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Hematological profile of children under five years with typhoid fever at Idaman Banjarbaru Hospital, Indonesia

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ABSTRACT

Introduction: Typhoid fever is a disease caused by Salmonella typhi, Salmonella paratyphi A, B, C. An estimated 200,000 people die each year from about 21.6 million people infected with typhoid fever. This study aims to determine the hematological profile in typhoid fever cases in children under five at Idaman Banjarbaru Hospital.

Methods: The research was carried out with a retrospective descriptive approach with a consecutive sampling technique. The research subjects were children under five diagnosed with typhoid fever recorded in the Idaman Banjarbaru Hospital's medical records for July 2018 to January 2019.

Results: The sample consisted of 58 patients, 32 boys, and 26 girls. Most patients were found in 12 - <36 months, namely 28 (48.28%) children. Thirty-eight (65.52%) children have a normal weight. The hematological profile showed that 46.55% of the patients had iron deficiency anemia (IDA). Hematocrit levels decreased in 51.72% of patients. Erythrocyte levels in 86.21% of patients were normal. Low MCV, low MCH, IDA were found in 46.55%, 36.21%, 46.55% of patients. Leukopenia was present in 17.24% of children. All patients had normal basophil values. Eosinopenia, band neutropenia, segmented neutropenia, lymphocytosis, monocytosis were found in 69.09%, 90.90%, 56.37%, 58.18%, 58.18% of children, respectively. Thrombocytopenia and thrombocytosis were found in the same percentage, 13.80%.

Conclusion: The haematological profile of typhoid fever patients in children under five can have different results depending on each child's body's response to S. typhi and S. paratyphi that enter the body.

Keywords: *typhoid fever, under-five children, haematological profile.*
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INTRODUCTION

Typhoid fever is a disease caused by Salmonella typhi, Salmonella paratyphi A, B, and C. This disease is commonly found in children, especially in tropical countries.[1]

It is estimated that 200,000 people die each year out of the approximately 21.6 million people infected with typhoid fever. Central Asia, South Asia, Southeast Asia, and South Africa have an incidence of > 100 cases per 100,000 population per year and are classified as countries with a high incidence of typhoid fever.[2] Although it is not consider as a deadly disease anymore, it still has high incidence, especially in rural areas as well as children and responsible for a significant percentage of non-fatal hospitalization.

Typhoid fever has a clinical picture that varies widely from mild to severe, even with complications. The study at Kotabaru Hospital showed leucocytosis in 35% of patients, leukopenia in 17% of patients, and thrombocytopenia in 13% of patients.[3] In fact, the clinical profile of typhoid fever often very similar or confused with dengue haemorrhagic fever, in which observation until the third fever-day is often required. However, studies evaluating the haematological profile of typhoid fever across age groups are not yet frequently conducted and there is still no clear guideline regarding laboratory findings.

Therefore, the aim of this study was to observe the haematological profile of children under five with typhoid fever. The results are expected to provide a local and national reference regarding laboratory findings of typhoid fever in children.

METHODS

The research was carried out with a retrospective descriptive approach with a consecutive sampling technique. The research subjects were children under five diagnosed with typhoid fever recorded in the RSD Idaman Banjarbaru's medical records for July 2018 to January 2019. The inclusion criteria were children under five with typhoid fever and had a complete blood count, Widal or IgM Salmonella typhy (Tubex test). The exclusion criteria were incomplete data from laboratory tests on medical records. All data were analyzed descriptively. Nutritional status is assessed based on body weight-for-age, divided into normal-weight and under-weight.[4] In this study, normal-weight if the z-score of -2 SD to +1 SD. The Under-weight if the z-score -3 SD < z <-2 SD.

This study has obtained ethical clearance from the Research Ethics Commission of Medical Faculty of University of Lambung Mangkurtat No. 502/KEPK-FK ULM/EC/I/2021.

RESULTS

There were 58 children under five diagnosed with typhoid fever in this study, 32 males and 26 females. The mean age of subjects was 30.50±16.30 months with age group 12–36-month-old comprised the largest part of the total subjects. In our observation, only 34.48% of subjects had under-weight. Patient characteristics can be seen in Table 1.

