بِسْمِ اللّهِ الرَّحْمَنِ الرَّحِيمِ

قال الله تعالى

وَأَنْزَلَ اللَّهُ عَلَيْكَ الْكِتَابَ وَالْحِكْمَةَ وَعَلَّمَكَ مَا لَمْ تَكُنْ تَعْلَمُ وَكَانَ فَضْلُ اللَّهِ عَلَيْكَ عَظِيمًا

صدق الله العظيم

سورة النساء الآية(113)

Dedication

To my parents who supported me through my lives.

To my family and to my best friends.

To my teachers and supervisor who gave us the chance to prove my selves and opened my ways to the future careers.

To the coming generation that we hope will benefit my work.

To all the above mentioned we dedicate this research.

Acknowledgments

Praise and thanks to Allah, the almighty, who gave me health, knowledge, power and patience to carry out this work.

Special thanks to my supervisor **Dr.Sana Al.Taher**.

Greatest thanks are extended to my teachers of hematology department of sudan university of science and technology.

Finally thanks to all nice people who helped me to achieve this research.

Abstract

Malaria is major causes of morbidity and mortality in the tropical countries, effect in hematological variables as outcome. The aim of study to measure of complete blood count which included RBCs count, Hb, HCT, MCV, MCH, MCHC , WBCs count and differential, platelet count and platelet indices included PDW and MPV , also measure of reticulocyte count among patients with malaria.

This is a cross -sectional descriptive study done in Khartoum state. Fifty blood samples were collected from individual with malaria and twenty five blood samples collected from healthy individual as control drained into the sterile EDTA containers using automated hematology analyzer (sysmex KX-2IN).

The study explain that mean value of RBCs in patients with malaria was (4.1 ×1012/L ± 0.8) ,mean value of hemoglobin (11.5 × g/dl ± 2.6),mean value of HCT(36.9% ± 7.6) , mean value of MCV, MCH and MCHC(88.7 fl ± 7.5 ,27.7 pg ± 3.4 and 31.1 % ± 2.0) respectively, mean value of reticulocyte count (1.48 % ± 0.55), also explain mean value of WBCs (6.69×109 /L ± 3.9)and differential (neutrophil 4.0×109 /L ± 2.7 ,lymphocyte 2.1×109 /L ±1.9, monocyte 0.5×109 /L ±0.32 and eosinophil 0.15×109 /L ± 0.08). And explain mean value of platelet count (137 ×109 /L ± 97) and platelet indices (PDW 14.1 ± 3.6, MPV 10.1± 1.4) . The study explain the main type of anemia in patients with malaria was normocytic normochromic anemia.

The study done in male (68%) than female(32%) and most of them in age group 26 to 39 years.

The study reveled that , there was no change in (MCV, MCH , MCHC , reticulocyte count ,WBCs and differential , but they were decreased significantly in (RBCs, Hb, HCT and PLT count) and increased significantly in platelet indices (MPV and PDW).

ملخص الدراسه

هذه دراسه مقطعية وصفية اجريت فى ولايه الخرطوم لقياس تعداد الدم الكلى و كريات الدم الحمراء ومؤشراتها, HCT, يشمل الهيموغلوبين (MCV, MCH , MCHC) و كريات الدم البيضاء والتفضليه Neutrophil ,Lymphocyte) Monocyte , eosinophil) وتعداد الصفائح الدمويه كذلك شملت قياس تعداد الشبكيات ومؤشرات الصفائح الدمويه (PDW,MPV) فى المرض الذين يعانون من الملاريا .

