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Methemoglobinemia: Case Report and Review of Literature

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Abstract: ***Methemoglobinemia is an elevated level of methemoglobin in the blood leading to hypoxia and cyanosis due to the decreased oxygen supply to the tissue, Compensatory erythrocytosis has been reported in patients with hereditary methemoglobinemia, because methemoglobin alters oxygen affinity of the hemoglobin molecule and induce shift to the left, there formethemoglobinemia should be put on the differential diagnosis of polycythaemia and cyanosis, especially with presence of typical brown colour of blood in test tube, that shouldraise suspicion about the diagnosis which is confirmed by direct measurement ofmethemoglobin by blood gas analysis.***

Keywords: methemoglobinemia, polycythaemia**,** blood gas analysis

1. Introduction

Absolute erythrocytosis results from increased red cell mass which includes primary and secondary polycythemia[1.] Primary polycythemia – Polycythaemia Rubra Vera (PRV) is not dependent on hypoxia. Secondary Polycythemia may be acquiredor congenital[2], if the polycythaemia is secondary to hypoxia, Congenital heart diseases are common cause of congenital cyanosis with polycythemia. Congenital methemoglobinemia is arare cause of lifelong cyanosis which may present withpolycythemia.3Methemoglobinemia is an elevated level of methemoglobin in the blood leading hypoxiaand cyanosis due to the decreased oxygen supply to the tissue. Unfortunately, this does not improve with oxygen therapy. Methemoglobin is an abnormal form of hemoglobin[4]. The core function of hemoglobin is to carry oxygen inthe red blood cells[5]; however, if the ferrous form of hemoglobin (Fe2+) becomes oxidized, it will convert to its ferric (Fe3+) form which will cause the RBC (red blood cell) to lose its ability to carry oxygen, thus forming methemoglobin[6]. Methemoglobinemia can becongenital or acquired. Acquired metHb is due to oxidative drugs when given to susceptible individuals i. e. with G6PD deficiency[7]. Methemoglobinemia is mainly diagnosed clinically and is confirmed by direct measurement of methemoglobinemia by venous or arterial blood gas analysis. A methemoglobin concentration of>3% (normal range is 0 - 3%) is the definitive diagnosis[8]. Here, we report a rare case of methemoglobinemia presented with persistent polycythemiain the absence of cardiopulmonary disease that remained unnoticed till early adulthood.

2. Case Report

Our patient is 22 years old non – smoker male, was admitted to AL - Nuaman teaching hospital for evaluation of his polycythaemia, he had headache, generalized fatigue and discoloration of hands, he also complained of reduced exercise tolerance since his childhood, There was also history of on and off bluish discoloration of fingertips and lips. He had no history of palpitations, chest pain, syncope, or breathlessness on lying position with no history of drugs intake or exposure to oxidant chemicals. None of his parents or any relative had suffered from such type of illness. On examination his pulse rate was 80 per minute, respiratory rate was 22per minute, pulses and blood pressure in all four limbs were normal. Mild peripheral and central cyanosis was present. Systemic examination revealed no abnormality, There was no history of growth or developmental retardation or neurological symptoms and no hepatosplenomegaly, O2 saturation 82% mm Hg by pulse oximetry, on investigations chocolate - brown blood in the test tube was noted. Hb: 17.9gm/ dl (normal value: 12 - 16 gm/dl), RBC: 5.77 x 10^{12}/L (normal value: 3.8 - 5.5 x10^{12}/L) HCT: 52.76% (normal value: 37 - 52%) MCV: 91.4fL (normal value: 84 - 98 fl), MCH: 31.0 pg (normal value: 27 - 32 pg), MCHC: 33.9 g/dl (normal value: 31 - 35 g/dl), WBC: 9.63 X 10^{9}/L, PLT: 219 X10^{9}/L, peripheral blood film showed normal blood film morphology with no immature or abnormal cells seen. Renal and liver function tests were normal, x – ray chest, ECG, Echocardiography, and Ultrasonography of the whole abdomen all were normal. Hemolysis work up including hemoglobinopathies screening by high performance liquid chromatography (HPLC) revealed normal hemoglobin pattern. Arterial blood gas analysis

showed pH: 7.38 (7.35 - 7.45), SaO2: 96.0 % (95 - 98), PCO2: 39.8 mmHg ((35 - 45)), HCO3: 22mmol/l (21 - 28) TCO2: 22.28 mmol/l (22 - 30), SaO2: 96.6 % (95 - 98%) MetHb 18% (normal value - 0.00 - 2.00%).

