigated had mild PNA, whereas 42% and 12% of the babies had moderate and severe PNA. ARF was discovered in 24% of PNA patients, with oliguric renal failure (ORF) in 42% and non-ORF (NORF) in 58%. Blood urea was elevated in all instances with ARF (100%) but only 8% of non-ARF patients. ARF was found in 100% of individuals with severe PNA, but only 28% of patients with mild PNA. ARF was not found in any of the individuals with mild PNA. Only 3 (4%) of asphyxiated babies had abnormal renal USG results.
Conclusions: Our findings revealed a substantial link between PNA severity and ARF, with no ARF in mild PNA. The incidence of ARF and the stage of HIE were shown to have a linear association in this study. Only ORF instances resulted in death.

Keywords: PNA, APGAR, ARF, RIFLE

INTRODUCTION

Perinatal asphyxia (APN) is still a concern because of the high death rate in severe cases and the problems it causes.[1,2] After the central nervous system, the kidney is the second most injured organ, and renal impairment is linked to the severity of neurological symptoms.[1-8] All of the following must be present for the diagnosis of asphyxia, according to the American academy of paediatrics and the American college of obstetrics and gynaecology.

(a) Severe metabolic or mixed acculturation (pH-7.00) in cord blood, (b) Apgar score 0-3 for more than 5 minutes, (c) Neonatal neurologic sequelae (e.g., seizures, coma, hypotonia), (d) Multiple organ involvement (e.g., Kidney, lungs, liver, heart, intestine).[9]

The total prevalence of PNA varies between 1.0 and 1.5 percent depending on the centre, and is linked to gestational age and birth weight.[10] Almost every tissue and organ can be harmed by hypoxia. Renal, neurologic, cardiac, and pulmonary abnormalities are present in 50%, 28%, 25%, and 23% of term infants with PNA, respectively. The basic physiological mechanisms that cause hypoxic-ischemic encephalopathy are brain hypoxia and ischemia as a result of systemic hypoxia, decreased cerebral blood flow (CBF), or both.[11]

ARF and renal vein thrombosis are two well-known birth asphyxia consequences. ARF is the most prevalent and has a poor immediate prognosis, as well as the potential for lasting kidney impairment in survivors. ARF is defined by a rapid decline in renal function, resulting in the build-up of nitrogenous end products. The kidneys' reaction to an acute hypoxia insult is a decrease in GFR and tubular function paralysis. The condition can be classified as prerenal, renal, or postrenal in nature.[12]

The RIFLE criteria for acute kidney injury categorization include three graded degrees of injury (Risk, Injury, and Failure) based on the severity of serum creatinine or urine output rise, as well as two outcome variables (Loss and End-stage renal disease).[13]

Early diagnosis of renal impairment is critical in asphyxiated infants with HIE, who require a stable biochemical environment, since it allows for proper fluid and electrolyte replacement. Renal function has become a clinical item of concern as the survival of unwell asphyxiated infants has increased due to developments in medical treatment.

Thus, this prospective study was planned with following aims and objectives:

Aims and objectives

Aim and objectives were to find out how often ARF is in PNA patients, to determine the relationship between the severity of the Apgar score and the grading of hypoxic ischemic encephalopathy and the occurrence and prognosis of ARF.

METHODS

The study type was of prospective, hospital-based study. The study carried out at GMC Srinagar. The study conducted from April 2017 to March 2018.

This study after included neonates with PNA (who satisfied the criteria for PNA) using a non-probability convenience sampling strategy.

Inclusion criteria

All neonates with a gestational age of greater than 34 weeks (as determined by the Ballard scoring system) and a history of birth asphyxia. Patients with evidence of HIE-related neurological abnormalities (altered tone, seizures, depressed level of consciousness) and non-intubated babies with an Apgar score of 6 or less at 5 minutes, and intubated new-borns with an Apgar score of 7 or less at 5 minutes were also included in the study.

Exclusion criteria

Patients who received aminoglycoside antibiotics, with kidney and/or urinary tract/cardiovascular abnormalities that are present at birth were excluded from the study, so were neonates with severe respiratory distress syndrome, necrotizing enterocolitis, severe septicaemia Because of insufficient investigations, patients who died within 48 hours of admission were also eliminated.

The asphyxia was classified as mild (score of 6 or 7), moderate (scoring 5 or 4) or severe (score 5 or 4) based on the Apgar score at 5 minutes (score 3 or less). The Sarnat and Sarnat grading system was used to stage all infants with clinical symptoms of HIE as follows:[14]

Hyper alert (irritable), normal tone, weak suck, strong Moro's reaction, mydriasis, and tachycardia are all symptoms of-grade I-HIE.

Lethargic, seizures, differential tone legs more than arms, weak Moro's response, absent or weak suck, miosis, and bradycardia are all symptoms of-grade II-HIE.

Comatose, flaccid, no suck, no Moro reflex, protracted and frequent convulsions, uneven pupils, and a fluctuating heart rate are all symptoms of-Grade III-HIE.

