

Changes in Biochemical Renal Parameters Associated with Typhoid Infection

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ABSTRACT

Background Typhoid is a vital health hazard globally but its incidence is greater in developing compared to developed countries owing to low sanitation, poor hygiene practices, unsafe food and drinking water.

Objective This study was designed to determine the changes in renal parameters associated with male and female Typhoid patients.

Materials and methods A hundred and twenty male and hundred and twenty female Typhoid patients were divided into four groups made up of sixty Typhoid positive male, sixty Typhoid negative male, sixty Typhoid positive female and sixty Typhoid negative females. The renal parameters were evaluated using Spectrophotometer. The results were analyzed using statistical package for social science version 20 statistical software.

Results The result of renal changes associated with male and female Typhoid fever patient showed insignificant increase ($p < 0.05$) in Total serum Protein and significant increase ($p < 0.05$) in Creatinine level of both male and female patient compared to their control. It showed insignificant increase ($p < 0.05$) in potassium ion and sodium ion of the Typhoid positive male patient, significant decrease in sodium ion and insignificant decrease in potassium ion of the Typhoid positive female compare to their controls. Similarly, the result of the Typhoid positive male patients showed significant increase ($p < 0.05$) in Chloride ion and insignificant decrease ($p < 0.05$) in Chloride ion of Typhoid positive female compare to their control. Furthermore, it showed insignificant decrease ($p < 0.05$) in Urea level of the Typhoid positive males and insignificant increase ($p < 0.05$) in Urea level of the Typhoid positive females.

Conclusions Renal parameters as a tool for examining cases of early typhoid infections may aid in detecting early complications related to typhoid fever so as to aid in patients care and avert death that may come from such complication.

Keywords: Typhoid, Male, Female, Renal Parameters

1.INTRODUCTION

Typhoid fever is a systemic infectious disease caused by *Salmonella typhi* and is transmitted through the ingestion of food and water contaminated by the feces and urine of an infected patients [1]. The clinical scope varies from mild illness with a low-grade fever to severe clinical disease with abdominal discomfort and multiple complications, including gastrointestinal

39 bleeding, intestinal Perforation (ileum), Rhabdomyolysis and acute renal failure [2]. Recent
40 estimates showed that there are approximately 20.6 million cases and 223,000 typhoid-related
41 deaths annually worldwide [3]. The outbreaks of this disease have been documented in many
42 countries and are associated with poor sanitation, inadequate hygiene practices and unsafe food
43 and drinking water [4].

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45 Typhoid fever affects children and young adults, causing a global morbidity rate of over 12.6
46 million cases and an estimated 600000 mortality annually [5]. The attack rate as high as 1100
47 cases per 100000 populations have been documented in developing countries [6]. The primary
48 source of the disease is poor sanitary hygiene especially drinking water and food contamination
49 [7, 8, 9], hence, direct fecal-oral transmission is most common [10]. The transmission also
50 occurs through eating raw fruits and vegetables fertilized by human excreta and through
51 ingestion of contaminated milk and milk products whenever they are not well decontaminated.

52 In Nigeria, typhoid remains a major disease because of factors such as increased urbanization,
53 inadequate supplies of potable water, regional movement of large numbers of immigrant
54 workers, inadequate facilities for processing human waste, overburdened health-care delivery
55 systems, and over use of antibiotics that contribute to the development and spread of antibiotic-
56 resistant *S. typhi*. Untreated typhoid fever may lead to kidney failure, or intestinal bleeding,
57 which can be fatal [3]. If the infection spreads to the gallbladder, one could become a chronic
58 carrier of the bacteria that causes typhoid, a carrier may be asymptomatic but is capable of
59 spreading the infection to others. Typhoid fever leads to noteworthy biochemical alterations as
60 well as hepatic dysfunction and the involvement of kidney is usually associated with high
61 frequency of extra hepatic complications. Despite the high incidence and serious nature of the

