

Dedication

This study is dedicated to my Father's spirit, Mother, Brothers, and Sisters for their continuous support and encouragements throughout the study.

To my small family, my wife and my daughters (Sara & Raneem) for their patience and support they offered to me to complete this work.

Acknowledgements

I would like to declare my acknowledgements and thankfulness to my supervisor prof. Babiker Ahmad Mohammad for his guidance, and keen supervision during conduction of this study. His valuable comment, advice and continuous encouraging for make this research possible.

Also I would like to express my gratitude and appreciation to Dr Mohoamod Mohamed Elgari, Dr Abozer Yousif Elderderly and Mr. Salaheldein Elzaki for their help and constructive advices without which I could not have accomplished my research.

My thanks also extended to Mr. Hassen Abdalla Abdalrahim, Mr. Abdelshaafea Abaker Hassan, Mr. Alsadig Idriss Ahmed, Ms. Abeer Adam Ahmad, Ms. Houida Mohammed Saleh and Ms. Manasik Ali Abd Allah for their help in collecting and analyzing samples of this research. My best regards and thanks to the member staff of Haematology Department (SUST), Alneelain University- Faculty of Medicine, Medical Research Centre, Khartoum and Tropical Medicine Research Institute, Alafia medical complex and El Fasher University for their co-operation and acceptance to do the research there.

I am deeply indebted to the blood donors (participants).My appreciations to all those who helped me to realize the importance of this research.

Abstract:

The study is a community based study that aimed to determine the prevalence of haemoglobinopathies. It conducted in Northern Darfur State tribes, during the period from July 2012 to August 2015. Following informed consent, a total of six hundred and sixty six individuals enrolled in the study, with mean age 21.7 ± 18.3 years for female and 20.9 ± 15.4 years for males. There were 369 (55%) females and 297 (45%) males. Most of the Northern Darfur tribes were included; the highest frequency was among Fur and Zagawa tribes. 5 mls venous blood samples were collected from each individual, Blood sample was collected in EDTA containers. In each specimen two tests were performed complete blood count and capillary zone electrophoresis and then haplotypes for the HbSS samples.

The results of mean hematological parameters was found within the normal range, the mean haemoglobin concentration was 12.6 ± 2.19 g/dl, PCV 38.5%, RBCs count $4.7 \pm 0.8 \times 10^{12}/L$, MCV 84.9 fl, MCH 27.9 pg, MCHC 32.8 g, TWBCs $6.9 \pm 2.2 \times 10^3/\mu L$ and the mean Plts count was $265 \pm 84 \times 10^3/\mu L$. While the mean Hb in AS individuals was 11.8 g/dl, in Hb SS individuals 6.95 g/dl and in Hb AD individuals was 12.4 g/dl.

Four variants of Hb were detected; these were Hb AA (86.94), Hb AS (10.51%), Hb SS (1.95%) and Hb AD (0.6%). Hb AA (adult Hb or normal Hb) was predominant. Hb AS and Hb SS had a higher frequency than other abnormal Hb.

The homozygous form of HbSS was found in four tribes, with higher frequency in Housa tribe 10.26 % and lower frequency in Zagawa tribe 1.74%. While the heterozygous form (HbAS) was found in many tribes of Northern Darfur state, the high frequency was in Keneen tribe 30.7% and the lower frequency in the Tongour tribe 5.4%. In contrast, HbS was not found in other tribes.

The heterozygous form HbAD (a new Hb variant was apparent in Northern Darfur, in addition to the known abnormal Hb), was found only in four ethnic groups of Northern Darfur, Gemer, Ziadya, Bartey and Zagawa tribes at 33.3%, 4.2%, 1.4 and 0.8% respectively.

Haplotypes could be assigned unequivocally to thirteen patients; four of the five typical β^s globin haplotypes were identified. The most frequent was the Cameroon (84.6%) followed by the Benin (53.8%), the Bantu (46.2%) and the Senegal (15.4%). The Indian – Arab haplotypes was not detected.

In conclusion, the mean hematological parameters were found within normal range among the study population, and the prevalence of haemoglobinopathies in this study was 13.06%, with Hb S most common among patients with abnormal Hb. A new Hb variant is apparent in Northern Darfur (Hb AD). Four African haplotypes were identified.

