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ORIGINAL ARTICLE

Outcome of Neonatal Acute Kidney Injury in a Special Care Baby Unit (SCABU)

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Abstract

Background: *Acute kidney injury (AKI) is common in neonates admitted in Special Care Baby Unit (SCABU) with high morbidity and mortality.*

Objective: *The present study was intended to see the immediate hospital outcome of neonatal acute kidney injury (AKI) in a Special Care Baby Unit (SCABU).*

Methods: *This observational study was carried out in SCABU, in the Department of Paediatrics, Dhaka Medical College Hospital, from October 2013 to March 2014. A total of 44 neonates (from 3-28 days) with AKI were included in this study. AKI staging was done by using pediatric RIFLE criteria as Risk, Injury, Failure. Patients were managed conservatively and immediate hospital outcome was assessed by SCABU stay, multiorgan failure, resolution of AKI, mortality and dialysis as needed.*

Results: *Demographic profile among the study population the neonate of d"7 days old comprised the main bulk. Majority of the neonates were of average birth weight. The diagnosis was based on estimated creatinine clearance(eCCL) criteria of pRIFLE showed that 40.9% neonates were at risk of AKI, 20.5% have had already injured. Higher proportions of neonates were classified as failure (38.6%).Outcome variables of neonatal AKI predicted by pRIFLE criteria was significantly higher in failure group in respect to SCABU stay (12.1+ 7.9) p value < 0.001, multiorgan failure (41.2 %) p value 0.026 and dialysis needed (88.2 %) p value < 0.001, resolution from AKI (47.1%) p value 0.885, Mortality (41.2%) p value 0.106. Here 43% neonates with AKI were improved with normal renal function and 29% improved with impaired renal function. Increased frequency of death (28%) in this series was due to multiorgan involvement and significantly higher in failure group with adequate dialysis support.*

Conclusion: *From the findings of the study it can be concluded that immediate hospital outcome of neonatal AKI is worst even after adequate dialysis support. Multiorgan involvements, increase length of hospital stay at SCABU, increase need for dialysis, are the important cause of increase mortality and morbidity. So, early detection, prompt referral and immediate supportive therapy could improve the outcome of neonatal AKI.*

Key words: *Neonatal acute kidney injury (AKI), Acute Kidney Failure (AKF),pediatric RIFLE criteria as Risk, Injury, Failure (p RIFLE),Outcome.*

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Introduction

Acute kidney injury (AKI) occurs in as many as 8% of neonates admitted to neonatal intensive care units. Most often, AKI is recognized as urine output < 0.5ml/kg/hour for 8 hours according to pediatric RIFLE criteria although nonoliguric neonatal AKI is being detected with increasing frequency.[1] The mortality of oliguric neonatal kidney failure may be as high as 60% in AKI and even higher in neonates with congenital heart disease or with anomalies of the genitourinary system.[2]

The cause of AKI is multifactorial.[2] The short-term outcome of AKI in neonates is highly dependent on the underlying etiology, the condition of other organs, and the facilities for renal replacement therapy. Mortality is more frequent and morbidity is much worse in neonates with multiorgan failure.[3] A substantial rise in serum creatinine (SCr) and a drop in urine output have been used to determine AKI in neonates. The Acute Dialysis Quality Initiative (ADQI) Group has published a consensus definition and classification system for acute kidney injury (AKI) termed the pRIFLE criteria (risk, injury, failure, loss, and end-stage.[4] The first 3 categories (risk, injury, and failure) of AKI based on whether the amplitude of SCr rise (or decreased in estimated GFR) and/or a drop in urine output[5]. The last two categories (loss and end-stage) defined temporary or permanent loss of kidney function after AKI.[5]

The present study was intended to determine the immediate hospital outcome of neonates with AKI. The findings obtained from the study would help us to institute early and effective intervention in neonates with AKI in order to prevent further progression of the disease and to reduce mortality and morbidity.

Materials and Methods

This observational study was carried out in the SCABU of Dhaka Medical College Hospital, Dhaka, from October 2013 to March 2014. All sick neonates (aged 3-28 days) admitted in SCABU and fulfilled the predefined eligibility criteria of AKI were the study population. A total of 44 neonates with AKI were included in the study as cases. AKI was suspected when urinary output was reduced <0.5 ml/kg/hr according to using pRIFLE criteria. Urine was collected by urine collecting adhesive bag and was recorded as per kilogram of body weight per hour in follow up sheets. From 3rd day of neonates to 28 days of neonates where urinary output was reduced o.5 ml/kg/hr or anuric for 12 hours then 2 ml blood sample was taken and immediately serum creatinine was done. Baseline serum creatinine was considered 0.3 mg/dl. Serum creatinine was noted when raised > 0.3 mg/dl or raised 1.5-2folds from the base line. Estimated creatinine clearance (eCCl) was measure by schwartch formula as follows :

