Utility of hemoglobin electrophoresis to detect hemoglobinopathies in adults not presenting with hematological problems

G. J. Vani Padmaja¹*, S. S. S. Quadri¹, O. Shravan Kumar¹

¹Department of Pathology, Gandhi Medical College, Secunderabad, Telangana, India
*Corresponding author email: drvanipadmaja@yahoo.co.in

Abstract

**Background:** Hemoglobinopathies are genetically acquired diseases. When present in new-born and in children they need to be treated and can be life threatening many a times. In the adults they can be asymptomatic and can manifest as disease during stress. They may present with other signs and symptoms not related to hemoglobinopathies.

**Aim:** To perform Hemoglobin (Hb) Electrophoresis to detect Hemoglobinopathies in patients not presenting with hematological problems coming to the Medical OPD at Gandhi Hospital.

**Materials and methods:** 3 ml Ethylene Diamine Tetra Acetic Acid (EDTA) whole blood was collected from cubital fossa from patients and Hb Electrophoresis was carried out on BIORAD - D10

**Results:** Hb Electrophoresis of a total of 464 patients were carried out over a period of six months (July to December 2015) and 14 cases of Sickle Cell Trait, 16 cases of Thalassemia Trait, 1 case of Hb E trait, 1 case of sickle cell disease and 1 case of sickle cell disease with low Hb A2 levels were identified.

**Conclusion:** Hemoglobinopathies can present themselves in the adults without symptoms related to red blood cell disorders. So when Patients present themselves with other symptoms and are not being relieved of their complaints by the conventional treatment, Hb Electrophoresis can help in identifying the hemoglobinopathies, especially when the Hb is normal or near normal for that age and sex of the patient.

**Key words**
Hb Electrophoresis, Hemoglobinopathies, Thalassemia, HbE, Sickle cell.
Introduction

Inherited hemoglobinopathies especially thalassemia and sickle-cell disorders are now common worldwide due to migration [1, 2]. Different types of inherited hemoglobin disorders present a significant health problem all over the world accounting 71% of 229 countries [3]. About 7% of the world’s population are carriers of hemoglobin disorders [4]. Data obtained from Sri Lanka as well as from two northwest states of India also show a noticeable variation in the frequency of beta thalassemia and Hb E [5, 6]. Weatherall and Clegg and added that at the younger age group inherited haemoglobin disorder are most commonly detected [7].

Hemoglobin electrophoresis is a blood test that can detect different types of haemoglobin. It uses the principles of gel electrophoresis to separate out the various types of haemoglobin and is a type of native gel electrophoresis. Hemoglobin is the protein inside red blood cells responsible for transporting oxygen. If it's abnormal in some way, it may cause too little oxygen to reach the tissues and organs. The most common types of normal haemoglobin in the Adults are:

- **Hemoglobin A**: (95 to 98 %) This is the most common type of haemoglobin found normally in adults. Some diseases, such as severe forms of Thalassemia, may cause haemoglobin A levels to be low and haemoglobin F levels to be high (Photo – 1).
- **Hemoglobin F (foetal haemoglobin)**: (0.8 to 2%) This type is normally found in foetuses and new born babies. Haemoglobin F is replaced by haemoglobin A (adult haemoglobin) shortly after birth; only very small amounts of haemoglobin F are made after birth. Some diseases, such as sickle cell anemia, aplastic anaemia, and leukaemia, have abnormal types of haemoglobin and higher amounts of haemoglobin F (Photo – 2).
- **Hemoglobin A2**: (2 to 3 %) This is a normal type of haemoglobin found in small amounts in adults (Photo – 3).

There are more than 350 types of abnormal haemoglobin. The most common are:

- **Hemoglobin S**: (0%) This type of haemoglobin is present in sickle cell disease. Red blood cells become hard and crescent-shaped. They block small blood vessels and prevent blood from circulating properly (Photo – 4).
- **Hemoglobin C**: (0%) This type of haemoglobin does not carry oxygen well.
- **Hemoglobin E**: (0%) This type of haemoglobin is found in people of Southeast Asian descent.
- **Hemoglobin D**: (0%) This type of haemoglobin is present in some sickle cell disorders.

Hemoglobin S and haemoglobin C are the most common types of abnormal haemoglobin that may be found by an electrophoresis test. Electrophoresis uses an electrical current to separate normal and abnormal types of haemoglobin in the blood. Haemoglobin types have different electrical charges and move at different speeds. The amount of each haemoglobin type in the current is measured. An abnormal amount of normal haemoglobin or an abnormal type of haemoglobin in the blood may mean that a disease is present. Abnormal haemoglobin types may be present without any other symptoms, may cause mild diseases that do not have symptoms, or cause diseases that can be life-threatening. For example, haemoglobin S is found in sickle cell disease, which is a serious abnormality of the blood and causes serious problems.

