



## RED BLOOD CELL INDICES VARIATIONS IN SICKLE CELL ANEMIA

**W.S.R. TO PANDU**

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### ABSTRACT

The presence of sickle hemoglobin (Hb S) in red blood cells causes sickle cell disease (SCD), one of the most significant and common hemoglobinopathies. When red blood cells are exposed to low oxygen tension, sickling occurs. It is usually autosomal recessive, meaning that a person inherits it from their parents. This disease is characterised by chronic Haemolytic Anaemia. Changes in Red Blood Cells can be observed and interpreted from a well furnished report of Red Blood Cell Indices. Red Blood Cell indices include PCV, MCV, MCH, MCHC and RDW. Ayurveda texts has not explained Sickle Cell Disease directly, rather explained it as *Pandu Rog* with the symptoms like *Raktalpta* (low Haemoglobin), *Aruchi* (Anorexia), *Daurbalya* (debility), *Shwas* (Dyspnoea), *Jwar* (Fever), *Shoola* (Pain) etc. It can be correlated with Sickle Cell Anemia due to the fact that many of the symptoms that are mentioned in *Pandu Rog* are similar to the symptoms mentioned in sickle cell disease. Further in this Article variations of Red blood cells Indices in Sickle Cell Anaemia w.s.r to *Pandu* will be highlighted.

**Keywords:** Sickle Cell Anaemia, Red Blood Cell indices, PCV, MCV, MCH, MCHC, RDW, *Anuman Praman, Pandu*

## INTRODUCTION

A genetic blood condition known as sickle cell anemia is caused by faulty hemoglobin. Because normal RBCs are 7.2  $\mu\text{m}$  in diameter, smooth, disk-shaped, and flexible—like doughnuts without holes—they may pass through vessels with ease and have a 120-day lifespan. When sickle cell red blood cells (RBCs) lose oxygen, they become stiff and sticky and take on the appearance of a sickle or crescent, similar to the letter C. These sickle cells only exist for ten to twenty days, have a tendency to group together, and are difficult to pass through blood arteries. The cluster restricts the flow of healthy, normal oxygen-carrying blood by obstructing small arteries or capillaries. This obstruction is the origin of sickle cell disease's excruciating and harmful side effects.

Red blood cell indices are blood tests that provide information about the hemoglobin content and size of red blood cells. Abnormal values indicate the presence of anemia and which type of anemia it is. Components which are - PCV (Packed cell volume / Hematocrit), MCV (Mean corpuscular volume), MCH (Mean corpuscular hemoglobin), MCHC (Mean corpuscular hemoglobin concentration) and RDW (Red blood cell distribution width).

Sickle cell Anemia is a condition where there will be *Vata-Pitta prakop & Kapha kshaya lakshanas*. Similar Pathology, signs & symptoms are observed in *Pandu roga*. Hence, It can be co-related with *Pandu roga*.

***Jatah pramehi madhumehino va na sadhya uktah sa hi bija doshat /***

***Ye cha api kechit kulaja vikara bhavanti tanscha pravasantaya asadhyaan //i***

Acharya Charak has mentioned all hereditary diseases as incurable (*Asadhya*). There are 2 types of *Asadhya* like *Yapya & Pratyakhyeya*, Sickle Cell Anemia is a *Yapya Vyadhi*

***Sa khalvapyo raso yakrut pleehanauprapya ragam upyaiti /***

***Rajjit aste jasa twapah sharir sthen dehinam /***

***Avyapannah prasannen raktam etya bhidhiyate //ii***

According to Acharya Sushruta, *Ahar paripak* produces *Rasa* which enters into Liver and Spleen, and gets coloured by the process of *rajjit (Ranjak Pitta)*. It's known as *Rakta*. ***Vistrata dravata ragah spandanm laghuta tatha /***

***Bhumiyadinam guna hi ate drashyante cha atra shonite //iii***

According to *Acharya Sushruta* human blood is made up of five primordial elements, such as the Earth (*Pruthvi Mahabhuta*), Water (*Jala Mahabhuta*), Fire (*Agni Mahabhuta*), Air (*Vayu Mahabhuta*), Ether (*Akash Mahabhuta*), as all these attributes are present in the blood (*Rakta*), and comprised of features like fleshy odour (*vistrata*), fluidity (*dravata*), redness (*ragah*), movement (*spandanam*) and lightness (*laghuta*).