$$eCCL = \frac{k \times Length}{Sr.\ Creatinine}$$

According to acute kidney injury classification (pRIFLE criteria), neonate with impaired renal function were classified as Risk, Injury, Failure group on the basis of eCCL and urine output.Patients with congenital anomalies and parents unwilling to allow their neonates to participate were excluded. Prior permission was taken for this study from the Ethical Committee of Dhaka Medical College Hospital, Dhaka, Bangladesh. Written informed consent was obtained from each parents/attendants. All precautions were taken to protect the anonymity of the participating subjects.

Operational definitions

Acute kidney injury classification: Paediatric RIFLE criteria[6-8]

	Estimated creatinine clearance(eCCL)	Urine output
Risk(stage-1)	eCCl decreased by 25%	<0.5ml/kg/hr for 8 hrs
Injury (stage-2)	eCCl decreased by 50%	<0.5ml/kg/hr for 16 hrs
Failure(stage-3)	eCCl decreased by 75%	<0.3ml/kg/hr 24 hrs or anuria for 12 hrs
Loss(stage-4)	Persistent failure for >4 weeks	
End-stage(stage-5)	Persistent failure > 3 month	

eCCl: Estimated creatinine clearance was measure **(**eCCL) by Schwartch formula as follows:

$$eCCL = \frac{k \times Length}{Sr.\ Creatinine}$$

Where, k (for preterm) = 0.27, k = (for term) = 0.37

Using computer software for SPSS windows version 16, data were processed and analyzed. The test statistics used to analyze the data were descriptive statistics, chi-square (χ^2) or fisher's exact test, probability test (for comparison of data presented on categorical scale), ANOVA statistics (for comparison of continuous data among three categories of AKI) and level of significance was set at 5% and p value <0.05 was considered significant.

Results

A total of 44 neonates (from 3-28 days) with AKI were included in the study. Demographic profile among the study population demonstrated that neonates of ≤7 days old comprised the main bulk. Majority of the neonates were of average birth weight.

Table I
Demographic profile among the study populations (n=44)

Variables	n (%)
Age	
<7 days	28 (64)
8-14 days	11 (25)
15-21 days	03 (7)
>21 days	02 (4)
Sex	
Male	21(48)
Female	23(52)
Male : Female	1: 0.9
Birth weight (gm)	
1000-1500	02(4)
>1500-2500	10(22)
>2500	32(73)
Gestational age	
Term	33(75)
Pre term	11(25)

Table I demonstrated that majority (64%) of the neonates were younger than 7 days age, male to female ratio is 1: 0.9. Most (73%) of them had average birth weight and 75% were term baby.

Table II
Distribution of neonates by their clinical characteristics (n=44) *

Clinical characteristics	No	%
Breathing difficulty	34	77.3
Anemia	33	75.0
Cyanosis	28	63.7
Reluctant to feed	23	52.3
Dehydration	22	50.0
Convulsion	19	43.2
Grunting	25	25.0
Distended abdomen	10	22.7
Fever	9	20.5

* Total will not correspond to 100%, for multiple responses.

Clinical characteristics were breathing difficulty (77.3%) and anemia (75%). The next common characteristics were cyanosis (63.7%), reluctant to feed (52.3%), dehydration (50%) and convulsion (43.2%). Other less common symptoms and signs were grunting, fever and distended abdomen.

Table III
*Causes of AKI in study cases (n=44)**

Perinatal/Neonatal characteristics	No	%
Prerenal		
Perinatal asphyxia stage II or stage III	30	68.2
Meconium aspiration syndrome	23	52.3
Septicaemia with shock	26	59.0
Early onset Neonatal Sepsis (EONS=18)	18	40.9
Late onset Neonatal Sepsis(LONS=8)	8	18.1
Prematurity	11	25.0
Diarrhoea	2	4.5
Vomiting	4	9.1
Renal		
Amino glycosides used during onset of AKI	23	52.3
Post-renal		
Hydro nephrosis with posterior urethral valve	1	2.3
Exostrophy of bladder	4	9.1
Cloacal exostrophy	2	4.5

* Total will not correspond to 100%, for multiple responses

More than two-thirds (68.2%) of the neonates experienced perinatal asphyxia stage-II or perinatal

Table IV
Outcome of different classes of AKI by pRIFLE criteria (n=44)

Outcome variables	pRIFLE			p-value
	Risk (n=19)	Injury (n=10)	Failure (n=15)	
SCABU stay* (days)	4.7 ±0.5	4.8± 0.4	12.1± 7.9	<0.001
Multi organ failure#	1(5.6)	4(44.4)	7(41.2)	0.026
Dialysis needed#	0(0.0)	0(0.0)	15(88.2)	<0.001
Resolution from AKI#	7(38.9)	4(44.4)	8(47.1)	0.885
Mortality#	2(11.1)	3(33.3)	7(41.2)	0.106

*Data were analysed using ANOVA statistics and were presented as mean±SD.
Data were analysed using Chi-square Test (χ^2) and were presented as n (%).

