

Article

Comparative study of hematological parameters in patients presenting with typhoid fever

Dr. Harsha Gajjar¹, Dr. Rugvi Patel², Patel Shruti Bharatbhai³ and Mahla Shrideviben Gamanbhai^{4,*}

¹ Assistant Professor, Department of Pathology, Narendra Modi Medical College, Ahmedabad, Gujarat.

² Senior Resident, Department of Pathology, Narendra Modi Medical College, Ahmedabad, Gujarat.

³ First Year Resident, Department of Pathology, Narendra Modi Medical College, Ahmedabad, Gujarat.

⁴ Second Year Resident, Department of Pathology, Narendra Modi Medical College, Ahmedabad, Gujarat.

* Correspondence: prachi02101997@gmail.com

Received: 21 October 2022; Accepted: 5 May 2023; Published: 20 May 2023.

Abstract: Background and Aim: Due to the etiological agent, *Salmonella enterica* serovar typhi (S.Typhi), enteric fever is a potentially lethal multisystemic disease. Leukopenia is considered a key feature of Enteric fever, but studies have shown it to be present in only 20-25% of cases. The aim of the present study was to determine specific hematological changes in typhoid fever.

Material and Methods: There were 300 individuals overall, who had typhoid fever clinical diagnosis. 150 patients were chosen as the case group and 150 as the control group out of the total. Blood samples were taken and analysed in a medical hospital for various haematological parameters as well as the Widal test in 300 patients with clinical suspicion of typhoid fever.

Results: In around one-third of cases, anorexia and abdominal pain were also observed. The least common symptoms were headache and diarrhoea. In patients who tested positive for typhoid, anaemia was present in 32% of cases, leukocytosis predominated over leukopenia, and thrombocytopenia affected roughly 24% of cases, which was significantly higher than the control group's rate.

Conclusion: Our research led us to the conclusion that men get typhoid fever more frequently than women. And this can be explained by the fact that male subjects exhibit higher levels of the predisposing factors that lead to typhoid fever; this is likely due to their occupational and social practises, which tend to give male subjects greater immunity to this infection than do female subjects. Typhoid fever also tends to infect those who are uneducated and of poor socioeconomic position. Significant haematological alterations occur in people with typhoid fever.

Keywords: Typhoid fever; Haematological examination; Symptoms, Control group.

1. Introduction

Due to the etiological agent, *Salmonella enterica* serovar typhi (S. Typhi), enteric fever is a potentially lethal multisystemic disease. *S. Paratyphi A*, as well as less frequently *S. Paratyphi B* and *S. Paratyphi C*, all induce a similar but milder illness. Typhoid fever and paratyphoid fever are also referred to as enteric fever. Despite great advancements in the domains of pharmacology, microbiology, and preventive medicine, enteric fever still affects children of all ages in impoverished nations and is a major source of significant morbidity and mortality [1,2].

Bretonneau (1826), who recognised intestinal lesions, presented a detailed study of enteric fever. Louis (1829) gave the illness the name "typhoid fever" to distinguish it from "typhus fever." Typhoid bacillus was first described in 1880 by Eberth. The World Health Organisation (WHO) has indicated that there are over 25 million cases of typhoid fever each year, and its prevalence and contribution to the rising death and morbidity rates are of major concern. Only humans can contract this type of *Salmonella*, which usually causes no symptoms. The majority of the time, the infection is contracted by consuming water or food that has been tainted by the urine or faeces of infected carriers. Typhoid has no known animal carriers, in contrast to other strains of *Salmonella* [3,4].

S. enterica subsp. *enterica* serovar bacterium is only known to be carried by humans. Typhi is disseminated via the fecal-oral route by both symptomless carriers of the bacteria and by those who are already sick. A person who is still passing typhoid bacteria in their stool a year after the acute stage of the infection is known as an asymptomatic human carrier [5,6].

Salmonella typhi is a bacterium that causes typhoid fever, an acute infection of the blood and gastrointestinal tract. There is a 10- to 14-day incubation period after intake. A characteristic protracted fever and persistent bacteremia without endothelial or endocardial involvement are the hallmarks of this severe multisystemic sickness. The invasion and expansion of mononuclear phagocytic cells in the liver, spleen, lymph nodes, and Peyer's patches of ileum are the telltale signs of typhoid fever [7,8].

