



EFFECT OF NORMAL SALINE VS RINGER LACTATE AS MAINTENANCE FLUID ON SERUM ELECTROLYTES IN CRITICALLY ILL PATIENTS IN PICU

Paediatrics

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ABSTRACT

Background: Intravenous fluid therapy plays a critical role in preserving extracellular volume and maintaining electrolyte balance in acutely ill children. The American Academy of Pediatrics (2018) and NICE (2020) recommend isotonic crystalloids such as Normal Saline (NS) and Ringer Lactate (RL) as maintenance fluids. However, their differing electrolyte compositions raise concern-NS with higher chloride may cause hyperchloremic metabolic acidosis, whereas RL, with added potassium and lower chloride, may influence electrolyte balance. **Objective:** To compare serum electrolytes in critically ill children receiving NS vs RL as maintenance fluid in PICU. **Methods:** This prospective observational study was conducted in the Pediatric ICU of M.S. Ramaiah Hospital (June 2023 – February 2025). Two hundred children aged 2 months–18 years received either NS or RL based on clinical need. Serum sodium, potassium, and chloride were measured at baseline and after 24 hours. **Results:** NS group showed higher mean serum sodium (139.45 mEq/L vs 138.3 mEq/L; $p = 0.0016$) and chloride (107.35 mEq/L vs 102.68 mEq/L; $p < 0.0001$). Hyperchloremia occurred in 15.5 % (NS) vs 0.5 % (RL). RL maintained potassium more stably; mild hypokalemia occurred in 3 % (NS) vs 0.5 % (RL). **Conclusion:** RL showed better electrolyte profile compared to NS with reduced risk of sodium and chloride elevation and better potassium conservation.

KEYWORDS

Normal Saline, Ringer Lactate, Hyperchloremia, Electrolyte Imbalance.

INTRODUCTION:

Fluid therapy is a cornerstone of pediatric critical care, essential for maintaining hemodynamic stability and electrolyte balance. Normal Saline (NS) and Ringer's Lactate (RL) are the most commonly used isotonic crystalloids for maintenance intravenous fluids as recommended by the AAP (2018) and NICE (2020) guidelines. However, their differing electrolyte compositions can influence electrolyte and acid–base status—NS, with higher chloride, is associated with hyperchloremic metabolic acidosis, while RL, containing lower chloride and lactate, better preserves acid–base equilibrium. Although balanced crystalloids have shown favorable outcomes in adults, limited pediatric data exist comparing their effects on serum electrolytes. Hence, this study aims to compare NS and RL as maintenance fluids in children, focusing on their impact on serum sodium, potassium, and chloride levels to guide safer and physiologically appropriate fluid selection in pediatric intensive care.

Literature Survey:

Weinberg et al. (2015) conducted a prospective comparative study and reported that patients receiving NS had a significant rise in serum chloride and fall in bicarbonate, indicating hyperchloremic metabolic acidosis, whereas RL maintained more stable acid–base parameters.

Kraut et al. (2016) observed similar findings in a randomized controlled trial, emphasizing that balanced crystalloids may reduce the risk of hyperchloremia and metabolic acidosis.

Mahmoodpoor et al. (2017) confirmed these results, showing greater biochemical stability with RL compared to NS. Patel et al. (2020) further demonstrated that children receiving RL had more stable chloride and bicarbonate levels and fewer acid–base disturbances than those given NS.

Methodology:

This was a prospective observational study conducted in the Pediatric Intensive Care Unit (PICU) of M.S. Ramaiah Medical College and Hospital, Bengaluru, over 19 months (June 2023 – February 2025). The study compared the effects of Normal Saline (NS) and Ringer Lactate (RL) as maintenance intravenous fluids on serum electrolytes in critically ill children.

A total of 200 children aged 2 months–18 years who required maintenance fluid therapy were enrolled. Patients were assigned to receive either NS or RL based on a pre-decided alternate-day allocation strategy. Fluid administration followed standard AAP (2018) and institutional protocols.

Inclusion criteria were all critically ill children requiring

maintenance IV fluids. **Exclusion criteria** included children with chronic or acute renal, cardiac, or hepatic disease, diabetic ketoacidosis, raised intracranial tension, or those receiving diuretics.

Blood samples were collected at baseline and after 24 hours of fluid therapy to measure serum sodium, potassium, and chloride. Data were documented using a structured proforma that included demographic and clinical parameters.

Statistical analysis was performed using SPSS version 22 (IBM, USA). Categorical variables were expressed as frequencies and compared using the Chi-square or Fisher's exact test, while continuous variables were expressed as mean $\pm$ SD and compared using independent t-test. Paired t-test was applied for within-group comparisons. A p -value < 0.05 was considered statistically significant. Graphical representations were generated using Microsoft Excel.