62 biochemical changes and kidney involvement, these changes are temporary and respond well to
63 the appropriate antimicrobial therapy. Typhoid fever kills an average of 22 million patients in
64 Africa annually [3] and in Nigeria more than 20 million people are exposed to *Salmonella typhi*,
65 out of these 11million people get infected with Typhoid and almost 161000 deaths are being
66 reported annually in the general population of which over 100,000 deaths are of adults [11].
67 There is paucity of scientific information on the effect of typhoid fever on kidney function
68 parameters, the need to fill this knowledge gap necessitated this study and made it of great
69 significance. If the relationship between typhoid infection and kidney function is clearly
70 understood, it could give insight on ways to control typhoid associated kidney dysfunction and
71 pave way for better patient care. The aim of this study is to determine changes in renal
72 parameters associated with typhoid patients in Oyigbo Rivers State, Nigeria.

73 2. METHODOLOGY

74 SPECIMEN COLLECTION

75 Ethnical approval was granted by the ethical committee of Cliniscan Diagnostics Center,
76 informed consent was obtained from patients aged between 20 - 65 years old and the study was
77 carried out in Cliniscan Diagnostic Center between 1st May and 14th June, 2019. Specimens was
78 only obtained from consenting patients attending the clinic.

79 STUDY DESIGN

80 Two hundred and forty participants were selected through simple random sampling and put into
81 four experimental groups that is made up of sixty typhoid positive male (TPM), sixty typhoid

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82 negative male (TNM), sixty typhoid positive female (TPF) and sixty typhoid negative female
83 (TNF).

84 INCLUSION AND EXCLUSION CRITERIA

85 Participants who consented to the study were selected on the following criteria: Patients with
86 fever of up to 37.5 °C and confirmed to have been having fever for at least three consecutive
87 days, patients who had a negative blood smear preparation for malaria parasites, participants who
88 had been off antibiotics for at least 14 days prior to hospital visit and patients with signs and
89 symptoms of typhoid fever.

90 Participants were excluded from the study based on the following criteria: patients who had been
91 on antibiotics for at least two weeks prior to the hospital visit, Patients with positive blood smear
92 preparation for malaria parasite, patients who are HIV positive, Patients with low titer value 20-
93 80, Drug addicts and drinkers.

94 EVALUATION OF RENAL PARAMETERS

95 Renal parameters such as urea, sodium ion, potassium ion, chloride ion, total serum protein and
96 creatinine was measured using a Spectrophotometer and RandoxKit.

97 DATA ANALYSIS

98 The data collected were pooled and analyzed for their central tendencies using descriptive
99 statistics, values were given as mean \pm standard deviation of sixty (60) observations. ANOVA
100 and LSD were employed to test the significant differences ($p < 0.5$) among treatment means. All
101 analysis was performed using SPSS for windows statistical software package version 20. The
102 resulting output were presented in tables.

103 **3. RESULT**

104 **Renal Changes Associated with Typhoid Male Patients**

105 The renal changes associated with Typhoid male patients showed that Potassium ion (K^+) and
106 Total Serum Protein (TSP) were increased from (3.74 ± 0.96) to (3.99 ± 1.57) and (6.24 ± 0.89)
107 to (6.41 ± 1.24) respectively and both differences were statistically insignificant at ($p < 0.05$)
108 compared to their control (Table 1). Also, Chloride ion (Cl^-) and Creatinine (CRT) were
109 increased from (84.90 ± 24.52) to (93.80 ± 9.55) and (1.29 ± 0.45) to (2.0 ± 1.82) and both
110 differences were statistically significant at ($p < 0.05$) compared to their controls (Table 1). On
111 the other hand, Sodium ion (Na^+) was increased from (128.20 ± 15.19) to (137.33 ± 13.66) and
112 the differences were statistically insignificant at ($p < 0.05$) compared to the control. Finally, Urea
113 (UR) was decreased from (5.10 ± 3.98) to (4.82 ± 3.029) and the difference was statistically
114 insignificant at ($p < 0.05$) compared to the control (Table 1).

