



ORIGINAL RESEARCH PAPER

Neonatology

CLINICO-BIOCHEMICAL PROFILE AND OUTCOME OF NEWBORNS WITH ACUTE KIDNEY INJURY IN NEONATAL INTENSIVE CARE UNIT

KEY WORDS: neonate, acute kidney injury, thrombocytopenia, NICU

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ABSTRACT	INTRODUCTION: Acute kidney injury (AKI) is strongly associated with severe morbidity and mortality, especially in newborns.
	Aims and objectives: To study clinical and biochemical profile and associated conditions in newborns with Acute Kidney Injury (AKI) in Neonatal ICU.
	MATERIAL AND METHODS: this is a prospective observational study for a period of three month at tertiary care neonatal intensive care unit in teaching hospital. All newborn admitted with acute kidney injury are enrolled for study.
	RESULTS: In present study total 40 neonates are enrolled with male:female ratio of 1.5:1. Most common presenting complaint was refusal to feed in (50%) followed by neonatal jaundice in (12.5%) and delayed cry after birth (7.5%). Most common complication was hypernatremia (40%) followed by thrombocytopenia (2.5%) and hyperkalemia in (12.5%) patients. Mean serum sodium, potassium, blood urea and creatinine levels were 154.75±14.47 mEq/L, 6.04±1.09 mEq/L, 186.45±121.89 mg/dl and 3.68±3.09 mg/dl respectively.
	CONCLUSIONS: High index of suspicion is required in sick neonates, whether oliguric or non-oliguric and prompt and appropriate management of these cases will go a long way in reducing high neonatal morbidity and mortality rate.

INTRODUCTION:-

Acute Kidney Injury (AKI) is one of the major clinical problems in hospitalised neonates. In recent years, there have been major & significant advancements in our understanding of acute kidney injury (AKI) and its impact on outcome⁽¹⁻⁴⁾. Acute kidney injury (AKI) is strongly associated with severe morbidity and mortality, especially in newborns⁵. It affects 8-24% of critically ill neonates and mortality rates vary between 10 to 61%⁶.

AKI is characterized by sudden (within 48 hours) impairment in renal function that results in the retention of nitrogenous waste products, e.g. urea and alters the regulation of ECF volume, electrolytes and acid base homeostasis⁷. The term Acute Renal Failure (ARF) has become obsolete, and is replaced by the term acute kidney injury (AKI). The initial definitions were based on Blood Urea Nitrogen (BUN) but BUN did not highlighted the actual status of kidney injury as it is affected by many other factors such as dehydration, steroid usage, increased catabolism etc.

The common conditions contributing to kidney injury in neonates according to various studies are perinatal asphyxia, neonatal sepsis, respiratory distress syndrome, dehydration, heart failure, nephrotoxic drugs, medication-phototherapy and urological anomalies with asphyxia and sepsis being the most common^{8,9}.

AKI can be divided in three categories 1) Pre renal 2) Renal (intrinsic) and 3) Post renal AKI¹⁰.

The Second International Consensus Conference of Acute Dialysis Quality Initiative (ADQI) group in 2004 formulated a multilevel classification system which was known as the RIFLE criteria for AKI¹¹. It was based on creatinine clearance, serum creatinine and oliguria.

The serum creatinine level is the simplest and most commonly used indicator of neonatal kidney function. The plasma creatinine (Pcr) concentration immediately after birth reflects the maternal creatinine concentration. The Pcr level gradually decreases from 1.1mg/dl in term infants (1.3 mg/dl in preterm infants) to a mean

value of 0.4 mg/dl within first two weeks of life. In general, each doubling of the serum creatinine level represents a 50% reduction in GFR. For the sake of uniformity for different gestational age of neonates we have taken ≥ 1.5mg/dl creatinine value as AKI¹².

Prognosis and outcome of patients of renal failure are quite variable and depend on early diagnosis of the condition, the underlying pathology and type of renal failure whether oliguric or non oliguric. Serum sodium should be monitored closely, based on basal requirements of 2-4 mEq/kg/day of sodium, and the daily provision adjusted based on estimated ongoing losses. Sodium concentrations should be normalized prudently in order to prevent negative neurological outcomes¹³. Hyperkalemia is common in the oliguric and anuric phase. In the recovering polyuric phase, hypokalemia can become an issue^{14,15}.

These are several studies which demonstrate that 40-50% of neonates who recovered from acute renal failure are being left with residual renal damage and manifest by structural, glomerular or tubular abnormalities or hypertension later in life.

Thus, this study was conducted with the objectives to study the clinical & biochemical profile and complications associated with AKI in neonates.

MATERIAL AND METHODS:-

This study was carried out in Department of Pediatrics, zanana hospital Jhalawar Medical College & associated Hospital, Jhalawar for a period of 3 months. It was prospective observational study.