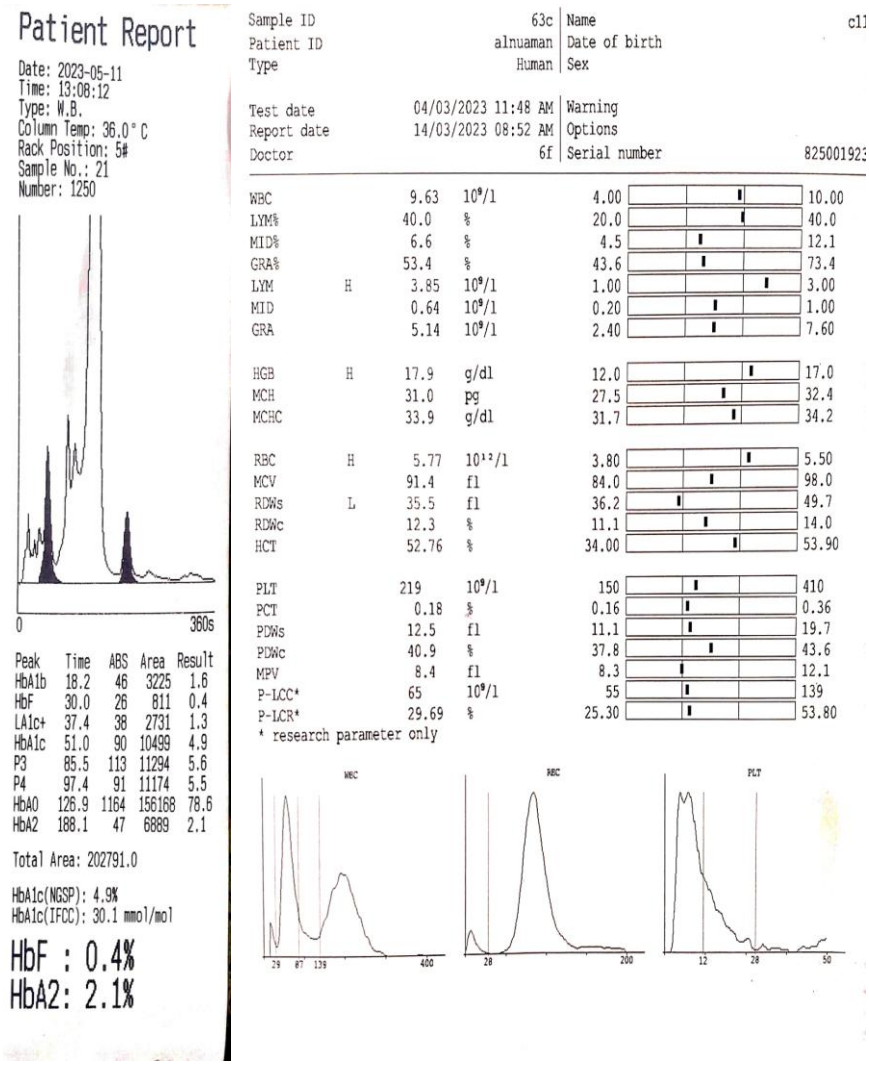
Cytochrome b5 reductase levels could not be assessed due to the non availability of the test in routine labs.

3. Discussion

Enzyme deficiency leads to two different types of recessive congenital methemoglobinemia. In type I, cyanosis is the only major symptom, and is restricted only to the red blood cells[9]. As in our patient having high methemoglobin (18%) had only vague clinical complaints and remained undiagnosed until 22 years of age. In type II, affecting all tissues and cyanosis is associated with severe mental retardation and neurological impairment.1[0]As no neurological abnormalities were detected in ourpatient and presentation was at early adulthood; diagnosis of type II enzyme deficiency was excluded. Compensatory erythrocytosis has been reported in patients with recessive hereditary methemoglobinemia, this is because methemoglobin alters oxygen affinity of the hemoglobin molecule and induce shift to the left in the oxyhemoglobin dissociation curve. This shift leads to increased affinity of the ferrous iron for oxygen.1[1]The end result of these changes is decreased oxygen delivery leading to tissue hypoxia. Our patient also had compensatory erythrocytosis (secondary polycythemia). Abnormal hemoglobin (hemoglobin M) having autosomal dominant inheritance an important differential diagnosis of congenital methemoglobinemia was excluded by normal Hemoglobin HPLC pattern (Hb A: 97.5%, Hb A2: 2.1%, Hb F: 0.4%). Due to rarity of the disease and lack of attention about it may lead to under diagnosis of this potentially dangerous disease which poses life threatening condition when exposed to oxidizing agents especially dangerous anesthetic agents[12].

4. Conclusions / Learning Point

In the present report, we highpoint on this rare entity, methemoglobinemia, on the differential diagnosis of polycythaemia and cyanosis, with presence of typical brown colour of blood in test tube, should raise suspicion about the diagnosis especially when cyanosis is present from birth without any cardiac or pulmonary impairment.



HPLC of the patient CBC of the patient

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List of abbreviations:
G6PD; Glucose 6 phosphate dehydrogenase
Hb: Hemoglobin
HCT: Hematocrit
MCV: Mean Cell Volume
MCH: Mean Cell Hemoglobin
MCHC: Mean Cell Hemoglobin Concentration 33.9 g/dl
WBC: White blood cells
PLT: Platelets
HPLC: high performanceliquid chromatography