بعد التاكد من الاصابه بالملاريا عن طريق عمل مسحه الدم والاى سيتى تم تجميع خمسون عينه فى وعاء مانع للتجلط يحتوى على ماده EDTA وايضا تجميع خمسه وعشرون عينه من اشخاص اصحاء . وقد بينت الدراسه ان متوسط قيم الهيموقلوبين (HCT و 0.8 ± L/كريات الدم الحمراء (4.1 × 10^{12}, 11.5) g/dl ± 2. (6 ومؤشرات كريات الدم الحمراء (MCV, MCH and MCHC)(5. 36.9% ± 7.6) (88.7 fl ± 7,

على التوالى , ,تعداد الشبكيات (1.48 % ± 2.5 ± % 31.1 and 3.4 pg ± 27.7 والتفضليه (3.9 ± L/ 0.55), كريات الدم البيضاء (6.69× 10^9) Neutrophil 4.0 × 10^9/L ±2.7 , Lymphocyte

2.1× 10^9/L ±1.9 , Monocyte 0.5× 10^9/L ±0.32 , Eosinophil 0.15× 10^9/L ± 0.08)

ومؤشرات الصفائح الدمويه (137× L/ والصفائح الدمويه (97 ± 10^9 PDW(14.1 ± 3.6) , MPV

وبينت الدراسه ان اكثر انواع الانيميا بين المرضى الذين يعنانون من (1.4 ±10.1) الملاريا هى (الانيميا السوى الصباغ السوى الكريات (normocytic normochromic anemia).

أجريت هذه الدراسه فى 68% من الذكور و 32% من الإناث وكان معظمهم فى الفئة العمرية من 26-39 سنه.

وخلصت الدراسه بانه لاتوجد تغيرات فى مؤشرات كريات الدم الحمراء , تعداد الشبكيات , كريات الدم البيضاء والتفضليه . وايضا وجدت انخفاض ملحوظ فى تعداد الهيموقلوبين, كريات الدم الحمراء , HCT وتعداد الصفائح الدمويه وزياده ملحوظه فى مؤشرات الصفائح الدموئه (PDW, MPV) .

Contents

Subject	Page
الاية	I
Dedication	II
Acknowledgment	III
Abstract (English)	IV
Abstract (Arabic)	V
List of contents	VI
List of tables	XI
List of figures	XII
List of abbreviation	XIII
Chapter one	1
1.0 Introduction and Literature review	1
1.1 Introduction	1
1.1.1 Blood constituents and functions	1
1.1.2 Haemopoiesis	2
1.1.3 Erythropoiesis	4
1.1.3.1 The Erythrocyte (Red Blood Cell)	5
1.1.3.2 Haemoglobin structure and function	5
1.1.4 Anaemia	6
1.1.4.1 Classification of anaemia	7
1.1.4.1.1 Morphologic Approach	7
1.1.4.1.2 Pathophysiologic (Functional or Kinetic) Approach	8

1.1.4.2 Symptoms and sings of anemia	9
1.1.4.3 Laboratory finding of anaemia	9
1.1.5 Complete blood count (CBC)	10
1.1.6 Reticulocyte count	10
1.1.7 Leukocytes (White blood cells)	11
1.1.7.1 Granulopoiesis	11
1.1.7.1.1Neutrophil (polymorph)	13
1.1.7.1.2 Eosinophils	14
1.1.7.1.3 Basophils	14
1.1.7.2 Monocytes	15
1.1.7.3 Lymphocytes	15
1.1.7.3.1 T. Lymphocyte	15
1.1.7.3.2 B.Lymphocyte	16
1.1.8 Thrombocyte (Platelets)	16
1.1.8.1 Platelet production	16
1.1.8.2 Platelet structure	17
1.1.8.3Platelets Indices	18
1.1.9 Thrombocytopenia	19
1.1.10 Malaria	20
1.1.10.1 Clinical feature of malaria	21
1.1.10.2 Life cycle of Plasmodium	21
1.1.10.3 Complication of malaria	22
1.1.10.4 The diagnosis of malaria	25
1.2 Literature review	26
1.3 Rational	30

