

SERUM ELECTROLYTES PROFILE OF PAEDIATRIC SURGICAL PATIENTS WITH TYPHOID INTESTINAL PERFORATION IN AMINU KANO TEACHING HOSPITAL, KANO - A 5-YEAR REVIEW.

Bilyaminu Ibrahim Liman^{1,2}, Muhammad Salele Aliyu³, Sa'ad Bashiru³, Lawal Barau Abdullahi^{4,5}, Loftus-John Chukwu-Emeka Anyanwu^{4,5}, Muhammad Aminu Muhammad^{4,5}

¹Department of Surgery, College of Health Sciences, Federal University Birnin Kebbi, Kebbi State

²Department of Surgery, Federal Teaching Hospital Birnin Kebbi, Kebbi State

³Department of Surgery, Federal Teaching Hospital Katsina, Katsina State

⁴Department of Surgery, College of Health Sciences, Bayero University Kano, Kano, Kano State

⁵Department of Surgery, Aminu Kano Teaching Hospital, Kano, Kano State

Corresponding Author: Dr Bilyaminu Ibrahim Liman, *Emails:* ibrahim.bilyaminu@fubk.edu.ng.

Received: 30-Nov-2025

Accepted: 28-Dec-2025

Published: 31-Dec-2025

Abstract

Introduction: It is estimated that there are about 17 million cases of typhoid fever worldwide every year. Intestinal perforation is a serious and common complication in these patients with fluid and electrolyte disturbances being common. These abnormalities may remain unrecognized and result in morbidity and mortality. Active surveillance and prompt correction is important to forestall adverse outcomes.

Aim: To assess the serum electrolyte profile of children with typhoid intestinal perforation in our center over a 5-year period.

Methodology: It was a retrospective study in which data was extracted from the records of consecutive patients managed for typhoid intestinal perforation between 2009 and 2013. This was achieved using a proforma designed for the study. Ethical approval was obtained from the Hospital's Research Ethics committee. Data was analysed using IBM SPSS version 21.0; statistical significance was set at p-Value < 0.05.

Results: A total of 129 patients were studied, 78 were males and 51 were females (M: F = 1.5:1). The mean age of the patients was 8.18 ± 2.63 years, and the mean duration of admission was 18 ± 15 days. Mean serum electrolyte values were Na^+ : $136.34 \pm 15.21\text{mmol/L}$, K^+ : $3.51 \pm 1.20\text{mmol/L}$, HCO_3^- : 26.62 ± 1.52 and Cl^- : 89.33 ± 21.26 . We found statistically significant association between serum K^+ and volume of peritoneal aspirate as well as number of intestinal perforations (p-Value < 0.05).

Conclusion: This study has demonstrated that serum electrolyte abnormalities are common among children with typhoid intestinal perforation and the commonest are Hypokalaemia and Hyponatraemia. In these patients hypokalaemia is associated with presence of higher volume of peritoneal fluid collection as well as presence of higher number of intestinal perforations. However, pre-and post-resuscitation electrolyte profiles did not show effects on outcome of treatment in our patients.

Key Words: Serum Electrolytes, Typhoid intestinal perforation, Children

Cite this article: Liman BI, Usman M, Aliyu MS, Bashiru S, Abdullahi LB, Anyawu LJC, Muhammad AM. Serum electrolytes profile of paediatric surgical patients with typhoid intestinal perforation in Aminu Kano teaching hospital, Kano - A 5-year review. Yob Med J.2025;1(3):46-53

Introduction

Typhoid fever, also called enteric fever, is caused predominantly by the bacterium *Salmonella typhii*, which is a gram-negative facultative anaerobe. The common mode of infection is by the feco-oral route. It is estimated that there are about 17 million cases of typhoid fever worldwide every year. Intestinal perforation is a serious and common complication in these patients¹. Electrolytes are substances that ionize when dissolved in suitable ionizing solvents such as water, occur in variety of conditions and may remain unrecognized and result in morbidity and mortality irrespective of primary pathology². Electrolyte imbalance is a common problem in children of all age groups, and this is more so in the tropical countries where most patients are usually victims of fluid losses from various etiologies³. An optimal balance of body fluid and electrolytes is critical to overall health as well as maintaining homeostasis. Electrolytes aid in enhancing muscle functions and in maintaining acid-base balance and body fluid levels⁴. The purpose of this study is to assess the serum electrolyte profile of children with typhoid intestinal perforation in Aminu Kano Teaching Hospital over a 5-year period.

Methods

Study Design/Study site

This was a retrospective study conducted at Aminu Kano Teaching Hospital, Kano, which is a tertiary health institution of Bayero University Kano (BUK), both situated in the ancient city of Kano.

