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Original Research Article

Spectrum of AKI and its outcome in an out born neonatal intensive care unit- A prospective observational study

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Abstract: AKI is associated with increased mortality in neonates but there is lack of studies regarding prevalence and outcome of AKI in neonates in western Rajasthan. The aim is to study the prevalence, co-morbidities and outcome of AKI in critically ill neonates. This single center prospective observational study was conducted for one year at tertiary care out born neonatal intensive care unit (NICU). 1004 neonates fulfilled admission criteria, out of them 93 neonates suffered from AKI on admission or later. AKI was categorized by AKIN staging. Associated co-morbidities were identified and clinical course followed till discharge/expiry. Analysis of data was done by using SPSS version 15 & differences in distribution of categorical variables were analyzed by chi square test. AKI found to be as common as 9.26% in critical ill neonates (stage 3 in 37.63%). AKI was more common in SGA and home delivered neonates. These neonates required higher percentage of inotropic support (51.61%) and mechanical ventilation (45.16%) with prolong NICU stay (6.95 ± 4.20 days) and increase mortality in compare to patients without AKI. Septicemia (65.59%), perinatal asphyxia (22.58%), gastroenteritis (8.60%) and DIC (8.60%) were leading comorbidities associated with AKI. AKI is common in NICU patients and associated with a grave prognosis. So we need to early diagnosis and management of AKI in critically ill patients.
Keywords: AKI, NICU, mechanical ventilation, vasopressor

INTRODUCTION-

AKI is classically defined as a rapid decline in the glomerular filtration rate (GFR) resulting in derangements in fluid balance, electrolytes, and waste products [1].

Presently AKI is defined on the basis of either rise in serum creatinine levels or decrease in urine output. Neonatal AKI-KDIGO group classified AKI as: [2]

- Stage 0
- Stage 1
- Stage 2
- Stage 3

AKI is associated not only with increased mortality in hospitalized neonates but increased risk for development of CKD also [3]. Most of the previous studies related to AKI have been done in adults or older children. Data regarding neonatal AKI are scarce. We planned this prospective study to find out the prevalence, spectrum, and outcome of AKI in sick out born neonates.

MATERIAL AND METHODS:

It was a prospective observational study conducted in out born Neonatal Intensive Care Unit (NICU) of Umaid Hospital, Dr. S N Medical College, and Jodhpur over a period of 1year.

Inclusion criteria- All extramural children of age <28 days admitted to out born NICU of this hospital for at least 24 hrs or more in duration and developed AKI on admission or later, were included in this study.

Exclusion criteria- Patients with structural kidney disease or End Stage Renal Disease (ESRD) were excluded.

Procedure of the study- Ethical committee of the Institute approved the study. Informed written consent was taken from parents of all patients. Demographic and clinical details were recorded. All participants were subjected to liver function tests, renal function tests, hemogram, arterial blood gas analysis, serum electrolytes, and urine microscopy and urine culture. Renal ultrasound was also done in all. For patients admitted with AKI, age matched serum creatinine levels, and for children who developed AKI during hospital course, serum creatinine levels at admission were taken as baseline for AKIN staging. Acute Kidney Injury Network (AKIN) staging was used for the diagnosis of AKI [4,5]. Similar number of age and sex matched patients admitted in NICU but without AKI were taken as control [6] (Table 1)

Our primary outcome measure was final outcome; death or survival. Survived babies were further classified as; not recovered, partial recovered, and completely recovered on the basis of discharge serum creatinine levels more than 150%, 121-150% and ≤120% from baseline respectively. Duration of hospital stay among survived babies was our secondary outcome measure.

Statistical Analysis:

Analysis of data was done by using SPSS version 15. Differences in distribution of categorical variables were assessed by chi square test. P value <0.05 was considered significant.

RESULTS:

In one year study duration, total 1004 out born neonates qualified to be included in the study group. Total 93/1004 (9.26%) children suffered from AKI, out of these 67 (72%) had AKI at admission and remaining 26(28%) developed it during course of hospital stay (figure 1). Prevalence of AKI in male and female children were 9.20% and 9.47% respectively, which is statistically insignificant (p >0.5). Incidence of AKI among rural dwellers was higher than urban (12.55%vs. 6.18%respectively), difference is statistically significant (p< 0.001).