المستخلص

هذه دراسة وصفية، تحليلية أجريت في قبائل ولاية شمال دارفور هدفت لتحديد نسب تردد جين اعتلالات الهيموقلوبين في هذه القبائل . استمرت الدراسة من يوليو 2012 الى سبتمبر 2015 . هدفت الدراسة لتكوين قاعدة معلومات لمعرفة مدى انتشار جين اعتلالات الهيموقلوبين في هذه الولاية. أخذت الموافقة من الأشخاص الذين سحب منهم الدم و قد تم أحاطتهم بأهداف البحث . تم اختيار ستمائه ستة وستون شخص بطريقة عشوائية من معظم قبائل الولاية، 297 (45%) من الذكور و369 (55%) من الاناث ، متوسط اعمارهم 21 ± 18.3 سنة .كانت قبيلة الفور والزغاوة هي الاكثر تردداً بين القبائل. تم تجميع العينات في وعاء سعة 5 مل يحتوى على مادة مانعة لتجلط الدم. تم فحص جميع العينات لمعرفة الرحلان الكهربائي للهيموقلوبين وعمل صورة الدم الكامله (قياس تركيز خضاب الدم ،تعداد كريات الدم الحمراء ،البيضاء والصفائح الدموية) وبعد ذلك تم تحليل العينات التي تحمل الجين SS لتحديد انماطها. النتائج التي تحصلت هي نتيجة الصورة الكامله للدم كان متوسط تركيز خضاب الدم 2.19 ± 12.6 غرام لكل 100 مل، متوسط تعداد كريات الدم الحمراء 0.8 ± 4.7 مليون لكل ملتر مكعب، متوسط حجم كرية الدم الحمراء 84.9 فمتوليتز، متوسط تعداد كريات الدم البيضاء 6.9 ± 2.2 الف لكل ملتمتر مكعب ،و متوسط تعداد الصفائح الدموية 84 ± 265 الف لكل ملتمتر مكعب. متوسط تركيز خضاب الدم عند الاشخاص الذين لديهم HbAS هو 11.8 غرام لكل 100 مل والذين لديهم HbSS متوسط خضاب الدم عندهم 6.95 غرام لكل 100 مل اما الذين لديهم خضاب الدم AD فمتوسط تركيز خضاب الدم عندهم 12.4 غرام لكل 100 مل.

تم تحديد اربعة انواع من الهيموقلوبين وهي Hb AA (86.94%) هو الاكثر شيوعاً ويليها HbAS (10.51%) ثم HbSS (1.95) و اقلها HbAD (0.6%). هيموقلوبين SS وجد في اربعة قبائل، أعلى تردداً في قبيلة الهوسا بنسبة 10.26% و اقل تردداً في قبيلة الزغاوة بنسبة 1.74%. اما هيموقلوبين AS فقد وجد في عدة قبائل، قبيلة الكنين كانت الاكثر تردداً بنسبة 30.7%، وقبيلة التتجر الاذنى تردداً بنسبة 5.4%. على النقيض من ذلك لم توجد هذان النوعان من انواع الهيموقلوبينات المذكورة انفاً في بقية القبائل. النوع الاخير وهو هيموقلوبين AD فقد وجد في اربعة قبائل فقط وهي قبيلة القمر، الزيادة ، البرتي و قبيلة الزغاوة بنسب 33.3%، 4.2%، 1.4% و 0.8% على التوالي.

نتيجة النمط الجيني للأشخاص الذين يحملون الجين غير طبيعي (SS) أظهرت وجود أربعة أنماط من الأنماط الخمسة المعروفة في سلسلة البروتين بيتا وهي على النحو التالي: أكثرها ترددا كامبيرون (84.6%) و ثم بنين (53.8%) وتليها بانتيو(46.2%) أخيرا (15.4%) سنيغال ولم تظهر الدراسة وجود النمط الخامس وهو العربي الهندي .

خلصت الدراسة الى ان متوسط نتائج الصورة الكاملة للدم طبيعية و أن انتشار جين اعتلالات الهيموغلوبين في قبائل ولاية شمال دارفور كانت 13.06% وكان HbS هو الأكثر بين اعتلالات الهيموغلوبين ، كما أظهرت الدراسة وجود نمط جديد من الهيموغلوبين (AD) في المنطقة خلافا للأنماط المعروفة سابقا ، أيضا أظهرت الدراسة وجود أربعة أنماط أفريقية من بروتين قلوبين بيتا لدى الأشخاص الذين يحملون HbSS ولم تظهر الدراسة وجود النمط الخامس وهو العربي الهندي.

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List of Abbreviations

CAE	: Cellulose acetate electrophoresis.
CAR	: Central African Republic.
CBC	: Complete blood count
CE	: Capillary electrophoresis.
CVS	: chorionic villus sampling.
CZE	: Capillary zone electrophoresis.
DNA	: Deoxyribonucleic acid.
2, 3-DPG	: 2, 3 Diphosphoglycerate-
Hb	: Haemoglobin.
HBP	: Haemoglobinopathies
HPLC	: High performance liquid chromatography.
MCH	: Mean cell haemoglobin.
MCV	: Mean corpuscular volume.
MM	: Master mix.
MW	: Molecular weight.
PCR	: Polymerase chain reaction.
PET	: positron emission tomography.
RBC	: Red blood Cell.
RFLP	: restriction fragment length polymorphisms.
SCA	: Sickle cell anaemia.
SCD	: Sickle cell disease.
SCS	: Sickle cell syndromes.
SCT	: Sickle cell trait
S HPFH	: Sickle cell trait, with hereditary persistence of fetal

SNP : Single Nucleotide Polymorphism.

Thal : thalassemia.

Haemoglobin.

TIA : A transient ischemic attack.

WBC : white blood cell.