

DETECTION AND IDENTIFICATION OF HAEMOGLOBIN VARIANTS: EXPERIENCE WITH A POINT OF CARE TEST - GAZELLE

Lília Fernandes¹, Filomena Seuanes¹, Cristina Vieira¹, Sílvia Martins¹, Luzia Samuel², Marta Chico², Alcina Costa¹, Armandina Miranda¹

¹Department of Health Promotion and NCD Prevention, Instituto Nacional de Saúde Doutor Ricardo Jorge (INSA, IP), Lisbon, Portugal

²Instituto Nacional de Investigação em Saúde (INIS), Luanda, Angola

1. Introduction

Sickle cell disease (SCD) is a major public health problem in Africa. Diagnostic laboratory techniques are expensive, requiring equipment that needs maintenance and trained/qualified technicians to interpret the results¹. Identification of haemoglobin (Hb) variants requires the use of at least two methods with different separation principles². The lack of rapid and reliable diagnostic methods for screening could result in many avoidable deaths in the affected population¹. This study was realised as part of the 'Força Saúde' project, which aims to strengthen the alliance between the African and Portuguese health systems through the training of human resources.

Objective: the aim of this study was to evaluate the performance of a point-of-care test (POCT) – Gazelle, a cellulose acetate electrophoresis rapid test in the detection and identification of Hb variants, in comparison with the diagnostic methods used in the laboratory, with a view to future implementation of this equipment in African countries.

2. Material and Methods

A total of 51 tests were performed, 48 on suspected cases of haemoglobin variants and 3 on samples without haemoglobin variants.

The samples (peripheral blood in EDTA) were analyzed using the methods established in the laboratory's algorithm for screening haemoglobinopathies (Figure 1), including the Red Cell Indices, hemoglobin isoelectric focusing (IEF), high-performance liquid chromatography (HPLC) solubility test (ST) and the Gazelle equipment (Figure 2), according to the manufacturer's instructions.³

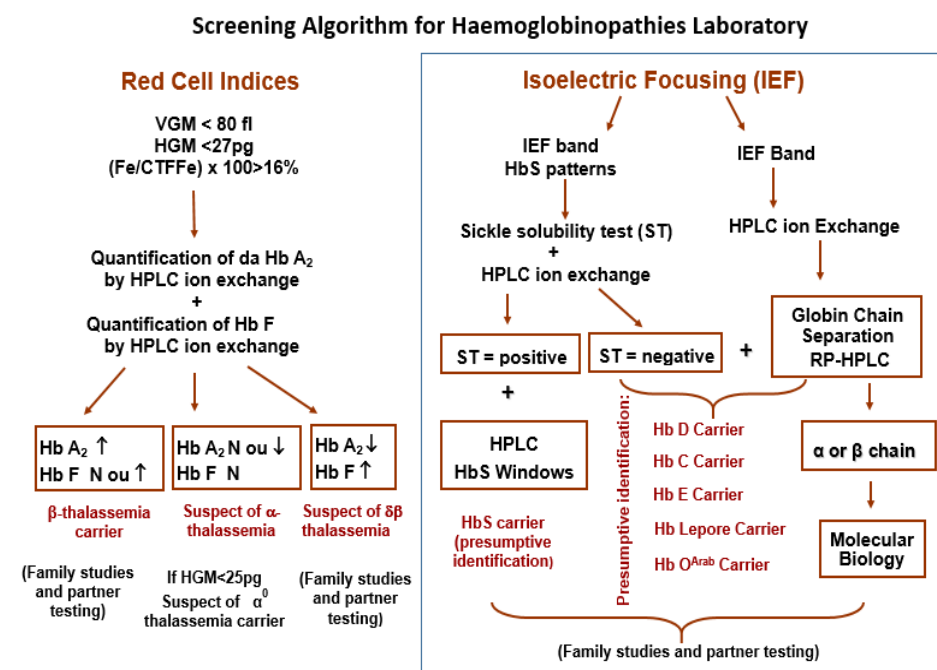


Figure 1- Screening Algorithm for Haemoglobinopathies Laboratory.

Gazelle is a point-of-care test (POCT), based in a cellulose acetate electrophoresis, rapid test to the detection and identification of Hb variants. A disposable cartridge containing a lysed blood sample is inserted into the reader, the haemoglobin types are separated according to their charge. In about 8 minutes, the interpretation (normal, trait, disease) as well as the haemoglobin types and percentages are displayed on the screen and stored digitally.



Figure 2- Gazelle equipment and display showing the HbS quantification (HbS=42%).

3. Results and Discussion

From a total of 51 cases, 48 (94.1%), were valid and 3 were considered invalid (5.9%) because they were inconclusive and were not included in the analysis.

The 48 cases with valid results represented individuals with a mean age of 32 years, of whom 33 (69%) were female and 15 (31%) male (Figure 3).

Sample distribution by gender (N,%)

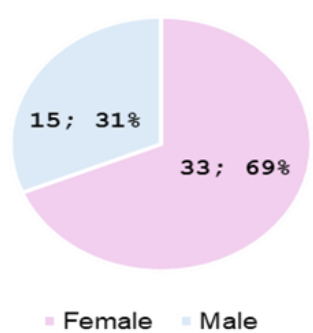


Figure 3- Sample distribution by gender.

The Gazelle test correctly identified all the cases of HbS carriers (n=10) and the SCD patients (n=4) (Table 1). The specificity was 100% for identifying SCD patients and 84.4% for identifying Hb S carriers.