INCLUSION CRITERIA:

All newborn admitted with Acute kidney injury in Neonatal intensive care unit.

EXCLUSION CRITERIA

Life threatening congenital anomaly

METHODS & COLLECTION OF DATA:

This prospective observational study was carried out in the

department of Pediatrics, Jhalawar medical college, Jhalawar. Informed consent was taken from parents. A detailed history and clinical examination was done and relevant clinical and laboratory findings, demographic features, gestational age (term or preterm), birth weight/weight on admission, antenatal, perinatal history was recorded on predesigned proforma. Any associated contributing conditions including perinatal asphyxia (newborn presenting with history of delayed cry or having sign and symptoms of hypoxic ischaemic encephalopathy), sepsis, respiratory distress syndrome, dehydration, heart failure, meconium aspiration syndrome and history of surgical operation were also recorded.

Relevant investigations like complete blood count, blood urea, serum creatinine, serum electrolytes (sodium and potassium) and culture and urine examination were done in all enrolled neonates. Oliguria was defined as urine output <1.0 ml/kg/hour and anuria are defined as absence of any urine output within 24 hours after birth. Twenty-four hours urine output was measured by collecting urine in baby urobags.

STATISTICAL ANALYSIS

Appropriate statistical tools were used to test significance and to compare data. Categorical variables were presented as number and percentage. Microsoft word and excel have been used to generate tables

RESULTS:-

In present study, 40 newborn were included who are fulfilling the inclusion criteria.

Out of 40 cases 24 (60%) neonates were male and 16 (40%) were female with male:female ratio of 1.5:1. Out of 40 patients, 10(25%) cases were out born and 30 (75%) neonates were inborn. Thirty two (80%) were delivered vaginally and 8(20%) were delivered by caesarean section. **Table-1**

In study out of 40 neonates only 18 (45%) were feed exclusive breast feeding while top feeding along with breast feed was given in 14(35%) and only Top feed was given in feed 8(20%) neonates. Most common presenting complaint among enrolled newborn was refusal to feed in 20 (50%) followed by neonatal jaundice in 5(12.5%), delayed cry after birth in 3(7.5%), convulsion in 3(7.5%), hyperthermia in 3(7.5%), respiratory distress in 3(7.5%) and oligurea in 2(5%) patients.

Among 40 neonates with AKI most common complication was hypernatremia in 16 (40%) followed by thrombocytopenia in 10(2.5%), hyperkalemia in (12.5%), anaemia in 1 (2.5%) and hypoglycemia in 1 (2.5%) patints. Three (7.5%) patients required mechanical ventilation and 2 (5%) patient died of Complications.

Table -2

In our study the mean serum sodium level in neonates was 154.75 ± 14.47 mEq/L and sodium level normalise after average 6.8 days. The mean potassium level in neonates was 6.04 ± 1.09 mEq/L and potassium level normalise after average 3 days.

Mean level of blood urea in newborn was 186.45 ± 121.89 mg/dl and blood urea levels normalise after average 8.2 days. Mean level of serum creatinine was 3.68 ± 3.09 mg/dl and creatinine level normalise after average 8.0 days. **Table-3**

Overall Mortality was 5% in our study and all patients who died had multi-organ dysfunction at admission and delayed presentation to hospital. About 82.5% of patients were successfully discharged with complete recovery of renal functions.

DISCUSSION:-

Increased incidence of AKI amongst newborns in intensive care units has been attributed to prolonged survival of seriously ill neonates with improved resuscitative and ventilatory support, increased use of nephrotoxic drugs, increased incidence of sepsis and higher risk of renal failure in premature neonates due to physiological immaturity of renal function.

The early recognition of renal dysfunction is important in critically sick neonates because it facilitates appropriate fluid and electrolyte management and modification in drug dosage if required.

In present study 60% male and 40% female neonates were diagnosed as AKI and male to female ratio was 1.5:1. In a simple randomized manner, though there was no statistically significant difference between outborn and inborn neonates on the basis of gender. Similarly Airede et al studied 43 neonates with AKI and observed male to female ratio was (M: F; 3.3:1)¹⁶. Higher number of male neonates in the study might be explained by the fact that there is always a significant social and cultural bias against the female child in community in general.

In our study we found that most of cases 25% were outborn neonates whereas 75% cases were inborn neonates. Similarly Airede et al studied 43 neonates with AKI and revealed 68% neonates were outborn¹⁶. The higher proportion of AKI amongst neonates in NICU might be due to the fact that these newborn were brought in advanced stage of disease such as dehydration, sepsis and had either compensated or decompensated shock. Low proportion of AKI amongst newborns of inborn NICU might be explained by the fact that these neonates were delivered within our hospital, picked up at an early stage of disease and managed appropriately that must have taken care of hypoperfusion of various body organs particularly that of kidneys.