Regarding the haematological profile, we found a significant portion of subjects having haematological value under the reference values (Table 2). 46.55% of subjects were diagnosed as having anaemia according to haemoglobin measurement and 51.72% were found to have low haematocrit level. Microcytic and hypochromic characteristics were found in 46.55% and 36.21% of subjects.

Regarding the leukocyte profiles, we found that the majority of subjects tend to have low eosinophils count (69.09%), low band neutrophils (90.91%), and segmented neutrophils (56.37%). Despite the tendency, there were also a portion of the subjects who have increased count of segmented neutrophils (38.18%). On the other hand, the lymphocyte and monocyte counts were tended to be elevated (58.18%).

Table 1. Characteristics of children under five with typhoid fever at the Idaman Banjarbaru Hospital for the period July 2018 - January 2019.

Characteristics (n=58)	Sum (n)	(%)
Age (Months)		
6 - <12	8	13.79%
12 - <36	28	48.28%
36 - <60	22	37.93%
Mean±SD	30.50±16.30	
Gender		
Male	32	55.17%
Female	26	44.83%
Nutritional status (Weight-for-age)		
Under-Weight	20	34.48%
Normal-Weight	38	65.52%

Table 2. Haematological profile of children under five with typhoid fever based on erythrocyte index.

Hematological profile	<Normal	Normal	>Normal
Hemoglobin	27 (46.55%)	31 (53.45%)	-
Hematocrit	30 (51.72%)	28 (48.28%)	0 (0.00%)
RBC	7 (12.07%)	50 (86.21%)	1 (1.72%)
MCV	27 (46.55%)	31(53.45%)	0 (0.00%)
MCH	21 (36.21%)	36 (62.07%)	1 (1.72%)
MCHC	1 (1.72%)	56 (96.56%)	1(1.72%)
RDW	0 (0.00%)	23 (85.19%)	4 (14.81%)
Mentzer Index	0 (0.00%)	-	27 (100.0%)
RDW Index	3 (11.11%)	-	24 (88.89%)

Footnote :
RBC=Red Blood Cell; MCV=Mean Corpuscular Volume; MCH=Mean Corpuscular Haemoglobin; MCHC=Mean Corpuscular Haemoglobin Concentration; RDW=Red cell Distribution Width.

Table 3. Haematological profile of children under five with typhoid fever based on leukocytes and leukocyte count.

Hematological profile	<Normal	Normal	>Normal
Leukocyte	10 (17,24%)	41 (70,69%)	7 (12,07%)
Basophils	0 (0,00%)	55 (100,00%)	0 (0,00%)
Eosinophils	38 (69,09%)	15 (27,27%)	2 (3,64%)
Band Neutrophils	50 (90,91%)	5 (9,09%)	0 (0,00%)
Segmented Neutrophils	31 (56,37%)	3 (5,45%)	21 (38,18%)
Lymphocyte	19 (34,55%)	4 (7,27%)	32 (58,18%)
Monocyte	3 (5,46%)	20 (36,36%)	32 (58,18%)

DISCUSSION

Based on Table 1, most of the subjects were in 12 - <36 months age group with a percentage of 48.28%. This may be because, at that age, the children's hygiene habits are still lacking, and the children already have the habit of buying snacks at street vendors.[5] Inadequate hygienic habits were associated with higher chance of contracting carriers of bacterial enteric pathogens in families with children who had typhoid fever.[6] Salmonellae colonies on the hands of convalescent carriers are easily removed by washing hands with soap and water.[7] In contrast to Setiabudi et al.'s research, it was found that the highest percentage was found in children under five years of age with a percentage of 65.8%.[8]

Based on gender, it appears that typhoid fever was more prevalent in male children under five. This phenomenon is likely caused by the more active nature of male children compared to female and their higher tendency to snacking at street vendors.[9]

According to nutritional status, it appears that most children have normal body weight, despite considerable percentage of underweight in our sample population. Our finding was different than Ramaningrum that showed children with poor nutritional status will be at risk of suffering from typhoid fever due to decreased immune systems.[10] However, because of the high prevalence of underweights in our sample population, this portion of children could be at higher risk, similar with Ramaningrum findings.