Sample size

The records of 129 patients managed for typhoid intestinal perforation from 2009 and 2013 were retrieved, and the required information was extracted.

Study population

The study population was constituted by consecutive patients who were treated for

typhoid intestinal perforation over the period of 5 years in Aminu Kano Teaching Hospital.

Ethical approval

Ethical approval was obtained from Aminu Kano Teaching Hospital Health Research Ethics Committee, before carrying out the research. All information gathered from the records was kept confidential.

Data analysis

Data collection was done using a proforma prepared for the study. Data analysis was done using compatible SPSS statistics for Windows, Version 21.0, IBM Corp. Armonk, New York. Quantitative variables were summarized using means, SD, while qualitative variables were summarized as frequencies, proportions, tables and charts. The serum electrolytes were categorized as follows: Serum sodium Levels as Normal (130 mmol/L – 145 mmol/L), Hyponatraemia (<130 mmol/L), and Hypernatraemia (>145 mmol/L). Serum Potassium levels as Normal (3.5 mmol/L - 5.4mmol/L), Mild Hypokalaemia (3.0 mmol/L - 3.4 mmol/L), Moderate Hypokalaemia (2.5 mmol/L - 2.9 mmol/L), and severe Hypokalaemia (< 2.5 mmol/L). The serum Bicarbonate levels were categorized as Normal (20 mmol/L – 27 mmol/L), Alkalosis (> 27 mmol/L) and Acidosis (< 20 mmol/L). Volume of peritoneal aspirate was also categorized into Mild (< 500 mls), Moderate (500 mls – 1000 mls) and Severe (> 1000 mls). χ^2 -test (Fishers' exact) test was used to test associations between categorical variables. In all tests, statistical significance was set at $p < 0.05$ for statistical analysis.

Results: A total of 129 patients were studied, out of which 78 (60.50%) were males and 51(39.50%) were females; male: female ratio was 1.5:1 (Fig. 1). The mean age of the patients was 8.18 years (SD \pm 2.63 years) while the mean duration of admission was 18 days (SD \pm 15 days).

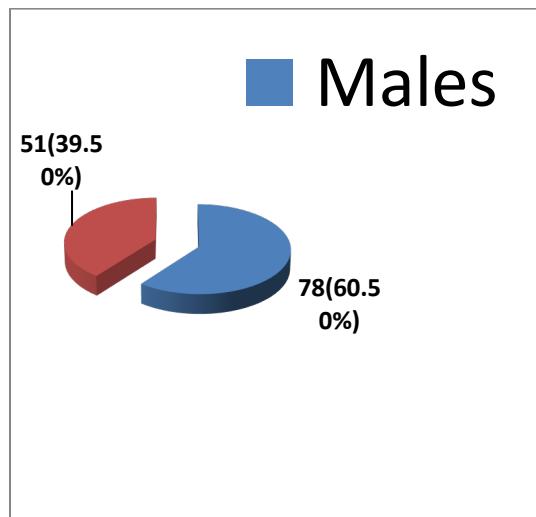


Figure 1: Pie chart showing distribution of patients by gender

Table 1: Summary of the mean values of Serum Electrolytes Pre and Post Resuscitation

Serum electrolytes	Mean (mmol/L)	SD _{pre}	SD _{post}
Na ⁺	130.41	6.41	15.21
K ⁺	3.37	0.64	1.20
HCO ₃ ⁻	20.13	1.12	1.52
Cl ⁻	84.31	11.62	21.26
Urea	6.90	3.11	1.78

Table 2: Association between Volume of Peritoneal Aspirate and Level of Serum Potassium

Vol. of Aspirate	<500 ml	500 mls -1000 mls	>1000 mls	Total
Serum K ⁺ level				
Normal	33	22	11	66
Mild Hypokalaemia	19	4	7	30
Moderate Hypokalaemia	5	6	4	15
Severe Hypokalaemia	10	4	4	18
Total	67	36	26	129

$\chi^2 = 96.4$ p-value < 0.05

Table 3: Association between Volume of Peritoneal aspirate and number of perforations

Vol. of Aspirate	<500 ml	500 mls - 1000 mls	>1000 mls	Total
No. of Perforations				
Single Perforation	55	22	17	94
2-3 Perforations	11	9	7	27
≥ 4 Perforations	2	4	2	8
Total	68	35	26	129

$\chi^2 = 10.4$

p-value < 0.05

Table 4: Association between Serum Potassium Level and Outcome of Patients

Serum K ⁺ Level	Outcome		
	Alive	Died	Total
Normal	60	6	66
Mild Hypokalaemia	28	2	30
Moderate Hypokalaemia	12	2	12
Severe Hypokalaemia	17	4	21
Total	115	14	129