115 **Table 1: Renal Changes Associated with Male Typhoid Patients**

Renal Parameters	Typhoid Negative Males	Typhoid Positive Males
K^+ (mEq/l)	3.70 ± 0.96^a	3.99 ± 1.57^a
Cl (mEq/l)	84.90 ± 24.52^a	93.80 ± 9.55^b
TSP (g/l)	6.24 ± 0.89^a	6.41 ± 1.24^a
CRT (Mg/dl)	1.29 ± 0.45^a	2.00 ± 1.82^b
UR (Mmol/l)	5.10 ± 3.98^a	4.82 ± 3.029^a

Na (mEq/l)

128.20 ± 15.19^a

137.33 ± 13.66^a

116 Values are given as Mean ± Standard Deviation (N= 60). Mean values in the same row with
117 different superscripts differ significantly (p < 0.05). **KEY:** K⁺= Potassium ion, Cl = Chloride ion,
118 CRT= Creatinine, UR= Urea, TSP= Total Serum protein, Na = Sodium ion.

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120 **Renal Changes Associated with Female Typhoid Patients**

121 The renal changes associated with Typhoid female patients showed that Potassium ion (K⁺) and
122 Chloride ion (Cl⁻) were decreased from (4.27 ± 0.72) to (4.24 ± 0.94) and (98.73 ± 10.55) to
123 (88.73 ± 10.91) respectively and both differences were statistically insignificant at (p < 0.05)
124 compared to their control (Table 2). Also, Total Serum Protein (TSP) and Urea (UR) were
125 increased from (5.43 ± 1.88) to (6.41 ± 1.63) and (4.29 ± 1.63) to (5.67 ± 6.40), both differences
126 were statistically insignificant at (p < 0.05) compared to their controls. Also, Creatinine (CRT)
127 was increased from (0.77 ± 0.15) to (1.63 ± 1.80) and the difference was statistically significant
128 compared to its control (p < 0.05). Finally, Sodium ion (Na⁺) was decreased from (140.53 ±
129 4.87) to (127.87 ± 2163) and the differences was statistically significant compared to the control
130 (p < 0.05) (Table 2).

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136 **Table 2: Renal Changes Associated with Female Typhoid Patients**

Renal Parameters	Typhoid Negative Females	Typhoid Positive Females
K⁺ (mEq/l)	4.27 ± 0.72 ^a	4.24 ± 0.94 ^a
Cl⁻ (mEq/l)	98.73 ± 10.55 ^a	88.73 ± 10.91 ^a
TSP (g/d)	5.43 ± 1.88 ^a	6.41 ± 1.63 ^a
CRT (Mg/dl)	0.77 ± 0.15 ^a	1.63 ± 1.80 ^b
UR (Mmol/l)	4.29 ± 1.63 ^a	5.67 ± 6.40 ^a
Na (mEq/l)	140.53 ± 4.87 ^a	127.87 ± 21.63 ^b

137 Values are given as Mean ± Standard Deviation (N= 60). Mean values in the same row with
 138 different superscripts differ significantly (p < 0.05). **KEY:** K⁺= Potassium ion, Cl⁻ = Chloride
 139 ion, CRT= Creatinine, UR= Urea, TSP= Total Serum protein, Na = Sodium ion.

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148 **Comparative effects of renal changes associated with male and female Typhoid Patients.**

149 The comparative effects of renal changes associated with male and female typhoid patients
150 showed that three renal parameters that is Potassium ion (K^+), Chloride ion (CL^-) and Sodium
151 ion (Na^+) were more affected in males than females. The percentage (%) changes were (+ 7.84 &
152 -0.70), (+ 10.48 & -10.12) and (+ 7.12 & -9.01) respectively (Table 3). On the other hand, three
153 renal parameters that is Total Serum Protein (TSP), Creatinine (CRT) and Urea (UR) were more
154 affected in females than males. The percentage (%) differences were (+ 2.72 & +18.05), (+ 55.04
155 & + 111.69) and (- 5.49 & + 7.50) respectively (Table 3). Finally, the females were more
156 affected than the males overall as they recorded very high percentage changes compared to the
157 males (+ 55.04 & + 11.69) and (+ 2.72 & + 18.05) (Table 3).

