

Original Research Article

The incidence of acute kidney injury in newborns experiencing hypernatremic dehydration

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ABSTRACT

Background: Hypernatremic dehydration is a significant concern for neonates, particularly in hot climates where the risk factors for dehydration are heightened. It can lead to life-threatening complications such as acute renal failure. Determining the incidence of acute kidney injury (AKI) in newborns experiencing hypernatremic dehydration help to understand the relationship between hypernatremic dehydration and acute kidney injury in newborns, with the goal of enhancing patient care and outcomes.

Methods: A hospital-based prospective study was conducted in the neonatal intensive care unit (NICU) at Navodaya Medical College, Raichur, over one year involving 50 neonates aged less than or equal to 28 days with hypernatremic dehydration. Neonates with congenital kidney anomalies, diagnosed with sepsis and who have experienced birth asphyxia were excluded. The diagnosis of AKI was based on the criteria outlined in the modified kidney disease: improving global outcomes (KDIGO).

Results: Out of 50 neonates with hypernatremic dehydration 30 (66%) had AKI. Out of 33 neonates with AKI 3% had sodium levels between 146-149 mEq/l, 72.7% between 150-169 mEq/l and 24.2% between ≥ 170 mEq/l. p value is 0.003 (<0.05) and is statistically significant.

Conclusions: Neonates who experience weight loss exceeding the normal physiological range and exhibit signs of dehydration should be assessed for hypernatremic dehydration. The incidence of AKI in newborns experiencing hypernatremic dehydration is a significant clinical concern that warrants attention. Early identification and management of hypernatremic dehydration are crucial to mitigate the risk of renal impairment.

Keywords: Hypernatremic dehydration, AKI, Neonatal intensive care unit, Dehydration assessment

INTRODUCTION

Neonatal hypernatremia is defined as serum sodium concentration exceeding 145 mEq/L.¹

It is divided into 3 groups based on the severity of hypernatremia – mild (146-149 mEq/L), moderate (150-169 mEq/L) and severe (≥ 170 mEq/L).² Hypernatremic dehydration occurs when there is a deficit of water in relation to the total body sodium content, which can arise from factors such as insufficient breast milk intake, diarrhea, vomiting, exposure to radiant warmers, and renal

dysplasia. Hypernatremic dehydration can lead to life-threatening complications such as acute renal failure, cerebral edema, intracranial hemorrhage, hydrocephalus, disseminated intravascular coagulation, and seizures.³

Hypernatremic dehydration, often resulting from insufficient lactation in exclusively breast-fed infants, can lead to acute kidney injury (AKI), a serious complication. If this condition persists, it may evolve from prerenal injury to intrinsic renal damage.⁴ AKI is defined according to the modified neonatal kidney disease: improving global outcomes criteria (KDIGO).⁵ Neonatal AKI may result in complete recovery or could leave behind residual renal

damage, which may lead to long-term complications such as hypertension and chronic renal insufficiency later in life.⁶

Due to the limited data on the incidence of acute kidney injury in neonates with hypernatremia dehydration, this study aims to investigate the incidence of AKI in this population. This study aims to enhance understanding of acute kidney injury in neonates suffering from hypernatremic dehydration, contributing valuable data that may influence clinical practices and improve neonatal outcomes.

METHODS

Hospital based prospective study was conducted in the NICU at Navodaya Medical College, Raichur, over one year from August 2023 to September 2024. 50 Neonates aged 28 days or younger who exhibit significant weight loss (>10% of birth weight) and signs of dehydration along with hypernatremia (sodium levels >145 mEq/l), was included in the study after obtaining written informed consent from their parents or guardians.

Inclusion criteria

Neonates aged 28 days or younger requiring admission to the neonatal ward with hypernatremic dehydration were included.

Exclusion criteria

Neonates with congenital kidney anomalies, neonates diagnosed with sepsis and neonates who experienced birth asphyxia.

A comprehensive clinical examination will be performed, which includes: measuring axillary temperature; a temperature exceeding 38 degrees Celsius will be

classified as fever; evaluating the infant for signs of dehydration, such as weight loss, a depressed anterior fontanelle, and delayed skin turgor; assessing for icterus and grading it according to Kramer staging; and weighing the infant using a digital infant weighing scale. Blood samples will be collected via venipuncture and sent to for analysis.

The investigations will include a complete blood count (CBC), C-reactive protein (CRP), total and direct bilirubin levels, serum electrolytes, and serum creatinine levels.

Ethical clearance was obtained from institutional ethics committee of Navodaya Medical College and Research centre, Raichur.

Statistical analysis

All statistical analysis was performed according to intention to treat principle by statistical package for the social sciences (SPSS) software version 27 for Windows (SPSS Inc., Chicago, IL, USA). Data was entered into Microsoft excel data sheet and was analysed using SPSS 27 version software. Categorical data was represented in the form of frequencies and percentage. Chi-square test/pooled Chi square was used as test of significance for qualitative data.

RESULTS

A total 40 (80%) newborns presented within 1st week of life out of which 18 (36%) were males and 22 (44%) were females. 9 (18%) in second week of life of which 4 (8%) male neonates and 5 (10%) female neonates. Only 1 (2%) case which was female baby presented in the third week of life. No case was presented in the fourth week of life. Maximum cases were reported in the first week of life and with overall female predominance. Mean age of presentation is 5.9±3.4 days of life (Table 1).

