



Original Research Article

Renal functions in term neonates with weight loss of more than 10% in early neonatal period - A cross sectional study

Anjali Edbor^{1,*}, Himanshu Dua¹¹Dept. of Pediatrics, NKPSIMS & RC & LMC, Nagpur, Maharashtra, India

ARTICLE INFO

Article history:

Received 30-04-2021

Accepted 12-08-2021

Available online 30-04-2022

Keywords:

Acute kidney injury

Hypernatremic

nRIFLE criteria

ABSTRACT

Introduction: Normally neonates lose 5-7% of their birth weight in the first week of life. Inadequate breastfeeding resulting from different factors may result in dehydration and excessive weight loss. Hypernatremic dehydration leading to acute kidney injury (AKI) is a well-known complication of lactational insufficiency in exclusively breast-fed babies progresses from pre-renal to intrinsic renal injury, if persistent. Acute kidney injury (AKI) is a complex disorder which has a clinical manifestations ranging from mild dysfunction to complete anuric kidney failure.

Aim: To evaluate renal function tests (RFT) in term neonates with more than 10% weight loss within 7 days of life.

Primary Objective: To determine the frequency of acute kidney injury in term neonates with more than 10% weight loss within 7 days of life.

Secondary Objectives : 1: To determine type of acute kidney injury (Prerenal, Renal); 2: Assess the percentage of dehydration in terms of percentage of weight loss (more than 10%, more than 15%); 3: Assess type of dehydration (hypernatremic, isonatremic, hyponatremic); 4: To assess type of dehydration with acute kidney injury.

Material and Methods: A hospital based prospective study was conducted on term neonates in a tertiary care hospital for period of 12 months from July 2019 to June 2020. Daily weight of all the neonates was recorded using electronic weighing machine. 103 new-borns presenting with weight loss of more than 10 % of birth weight within 7 days of life were enrolled as per convenient sampling technique without any bias. Neonates with congenital anomalies of kidney, sepsis, birth asphyxia and diabetes insipidus were excluded. Neonates were assessed by performing renal function test as a marker of dehydration.

Observation and Results: One hundred and three neonates with weight loss of more than 10% were enrolled in the study. Among them, 88 (85.4%) had prerenal AKI and 15 (14.5%) had renal AKI; 68(66%) neonates had dehydration of 10-15% while, 35 (34%) had dehydration of more than 15%. Most of the neonates 75(73.4%) had hypernatremic dehydration while 25(25%) and 3(1.5%) had isonatremic and hyponatremic dehydration respectively. 69, 16 and 3 neonates with prerenal AKI had Hypernatremia, isonatremia and hyponatremia respectively while 5 and 9 neonates with renal AKI had Hypernatremia and isonatremia respectively. None of the neonate had renal AKI with hyponatremia.

Conclusion: Hypernatremia is severe enough to cause prerenal AKI progressing to renal AKI in exclusively breast-fed babies without any associated comorbidities. Training of mothers, care givers and doctors and weight monitoring of breast-fed babies to identify at risk neonates is important in early diagnosis.

This is an Open Access (OA) journal, and articles are distributed under the terms of the [Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License](https://creativecommons.org/licenses/by-nc-sa/4.0/), which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: reprint@ipinnovative.com

1. Introduction

Normally neonates lose 5-7% of their birth weight in the first week i.e within first 7 days of life.¹

* Corresponding author.

E-mail address: dranjali.edbor@gmail.com (A. Edbor).