High rates of enteric fever are caused by insufficient water filtering and poor sanitation. Common risk factors include contaminated water, food and drink bought from street sellers, frozen meals, inappropriate milk and milk product preservation in refrigerators, use of sewage water for the production of fruits and vegetables, and lack of access to toilets. In endemic locations, enteric fever is more prevalent among young children and adolescents, as well as in urban rather than rural areas [8,9].

Investigations for this illness involve isolating bacilli from blood, faeces, and urine as well as performing a serological Widal test using growing antibody titres in both diseased and asymptomatic carriers. Widal test has been chosen and is still frequently used, despite the fact that culture is still the gold standard for conclusive salmonella diagnosis. This is because it takes longer to isolate the organism and requires fewer resources [10]. Rising Widal test "O" and "H" antigen titers have diagnostic value. Anaemia, an increased ESR, thrombocytopenia, reactive lymphocytosis, an increased PT, an increased APTT, and a lowered fibrinogen level are frequently non-specific data. Leukopenia is considered a key feature of Enteric fever, but studies have shown it to be present in only 20-25% of cases. The aim of the present study was to determine specific hematological changes in Typhoid fever [11].

2. Material and methods

At the Medical College and its affiliated hospital, the current case control study was carried out. There were 300 individuals overall, 300 of each gender, who had a typhoid fever clinical diagnosis. 150 patients were chosen as the case group and 150 as the control group out of the total.

The patients' ages ranged from 18 to 70. Patient's detailed history was examined including age, sex, socioeconomic status, clinical examination, hematological and biochemical changes examined in all patients. Previous history regarding liver failure, blood disorder, and renal disease were taken from all the patients through a questionnaire. The patients were explained in detail about the study and the consent letter was signed prior to the inclusion in the study.

Clinically suspected cases of typhoid fever with signs including a 1-2 week protracted fever, stomach pain, rose spots, and hepatosplenomegaly are included.

Patients with other common causes of fever, such as dengue, malaria, etc., are excluded. Patients who had begun taking antibiotics before coming to our hospital were not included. Patients with history of liver disease, renal disease, haematological diseases, immunocompromised condition (drugs/HIV), malaria, or any other serious systemic sickness were disqualified.

2.1. Sample Collection

Blood samples were taken and analysed in a medical hospital for various haematological parameters as well as the Widal test in 300 patients with clinical suspicion of typhoid fever. Using an antecubital vein and a disposable plastic syringe and needle, whole blood samples were taken with the least amount of stasis possible and placed into 5 ml EDTA and plain containers.

To guarantee anticoagulation and avoid cell lysis, each sample was then carefully and completely combined. Complete blood counts were performed on EDTA anticoagulated samples while Widal assays were performed on serum samples. On the basis of the Widal test, suspected patients have been diagnosed with typhoid fever. In each case, a peripheral blood smear stained with Leishman's solution was made and examined to determine the general blood image and presence of Plasmodium species. Serum from the sample was isolated and placed in a simple container for the Widal test. *Salmonella typhi* O and H agglutination titres >1:80 and >1:160 were deemed significant and were counted as Widal positive cases in the study. Where

findings were available, blood cultures were documented. To check the significance of association, chi-square test was used.

3. Results

The case control research that informs this analysis. 300 people participated in this study, 150 of whom tested positive for typhoid fever (the case group) and 150 of whom were healthy individuals who tested negative for the disease. Patients in the case group ranged in age from (MeanSD) 35.77 to 18.25 years. Blood haematological tests (including those for haemoglobin, total leukocyte count, platelet count, and typhoid fever antibody) were used to examine each of them. Using SPSS software version 16 (SPSS Inc., Chicago, IL, USA), demographic factors, clinical data, and laboratory parameter details were recorded and analysed. They have the following effects.

The information gathered led researchers to the conclusion that the subjects in both groups shared the same demographic characteristics. We learn from the case group that 64% of the patients were men, which means that men were two times more likely to contract typhoid fever. Additionally, people who have typhoid fever belong to the poor and middle classes. According to our study, typhoid fever affects uneducated people more than educated ones.

The outcome reveals that none of the patients in the control group had any clinical symptoms, while in the case group, the clinical signs and symptoms were as follows. Nearly all patients had a fever as their primary presenting symptom. In around one-third of cases, anorexia and abdominal pain were also observed. The least common symptoms were headache and diarrhoea. In patients who tested positive for typhoid, anaemia was present in 32% of cases, leukocytosis predominated over leukopenia, and thrombocytopenia affected roughly 24% of cases, which was significantly higher than the control group's rate.