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171 **Table 3: Comparative effects of renal changes associated with male and female typhoid patients**

Renal Parameters	% Change in Typhoid male patients	% Change in Typhoid Female patients
K⁺ (mEq/l)	+ 7.84*	- 0.70
Cl⁻ (mEq/l)	+ 10.48*	- 10.12
TSP (g/d)	+ 2.72	+ 18.05*
CRT (Mg/dl)	+ 55.04	+111.69*
UR (Mmol/l)	- 5.49	+ 7.50*
Na⁺ (mEq/l)	+ 7.12*	-9.01

172 Key = * indicated as superscript shows which sex was more affected in the parameters under
173 consideration. -ve denotes negative percentage change (decreased). +ve denotes positive
174 percentage change (increased). Changes were compared to the controls (negative male and
175 female patients).

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183 **4. DISCUSSION**

184 This study showed an insignificant increase ($p < 0.05$) in Potassium ion, Total Serum Protein,
185 Sodium ion and insignificant decrease ($p < 0.05$) in Urea level of Typhoid positive male compare
186 to the control. This result also showed significant increase ($p < 0.05$) in creatinine level and
187 Chloride ion level of Typhoid positive male compare to the control. The insignificant increase
188 has no effect on the typhoid positive male compare to the control and may not lead to
189 Hyponatremia which is characterized by high levels of sodium ion in the blood. The
190 insignificant decrease in Urea level showed typhoid fever has no effect on Urea level. The
191 insignificant increase in Potassium ion level showed it has no effect on Typhoid positive male
192 and may not lead to Hyperkalemia which is characterized by abnormally high potassium ion
193 levels in the blood. Furthermore, the insignificant increased in Total Serum Protein level shows
194 typhoid has no effect on Total Serum Protein level and may not lead to Hyperproteinemia which
195 is characterized by abnormally elevated plasma protein concentration [12]. The significant
196 increase in creatinine level may lead to Azotemia which is characterized by abnormally high
197 levels of nitrogen-containing compounds in the blood [13], it could also lead to Rhabdomyolysis,
198 a condition in which damaged skeletal muscle breaks down rapidly [14]. Finally, the significant
199 increase in Chloride level may lead to Hyperchloremia which is characterized by an elevated
200 level of metabolic Alkalosis in the blood.

201 This present study showed insignificant decrease ($p < 0.05$) in Potassium ion and Chloride ion
202 level and also significant decrease ($p < 0.05$) in Sodium ion level of the Typhoid positive females
203 compare to their control. It also showed insignificant increase ($p < 0.05$) in Total Serum Protein
204 and Urea level and significant increase in Creatinine level of Typhoid fever positive female

205 compared to their control. The significant increase in Creatinine level may lead to Azotemia
206 which is increased levels of Nitrogenous compound in the blood [13]. The significance decrease
207 in sodium ion may result to Hyponatremia which is low levels of sodium concentration in the
208 blood. The insignificant increase in Total Serum Protein may not lead to Hyperproteinemia
209 which is characterized by high level of protein in the blood [12]. The insignificant increase in
210 urea level may not lead to Uremia which is characterized by high levels of Urea in the blood or
211 Azotemia which is characterized by abnormally high levels of nitrogen-containing compounds in
212 the blood [13]. Also, the insignificant decrease in Potassium ion and Chloride ion level has no
213 effect in Typhoid positive females compare to their control and may not lead to Hypochloremia
214 and Hypokalemia.

215 **5. CONCLUSION**

216 From the findings of this study, it can be safely concluded that Typhoid may lead to Azotemia in
217 both male and female. It may also lead to Hyperchloremia in male and Hyponatremia in female.
218 Another implication of this result is that Typhoid has no effect on Potassium level of both male
219 and female Typhoid patients and may not lead to Hyperkalemia or Hypokalemia. Typhoid
220 affected potassium ion, chloride ion and sodium ion level of male patient more than female. On
221 the other hand, it affected urea, creatinine and total serum protein level in female more than male
222 patients. Renal parameters as a tool for examining cases of early typhoid infections may aid in
223 detecting early complications related to typhoid fever so as to aid in patients care and avert death
224 that may come from such complication.

225 **CONFLICTS OF INTERESTS**

226 The Authors hereby declares no conflicts of interests

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