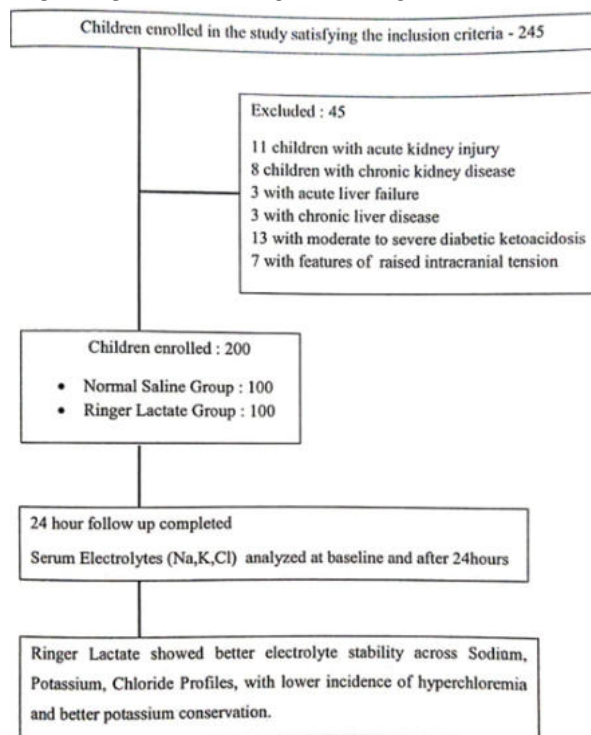


Image 1: Flow chart of Participants in the study

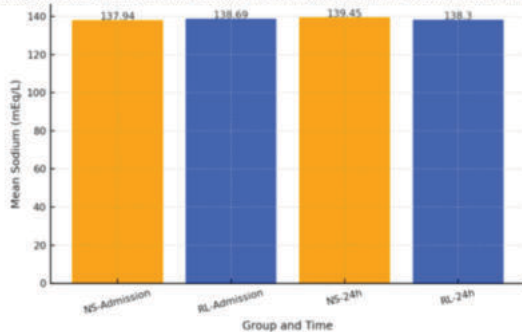
RESULT:

A total of 245 children aged 2 months to 18 years were screened; 200 met inclusion criteria and were enrolled, with 100 each receiving Normal Saline (NS) or Ringer's Lactate (RL). Baseline characteristics were comparable between groups.

At admission, mean serum sodium was slightly lower in the NS group (137.94 ± 2.55 mEq/L) compared to RL (138.69 ± 2.38 mEq/L; $p = 0.0328$). After 24 hours, sodium increased significantly in the NS group (139.45 ± 2.70 mEq/L) and decreased in the RL group (138.3 ± 2.36 mEq/L; $p = 0.0016$).

Image 2

Comparison of Mean Serum Sodium Between NS and RL at Admission and 24 Hours

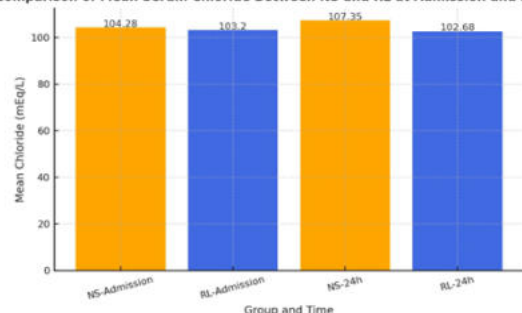


Serum potassium levels were similar at admission (NS 4.24 ± 0.47 mEq/L; RL 4.18 ± 0.46 mEq/L; $p = 0.3969$). After 24 hours, NS showed a mild decline (4.09 ± 0.46 mEq/L) while RL remained stable (4.20 ± 0.47 mEq/L; $p = 0.0884$).

Serum chloride was significantly higher in NS both at admission (104.28 ± 2.88 mEq/L vs 103.20 ± 2.83 mEq/L; $p = 0.0082$) and after 24 hours (107.35 ± 3.14 mEq/L vs 102.68 ± 2.59 mEq/L; $p < 0.0001$).

Image 3

Comparison of Mean Serum Chloride Between NS and RL at Admission and 24 Hours



Overall, Ringer's Lactate demonstrated a more favorable electrolyte profile, maintaining acid-base stability and showing reduced risk of hyperchloremia compared with Normal Saline.

CONCLUSION:

This study reinforces importance of choosing the appropriate fluid composition in pediatric critical care. Ringer's Lactate demonstrated better stability in maintaining serum electrolytes, particularly with respect to chloride and potassium, compared to Normal Saline. These findings highlight its role as a physiologically balanced maintenance fluid and support its consideration as a preferred option in PICU settings. The results are consistent with emerging trends in pediatric fluid therapy that advocate for balanced crystalloids to reduce iatrogenic complications.

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