Table 1. Comparison of the various hematological parameters in both case and control groups

Blood test	Case group (n = 150)		Control group (n = 150)	
	No. of patients	Percentage	No. of patients	Percentage
Hemoglobin	48	32	15	10
WBC count >11000 cell/mm ³	12	8	9	6
WBC count <4000 cell/mm ³	33	22	6	4
Thryombocytopenia <1.5 lac	36	24	3	2

4. Discussion

Salmonella typhi is still a significant issue in developing nations. In tropical nations, it is still one of the main causes of morbidity and mortality, particularly in children. Food, drink, or water that was tainted allowed the bacilli to spread. The most common cause of typhoid fever is poor personal cleanliness. It is common in areas with inadequate sanitation, but especially in areas where there is a chance that human excreta would contaminate the water supply. It is a systemic infection that manifests itself in various ways. Fever, mild bradycardia, diarrhoea or constipation, and abdominal pain are typical presenting symptoms [12,13].

In India, enteric fever has a high death and morbidity rate. Clinical suspicion is used to make the diagnosis of enteric fever, and laboratory testing are used to confirm it. With good care, enteric fever is a short-term febrile disease with few sequelae and a 0.2% risk of fatality. Typhoid fever's patho-physiology consists of various stages. The reticuloendothelial system will exhibit widespread macrophage proliferation during the asymptomatic incubation phase of 7–14 days. Progressive temperature rise with bacteremia throughout the first week of clinical illness. Rose spots, abdominal pain, and splenomegaly in the second week. Complications in the third week include perforation, haemorrhage, pneumonia, and encephalopathy [14,15].

Clinical suspicion is used to make the diagnosis of enteric fever, and laboratory testing are used to confirm it. In the current investigation, positive instances of enteric fever were frequently detected in young adults, which is consistent with the Wasfy et al. study [16]. Enteric fever is a short-term febrile illness with minimal sequelae and a 0.2% chance of mortality with good treatment. Males are more affected than females in our study group. Other research have confirmed this as well [3].

Anaemia, leucopenia, leukocytosis, thrombocytopenia, and occasionally pancytopenia are among the haematological abnormalities that frequently occur in typhoid fever. Haematological alterations are thought to be caused in part by hemophagocytosis and inhibition of the bone marrow. Most patients' haemoglobin is normal in the early stages of the illness, but it drops slowly, which is why varied findings are shown in different research. In line with the findings of Ahmed et al. (38%) and Alam (31%), 32% of the patients in our research exhibited anaemia [17].

It is nevertheless less than what Joseph et al. (77.8%) and Rasoolinejad et al. (79.4%) reported. Most of the patients' leukocyte counts were normal, which is consistent with past observations. According to reports, leucopenia is a typical haematological finding in typhoid fever. In our study, leucopenia was seen in 22% of cases, whereas Ahmet et al. and Rasoolinejad et al. found it to occur in 18% and 11.2% of cases, respectively. 40% of cases had thrombocytopenia, which is more than the 10% and 9.1% reported by other researchers [18].

There aren't any known research in our region on the haematological characteristics of typhoid fever patients. 20% of patients had leucopenia, according to Akgun et al. In their investigation on children, Yaramis A et al. observed leucopenia in 18% of cases and thrombocytopenia in 10% [19].

In 78% of the cases, they reported a left shift. In most cases, the leukocyte count is not fewer than 2500/mm³, and severe leucopenia (less than 2000/mm³) is extremely uncommon. In the first 10 days of illness and in cases of haemorrhage, leukocytosis is frequently observed in youngsters. In their study, P K Yap and C T Chua found that 13% of cases had anaemia, 16% had leucopenia, and 32% had thrombocytopenia [20].

5. Conclusion

Our research led us to the conclusion that men get typhoid fever more frequently than women. And this can be explained by the fact that male subjects exhibit higher levels of the predisposing factors that lead to typhoid fever; this is likely due to their occupational and social practises, which tend to give male subjects greater immunity to this infection than do female subjects. Typhoid fever also tends to infect those who are uneducated and of poor socioeconomic position. The most frequent initial symptom is fever, though gastrointestinal problems might occasionally appear. Significant haematological alterations occur in people with typhoid fever.

Author Contributions: All authors contributed equally to the writing of this paper. All authors read and approved the final manuscript.

Conflicts of Interest: The authors declare that they do not have any conflict of interests.

