Neonatal acute kidney injury in a tertiary care hospital in Kashmir, Jammu and Kashmir, India

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ABSTRACT

Background: Acute kidney injury (AKI) is a common entity in neonates admitted to the neonatal intensive care unit (NICU). Neonatal AKI is associated with increased morbidity and mortality and a greater risk of chronic kidney disease among the affected ones in future. **Objectives:** The objectives of this study were to study the incidence and outcome of neonatal AKI in our NICU. **Materials and Methods:** This single-center retrospective study included all infants who were admitted in a tertiary care hospital, J and K, from June 2013 to May 2014. Neonates, who had known congenital kidney diseases or if they did not survive beyond the first 48 h of life or had a hospital stay for <24 h, were excluded from the study. AKI was defined according to the kidney disease: Improving global outcomes criteria. Both AKI and non-AKI neonates were followed up until NICU discharge. Outcomes studied included mortality and length of NICU stay. **Results:** A total of 1439 neonates were studied among whom 72.89% (1049/1439) were normal weight, 11.46% (165/1439) were low birth weight, and 15.63% (225/1439) were very low birth weight. Of 1436 studied, 72% (1036) were term babies and 28% (403) were preterm babies. Perinatal asphyxia accounted for 43% (620/1439), seconded by neonatal sepsis 31.6% (455/1439) as a cause of NICU admission. Incidence of neonatal AKI in our study was 8.33% (120/1439). Mortality rate among the neonatal AKI patients was 34.1% (41/120). **Conclusion:** Our study shows an incidence of 8.3% among the NICU patients with a high mortality rate of 34.1%, implying a heightened awareness and very close monitoring of renal function during hospitalization and after discharge in such infants.

Key words: *Acute kidney injury, Mortality, Neonatal intensive care unit, Neonate*

Acute kidney injury (AKI) is a syndrome of renal dysfunction resulting in sudden onset decline in glomerular filtration rates (GFRs) and inability of kidneys to regulate acid, electrolyte, and fluid balance [1]. Kidney functions in neonates are unique as their GFR may vary depending on the degree of renal development at birth [2]. The predominant risk factors for impaired renal function in neonates are low gestational age, low birth weight, postnatal administration of vasopressors, indomethacin and antibiotics, postnatal illness, and use of positive pressure ventilation [3]. Various reviews of neonatal AKI among neonatal intensive care unit (NICU) patients report an incidence of 8–40%, depending on the definition used [4,5]. Mortality in neonates with AKI is as high as 60% [6]. Since majority of the studies related to the neonatal AKI are from the developed countries, we aimed to know the incidence rate of AKI and its associated risk factors among the NICU patients to depict the disease burden and its impact.

MATERIALS AND METHODS

This retrospective study was based on the data analysis of the records of the discharged and deceased patients, hospitalized in NICU from June 1, 2013, to May 31, 2014, in our tertiary care center catering the whole pediatric population of the Kashmir valley. The study was approved by the research and ethics committee of the institution. Newborns, who had known congenital kidney disease or if they did not survive beyond the first 48 h of life or who had a hospital stay for <24 h, were excluded from the study.

The following information was collected for data analysis: Age, gender, weight, provisional diagnosis, and treatment given including nephrotoxic drugs, important underlying metabolic/chronic condition(s), diagnoses, and serum creatinine (SCr) concentrations. The creatinine level was measured using the Jaffe method [7], and the GFR was determined using the updated Schwartz formula {height in cm × K/creatinine (mg/dL), where K = 0.413} [8]. Urine output criterion was not used for defining or staging AKI in our study.

Neonatal AKI was defined using the kidney disease: Improving global outcomes AKI definition, with one modification. Here, Stage 1 was defined as an increase of SCr ≥0.3 mg/dl or an increase in SCr by ≥50% within the 7 days of life, Stage 2 was defined as a doubling of SCr, and Stage 3 was defined as tripling of SCr [9]. We did not include urine output criteria because it

is often difficult to measure urine output in babies, and many premature infants with AKI are non-oliguric due to poor tubular function. Neonatal sepsis is defined as the presence of positive bacterial cultures in blood, cerebrospinal fluid, and/or urine associated with systemic clinical signs of infection such as fever, temperature instability, irritability, poor feeding, and respiratory distress [10].

RESULTS

Records of 1439 patients were analyzed, including 64.9% of male and 35.1% of female neonates. In our study, the incidence of AKI was 8.3% with a mortality rate of 34.1% among AKI neonates. Comprehensive result details of the study are given in Tables 1 and 2.