Unsatisfactory breastfeeding resulting from different factors may result in dehydration and excessive weight loss. Hypernatremic dehydration leading to acute kidney injury (AKI) is a notable complication of lactational insufficiency in exclusively breast-fed babies progresses from prerenal to intrinsic renal injury, if persistent.¹ Acute kidney injury (AKI) is a complex disorder which has a clinical presentations ranging from mild dysfunction to complete anuric kidney causing failure.² Although successful breastfeeding provides intense advantages to infants and mothers, inadequate breastfeeding may result in life threatening hypernatremic dehydration leading to AKI.³ During the first postnatal days, newborns are at excessive risk of developing AKI because they are born with low GFR, high renal vascular resistance, decreased intercortical perfusion, high plasma rennin activity, and decreased reabsorption of sodium in the proximal tubules.⁴ Neonatal AKI can have a absolute recovery or may have residual renal damage which may have consequences in later life such as hypertension and chronic renal insufficient.⁵

Present study was conducted to find out the renal functions among term neonates with weight loss of more than 10% in first 7 days of life and to determine type of AKI and dehydration, percentage of dehydration and to correlate type of dehydration with AKI

2. Materials and Methods

A hospital based prospective study was conducted on term neonates in a tertiary care hospital for period of 12 months from July 2019 to June 2020. The study was approved by ethics committee of the hospital. Daily weight of all the neonates was recorded using electronic weighing machine. 103 new-borns presenting with weight loss of more than 10% of birth weight within 7 days of life were enrolled as per convenient sampling technique without any bias. Neonates with congenital anomalies of kidney, sepsis, birth asphyxia and diabetes insipidus were excluded. Neonates were assessed by performing renal function test as a marker of dehydration by Beckman Coulter AU480 chemistry analyzer (Siemens ADVIA 2400). Type of AKI was determined by calculating blood urea to creatinine ratio. Ratio of more than 20:1 had prerenal while less than 20:1 had renal AKI. Dehydration was diagnosed if weight loss after birth was more than 10% in term neonates. Percentage of weight loss was divided in two groups as weight loss of 10-15% and more than 15%. Type of dehydration was assessed depending of serum sodium levels and were tabulated in three groups as hypernatremic, isonatremic and hyponatraemic dehydration as per serum sodium levels of more than 145, 130-145 and less than 130 meq/dl respectively. Type of dehydration was then assessed with type of AKI. Severity of AKI was evaluated using nRIFLE criteria.

2.1. Operational Defeniation

1. Acute kidney Injury (AKI): Acute kidney injury is characterized by a sudden (within 48 hrs) impairment in kidney function that results in the retention of nitrogenous waste products (e.g., urea) and alters the regulation of extracellular fluid volume, electrolytes and acid base homeostasis.⁶
2. Hypernatremic dehydration: Hypernatremia was defined as serum sodium >145 mEq/L.¹
3. nRIFLE criteria: The RIFLE defines 3 grades of increasing severity of ARD as risk (R), injury (I), and failure (F) as well as the 2 outcome variables of loss (L) and end-stage kidney disease.⁷

	CREATININE OR GFR CRITERIA	URINE OUTPUT CRITERIA
RISK	INCREASED Cr X 1.5 OR GFR DECREASES >25%	UO <1.5ML/HR *24 HOURS
INJURY	INCREASED Cr X 2 OR GFR DECREASES >50 %	UO <1 ML/KG/HR *12 HOURS
FAILURE	INCREASED Cr X 3 OR GFR DECREASES >75% OR Cr ≥4MG/DL	UO <0.7 ML/KG/HR X 24 HOURS OR ANURIA X 12 HOURS
LOSS	PERSISTENT ARF = COMPLETE LOSS OF RENAL FUNCTION FOR >4 WEEKS	
ESRD	END STAGE RENAL DISEASE (persistent failure >3 months)	

3. Results

One hundred and three neonates with weight loss of more than 10% were enrolled in the study. Among them, 88 (85.4%) had prerenal AKI and 15 (14.5%) had renal AKI; 68(66%) neonates had dehydration of 10-15% while, 35 (34%) had dehydration of more than 15%. Most of the neonates 75(73.4%) had hypernatremic dehydration while 25(25%) and 3(1.5%) had isonatremic and hyponatremic dehydration respectively. 69, 16 and 3 neonates with prerenal AKI had Hypernatremia, isonatremia and hyponatremia respectively while 5 and 9 neonates with renal AKI had Hypernatremia and isonatremia respectively. None of the neonate had renal AKI with hyponatremia. Severity of AKI using RIFLE criteria suggested that 42(40.7%) 45(43.6%) and 16(15.5%) neonates were in stage 1, 2 and 3 i.e. in risk, injury and failure respectively

