

THE EFFECT OF ABNORMAL HUMAN HEMOGLOBIN (HbS) ON THE BLOOD MEAL SIZE OF THE HEMATOPHAGOUS BUG *RHODNIUS PROLIXUS*

Eva Maria Curvelo de Almeida ARANDAS, Sebastião LOUREIRO and Eliane S. AZEVEDO

SUMMARY

Fifty individuals carriers of sickle cell trait (experimental group) were paired by age, race and sex to fifty other individuals whose hemoglobin was normal (control group). Each pair of experimental and control individuals was simultaneously exposed, during thirty minutes, to the kissing bug *Rhodnius prolixus*. Each pair of bugs was of similar size and had been fastened for the same length of time. The average size of the blood meal ingested was significantly larger ($p < 0.03$) in the bugs which fed on the carriers of abnormal hemoglobin S than in those which fed on their normal matched control.

INTRODUCTION

Several studies on human genetics had shown molecular variation of human hemoglobin which leads to alteration of the physical and chemical properties of the blood. Sickle hemoglobin, HbS, besides being the most frequent human hemoglobin variant, has a characteristic sickling tendency under reduced oxygen tension. The sickling of the red blood cell increases its mechanical fragility making it more prone to hemolysis^{3, 1}.

The purpose of the present paper is to investigate if human hemoglobin S has some effect on the blood meal size of the kissing bug *Rhodnius prolixus*. Both sickle cell trait and South American trypanosomiasis (Chagas' disease) are frequent in the population of Northeastern Brazil.

MATERIAL AND METHODS

Carriers of hemoglobin S and controls — The microscope-slide sickle cell test was done on patients at the Hospital Prof. Edgard

Santos, in Salvador, Bahia, Brazil. Blood was collected from a finger prick, and a daily fresh solution of $19.2 \times 10^{-2}M$ sodium bisulphite was used as the sickling reagent⁴. From those patients whose sickle cell tests were positive a venous sample of blood was collected for hemoglobin phenotyping by electrophoresis. Starch gel electrophoresis was carried out on phosphate buffer pH 8.6⁶ and the hemoglobin bands were stained with benzidine². All individuals with a positive sickle cell test were found to have hemoglobin S on electrophoresis. Fifty heterozygous, HbA/HbS, were selected for the study and will be referred to as the experimental group.

A control group also of fifty individuals, was selected based on a negative sickle cell test as the initial screening, followed by starch gel electrophoresis to exclude other abnormal hemoglobins.

Control and experimental individuals were paired by age, race and sex. Race was classified on a five point scale (white, light

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mulatto, medium mulatto, dark mulatto, and negro) according to criteria previously established⁵.

Estimation of the blood meal size — Empty round boxes closed with a piece of mesh and a rubber band were weighed on an accurate balance with approximation to the fourth decimal (weight one). A single bug *Rhodnius prolixus* was introduced in each box which then was weighed again (weight two). After the bug was permitted to feed through the mesh on the arm of a subject for thirty minutes the boxes with fed bugs were again weighed (weight three). The body weight of the bug and the size of the ingested blood meal were calculated respectively as the difference between weights one and two and two and three.

The following precautions were taken in an attempt to avoid human errors or casual distortion of the results: a) every weighing procedure was repeated twice and the average of the three values taken as the real weight; b) the experimental individual and paired control were tested simultaneously; c) for every pair of experimental and control individuals the bugs used were of similar size; d) for every pair of experimental and control individuals the bugs used had been fasted for the same length of time; e) during the thirty-minute blood meal, experimental and control individuals were instructed not to move the arm; f) in both groups the box was fixed on the central part of the forearm.

RESULTS

The plotting of the variables on a histogram did not suggest normality, thus non-parametric statistics was preferable. The matched-pairs signed-rank test of WILCOXON⁶ was used throughout the analysis.

The mean age for the experimental individuals was 42,00 years and for the controls 41,40 years. The difference is not significant ($p = .40$).

The mean weights for the bugs used as the experimental group was 29,66 mg, and of those used for the control group was 26,84 mg. The difference is not significant ($p > 0.09$).

The average blood meal size was 207,27 mg when the human blood had only normal hemoglobin (HbA/HbA) and 246,85 mg when the human blood had hemoglobin S (HbA/HbS). The difference is significant ($p < 0.03$).

DISCUSSION

The association between human hemoglobin S and a larger blood meal size by the *Rhodnius prolixus* is probably related to some characteristic of the blood containing hemoglobin S. However, the results of these experiments allow no conclusion regarding the basic mechanism for the association, nor do they indicate that the larger blood meal makes the carriers of hemoglobin S more exposed to South American trypanosomiasis. Nevertheless, a speculative hypothesis to investigate is to assess if the higher frequency of negroes among the necropsy cases of South American trypanosomiasis⁷ is related to the fact that hemoglobin S has also a higher frequency among the negro. Undoubtedly, further investigations on the subject are highly desirable.

RESUMO

Efeito da hemoglobina humana (HbS) na quantidade de sangue ingerida pelo hematófago Rhodnius prolixus

Cinquenta indivíduos portadores do traço da falcemia (grupo experimental) foram pareados por idade, raça e sexo a cinquenta portadores de hemoglobina normal (grupo controle). Cada par, isto é, indivíduo do grupo experimental e o seu controle, era, simultaneamente, durante trinta minutos, exposto à sucção pelo barbeiro *Rhodnius prolixus*. Os barbeiros, para cada par, tinham tamanho semelhante e estavam sem alimentação por períodos idênticos. A quantidade média de sangue ingerida pelos barbeiros que sugaram indivíduos portadores de hemoglobina S, foi significativamente maior ($p < 0,03$) que naqueles que tinham hemoglobina normal.

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