References

- [1] Amicizia, D., Micale, R. T., Pennati, B. M., Zangrillo, F., Iovine, M., Lecini, E., ... & Panatto, D. (2019). Burden of typhoid fever and cholera: similarities and differences. Prevention strategies for European travelers to endemic/epidemic areas. *Journal of preventive medicine and hygiene*, 60(4), E271.
- [2] Nuzhat, S. N. (2016). Prevalence and patterns of antimicrobial resistance in salmonella enterica serovar Typhi and Salmonella enterica serovar Paratyphi, Bangladesh (Doctoral dissertation, BRAC University).
- [3] Azim, A. M. Hematological Changes in Typhoid Fever.
- [4] Uplaonkar, S. V., Kauser, S. H., & Tengli, M. B. (2017). Haematological profile in typhoid fever. *Indian J Pathol Oncol*, 4(2), 263-265.
- [5] Goldstein, E. J., & Abrahamian, F. M. (2016). Diseases transmitted by cats. *Infections of Leisure*, 133-150.
- [6] Patel, S., & Metgud, R. (2015). Estimation of salivary lactate dehydrogenase in oral leukoplakia and oral squamous cell carcinoma: a biochemical study. *Journal of cancer research and therapeutics*, 11(1), 119-123.
- [7] Begum, Z. (2008). Comparison among the different diagnostic procedures for early & rapid diagnosis of typhoid fever (Doctoral dissertation, M. Phil thesis).
- [8] Barrow, P. A., & Methner, U. (Eds.). (2013). Salmonella infections. 337.
- [9] Gasem, M. H., Dolmans, W., Keuter, M. M., & Djokomoeljanto, R. R. (2001). Poor food hygiene and housing as risk factors for typhoid fever in Semarang, Indonesia. *Tropical Medicine & International Health*, 6(6), 484-490.
- [10] Edelman, R., & Levine, M. M. (1986). Summary of an international workshop on typhoid fever. *Reviews of infectious diseases*, 8(3), 329-349.
- [11] Kumar, V., Angurana, S. K., Baranwal, A. K., & Nallasamy, K. (2022). 1. Nasotracheal vs Orotracheal Intubation and Post-extubation Airway Obstruction in Critically Ill Children: An Open-label Randomized Controlled Trial (Conference Abstract ID: ABS0001). *Indian Journal of Critical Care Medicine*, 26(S1).

- [12] Mukhopadhyay, B., Sur, D., Gupta, S. S., & Ganguly, N. K. (2019). Typhoid fever: Control & challenges in India. *The Indian journal of medical research*, 150(5), 437.
- [13] Cunha Neves, J. A., Roseira, J., & Queirós, P. (2022). Severe Hemorrhagic Enteropathy Secondary to Salmonella typhi. *GE-Portuguese Journal of Gastroenterology*, 29(4), 296-298.
- [14] Wijedoru, L., Mallett, S., & Parry, C. M. (2017). Rapid diagnostic tests for typhoid and paratyphoid (enteric) fever. *Cochrane Database of Systematic Reviews*, (5).
- [15] Maitra, S., Hazra, K., & Roy, S. (2022). Variable Presentations of Enteric Fever, beyond Fever and Pain Abdomen: A Case Series. *Journal of Clinical & Diagnostic Research*, 16(12).
- [16] Parry, C. M., Wijedoru, L., Arjyal, A., & Baker, S. (2011). The utility of diagnostic tests for enteric fever in endemic locations. *Expert review of anti-infective therapy*, 9(6), 711-725.
- [17] Levine, A. B., & Erkan, D. (2011). Clinical assessment and management of cytopenias in lupus patients. *Current rheumatology reports*, 13, 291-299.
- [18] Ahmed, A. E., Ali, Y. Z., Al-Suliman, A. M., Albagshi, J. M., Al Salamah, M., Elsayid, M., ... & Al-Jahdali, H. (2017). The prevalence of abnormal leukocyte count, and its predisposing factors, in patients with sickle cell disease in Saudi Arabia. *Journal of blood medicine*, 185-191.
- [19] Mallouh, A. A., & Sa'Di, A. R. (1987). White blood cells and bone marrow in typhoid fever. *The Pediatric Infectious Disease Journal*, 6(6), 527-528.
- [20] Rahman, M. M., Ahmed, A. N. U., Iqbal, M. J., Al Mamun, M. A., Hossain, N., & Islam, M. A. Haematological Profile of Enteric Fever in Children: Study in Dhaka Shishu (children) hospital, Dhaka, Bangladesh.



© 2023 by the authors; licensee PSRP, Lahore, Pakistan. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC-BY) license (<http://creativecommons.org/licenses/by/4.0/>).