Table 1: Demographic profile and AKI of the studied neonates

Profile	Total, *n* (%)	AKI present, *n* (%)
Gender		
Males	933 (64.9)	78 (65)
Females	506 (35.1)	42 (35)
Gestational age		
Term	1036 (72.2)	72 (60)
Preterm	403 (27.9)	48 (40)
Birth weight (g)		
1000–1500	225 (15.6)	24 (20)
1501–2499	165 (11.5)	34 (28.3)
≥2500	1049 (72.2)	62 (51.7)
Total	1439 (100)	120 (100)

Table 2: Disease patterns, AKI, and mortality

Diagnosis	Number	AKI (%)	Deaths (%)
Perinatal asphyxia	620	149 (7.9)	34
Stage I	338	6 (1.7)	0
Stage II	192	12 (6.2)	1 (8.3)
Stage III	90	31 (33.6)	16 (51)
Sepsis (including pneumonia, meningitis, and septic arthritis)	469	48 (10.2)	19 (39)
Neonatal hyperbilirubinemia (total bilirubin>15 mg/dL)	291	8 (2.7)	1 (12.5)
Hyaline membrane disease	30	2 (6.6)	1 (50)
Infant of diabetic mothers with hypoglycemia	10	1 (10)	0
Congenital heart disease with congestive cardiac failure	9	1 (11)	1 (100)
Necrotizing enterocolitis	6	3 (50)	1 (33.3)
Inborn errors of metabolism (prolonged hypoglycemia, neonatal cholestasis, seizures, etc.)	2	1 (50)	1 (100)
Anatomical/congenital KUB malformations	2	1 (50)	0
Total	1439	120	41

AKI: Acute kidney injury

DISCUSSION

Various studies around the world have estimated that neonatal AKI affects 18–70% of the critically ill neonates and is associated with high mortality [11-13]. Neonates admitted to the NICU have prolonged hospital stay and are exposed to various drugs, interventions, and environment which influence the kidney development and the risk for the development of AKI. From our study, the overall incidence of AKI was 8.3%, which is similar to earlier studies [4,5]. However, the incidence rate in our study is lower than the other studies [11-13], which can be explained from the fact that we did not use highly sensitive urine and blood markers, and our study population was less critically ill.

The incidence by gestational age category showed the highest rates in the full term (>37 weeks) and lower rates in preterm (28–36 weeks) neonates. AKI rate in term neonates (>37 weeks or older) was 60% which is consistent with those in other studies of term infants [14,15]. Lower incidence (40%) in the age group born at ≥29 weeks, could possibly be that these infants are not as critically ill as those of the <29 weeks and those of >37 weeks of gestational age groups. However, it has been observed in various studies that extreme premature born infants have the highest risk for developing the AKI as these are more often outborn, had lower Apgar scores, and had higher rates of respiratory failure, sepsis evaluation, hypoxic-ischemic encephalopathy, necrotizing enterocolitis, and maternal vaginal bleeding.

The AKI surveillance area with the lowest number of SCr checks had low AKI incidence, whereas the area with more often, SCr checks had higher AKI incidence rates. These findings suggest that the incidence of neonatal AKI would have been even higher if more rigorous AKI surveillance protocols were implemented. The most common cause for neonatal admission in our NICU was perinatal asphyxia followed by neonatal sepsis. It was observed that 7.9% of asphyxiated neonates and 10.2% of septic neonates had AKI, implying that septic neonates were the most frequently involved group for the development of AKI which is similar to other studies [4,16].

Our study shows a mortality rate of 34.1% (41/120) among the AKI affected neonates which is similar to the study conducted by Koralkar *et al.* [17]. However, it is higher than the more recent study [18], where mortality rate was 10% in AKI neonates, which could possibly be due to very robust system in detecting and treating the neonatal AKI in their setting. AKI mortality in our study was lower than the AKI mortality in septic neonates which was 70.2% [19] which could possibly be due to the higher number of critically sick neonates, delayed referral, and exposure to nephrotoxic drugs.

Adding to the limitation of this study was the fact that the data analysis of our study is retrospective; hence, the parameters we assessed were performed as part of clinical care when available and so the true incidence may be even higher. Second, our findings are limited by our definition of AKI, which relies on SCr changes to diagnose AKI in addition to the fact that we did not take urine output as a marker of AKI.

CONCLUSION

AKI is common in NICU patients and carries a high mortality risk. Most infants who developed AKI were suffering from varied neonatal insults and developed AKI within the 1st week of life. Heightened awareness and concrete efforts can prevent and ameliorate the impact of neonatal AKI in this vulnerable population.

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