Original Article

Renal Failure in Asphyxiated Term Babies Frequency and Severity Associated with Apgar Scoring and Hie Grading

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ABSTRACT

Objective: To determine the frequency and severity of renal failure in asphyxiated neonates and to correlate it with Apgar score and Hypoxic ischemic encephalopathy (HIE) grading.

Study Design: Analytic Study.

Place and Duration of Study: This study was conducted in Department of Pediatrics, Lahore General Hospital (LGH)/Postgraduate Medical Institute (PGMI) Lahore for a period from Feb 2010 to Jan 2011.

Materials and Methods: All the deliveries taking place in LGH during the working hours of 8 am to 2 pm were attended by senior doctors on call and asphyxiated babies (apgar 7 or less at 5 mins) were enrolled for the study. After every one week one non asphyxiated baby with no known confounding factor believed to alter renal function was randomly picked up to serve as a control. Gestational age, birth weight, relevant perinatal history, findings on physical evaluation and systemic sings were entered in a predesigned proforma. Investigations like urine complete, renal functions test (RFTs) and serum electrolytes were monitored initially within 24 hours of birth, day 3rd of life and repeated when required. Abdominal ultrasound, arterial blood gases (ABGs) and electrocardiography (ECG) was done when required. Data were analyzed and relation of frequency and severity of renal failure with apgar scoring and HIE was noted.

Results: Of 150 asphyxiated babies, 60 (40%) had renal failure. 29(19.33%) had proteinuria ++ or more and 17(11.33%) developed hematuria. Of 40 non-asphyxiated babies no neonate had abnormal renal function. Sonography was abnormal in 55 cases, all were those having renal failure. Renal parameters normalized in all neonates by two months of age. 11(7.33%) babies expired. All of them were of oliguric renal failure.

Keywords: Birth asphyxia, Renal failure, Hypoxic ischemic encephalopathy.

INTRODUCTION

Perinatal asphyxia is an important cause of morbidity and mortality. Assessment of perinatal asphyxia has relied on a combination of clinical observations, such as Apgar score, and measurement of systemic indices of tissue ischemia, such as serum creatinine.[1]

In spite of successful resuscitation of an asphyxiated infant, hypoxic-ischemic encephalopathy (HIE) develops in the setting of perinatal asphyxia, which is a multiorgan system disease. Involvement of one or more organs occur in 82% of the infants; the central nervous system (CNS) is most frequently involved (72%). Severe CNS injury always occurs with involvement of other organs; pulmonary in 26%, cardiac in 29% and gastrointestinal in 29% of the infants.[2,3]Renal involvement occurs in 42% of the infants and presents as oliguria and azotemia. The cause of acute renal failure in newborn is attributed to asphyxia in 53.4% of the cases. The reason can be either pre-renal due to fluid restriction or inadequate blood volume or renal because of direct effect of asphyxia causing acute tubular necrosis. Elevated urine retinol binding protein and myoglobinuria, decreased urinary output, early rise in creatinine are features of renal failure. Studies have shown that asphyxiated newborns that develop renal failure are at greater risk for long-term neurologic sequelae and a worse overall prognosis.[4,5,6]

Acute renal failure is common in the neonatal period. It usually manifests by abnormal biochemistry and decreased urine output (<1 ml/kg/h), but non-oliguric renal failure is also not uncommon.[7,8]The mean GFR for a full term infant is about 26 mL/min per 1.73 m^2 and doubles by one to two weeks of age to 54 mL/min per 1.73 m^2. GFR for preterm infants is challenging because GFR varies with gestational age and increases after birth.[9,10]ARF is defined as anuria (no urine voided for at least 24h) or documented oliguria less than 1 ml/kg/hr together with either blood urea concentration of more than 40 mg/dl (14.3 mol/L) or serum creatinine concentration of more than 1.5 mg/dl (133 µmol) with normal maternal renal function. Patients considered to have nonoliguric renal failure if urine output is more than 1 ml/kg/hour.[11,12]Treatment is supportive. IV fluid and dopaminergic doses of dopamine (2-3 microgram/kg/min) are administered to improve renal blood flow. Dialysis may be required.[4]

Birth asphyxia constituted a large proportion of mortality and morbidity in Pakistan and it makes up large proportion of admission to our neonatal unit. It almost makes the 31-50% of all admissions and 25-31% of case fatality. Previously some study has been conducted on this topic. We did this study to show the status of such relationship between the Apgar scoring and ARF as well as HIE grading and ARF in our set up.