Table 1: Type of AKI

Type of AKI	No.	%
Prerenal	88	85.4
Renal	15	14.5
Total	103	100

Table 2: Percentage of dehydration in terms of percentage of weight loss

% of weight loss	No.	%
10-15%	68	66
More than 15%	35	34
Total	103	100

Table 3: Type of dehydration

Type of dehydration	No.	%
Hypertremic	75	73.4
Isonatremic	25	25
Hyponatremic	3	1.6
Total	103	100

Table 4: To assess type of dehydration with AKI

	Hypertremic	Isonatremic	Hyponatraemic
Prerenal	69	16	3
Renal	6	9	0

Table 5: Severity of AKI as per RIFLE criteria

	No.	%
Risk(stage1)	42	40.7
Injury(stage2)	45	43.6
Failure(stage3)	16	15.5
Total	103	100

4. Discussion

Dehydration in neonates is very common and may undergo renal impairment due to its late diagnosis. Exclusive breastfeeding is the universal recommendation till 6 months of life which has health benefits to both infant and mother. Many mothers continue breast feeding without a good watch on its adequacy and weight gain in the baby. Most neonates start gaining their weight by the 10th day of life if sufficiently breast fed. Dehydration in neonates is hazardous and if not looked upon and discovered in its early stage it may lead to complications like cerebral oedema, cerebral vessel thrombosis, intracerebral hemorrhage, seizures, and Disseminated intravascular coagulation prior to death.¹ The main objective of our study is to know the burden of AKI in term neonates with dehydration without any associated comorbidity within first 7 days of life.

A total of one hundred and three term neonates with weight loss of more than 10% were enrolled in the study. Among the study population, 88(85.4%) neonates had prerenal AKI while 15 (14.5%) had renal i.e., intrinsic AKI. This is comparable to the study conducted by Maralihalli et al where incidence of prerenal AKI 11(35.7%) was more than renal AKI 7(23.3%).⁸ The renal functions are affected due to prerenal cause of low intravascular volume, but as the severity of dehydration increases, it leads to acute kidney injury causing deranged renal functions and sometimes

neonates land into acute renal failure and some of them may require dialysis too.¹

In this study, 68(66%) neonates had dehydration of 10-15% while, 35 (34%) had dehydration of more than 15%. This finding was similar to the results obtained by Sunny Malvia at al where he found 170 (62.5%) had weight loss 10-15% after birth and remaining 102(37.5%) had weight loss of more than 15%.¹ Dehydration was probably because of decreased intake due to inadequate and faulty technique of breast feeding or sometimes due to excessive insensible losses through lungs and skin during summers.

In present study most common type of dehydration was hypertremic 75(73.4%) followed by isonatremic 25(25%) and hyponatraemic 3(1.5%). Susana Castilho at al⁹ also found Hypertremia in 44.7% (n = 146) of the total sample (329) in her study. 156 (57.4%) out of 272 neonates had hypertremic dehydration at admission in the study results of Sunny Malvia at al.¹ Main cause of Hypertremia in neonates is water deprivation which is secondary to insufficient breast feeding and also due to excess of water loss through skin and lungs when ambient temperature is high. Previously it was thought that high concentration of sodium in breast milk is the cause of hypertremia in neonates. As most of the neonates are insufficiently breast fed and this low quantity of breast milk would not increase serum sodium levels to that levels found in dehydrated neonates.¹

As per our study maximum neonates with hypertremic dehydration (69) had prerenal AKI. There are not many studies which has observed the Correlation of type of dehydration with AKI.