Table V
Immediate hospital outcome of neonates with AKI (n=44)

pRIFLE criteria	Improved with normal renal function	Improved with impaired renal function	Mortality (multi organ involvement, sepsis, perinatal asphyxia)
Risk	07	0	2
Injury	04	06	3
Failure	08	07	7
Total = 44	19(43.18%)	13(29.5%)	12(27.27%)

asphyxia stage-III and 52.3% were exposed to meconium aspiration syndrome during delivery. Prematurity was found in 11(25%) cases. Septicaemia with shock, acute respiratory distress syndrome, history of amino glycosides used in neonates and neonatal jaundice were reported in 59.1% (EONS 40.9% and LONS 18.2%), 20.5%, 52.3% and 13.6% respectively (Table III).

There was no difference between Risk and Injury in terms of duration of SCABU stay. However, failure group had a significantly longer stay compared to Risk and injury group ($p < 0.001$). Multiorgan failure was found to be staggeringly lower in the risk group compared to other two groups ($p = 0.026$). Most of the failure group needed dialysis as compared to the risk and injury group ($p < 0.001$). The resolution from AKI was almost similar among the groups ($p = 0.885$). The mortality was progressively higher from risk to failure groups ($p = 0.106$ but it was not statistically significant.

Overall 27.27 % of the neonates was suffering from acute kidney Injury and there cause of death were multi organ failure, septicemia, perinatal asphyxia, meconium aspiration syndrome and others. Improved with normal renal function (43.18%) and 29.5% improved with impaired renal function.

Discussion

The aims of the present study were to see the immediate outcome of neonates with AKI.The incidence of AKI varies according to the population studied, the level of attention of the hospital center and the country's level of development.[1,2] Presently, the tendency is to perceive AKI as an evo-lutionary spectrum and classify it with scales of severity or stages of AKI like the pRIFLE Scale, which was validated in 2007.[3,4] It has been shown that the incidence of AKI increases when applying the pRIFLE Scale.[5,6,7] Rovetto et al reported the incidence of AKI in the SCABU is 16 times higher than in wards, which shows that the risk of AKI increases as the patient is most critical.[8]

The widespread acceptance of consensus definitions for AKI is reflected in the increased utilization of pRIFLE in the literature. In order to progress further, establishment of a uniform definition for AKI

applicable in a variety of patient populations is necessary.[9-12.]

In compare to other study[13-15] there was no difference in age, sex, birth weight for diagnosis of AKI. Majority of causes are septicemia, hypovolemia, hypotension, multi -organ failure ,intravascular volume depletion, intraventricular hemorrhage, uses of phototherapy due to increased nitric oxide which causes vasodilatation, hypernatremia dehydration, different nephrotoxic drug users.[16-18.]

In the present study the outcome of AKI in neonates predicted by pRIFLE criteria showed significantly higher number of neonates in failure group with respect to SCABU stay. Multiorgan failure was found to be significantly higher in the Failure group. All of the failure group neonates needed dialysis . The mortality was increasingly higher in Failure Groups.

Previous study report also suggested that longest SCABU stay with intervention needed in both failure group.[18-20]

Likewise 15 neonates were diagnosed as acute kidney failure by pRIFLE and all of them needed intermittent peritoneal dialysis. Failure group of pRIFLE criteria had two group improved with normal renal function and improved with impaired renal function .both grops were needed IPD. 08 of neonates in failure group had improved with normal renal function after IPD and also 07 of neonates in failure group had impaired renal function. Impaired renal function group of patients referred to Chronic Kidney Disease follow up clinic.

The pediatric RIFLE (pRIFLE) was found to be better in classifying AKI and reflects the course of AKI in neonates admitted to the intensive care unit (NICU). [21-23]

Conclusion

From the findings of the study it can be concluded that immediate hospital outcome of neonatal AKI is worst even after adequate dialysis support. Multiorgan involvements, increase length of hospital stay at SCABU, increase need for dialysis, are the important cause of increase mortality and morbidity. So, early detection, prompt referral and immediate supportive therapy could improve the outcome of neonatal AKI.

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