MATERIALS AND METHODS

This study was undertaken in NICU of Lahore General Hospital Lahore. It was a prospective case control study

in which all the deliveries taking place in the hospital during the morning hours from 8 am to 2 pm were attended by the senior doctor on call. Severely asphyxiated babies (apgar 7 or less at 5 mins at birth) were enrolled for the study. Every week one non asphyxiated baby with no known confounding factor believed to alter renal function such as necrotizing enterocolitis (NEC), respiratory distress syndrome (RDS), sepsis and major congenital malformations etc was randomly picked up to serve as a control. The enrolled babies were divided into two groups, group A comprised of 150 asphyxiated newborns, while group B had 40 healthy babies. Asphyxiated babies were further divided into three groups mild (score 6 or 7), moderate (score 4-5) and severe (score 3 or less). Sarnat scoring system was used for grading of asphyxia. To rule out any malformation of urinary tract ultrasonography was done within 24 hours of birth. Gestational age, birth weight, relevant perinatal history, physical evaluation and systemic signs were recorded on a predesigned proforma. 24 hours urinary out put was strictly measured. Blood urea, serum creatinine, serum electrolyte and urine complete examination was monitored within 24 hours of birth and day three of life. Babies having abnormal renal function had their laboratory parameters monitored every alternative day till recovery. ABG's and ECG were done as and when required. Babies having urine output <0.5 ml/kg/hr, blood urea >40mg/dl, serum creatinine > 1mg/dl, significant hematuria or proteinuria were labeled as having renal failure. Asphyxiated babies having impaired renal function were grouped as A2 and those having normal function were A1. Statistical analysis was performed using the students't' test and chi- squire test. Neonates having renal failure were followed up at one and six months of age to detect any residual abnormality. Ultrasonic imaging of kidney was also carried out on day of discharge and repeated at 1 and 6 months of age.

RESULTS

A total of 190 babies were enrolled, 150 asphyxiated babies and 40 healthy control. 112 (58.95%) were male and 78(41.05%) were females. Mean birth weight in group A was 2.7 ± 0.34 and group B was 2.65 ± 0.42. of the 150 asphyxiated babies 44 (29.33%) had mild asphyxia, 73 (48.66%) had moderate asphyxia and 33(22%) had severe asphyxia. Compared to control group RFT's were significantly deranged in asphyxiated babies (Table-3). There was no case of HIE in control group. However there were 5 (3.33%) cases of HIE stage I, 13(8.67%) stage II and 22 (14.66%) of stage III. Of the 150 asphyxiated babies 29 (19.33%) had proteinuria +2 or more while 17 (11.33%) had hematuria whereas both proteinuria and hematuria were seen in 18(12%) cases. Out of 50 control babies 3 (6%) showed hematuria and 9 (18%) had proteinuria +1. RFTs were significantly derange in asphyxiated babies compared to control group ($p<0.02$). It was also observed that RFTs were significantly in babies having HIE staging I-III (Table 2). Out of 150 asphyxiated babies RFT's were deranged in 60 (40%) (group A2) while 90 (60%) showed no abnormality (group A1). out of these 60 babies (group A2) non oliguric renal failure was seen in 53 (88.33%) and oliguric renal failure were seen in 7 (11.67%). Same trend was noted in relation to RFTs and apgar scoring (Table 3).

Table No.I: Urea and Creatinine Levels (mean ± SD) on Day 3 in Study and Control Group

	Study	Control	*P* value
Blood urea (mg/dl)	(n=150)38.48 ±15.41	(n=40)23± 4.2	<0.001
Serum creatinine (mg/dl)	(n=150)1.10± 0.54	(n=40)0.71 ±0.15	<0.004

Of the non asphyxiated babies (group B) non had abnormal renal function. 11(7.33%) babies expired, all belonged to group A2. All of these babies were those of oliguric renal failure. Remaining 49 babies improved within next 10 days and 6 babies within next one month.

