

TERM DEFINITIONS



Mean cell volume (MCV) is defined as the average size of red blood cells.



Mean corpuscular hemoglobin concentration (MCHC) is defined as the average weight of Hb per volume of red cells.



Mean corpuscular hemoglobin (MCH) is defined as the average weight of Hb per red cell.

NORMAL VALUES

With today's automated counters, MCV is directly measured, while MCHC and MCH are derived

MCV: 80-100 fL

MCHC: 32-36 g/dL

MCH: 28-32 pg

DERIVATION

- MCV = Hct/RBC count
- MCHC = Hb/Hct
- MCH = Hb/RBC count

CLINICAL PEARLS



MCV

The MCV gives the most discriminatory value when diagnosing anemias < 80 fL = microcytosis > 100 fL = macrocytosis



MCHC

The MCHC allows for the classification of microcytic anemia; it is usually normal or decreased (< 32 g/dL, hypochromic). The MCHC is rarely increased since Hb is already supersaturated.



The MCH tracks with the MCV and MCHC and therefore provides little useful additional information. You can ignore the MCH for all intense and purposes.

Thought Experiment



NOT - NO

Imagine a red cell as large as planet earth. Assuming a normal fractional volume of Hb or MCHC the MCH will be astronomical (no pun intended).

Complete Blood Count



When assessing red cell indices, start with the Hb, then move to the MCV and finally the MCHC. Ignore the MCH.

MCHC & MCV IN SCHEMATIC FORM

Depiction of RBCs according to cell size and Hb concentration



Note: Mean corpuscular hemoglobin (MCH) decreases left to right in both scenarios



PROXIMATE **MECHANISMS**

Red cell volume is partly regulated by the number of erythroid cell divisions, which in turn is governed by the intracellular Hb. Red cell precursors normally undergo several divisions to produce a mature RBC. Terminal divisions are associated with a reduction in cell size. If Hb is limiting, for example in iron deficiency, the red cells undergo an additional cell division, leading to microcytosis. The regulation of

MCHC is poorly understood.

EVOLUTIONARY MECHANISMS

Life is all about trade-offs! Increased Hb improves our our oxygen carrying capacity. But it also increases our Hct which, in turn, increases blood viscosity and decreases cardiac output. Increased MCHC also boosts our oxygen carrying capacity, but a higher MCHC means less RBC deformability and increased viscosity of blood. Based on these balances, evolution has selected for an optimal Hb/Hct and MCHC.





HISTORY OF MEDICINE

Technological advances in the 1800s led to the ability to count red cells, calculate Hb, and measure Hct. Over time, astute physicians realized that if you take the Hb and divide by the red cell count, you arrive at the MCH, which was used for years as a surrogate for cell size. Then someone thought to divide the Hct by the RBC count to derive the **mean cell volume** (they called this the volume index). And finally, it was realized that Hb/Hct provided an index that would ultimately called the MCHC. Slow but steady progress!

NOTES

ATTRIBUTIONS

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