Mode of delivery did not influence the prevalence of AKI amongst neonates. Prevalence of AKI in sick term and preterm neonates were 10.64% and 6.14% respectively, the difference was statistically significant (<0.05). Small for gestational age (SGA) neonates (23.08%) were affected more than appropriate for gestational age (AGA) neonates (7.82%) with ratio of 2.95:1 which is statistically significant (p <0.01). Home delivered neonates (27.62%) were affected more than hospital delivered neonates (7.11%), difference is statistically significant (p< 0.001). According to AKIN $_{(s.cr)}$ staging majority had AKI stage 3 (37.63%) followed by stage 2 and 1. Sepsis (65.59%) was the most common co-morbidity followed by shock (51.61%), perinatal asphyxia (22.58%), gastroenteritis (8.60 DIC (8.60%) and pyomeningitis (7.53%) (Table 2).

Inotropic support was required in 51.61% of AKI patients against 30.10% in the control group (p <0.001). Inotropes were required mostly in stage 3 (80%) than stage 1 and 2 (39.39% and 28% respectively p <0.001).Among AKI cases, 45.16% patients required ventilator support while only 26.88% of control group patient's required ventilator support (p <0.05). Ventilator support was required in 74.28% patients of AKI stage 3 while 33.33% of stage 2 and 20%of stage 1 patients. Mortality was higher in AKI group (36.56%) in comparison to control group (23.65%) (p<0.05). Mortality in stage 1, 2 and 3 was 12%, 27.27% and 62.86% respectively. Complete recovery was attained by majority (61.29%). A small chunk (2.15%) showed partial recovery (fig 1). Remaining (36.56%) either did not recover or expired. PICU stay in patients with AKI was 6.95 + 4.20 days while in control group it was 3.78 ±2.53 days (p<0.001).PICU stay was maximum in patients with AKI stage 3 (8.32 ± 4.35 days) while it was 6.74 ± 4.18 days and 5.32 ± 3.63days respectively in stage 2 and 1.(Table 3, fig 2)

Table 1 demographic distribution of study and control group

Characteristics	AKI group	Control group	P value
Mean age (days)	8.75	4.76	
Mean weight (kg)	2.34	2.32	
Sex ratio(M/F)	69/24	70/23	1.00
Rural/urban ratio	61/32	74/19	0.048

Table 2: Distribution of AKI cases according to associated co-morbidities

Co-morbidities	Number (n=93)	%
Septicemia	61	65.59
Perinatal asphyxia	21	22.58
Diarrhea/vomiting	8	8.60
DIC	8	8.60
Pyomeningitis	7	7.53
CHD	6	6.45
MAS	4	4.30
NEC	4	4.30
RDS	3	3.23
Bilirubin encephalopathy	2	2.15
HPS	1	1.07

Table 3: Comparison of outcome in AKI cases v/s controls in NICU

AKI stage	No. (%)	Inotropes required (%)	Mechanical ventilation (%)	Expiry (%)	PICU stay in days (Mean+SD)
Stage 1	25 (26.88)	7 (28)	5 (20)	3 (12)	5.32+ 3.63
Stage2	33 (35.48)	13 (39.39)	11 (33.33)	9 (27.27)	6.74+ 4.18
Stage 3	35 (37.63)	28 (80)	26 (74.28)	22 (62.86)	8.32+ 4.35
Total AKI pts	93	48 (51.61)	42 (45.16)	34 (36.56)	6.95+ 4.20
Control pts	93	28 (30.10)	25(26.88)	21 (23.65)	3.78+ 2.53