The criteria of ARF in an asphyxiated neonate as having renal failure were: 1. Oliguria with Urine output less than 0.5 ml/kg/hr, 2. Blood urea more than 40 mg/dl, 3. Deranged RFTs with serum creatinine more than 1.5 mg/dl, 4. Presence of significant haematuria/ proteinuria

These criteria were evaluated on the third day of life, and if three of the four were met, it was deemed as a sign of renal failure. To keep a strict intake output chart, urine was collected in a paediatric urine collecting bag. The fluid consumption for the previous 24 hours was recorded, as well as the daily body weight. The urine was tested for blood, glucose, and protein using the multi-Stix technique, as well as pus cells and casts microscopically. The indices of renal function were measured within 24 hours of delivery and again on day three of life. Those new-borns with aberrant renal functions (i.e., those with ARF) were examined for laboratory parameters every other day for the next three days until they recovered, were discharged, or died during their hospital stay. At 3 months of age, neonates with renal failure were monitored to see whether any residual problems had developed. USG imaging of the kidneys was performed at the start of the study, on the day of release, and three months after discharge from the department of radiology.

The size of the kidneys, the echotexture, and the corticomedullary differentiation were all noticed.

Statistical analysis

Entries and tabulation done on Microsoft excel 2016 software.

RESULTS

Seventy-five neonates with PNA were enrolled in this study with following base line characteristics.

Table 1: Severity of PNA on the basis of Apgar score at 5 minutes.

APGAR score	Number of subjects having Apgar score at 5 min (%)	Severity of PNA
6-7	35 (46)	Mild
4-5	31 (42)	Moderate
0-3	9 (12)	Severe

Most of the patients presented with mild symptoms which was inversely proportional to the APGAR score of the individuals.

Table 2: Severity of HIE grading in asphyxiated neonates.

Severity of HIE	Number of cases (%)
Normal	31 (42)
HIE-1	20 (26)
HIE-2	13 (18)
HIE-3	11 (14)

Similarly, the grading of HIE revealed that most of the patients were mildly symptomatic while as least of them had grade III HIE.

Table 3: Corelation of incidence of ARF with severity of HIE staging.

Staging of HIE	Number of cases with HIE	Number of patients had ARF (%)
HIE-1	20	3 (15)
HIE-2	13	6 (44)
HIE-3	11	9 (86)
Total	43	18 (41)

Out of the total 75 patients 18 patients developed ARF, most among them were those who had a higher grade of HIE.

Oliguria was found in 22% cases of PNA. Its incidence was higher in ARF cases (42%) than non ARF cases (19%). Fifty eight percent of ARF cases were non-oliguric and 58 % of cases had oliguria but no ARF.

Table 4: Abnormal biochemical parameter and incidence of ARF.

Abnormal biochemical parameters on day 3rd	Number of cases with ARF	Number of cases with no ARF
Oliguria (<0.5 ml/ kg/ hr)	7	11
Increased Blood urea (>40 mg/dl)	18	5
Increased serum creatinine (>1.5 mg/dl)	16	-
Urinary abnormalities (Proteinuria or hematuria)	18	5

Table 5: Baseline characteristics.

Variables	Characteristic	Number of cases
Gestational age (weeks)	34-36 (Preterm)	16 (22)
	> 37 (Term)	59 (78)
Sex	Male	51 (68)
	Female	24 (32)
Mode of delivery	NVD	42 (56)
	LSCS	33 (44)
Weight (kg)	<2.5	21 (28)
	>2.5	54 (72)

Demographic distribution of the patients is depicted in the Table 5.

Table 6: Corelation of incidence of ARF with severity of PNA.

Severity of APGAR score (PNA)	Number of patients who had PNA	Number of patients who had ARF (%)
6-7 (Mild)	34	0
4-5 (Moderate)	32	9 (28)
0-3 (Severe)	9	9 (100)

There was a direct co relation between APGAR score and patients who presented with PNA.

DISCUSSION

In infants, the PNA is the most common cause of renal failure.[4-6] Because the renal failure seen during the acute phase was reversible in the survivors, the kidney is a rather resistant organ to anoxo-ischemia.[3,6,15,16] Different physiopathological processes (hypoperfusion, tubular necrosis, or rarely cortical necrosis) explain the onset of renal failure after anoxoischemia.[6.15] Before the 48th hour of life, the mother's serum creatinine level frequently mirrors the childs.[17,18]

In the current study, the male to female ratio was 2:1 among fifty new-borns. Mild PNA affected 46% of

patients (Apgar score at 5 minutes between 6-7), whereas moderate and severe PNA affected 42% and 12% of patients, respectively (Apgar scores 4 to 5 and between 0-3 respectively). In PNA, just 58 percent exhibited clinical indications of HIE. According to Sarnat and Sarnat staging, 26% of asphyxiated patients had HIE-1, 18% had HIE-2, and 14% had HIE-3.[13]

While decreased urine production is a sign of kidney disease, certain patients may have an abrupt loss of renal function without oliguria. NORF is a well-known complication of PNA. Furthermore, patients in non-ARF recovered from oliguria sooner (on day 5) than those in ARF cases (on day 7). Many researchers have stated that oliguria affects a large percentage of patients. Oliguria was detected in 40% of Perlman et al PNA trial sample.[1] Eric et al found that 77% of people had normal urine flow and 23 percent had oliguria. Oliguria was also found in 24 percent of PNA patients in our research.