In our study maximum numbers (50%) of patients were of up to 7 days of age. Tellier B et al in their study also found that age <24 hours, underlying diseases, low urine output were important prognostic factors¹⁷.

Our study revealed that 32 (80%) neonates were delivered by normal vaginal delivery in comparison to 8(20%) neonates who were delivered by caesarean section. This can be attributed to multiple factors like higher antenatal risk factors such as fetal distress, prolonged hospitalization and more occurrence of dehydration due to ineffective lactation. Yaseen H et al reported that dehydration fever was associated with caesarean section¹⁸.

In present study, proportion of AKI was more in normal weight babies (75%) and mostly they were term. Term neonates had higher proportion of AKI because of complication like birth asphyxia and septicaemia. Koralkar et al reported incidence of AKI using modified KDIGO criteria to be 18% amongst normal birth weight infants. They also reported higher mortality in the AKI group¹⁹.

In present study, Refusal to feed was the most common presenting complaint in 50% patients, followed by NNJ in 12.5%, Delayed cry after birth (7.5%), Convulsion (7.5%), Hyperthermia (7.5%), Respiratory distress (7.5%) and Oligouria (5%) of patients. Similarly Kapil et al observed that neonatal sepsis (refusal to feed) was the commonest presentation followed by perinatal asphyxia and respiratory distress²⁰.

In our study hypernatremia (40%) was the most common complication, followed by thrombocytopenia (25%), anaemia (15%), hypoglycemia (15%) and hyperkalemia (12.5%). Boskabadi H et al in their study observed thrombocytopenia was most common complication in 41 % of patients and hypernatremia was in 36% of patients²¹.

In our study the mean serum sodium level in neonates was 154.75 ± 14.47 mEq/L and mean potassium level in neonates was 6.04 ± 1.09 mEq/L. Mean level of serum creatinine was 3.68 ± 3.09 mg/dl. Study by Nair S et al observed that Mean (SD) sodium on admission was 157.7 ± 9.41 mEq/L and mean potassium level in neonates was 5.7 ± 1.05 mEq/L and mean level of serum creatinine was 3.2 ± 0.808 mEq/L²².

In present study 5% neonates with AKI expired. All expired

neonates were oligouric. Many studies reported that oligouric renal failure carried a poorer prognosis than non oligouric renal failure^{23,24}.

LIMITATION-

It was single centre study and has small sample size. There are many other factors contributing to kidney injury which were also not analysed. So multi centric study with adequate sample size is required to generalise the result.

CONCLUSION:-

AKI contribute significantly to alarmingly high neonatal morbidity and mortality. Term, male gender, less than 7 days of age and sepsis came out as significant risk factors for AKI. High index of suspicion is required in sick neonates, whether oliguric or non-oliguric and prompt and appropriate management of these cases will go a long way in reducing high neonatal morbidity and mortality rate.

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Table -1 Baseline Characteristic Of Patients

Characteristic	Number of patients n (%)
Sex	
Male	24(60)
Female	16(40)
Age	
Up to 7 days	20(50)
8 to 14 days	10(25)
15 to 28 days	10(25)
Place of birth	
Outborn	10(25)
Inborn	30(75)
Mode of delivery	
Vaginal	32(80)
Caesarean section (CS)	8(20)
Feeding	
Exclusive breast feed	18(45)
BF+Top feed	14(35)
Only top feed	8(20)
Birth weight	
>2500 gm	30(75)
< 2500 gm	10(25)

Table -2 Clinical And Complication Profile Of Newborn

Clinical profile	No of patients (n=40) n(%)
Clinical Presentation	
Refusal to feed	20(50)
Neonatal jaundice	5(12.5)
Delayed cry after birth	3(7.5)
Convulsion	3(7.5)
Respiratory distress	3(7.5)
Hyperthermia	3(7.5)
Oligourea	2(5)
Diarrhoea	1(2.5)
Complications	
Hypnatrimia	16(40)
Thrombocytopenia	10(25)
Hyperkalemia	5(12.5)
Anaemia	1(2.5)
Hypoglycemia	1 (2.5)
Shock	2(5)
Need of mechanical ventilation	3(7.5)
Death	2(5)

Table- 3 Investigation Parameter Of Patients

Blood investigations	Mean + SD
Heamoglobin (gm/dl)	16.815±4.3
Platelets (mm3)	210010±170870.9

Total leucocytes count(mm3)	17318±8879.6
Urea(mg/dl)	186.45±121.8
Creatinine(mg/dl)	3.685±3.096
Sodium(meq/lt)	154.75±14.47
Potassium(meq/lt)	6.04±1.09 mEq/L
Time to normalize dearranged parameter	
Blood urea	8.2 days
S. creatinine	8 days
Sodium	6.8 days
Potassium	3 days

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