Severity of AKI in our study was studied using RIFLE criteria according to which 42(40.7%) 45(43.6%) and 16(15.5%) neonates were in stage 1, 2 and 3 i.e., in risk, injury and failure respectively. But as per the study of Shobha Sharma et al¹⁰ the findings were that 75% (12) had stage III AKI and 12.5% each with stage II and I.

5. Limitation

Major limitation of the study lies in small sample size. Also, this was a single-center observational study in a tertiary NICU and thus, the present findings may not be representative of the situation in other NICUs as patient populations and clinical practices may vary.

6. Conclusion

Hypertremia is severe enough to cause prerenal AKI progressing to renal AKI in exclusively breast-fed babies without any associated comorbidities. Hence it is important to have high index of suspicion of AKI in all the neonates with significant weight loss and dehydration.

Training of mothers, care givers and doctors and weight monitoring of breast-fed babies to identify at risk neonates

is important in early diagnosis.

These neonates may merit long term follow-up for possible sequelae. Therefore, there is an urgent need for follow-up studies of such babies into childhood as well as in adulthood to look for unrecognized sequelae of such insult.

7. Sources of Funding

No financial support was received for the work within this manuscript.

8. Conflicts of Interest

No conflicts of interest.

References

1. Malvia S, Goyal S, Meena P, Poswal L, Meena M. Renal functions in term neonates admitted with dehydration in a tertiary care center in southern Rajasthan. *Curr Pediatr Res*. 2018;22(3):215–8.
2. Askenazi DJ, Ambalavanan N, Goldstein SL. Acute kidney injury in critically ill newborns: What do we know? What do we need to learn? *Pediatr Nephrol*. 2009;24(2):265–74.
3. Yildiz N, Erguven M, Yildiz M, Ozdogan T, Turhan P. Acute peritoneal dialysis in neonates with acute kidney injury and hypernatremic dehydration. *Perit Dial Int*. 2013;33(3):290–6.
4. Nadaa A, Bonacheac EM, Askenazid DJ. Acute kidney injury in the fetus and neonate. *Semin Fetal Neonatal Med*. 2017;22(2):90–7. doi:10.1016/j.siny.2016.12.001.
5. Barman H, Das B, Duwarah S. Acute kidney injury in hypernatremic dehydration in exclusively breastfed babies: Don't ignore it! *J Clin Neonatal*. 2014;3(2):124–5. doi:10.4103/2249-4847.134716.
6. Durga D, Rudrappa S. Clinical profile and outcome of acute kidney injury in neonatal sepsis in a tertiary care Centre. *Int J Contemp Pediatr*. 2017;4(2):635. doi:0.18203/2349-3291.ijcp20170723.
7. Ricci Z, Ronco C. Neonatal RIFLE. *Nephrol Dial Transplant*. 2013;28(9):2211–4. doi:10.1093/ndt/gft074.
8. Maralihalli M, Matti M, Kathasagaram V, Kulkarni V. Clinical profile of Hypernatremic dehydration in neonates with special emphasis to acute kidney injury. *J Pediatr Crit Care*. 2018;5(5):26–30.
9. Castilho S, Miranda AM, Fernandes CA, Cunha M, Barroso R. Excess weight loss and Hypernatremia in exclusively breastfed infants. *J Pediatr Neonatal Individ Med*. 2018;7(2):1–8.
10. Sharia S, Poddar S, Yadav A, Debata PK, Roy N. Hypernatremia and Acute Kidney Injury in Exclusive Breast Fed Babies-Time to Reconsider! *J Clin Diagnostic Res*. 2019;13(3):18–22.

Author biography

Anjali Edbor, Associate Professor

Himanshu Dua, Associate Professor

Cite this article: Edbor A, Dua H. Renal functions in term neonates with weight loss of more than 10% in early neonatal period - A cross sectional study. *Panacea J Med Sci* 2022;12(1):82-85.