Materials and methods

The blood samples of 464 patients were taken over a period of 6 months (July to December 2015). All the inclusion and exclusion criteria were met with. These patients were from the Medical OPD at Gandhi Hospital, who came with complaints of some non-specific minor
ailments and not those related to hemoglobinopathies. These patients were asked to come back for review the next week on the same day to consult the same physician.

**Photo – 1:** Hb electrophoresis – Normal.

- Hemoglobin values were between 10 to 12 gm%

**Photo – 2:** Hb electrophoresis – HbF = 5.0 = Sickle anemia.

**Inclusion criteria**
- Age: between 25 to 40 years.
- Both Males and females were included.
- The patients were not treated for and did not have symptoms related to hemoglobinopathies, like anaemia, weight loss, tiredness, fatigue, pallor, jaundice, bone aches and abdominal mass or pain. (All the above were not chronic)
Exclusion criteria

- Age: below 25 and above 40 years.
- Patients with specific haematological symptoms
- Hemoglobin values below 10 gm%
Results
Evaluation of the peripheral blood smear was done for all the patients. The results of the peripheral blood smear did not reveal any abnormality, except for the patient with HbSA0 (51.0) + HbS (37.7) which showed sickle cells (Table – 1).

Table – 1: Hb pattern.

<table>
<thead>
<tr>
<th>Elevated window</th>
<th>Interpretation</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal Pattern</td>
<td></td>
<td>431 (204 Females)</td>
</tr>
<tr>
<td>Hb S</td>
<td>Sickle cell Trait</td>
<td>014 (09 Females)</td>
</tr>
<tr>
<td>Hb A2</td>
<td>Thalassemia Trait</td>
<td>016 (10) females</td>
</tr>
<tr>
<td>Hb A2 (28.6)</td>
<td>Hb E Trait</td>
<td>001 (01 Female)</td>
</tr>
<tr>
<td>HbF (5.0)</td>
<td>Sickle Thalassemia</td>
<td>001 (Male)</td>
</tr>
<tr>
<td>HbA0 (51.1) + HbS (37.7)</td>
<td>Sickle Cell Disease</td>
<td>001 (Female)</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>464 (225 Females)</td>
</tr>
</tbody>
</table>

Discussion
Hemoglobinopathies can present themselves in the adults without symptoms related to red blood cell disorders. They can be a cause for constant feeling of not being well, and hence may affect the quality of life. They may manifest as other problems which need to be addressed to. Many a times a retinue complete blood picture (CBP) may not reveal the exact morphology needed to identify the hemoglobinopathy, hence the need to perform Hb electrophoresis in such cases. Sometimes the CBP may show microcytes or crenated Red Blood cells, which may not correlate with the patients complaints. There may not be any evidence of hemolyisis to suspect a hemoglobinopathy, hence the need to do Hb electrophoresis is such patients.

Higher-than-normal amounts of both hemoglobin A2 and haemoglobin F may mean a mild form of thalassemia is present. A very low level of hemoglobin A and a high level of hemoglobin F may mean a more severe form of thalassemia. High levels of hemoglobin F may be seen in a rare condition called hereditary persistence of fetal hemoglobin.

Hemoglobin S in moderate amounts can mean that sickle cell trait is present. Hemoglobin S in high amounts means sickle cell disease.

Hemoglobin C in low amounts can mean that haemoglobin C is present. Hemoglobin C in high amounts means hemoglobin C disease, which causes anaemia and an enlarged spleen.

Hemoglobin types S and C mean hemoglobin S-C disease, which causes a mild or moderate form of sickle cell disease.

Hemoglobin E in low amounts means the presence of haemoglobin E trait. Hemoglobin E in high amounts means hemoglobin E disease, which causes anemia and smaller-than-normal red blood cells.

Conclusion
In South East Asia, inherited haemoglobin disorders are one of the most common inherited disorders and put tremendous burden to the national budget. Most of the carriers remain asymptomatic and pass relatively normal life. Through population based screening programmes, it is recommended to screen all

Healthy individuals to detect such asymptomatic carriers and to provide genetic counseling.

**Photo – 5:** Hb electrophoresis - Hb A0 = 51.1+S = 37.7 = sickle cell disease.

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References