1.4 Objectives	31
1.4.1 General objective	31
1.4.2 Specific objective	31
Chapter two	32
2.0 Material and Methods	32
2.1 Study design	32
2.2 Study population	32
2.2.1 Inclusion criteria	32
2.2.1 Exclusion criteria	32
2.3 Data collection	32
2.4 Sample collection	32
2.5Ethical considerations	33
2.6Laboratory requirements	33
2.7Methods	33
2.7.1Complete blood count (CBC)	33
2.7.1.1Principle of sysmex	33
2.7.1.2 procedure	34
2.8 Platelets (PLTS) analysis	35
2. 8.1platelets Indices	36
2.8.1.1 PDW (Platelet distribution width)	36
2.8.1.2 MPV (Mean platelet volume)	36
2.8.1.3 Normal Values of Platelet Indices	37
2.9 Thin blood film	37
2.9.1 Preparation of thin film	37
2.9.2 Staining film	37

2.9.3 Examination blood film	38
2.10 Reticulocyte count	38
2.10.1 Principle	38
2.10.2 Procedure	38
2.10.3 Calculation	39
2.11 Statistical analysis	39
Chapter three	40
Results	40
Chapter four	50
Discussion, Conclusion and Recommendation	50
4.1 Discussion	50
4.2 Conclusion	51
4.3 Recommendation	52

References and Appendices	55
References	55
Appendix (1)	57
Appendix (2)	58
Appendix (3)	60

List of Tables

Table	Title	Page
(2.1)	Normal range of platelet Indices (PDW and MPV)	37
(3.1)	The mean value of RBCs count , hemoglobin , hematocrit , red cells indices and reticulocyte count of patients with malaria parasite and control	41
(3.2)	The mean value of WBCs count and differential (Neutrophil, Lymphocyte, Monocyte , Eosinophil)of patients with malaria parasite and control	42
(3.3)	The mean value of PLT count and platelet indices (PDW and MPV) of patients with malaria parasite and control	43

List of Figures

Figures	Title	Page
(1.1)	Diagrammatic representation of the bone marrow pluripotent stem cell and the cell lines that arise from it	3
(3.1)	Show RBCs morphology in patients with malaria	45
(3.2)	Show neutrophilia in patients with malaria	46
(3.3)	Show lymphopenia in patients with malaria	47
(3.4)	Show monocytosis in patients with malaria	48
(3.5)	Show the age group 26 to 39 more effected with malaria parasite than lowest than 25 and highest than 40	49

Abbreviations

ADP	Adenosine Diphosphate
AGM	Aorta Gonads Mesonephros
ATP	Adenosine Triphosphate
BFU_E	Burst Forming Unit Erythroid
CBC	Complete Blood Count
CFU_{CEMM}	Colony Forming Unit Granulocyte, Erythroid, Monocyte and Megakaryocyte
CFU_E	Colony Forming Unit Erythroid
CO_2	Carbon Dioxide
Da	Dalton
DNA	Deoxyribonucleic Acid
EDTA	Ethylene Diamine Tetra Acidic Acid
G-CSF	Granulocyte - Colony Stimulating Factor
GM-CSF	Granulocyte Macrophage - Colony Stimulating Factor
Hb	Hemoglobin
HCT	Hematocrit
ICT	Immuno Chromatographic Test
Ig	Immunoglobulin
IL	Interleukin
MCV	Mean Corpuscular Volume
MCH	Mean Corpuscular Hemoglobin
MCHC	Mean Corpuscular Hemoglobin Concentration
MCSF	Monocyte Colony Stimulating Factor
MPV	Mean Platelet Volume

NADH	Nicotinamide Adenine Nucleotide Phosphate
NADPH	Nicotinamide Adenine Dinucleotide Phosphate
PCR	Polymerase Chain Reaction
PCT	Platelet Crit
PCV	Packed Cell Volume
PDGF	Platelet Derived Growth Factor
PDW	Platelet Distribution Width
PLT	Platelet
RBCs	Red Blood Cells
RDW	Red cell Distribution Width
RNA	Ribonucleic acid
SPSS	Statistical Package for Social Science
WBCs	Withe Blood Cells
WHO	World Health Organization
vWF	von Willebrand Factor