Based on Table 2, it appeared that 27 (46.55%) children suffered from anaemia. Based on the RDW value, the Mentzer index (MCV: RBC), and the RDW index (MCV: RBCxRDW), all 27 children suffering from anemia had iron deficiency

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anemia. The Mentzer Index and RDW index are used as IDA indicators.[11] If the Mentzer index value is <13, anemia is suspected due to minor thalassemia. If the Mentzer index value is ≥13, then the anemia may be due to iron deficiency. RDW index value ≥220 indicates anemia caused by iron deficiency.[11] The results of this study are different from the research by Lestari et al., which found that out of 158 children with typhoid fever, 116 (73.4%) children had normal hemoglobin levels.[12] Low serum iron concentrations characterize anemia caused by inflammation (including typhoid fever); due to inhibited iron absorption because hepcidin degrades ferroportin, resulting in iron accumulation in intra-enterocyte cells.[13–15]

Leukopenia is also prevalent in our sample population. Leukopenia is associated with fever and disease toxicity.[1] Qamar found 78 patients (52%) had leukopenia.[16] Leukopenia occurs because patients infected with S. typhi bacteria secrete endotoxin on the germ's outer wall in the form of lipopolysaccharide to stimulate activated macrophages and phagocyte leukocytes and function to activate neutrophils. Also, leukopenia results from depression of the bone marrow by the endotoxins and endogenous mediators present.[16-18]

On the leukocyte count, all patients had normal basophil values. Eosinopenia was found in 38 (69.09%) pediatric patients. Ishaq et al. study (2020) found that 59% of typhoid fever patients experience eosinopenia.[19] Eosinophils are active primarily in the late stages of inflammation when antigen-antibody complexes are formed and have the ability to phagocytose.[20] Eosinopenia is usually associated with the presence of an acute bacterial infection that usually causes fever. The decrease of eosinophils is caused by the release of cytokines during margination that occurs in eosinophils.[19]

Band neutropenia was seen in 50 (90.90%) children and segmented neutropenia in 31 (56.37%) children. Neutropenia is caused by decreased neutrophil production, increased cell damage, bacterial and viral infections, administration of chemotherapy, and severe infections.[20] This is suits with the study of Qamar et al. (2013) and Uplaonkar, which found neutropenia in 48 (32%) typhoid fever patients.[21,22]

Lymphocytosis was found in 58.18% of children. Relative lymphocytosis followed by neutropenia during the recovery phase is considered a feature of complications of typhoid fever.[23] Monocytosis was found in 58.18% of pediatric patients. This study's results are the same as that of Qamar et al. (2013), who found monocytosis in 30.67% of typhoid fever patients.[22] Monocytes are the largest blood cells and have a function as the body's second layer of defense and can perform phagocytosis properly and include macrophages. In the blood, monocytes will go to the source of inflammation to assist the host immune response and act as mediators of antimicrobial defense. Monocytosis is usually caused by infection with viruses, bacteria, parasites, autoimmune diseases.[24]

In this study, thrombocytopenia and thrombocytosis were found in the same percentage, namely 13.80% of children. In Ahmad et al. study, they found thrombocytopenia in 127 (63,5%%) patients.[25] Thrombocytopenia is an essential marker in children presenting with typhoid fever, especially in those having severe symptoms. So, platelet count should be monitored in patients with enteric fever. Because severe thrombocytopenia can lead to multi-organ failure and can considerably lead to increased morbidity and mortality.[15]

CONCLUSION

This study showed that a significant portion of the children under five with typhoid fever might be suffered from IDA according to haematological profile. Also, leukopenia, eosinopenia, band neutropenia, segmented neutropenia, lymphocytosis, and monocytosis were also observed in the majority of the subjects. The haematological profile of typhoid fever patients in children under five can have different results depending on physiological response to S. typhi and S. paratyphi. The bacterial virulence, the patient's immune status, the previous vaccination against typhoid fever, and resistance to antibiotics are among factors that influence hematological profile changes.

CONFLICT OF INTEREST

The authors have no conflicts of interest to declare that are relevant to this article's content.

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ETHICS STATEMENT

This case report has been approved by The Ethical Committee of Medical Research, Medical Faculty, University of Lambung Mangkurat, Banjarmasin – Indonesia, No. 502/KEPK-FK ULM/EC/I/2021.

AUTHOR CONTRIBUTION

All authors contributed equally in the research process and the writing of this article

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