Table No.2: Urea and Creatinine Levels Correlated with HIE Staging

HIE Staging of Group A	n	Blood Urea (mg/dl) mean ± SD	*P* value (com-pared to control)	S. creatinine (mg/dl) mean ± SD	*P* value (A group vs B group)
0	110	26.7±12.1	<0.01	0.79±0.19	>0.12
I	05	40.2±9.8	<0.04	1.05±0.4	<0.05
II	13	39.6±18.4	<0.03	1.2±0.91	<0.04
III	22	49.2±25.3	<0.01	1.6±0.85	<0.04
Total	150	36.3±16.4	<0.01	1.21±0.6	<0.02
Control B group	40	22.3±4.8	---	0.75±0.17	<0.001

Renal Sonography showed increased size, altered echotexture and loses of corticomedullary differentiation in babies having abnormal renal functions but normal imaging in controls and group A1. Babies expired were those having HIE grade III.

Biochemical parameters were repeated at one and six month of life to determine any residual damage. Two babies were found to have deranged RFTs at 2 months of age which became normal afterwards. No abnormal ultrasound finding was observed in any baby on follow up.

Table No.3: Biochemical parameters on Day Three

Group	N	Urea (mg%)	Creatinine (mg%)
A1	90	24.3±9.6	0.87±0.1
A2	60	47.1±21.8	1.5±3.8
B(Control)	40	20.7±0.3	0.7±0.15

A1: Asphyxiated babies with no renal failure. A2: Asphyxiated babies with renal failure.

Comparison of groups

A1 Vs B	Urea: P value >0.5; Creatinine P >0.45
A2 Vs B	All parameters showed significant difference
A1 Vs A2	(P<0.02).

DISCUSSION

Acute renal failure in the newborn is a common problem and occurs in as many as 8% of neonates admitted to neonatal intensive care units.[13] In the newborn renal failure may have a prenatal onset in congenital diseases such as renal dysplasia and in genetic diseases such as autosomal recessive polycystic kidney disease. Acute renal failure in the newborn is also commonly acquired in the postnatal period because of hypoxic ischemic injury and toxic insults. The diagnosis of renal failure is not usually straight forward because it occurs in the context of complicated clinical conditions.

The low glomerular filtration rate of newborn kidneys limits postnatal renal function adaptation to endogenous and exogenous stresses. Renal insufficiency may occur within 24 hours of a hypoxic ischemic episode. Of 150 asphyxiated babies in our study 60(40%) showed deranged renal function. 53(35.33%) were those of non-oliguric renal failure, comparative to this Gupta at all has reported 47.1% ARF cases and 78% of them were non oliguric type while Fernandez et al reported 46% ARF cases in their study[14,15] . Same trend was seen with HIE and renal failure and Apgar scoring and renal failure in our study. Other studies also support our results (Gupta at al).[14,15]

Kaur et al has reported acute renal injury in 9.1% infants with moderate asphysia and 56.0% infants with severe asphysia.[16]Gupta et al has reported 17.3% cases of severe asphyxia (Apgar 0-3), 30.6% moderate asphyxia (Apgar 4-5) and 23.4% mild asphyxia (Apgar 6-7). Almost same pattern is seen in our study. While no significant correlation could be seen between Apgar scores at 5 and 10 min and development of ARF, a significant relationship was seen between HIE and ARF patients by Mangi et al[17].

Obstruction of tubular lumen and back leak mechanism contributed to increase in urea and creatinine levels in asphyxiated neonates with renal damage. Impaired tubular function after asphyxia leads to occurrence of significant tubular proteinuria. Proteinuria was seen in 29(19.33%) and haematuria in 17(11.33%) in our study. While Mangi at al has reported no such finding in their study. 11(7.33%) of the asphyxiated babies expired and all of them had oliguric renal failure.[17]The average mortality as observed by Grylack et al was 70% in asphyxia associated with oliguric ARF, where as Piazza has reported 62% oliguric ARF in asphyxiated babies with 80% mortality.[18,19]

A reduction in number of functional nephrons caused by asphyxia and leading to ARF evokes compensatory hypertrophy of the residual nephrons thus leading to improved renal functions in early months of life. But whether subtle defects may persist, can be determined only after long term follow-up and one must be cautious in prognosticating these neonates.

CONCLUSION

We concluded that birth asphyxia is a significant cause of acute renal failure in neonates and degree of hypoxic ischemic encephalopathy as well as low Apgar score correlates with the severity of acute renal failure.

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