In our study, all patients with ARF (100%) had elevated blood urea, whereas only 8% of non-ARF individuals had elevated blood urea. As a result, taking into consideration elevated blood urea on day 3 of life, our study revealed 100% sensitivity and 92% specificity in diagnosing ARF in all PNA patients in non-ARF patients, no one had a higher serum creatinine level. As a result, taking into consideration elevated serum creatinine, this study found 92% sensitivity and 100% specificity for diagnosing ARF in all PNA patients. Jeffery et al found that asphyxiated infants had considerably increased blood urea and serum creatinine levels. Perlman et al, Martin et al, Jayshree et al, Mangi and associates, and Gupta et al all showed higher serum creatinine levels in asphyxiated new-borns.[1,23,8]

PNA patients with substantial urine abnormalities such as proteinuria, haematuria, or both were seen in 33% of cases. Urinary abnormalities were detected in all instances with ARF (100%) but only in 8% of non-ARF individuals. Proteinuria was found in 31% of ARF individuals in Martin et al's research. Polito et al and Mishra et al found that 100% and 50% of asphyxiated babies, respectively, exhibited urine problems.[19]

ARF was discovered in 24% of PNA patients. Perlman et al and Aldena et al both observed renal involvement in 50% of asphyxiated babies in their studies, whereas Gupta et al reported ARF in 47% of patients. We discovered ORF in 42% of the patients and NORF in 58%. In new-borns with severe hypoxia, Jayshree et al discovered ORF in 69.2% of cases and NORF in 30% of cases with ARF. In all asphyxiated new-borns, Gupta et al found ORF in 21% of cases and NORF in 78% of cases. Although ORF had greater blood urea and serum creatinine than NORF, the differences were not statistically significant (p=0.42 and p=0.68). Our findings revealed a high link between PNA severity and ARF, which was consistent with findings of Gupta et al, Jayshree et al, and Mangi and associates. PNA subjects developed HIE in 58% of cases. Patients with ARF made up 41% of the HIE cases. ARF was found in 15% of HIE stage 1 patients, 44% of HIE stage 2 patients, and 86% of HIE stage 3 patients.[20] This graph depicts a straight line between the occurrence of ARF and the stage of HIE. Mangi and colleagues found 41% ARF in HIE-II and 100% ARF in HIE-III, which is identical to the current study.

Only 3 (4%) of asphyxiated babies had abnormalities on renal USG, such as enlarged size, changed echo texture, and lack of corticomedullary differentiation. Both exhibited abnormal renal functions and were oliguric, but their USGs were normal at the three-month mark.

In our study, 24% of asphyxiated neonates with ARF on day 3 were treated conservatively, with 10/12 (83%) showing improvement and 2/12 (17%) babies dying within 3 days of birth. New-borns who had ARF as a result of hypoxia in the neonatal period were observed until they recovered and then again at three months to see if there was any residual impairment or development of renal dysfunction. After 7 days of life, no neonate remained oliguric. At three months, all fifteen neonates with ARF returned for follow-up and demonstrated biochemical markers, such as blood urea and serum creatinine, to be within normal ranges. In all follow-up patients, renal ultrasonography was likewise determined to be normal.

ARF was caused by a decrease in the number of functioning nephrons caused by the PNA insult. In the early months of life, however, compensatory hypertrophy of their remaining nephrons was able to compensate renal function. It will only be known whether it returns them to normal range after a lengthy period of follow up. As a result, it's important to be careful when predicting the long-term prognosis of new-borns who have had neonatal ARF. As a result, new-borns with ARF must be followed up on for the rest of their lives.

The inability to screen for serum electrolytes, blood pressure monitoring, urine concentrating capacity, and signs of renal tubular acidosis were all limitations of our investigation.

Limitations

The limitations of our study have been our inability to check for serum electrolytes, BP monitoring, urinary concentrating ability and evidence of renal tubular acidosis.

CONCLUSION

ARF was detected in 24% of asphyxiated infants. NORF accounted for 58% of the cases, whereas ORF accounted for 42% (ORF). As a result, the majority of people in PNA had NORF.

The urine production of new-borns with ORF was statistically considerably lower than that of new-borns with NORF. Our findings revealed a substantial link between PNA severity and ARF, with no ARF in mild PNA. The incidence of ARF and the stage of HIE were shown to have a linear association in this study. ORF instances were the only ones that resulted in death. In 4% of asphyxiated infants, a renal USG scan revealed abnormalities.

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