***Predanam jeevanam lepah sneho dharan purane /***

***Garbhopadasch dhatunam shreshtham karm krumat smrutam //iv***

*Acharya Vagbhat* has mentioned in *Astang Hridaya Jeevanam* is the function of *Rakta*, but in the case of Sickle Cell Anemia, *Rakta* will not be able to carry its normal function of *Jeevanam*. It will circulate in the body, but due to its Sickle shape it gets obstructed which also suggests that oxygen carrying capacity reduces & symptoms like *Shwas*, *Daurbalyata*, *Shoola*, *Jwar* etc will originate.

*Acharya Sushrut* and other *acharyas* has described about *Vata dosha* (*Su.Sa. Sh- 2/37*). On the bases of that *Vata* may break down the normal Red Blood Cells and convert them into abnormal shape, similar to a sickle or crescent.

In Sickle Cell Anemia, due to *kha-vaigunyata* which is possible due to *bijadushti* that person's normal Red Blood Cells will get converted into Sickle shape.

## **AIM AND OBJECTIVES**

To determine how Red blood cell indicators vary in sickle cell anemia.

To analyse the relation between Sickle Cell Anemia and *Pandu*.

## **MATERIALS AND METHODS**

*Charak samhita*, *Sushrut samhita*, *Madhav nidan*, Harrison's Principles of Internal Medicine, Davidson's Principle and Practice of Medicine and Google.com are referred for collection and compilation of Sickle Cell Anemia & *Pandu*.

## **DISCUSSION**

A complete blood count (CBC), also known as a hemogram, is a blood test used to assess your general health and identify a variety of conditions, such as leukemia, anemia, and infections. It examines a number of blood components and characteristics, such as: Red blood cells (RBCs), which carry oxygen; white blood cells (WBCs), which fight infection; and hemoglobin

(Hb), the protein in red blood cells that carries oxygen. Hematocrit is the ratio of red blood cells to plasma, the fluid component of blood, and platelets, which aid in blood coagulation.

### **Variations of individual RBC's indices in sickle cell Anemia**

**PCV** - Packed cell volume / Hematocrit, PCV is the percentage of red blood cells in circulating blood. Interpretation -It will decrease in Sickle Cell Anemia due to haemolysis, either genetic defect or bone marrow defect.

**MCV** -Mean Corpuscular Volume, Which is the average Red Blood size. Interpretation -It will be within normal limit in Sickle Cell Anemia because of an increased production of HbS as seen in Sickle cell disease.

**MCH** - Mean Corpuscular Hemoglobin, Which is the amount of haemoglobin per Red Blood Cell. Interpretation -It will be also within normal limit or decrease in Sickle Cell Anemia because there are insufficient numbers of red blood cells.

**MCHC** - Mean Corpuscular Hemoglobin Concentration, Which is the amount of haemoglobin relative to the size of the cell and haemoglobin concentration per Red Blood Cell. Interpretation - MCHC can be elevated in hereditary spherocytosis, sickle cell disease and homozygous haemoglobin C disease, depending upon the hemocytometer. MCHC can be falsely elevated when there is agglutination of red cells It is used to help diagnose the type, cause, and severity of Anemia.

**RDW** - Red blood cell distribution width, which measures the Red Blood Cells volume and size. Interpretation –It will also increase in Sickle Cell Anemia due to hemolysis, the abnormal breakdown of RBCs, either in blood vessels (intravascular hemolysis) or elsewhere in the human body (extravascular). RDW test determines the changes in the volume of the cells in the red cell population. The variations pertaining to the size of the red blood cells is called **Anisocytosis** and the shape is called **Poikilocytosis**.