 $\chi^2 = 3.4$

p-value > 0.05

Table 5: Association between Serum Sodium Level and Patient's Outcome

Serum Na ⁺ Level	Outcome		
	Alive	Died	Total
Normal	30	6	36
Hyponatraemia	78	7	85
Hypernatraemia	7	1	8
Total	115	14	129

 $\chi^2 = 2.7$

p-value > 0.05

Table 6: Association between Serum Bicarbonate Level and Patient's Outcome

Serum HCO ₃ ⁻ Level	Outcome		
	Alive	Died	Total
Normal	99	5	104
Alkalosis	12	6	18
Acidosis	4	3	7
Total	115	14	129

$\chi^2 = 3.3$ p-value > 0.05

Table 7: Association Between Number of Perforations and Serum Potassium Level

No. of Perforations	Serum K ⁺ Level				
	Normal	Mild Hypokalaemia	Moderate Hypokalaemia	Severe Hypokalaemia	Total
Single Perforation	48	23	8	4	83
2-3 Perforations	17	4	2	6	29
≥ 4 Perforations	1	3	2	11	17
Total	66	30	12	21	129

$\chi^2 = 111.2$ p-value < 0.05

The mean pre-operative serum concentrations of the electrolytes both pre- and post-resuscitation were summarized in **Table 1**. Mean serum levels of potassium were compared to the volumes of peritoneal aspirate collected which showed statistically significant association ($\chi^2 = 96.4$, p-Value <0.05) as depicted in **Table 2**. Volume of aspirated peritoneal collection was also compared to the number of intestinal perforations found at surgery which also showed statistically significant association ($\chi^2 = 10.4$, p-Value <0.05), **Table 3**. The individual serum levels of potassium, sodium and bicarbonate were all compared to the final outcomes of the patients (alive or mortality) and this showed no statistically significant association. (**Tables 4,5,6**). Serum potassium levels, however, when compared to the number of intestinal perforations showed statistically significant association ($\chi^2 = 111.2$, p-Value <0.05) as summarized in **Table 7**.

Discussion

Electrolyte abnormalities are common in patients with typhoid fever due gastrointestinal losses through vomiting, diarrhea and third space loss. These patients commonly present in critical condition. In this our study, we have shown that serum electrolytes abnormalities are very common in patients with typhoid intestinal perforation commonly resulting from the mechanisms in addition to inability to take orally. This finding was corroborated by Ekpe *et al*⁴ as well as Balaji *et al*². The study showed that at presentation, the mean serum potassium level before resuscitation was 3.37 ± 0.64 mmol/L which was below the AKTH's reference range (3.5 - 5.4 mmol/L), and this persist of after initial resuscitation (mean post-resuscitation serum potassium 3.51 ± 1.20 mmol/L). This is also like that of serum sodium with pre- and post-resuscitation values. Same observation was made for serum levels of chloride and bicarbonate. These abnormalities of hypokalaemia,

hyponatraemia and acid-base imbalances were also demonstrated by Konukseveret *et al*⁵ in their study that assessed sodium and potassium imbalances in Paediatric Emergency department, with gastrointestinal disorders being the commonest causes of electrolyte abnormalities, mainly hyponatraemia and hypokalaemia. This was also shown by Yen *et al*⁶ and Panda *et al*⁷ in their studies.

Naseem *et al*⁸ reported electrolyte imbalance in critically ill paediatric patients including children with typhoid intestinal perforation, noting hypokalaemia as the commonest electrolyte abnormality. Similar finding was demonstrated by Ali *et al*⁹ and Ebrahim *et al*¹⁰.

The hypokalaemia noted in this study, which is significantly associated with the volume of peritoneal aspirate collected at surgery ($p < 0.05$) as well as with number of intestinal perforations ($p < 0.05$) further affirms the significance of loss of potassium in the third space fluid in patients with peritonitis from typhoid intestinal perforation.

Lack of significant association between individual serum levels of the electrolytes in our patients with typhoid peritonitis when compared to the outcome of treatment (ie mortality) ($p > 0.05$) did not correlate with the findings of other studies. Elala *et al*¹¹ demonstrated statistically significant association between outcome of patients with serum potassium levels in critically ill children especially when compared with those who presented without electrolyte derangements. Hypokalaemia and hyponatraemia were also shown by Paidy *et al*¹² to affect the final outcome of critically ill children in an emergency when compared to children with normal values. Haidar *et al*¹³ also noted that mortality is higher in children presenting with electrolyte derangement when compared to those without. Similarly, Lin *et al*¹⁴ reported that variability of serum levels of sodium, potassium, and chloride are strongly

associated with mortality of paediatric patients with critical illnesses. The difference of association of outcome with serum electrolytes values observed in our study may be explained by the difference in the patients being compared. Whereas in this study the serum values were of monotonous group of patients with typhoid intestinal perforation, the above quoted literature compared the serum electrolytes values of heterogeneous group of patients with critical illnesses presenting with or without electrolyte abnormalities.