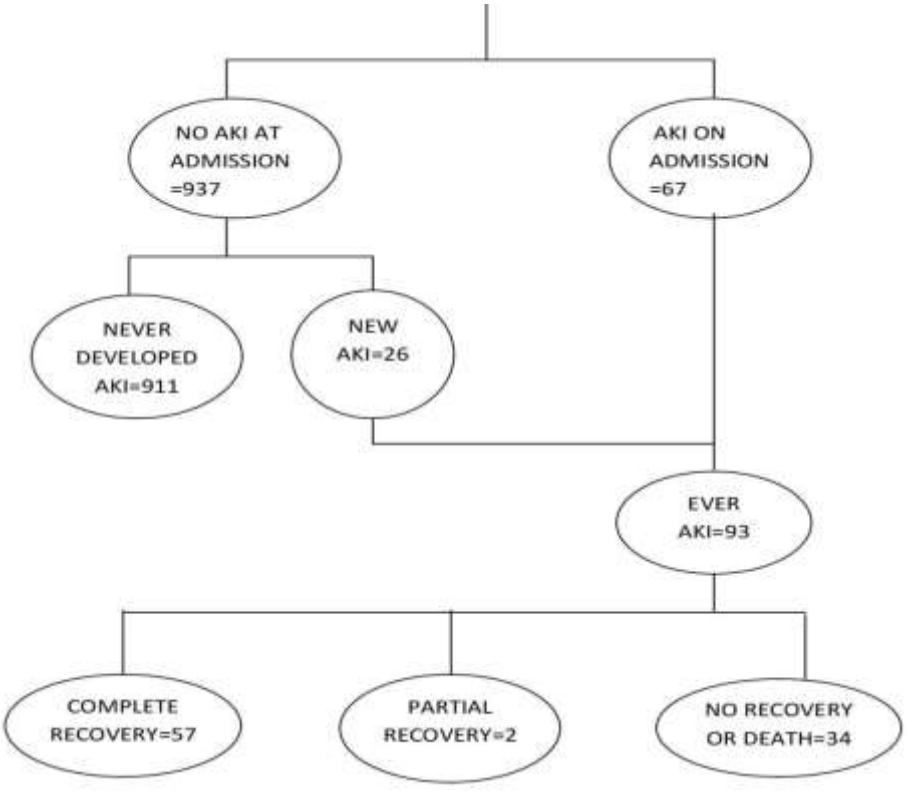

Fig 1: NICU statistics- 93 pts (9.6%) suffered from AKI on admission or later. Only 57 patients showed complete recovery while 34 patients expired. (36.56% mortality)

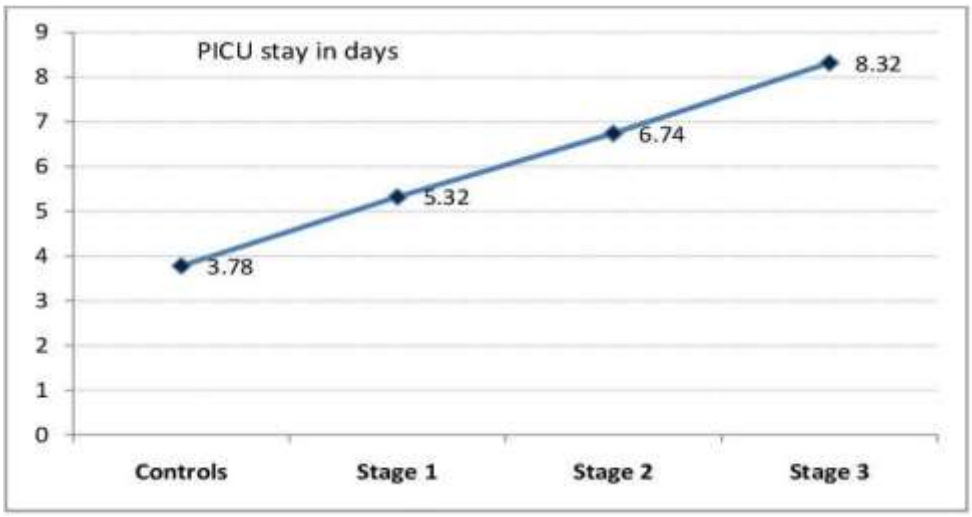

Fig 2: Showing NICU stay (days) in different groups

DISCUSSION:

AKI is a common complication in critically ill newborn and is associated with substantial increases in morbidity and mortality. The cause of AKI in the ICU is commonly multifactorial; it frequently develops from a combination of hypovolemia, sepsis, medications and hemodynamic disturbances. This higher incidence of AKI among sick neonates of rural areas might be due to poor socio-economic, educational status of their parents with delay in recognition of risk factors due to lack of expert medical care and appropriate facilities.