### ***Sarva dravyam panchabhoutikam* /<sup>v</sup>**

According to *Acharya Charak*, all *Dravyas* are *Panchbhautik*. In *Ayurveda Pancha Mahabhutas* changes the R.B.C's shape with the help of Tridosha like -*Vata prakop* will originate the symptoms like Pain because of *Vayu & Akash Mahabhut* dominance by the stimulation of *Kriyatmaka parivartan*.

*Pitta prakop* may destroys the R.B.C's or decrease the life span (10-20 days) of R.B.C's because of *Agni Mahabhuta* dominance by the stimulation of *Ushmanikya parivartan*.

*Kapha kshaya* will instead cause *Vata* increase in *Shareera* which will help in sickling or changing the normal shape of R.B.Cs and become rigid by the stimulation of *Rachnatmaka parivartan*. This condition of *Kapha kshaya* will reduce flexibility of Red cell Hb, which may stuck in small pathways/capillaries /microvasculature and will produce Haemolysis and Anemia which reducing blood flow in body parts which causes tissue, organ damage & bone disorders.

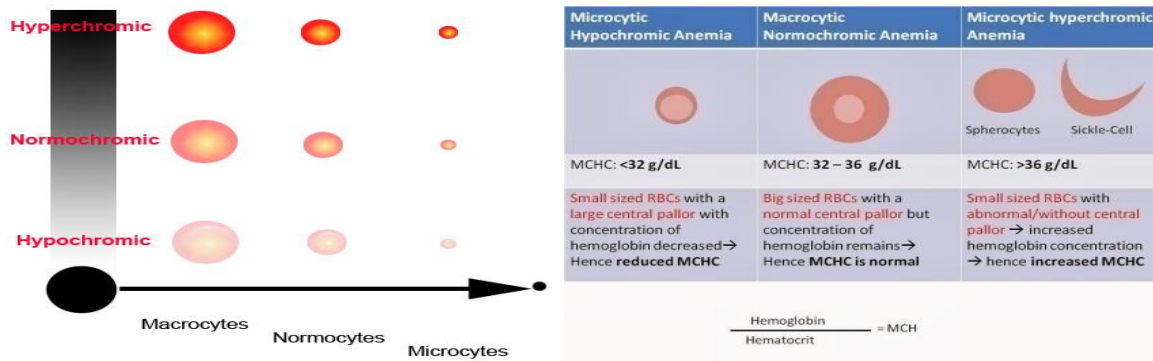
## CONCLUSIONS

Trait genes for hemoglobinopathies, primarily sickle-cell disease and thalassaemia, are present in about 5% of people worldwide. Worldwide, more than 2,50,000 infants are born with sickle cell anemia each year. It is estimated that 20 million Indians have sickle cell disease. According to reports, Orissa has the highest prevalence of the sickle cell gene in India, followed by Gujarat, Assam, Madhya Pradesh, Uttar Pradesh, and Tamil Nadu. In Orissa, the sickle gene is 9.1% prevalent, compared to an average of 4.3%. Gene mixing across populations is the primary cause of sickle cell hemoglobinopathy's population diversity in India.

Elevated RDW, low PCV, normal MCV, normal / low MCH and increase MCHC indicate the Sickle Cell Disease. These RBCs Indices interpretations will make the provisional diagnosis for Sickle Cell Anemia. The result can be compared to RBC morphology on a peripheral blood Smear to confirm the diagnosis.

In Ayurveda Panchamahabhutas changes the shape and qualities of the Red Cells with the help of *Tridosha*. *Vata prakop* will originate the symptoms like Pain, *Pitta prakop* may destroys the R.B.C's or decrease the life span (10-20 days) of R.B.C's & *Kapha kshaya* will reduce flexibility of Red cell Hb, which may stuck in blood vessels and will produce Haemolysis and Anemia.

Healthy RBC's which may converted into Sickling shape, we can compare with the conditions like *Vata Pitta prakop* and *Kapha kshaya Pandu*.



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