Conclusion

This study demonstrated that serum electrolyte abnormalities are common among children with typhoid intestinal perforation and the commonest electrolyte derangements were hypokalaemia and hyponatraemia. The study was also showed that the levels of serum potassium is directly related to the volume of peritoneal fluid collection and number of intestinal perforations with statistically significant association. Also, electrolyte abnormalities, despite adequate correction, may not directly affect mortality, possibly, other non-electrolyte factors contribute to mortality in our patients.

References

1. Anyanwu L-JC, Muhammad A., Abdullahi L., Farin Yaro A., Obaro S.; Determinants of postoperative morbidity and mortality in children managed for typhoid intestinal perforation in Kano Nigeria, *J Pediatr Surg* 2017, <https://doi.org/10.1016/j.jpedsurg.2017.11.058>
2. Balaji J. 2016. Clinical Profile, Etiology, Management and Outcome of Serum Electrolyte Disturbances in Children Admitted in Pediatric Intensive Care Unit in a Tertiary Care Centre [MD Dissertation, Institute of Social Pediatrics, Stanley Medical College]. Chennai-600001 India
3. Eke CB, Ndu IK, Edelu BO, Uleanya ND, Ekwochi U, Chinawa JM, *et al.* Clinical profile and electrolyte abnormalities in hospitalized under-five children with acute gastroenteritis in a tertiary health facility. *Niger J Med* 2020;29: P295-302
4. Ekpe EL, Uhegbu KO, Orji IK, Uhegbu VM, Osuji KC, Ejkem Eke CM. Pattern of Electrolyte Profile Among Admitted Children (1-18 Years) At the University of Calabar Teaching Hospital, Nigeria; *Med. Res. Chronicles* (2020); 7(1): P6-12
5. Konuksever D, Puren YS. Sodium and Potassium Imbalances in the Pediatric Emergency Department: Single-Center Experience. *Turkish J Pediatr Dis* 2022; DOI: 10.12956/tchd.1086983
6. Yen C.-W, Yu M.-C, Lee J. Serum Electrolyte abnormalities in Paediatric patients Presenting to an Emergency Department with various Diseases: Age-Related differences. *Pediatri-neonatol.* 2022; 63: P575-581
7. Panda I, Save S. Study of association of mortality with electrolyte abnormalities in children admitted in pediatric intensive care unit. *Int J Contemp Pediatr* 2018;5: P1097-103
8. Naseem F, Saleem A, Mahar IA, Arif F. Electrolyte imbalance in critically ill paediatric patients. *Pak J Med Sci.* 2019;35(4): P1093-1098. doi: <https://doi.org/10.12669/pjms.35.4.286>
9. Ali SH, Muhammad MM, Youssef RS. The Pattern Electrolyte Imbalance in Critically-ill Children Admitted in Pediatric Emergency Unit at Sohag University Hospital. *ejhm* 2021; 82(2) : P276-281
10. Ebrahim SA, Abd Elgawad ER, Ahmed BE. Electrolyte Disturbances in Critically Ill Patients. *Journal Ijar* 2016; 4(3) : P88-93
11. Elala G, Shimelis D. Patterns of electrolyte abnormalities in children 0-15 years of age admitted to Pediatric Emergency and Intensive Care Units of a

Tertiary Hospital. *IOSR-JDMS* 2018; **17(2)** : P12-16

12. Paidy AR, Thapar RK, Gupta RK. Electrolyte disturbances in critically ill children admitted to paediatric tertiary care centre. *J. Evolution Med. Dent. Sci.* 2017;6(41): P3269-3273, DOI: 10.14260/Jemds/2017/708

13. Haider M, Hameed A, Fatima S, Afrose M, Noor N, Arshad U. Frequency of Electrolyte Disorders and its effect on Mortality Among Children Admitted in Paediatric Intensive Care Unit. *JBUMDC* 2020; **10(2)** : P115-119

14. Lin J, Zhang Y, Chen M, Dai J, Song A, Chen J, Tao X . The Association Between Variability in Electrolytes and the In-Hospital Mortality in Critically Ill Children in Pediatric Intensive Care Units. *Front. Pediatr.* 2021; 9:692894. doi: 10.3389/fped.2021.692894