The 3 (6%) normal samples for Hb variants were correctly identified (Table 1).

Table 1- Results obtained with Gazelle and their comparison with the identification obtained by other methods (screening algorithm)

Identification confirmed by other methods	N=48	Gazelle Identification	Evaluation
Normal samples for Hb variants	3	Normal	Correct
HbS trait	10	S trait (AS)	Correct
HbC trait	15	C trait (AC) or E trait (AE)	--
HbE trait	6	C or E trait	--
HbD trait	6	S trait	Not correct
Hb Lepore trait	1	Normal	Not correct
Hb variant	1	S trait (AS)	Not correct
Hb SS	1	SCD-SS	Correct
HbS/HbC	3	SCD-SC or SCD-SE	Correct
Hb EE or Hb E/β ⁰ thalassaemia	2	HbCC or HbEE	--

As expected, since the method is based on cellulose acetate electrophoresis, it failed to distinguish HbD (n=6, 13%) from HbS (n=10; 21%) and HbC (n=15; 31%) from HbE (n=6, 13%). In the last case the Gazelle system display the result as HbC or E (Figure 4).

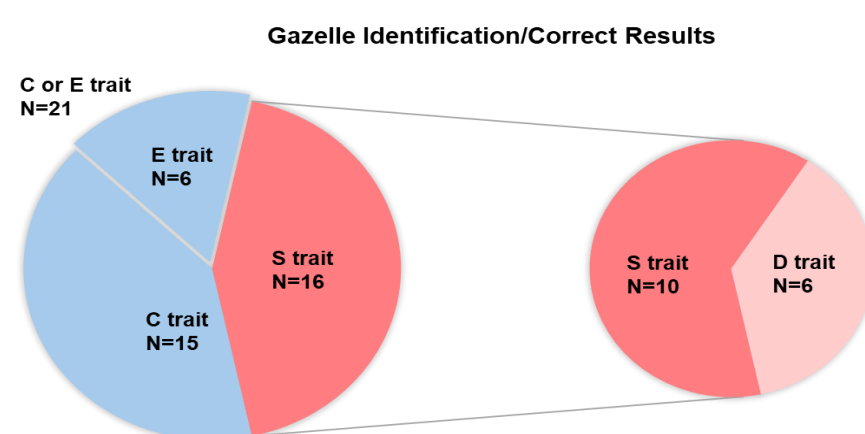


Figure 4- Gazelle system identification / correct results for HbS; HbD; HbC and HbE.

The quantification (%) of HbS obtained by HPLC (Variant II Bio-Rad) and by the Gazelle system was compared, obtaining a correlation of 0.8892 (Figure 5).

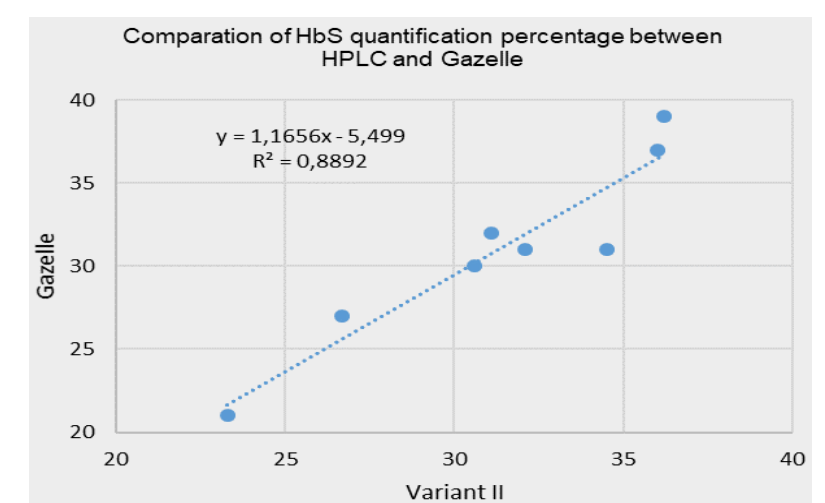


Figure 5- Comparison of HbS quantification percentage between HPLC (Variant II) and Gazelle system.

An example of a result obtained by Gazelle from a HbS carrier (35-year-old woman), whose result was confirmed by the different methods used in the screening algorithm (Figure 6).

RESULTS



INTERPRETATION
Likely sickle cell trait (AS)
Note: Transfusion can impact results

Figure 6- Result obtained by Gazelle of a HbS carrier (HbS=30% and HbA =70%).

4. Conclusion

The POCT - Gazelle demonstrated high sensitivity for the detection of Hb S and could be a potential screening tool for the rapid diagnosis of this variant in developing countries where it is highly prevalent and a serious health problem.

References

- (1) Shrivastava S, Patel M, Kumar R, Gwal A, Uikey R, Tiwari SK, et al. Evaluation of Microchip-Based Point-Of-Care Device "Gazelle" for Diagnosis of Sickle Cell Disease in India. *Front Med (Lausanne)*. 2021 Oct 13;8
- (2) Significant Haemoglobinopathies: Guidelines for screening and diagnosis. Barbara J. Bain et al. *British Journal of Haematology* (2023),201,1047-1065.
- (3) Gazelle Diagnostic Device User Manual. GZL-LBL-0004 r19. HemexDx. Navi Mumbai, India; p. 1–122.