Table 1: Demographic distribution of neonates (age and gender).

Days of life	No. of males (frequency)	No. of males (percentage)	No. females (frequency)	No. of females (percentage)	Total
1-7	18	36	22	44	40
8-14	4	8	5	10	9
15-21	0	0	1	2	1
22-28	0	0	0	0	0
Total	22	44	28	56	50

Incidence of AKI was present in 33 (66%) of the cases whereas there was no reported AKI in 17 (34%) neonates. Mean creatinine is 1.5±1.5 mg/dl (Table 2).

Out of 33 neonates with AKI, 1 neonate (3%) had sodium levels between 146-149 mEq/l, 24 neonates (72.7%) between 150-169 mEq/l and 8 neonates (24.2%) between ≥170 mEq/l.

P value is 0.003 (<0.05) and is statistically significant (Figure 1).

Table 2: Distribution according to incidence of acute kidney injury.

AKI	Frequency (n=50)	Percentage
Yes	33	66
No	17	34

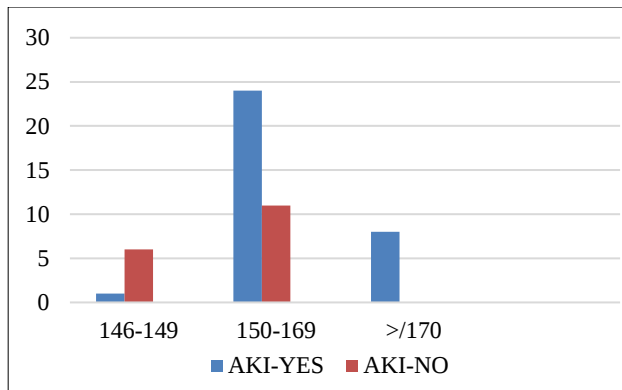


Figure 1: Distribution according to correlation of incidence of acute kidney injury with severity of hyponatremia.

DISCUSSION

In our study, all cases presented between 2-20 days of life. 40 (80%) presented within 1st week of life of which 10 cases were out born, 9 (18%) in second week of life of which 7 cases were out born babies, only 1 (2%) out born case presented in the third week of life. Maximum cases were reported in the first week of life with the mean age of presentation being 5.9 ± 3.4 days of life. It was similar to a study by Bolat et al, neonates were admitted between 2 and 17 days with mean ages of 5 days.⁷

In the present study gender distribution was female predominance with 28 (56%) female babies and 22 (44%) male babies, findings were consistent with study by Bhat et al at GB Pant Hospital, Srinagar where there was a slight preponderance of females (55%) over males (45%).⁸

In our study, AKI was identified in 33 cases (66%), whereas 17 neonates (34%) did not experience AKI. The highest serum creatinine level recorded was 6.4 mg/dl, with an average serum creatinine of 1.5 ± 1.5 mg/dl. A similar study conducted by Nair et al at Nehru Balchikitsalaya found that the incidence of AKI was 67%.⁹ Mahesh et al at a tertiary care centre in Maharashtra concluded that hyponatremic dehydration is important preventable, treatable dangerous condition in neonates. Central nervous system is most commonly affected, but acute renal failure is also an important complication. Early diagnosis and proper treatment gives good outcome; sometimes renal failure complicates the management.¹⁰

In our study among the 33 neonates with AKI, 3% had sodium levels between 146-149 mEq/l, 72.7% between 150-169 mEq/l and 24.2% between ≥ 170 mEq/l. The p value was 0.003, indicating statistical significance and demonstrating a correlation between elevated sodium levels and the incidence of AKI. The findings were similar to study by Pandya et al at GMERS, Gujarat where sodium between 150-169 meq/l was found in 40% and 3.3% in more than 170 meq. In neonates, hyponatremia is often a result of inadequate breastfeeding. This imbalance leads to

a depletion of water in ECF resulting in a hypertonic intravascular state that causes water shift from ICF to ECF, once compensatory mechanisms are saturated it leads to severe complications.¹¹

The recognition of AKI in newborns with hyponatremic dehydration is crucial for effective management.¹² Early identification allows for prompt fluid resuscitation, continuous monitoring of serum creatinine levels and urine output which is vital to assess renal recovery and prevent further complication and for preventive strategies like educating caregivers about proper feeding practices and recognizing signs of dehydration can help prevent hyponatremic dehydration.¹³

AKI is a serious complication that, if not addressed, can lead to intrinsic renal injury and lasting damage to the kidneys.¹⁴ Neonates are particularly vulnerable due to their underdeveloped kidney functions.¹⁵

Limitations

A limitation of this study is its limited sample size. Additionally, since the research was carried out in a single-centre observational environment within a tertiary NICU, the findings may not reflect the circumstances in other NICUs, where variations in patient demographics and clinical practices may exist.

CONCLUSION

Neonates who experience weight loss exceeding the normal physiological range and exhibit signs of dehydration should be assessed for hyponatremic dehydration. The incidence of AKI in newborns experiencing hyponatremic dehydration is a significant clinical concern that warrants attention. Monitoring the weight of breastfeeding infants, along with training for mothers, caregivers, doctors, nurses to recognize at-risk neonates, plays a crucial role in prevention and early detection. Additionally, close follow-up within the first week after hospital discharge to monitor weight gain and hydration is crucial.

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