This study AKI staging done by using AKIN criteria by which 26.88% children were in stage 1, 35.48% in stage 2 while 37.63% in stage 3. While Alkandari *et al.;* used AKIN staging and observed 54.64% cases in stage 1, 24.14% cases in stage 2 and 21.22% cases in stage 3 [7]. In our study, the incidence of AKI was 6.14% among preterm neonates and 10.64% among term neonates, Arriede *et al.;* [8] and Gharehbaghi *et al.;* [9] also observed higher incidence of AKI in term neonates in their study. All the preterm neonates who were sick clinically were also given intravenous fluid soon after admission to NICU and this might be cause of lower incidence of AKI in preterm neonates in our study. AKI was detected in 27.62% home delivered neonates as compared to 7.11% hospital delivered neonates, this difference was highly significant ($p < 0.001$).Higher incidence of birth asphyxia and various unhygienic practices in home deliveries might responsible for higher incidence of AKI in such neonates. Sepsis has been consistently shown to be a risk factor for the development of AKI across neonatal populations, contributing to up to 78% of the cases of AKI [10-12]. In our study we found sepsis is major co morbidity, responsible up to 65% of the cases of AKI while Mathur *et al.;* [13] described near 25% term neonates with sepsis developed AKI. Sean m bagshaw *et al.;* [14] found in their study that 42.1% AKI children had associated septicemia. In this study inotropic support (dopamine, dobutamine and adrenaline) required in 51.61% of cases of AKI patients (maximum in AKI stage 3) which was significantly higher than control group (30.10%), similar finding reported by Daher *et al.;* [15] his study. In this study, among AKI cases 45.16%patients' required mechanical ventilation while 26.88% of control group patients required mechanical ventilation. Alkandari *et al.;* [7] observed that 60% of AKI patients required mechanical ventilation in compare to 43.2% non AKI patients. Overall mortality among patients with AKI was significantly higher than control group similar results found by Daher *et al.;* [15] and Alkandari *et al.;* [7] Similarly, Jaishree *et al.;* [16] observed in their study that mortality was 50% in septicaemic neonates who had AKI as compared to 25% among those who had normal renal function. They concluded that AKI may additionally increase the mortality in sick neonates. In another study of Gupta BD *et al.;* [17] observed higher mortality rates in asphyxiated newborns that had AKI as compared to those who had normal renal functions.

In present study outcomes of AKI cases were categorized as per recovery. Complete recovery and partial recovery was seen in 61.29% and 2.15% of AKI cases respectively while death or no recovery was seen in 35.57% of AKI cases. Daher *et al.;* [15] observed in their studies that complete recovery occurred in 59.4%

patients, partial recovery in 13.5% patients and no recovery or death in 27.2% patients. Overall mean duration of NICU stay in study group was 6.95 + 4.20days while in control group it was 3.78 + 2.53days ($p < 0.001$). Alkandari *et al.;* [7] observed average stay of 9.7 days in AKI patients and 4.6 days in non AKI patients in their ICU while Daher *et al.;* [15] observed average stay of 7 days in AKI patients and 3 days in non AKI patients in their ICU.

CONCLUSION:

Kidneys are very sensitive to subtle changes in homeostasis which, if lasts longer may result in AKI. AKI needs to focus on defining risk factors, the implications of fluid balance, renal replacement therapy, and the long-term outcomes [18]. As stage of AKI increases chances of survival decreases, so timely recognition of morbidity and appropriate management can improve prognosis.

DECLARATIONS

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Conflict of interest: None

Ethical approval: Taken by college ethical committee

REFERENCES:

1. Clarkson MR, Friedewald JJ, Eustace JA, Rabb H. Acute kidney injury. In: Brenner BM, ed. Brenner &. Rector's The Kidney. 8th ed. Philadelphia, Pennsylva- nia, USA: Saunders, Elsevier; 2008:943–986.
2. AHEMIÏ K. KDIGO clinical practice guideline for anemia in chronic kidney disease. Kidney international. 2012; 2:279.
3. Waikar SS, Bonventre JV. Acute Kidney Injury: Harrison's Principles of Internal Medicine, 18thed, McGraw-Hill; 2012: 2293-2308.
4. Bellomo R, Ronco C, Kellum JA, Mehta RL, Palevsky P. Acute renal failure–definition, outcome measures, animal models, fluid therapy and information technology needs: the Second International Consensus Conference of the Acute Dialysis Quality Initiative (ADQI) Group. Critical care. 2004 May 24; 8(4):R204.
5. Mehta RL, Kellum JA, Shah SV, Molitoris BA, Ronco C, Warnock DG, Levin A. Acute Kidney Injury Network: report of an initiative to improve outcomes in acute kidney injury. Critical care. 2007 Mar 1; 11(2):R31.
6. Srivastava RN, Bagga A. IFCC Committee on Reference Intervals and Decision Limits. Pediatric Nephrology, 5th edition, 2011:544.
7. Alkandari O, Eddington KA, Hyder A, Gauvin F, Ducruet T, Gottesman R, Phan V, Zappitelli M. Acute kidney injury is an independent risk factor for pediatric intensive care unit mortality, longer length of stay and prolonged mechanical ventilation in critically ill children: a two-center retrospective cohort study. Critical Care. 2011 Jun 10; 15(3):R146.
8. Airede AK, Bello M, Weerasinghe HD. Acute renal failure in the newborn: incidence and outcome. Journal of paediatrics and child health. 1997 Jun 1; 33(3):246-9.
9. Gharehbaghi MM, Peirovifar AM. Evaluating causes of acute renal failure in newborn infants. Pakistan journal of medical sciences. 2007 Oct 1; 23(6):877.
10. Momtaz HE, Sabzehei MK, Rasuli B, Torabian S. The main etiologies of acute kidney injury in the newborns hospitalized in the neonatal intensive care unit. Journal of clinical neonatology. 2014 Apr; 3(2):99.
11. Vachvanichsanong P, McNeil E, Dissaneevate S, Dissaneewate P, Chanvitan P, Janjindamai W. Neonatal acute kidney injury in a tertiary center in a developing country. Nephrology Dialysis Transplantation. 2011 Sep 27:gfr477.
12. Bolat F. Acute kidney injury in a single neonatal intensive care unit in Turkey Fatih Bolat, Serdar Comert, Guher Bolat, Oznur Kucuk, Emrah Can, Ali Bulbul, Hasan Sinan Uslu, Asiye Nuhoglu. World J Pediatr. 2013; 9(4):323-9.
13. Mathur NB, Agarwal HS, Maria A. Acute renal failure in neonatal sepsis. Indian journal of pediatrics. 2006 Jun 1; 73(6):499-502.
14. Bagshaw SM, George C, Dinu I, Bellomo R. A multi-centre evaluation of the RIFLE criteria for early acute kidney injury in critically ill patients. Nephrology Dialysis Transplantation. 2008 Apr 1; 23(4):1203-10.
15. Daher EF, Marques CN, Lima RS, Silva Junior GB, Barbosa AS, Barbosa ES, Mota RM, Silva SL, Araujo SM, Liborio AB. Acute kidney injury in an infectious disease intensive care unit--An assessment of prognostic factors. Swiss medical weekly. 2008 Mar 8; 138(9-10):128-33.
16. Jayshree G and Saili A. ARF in septicaemic newborn. Indian J Pediatr 1991; 38 (1): 29-33.
17. Gupta BD, Sharma P, Bagla J, Parakh M, Soni JP. Renal failure in asphyxiated neonates. Indian pediatrics. 2005 Sep 1; 42(9):928.
18. Selewski DT, Charlton JR, Jetton JG, Guillet R, Mhanna MJ, Askenazi DJ et al. Pediatrics 2015;136;e463-473.