

Error in Noninvasive Spectrophotometric Measurement of Blood Hemoglobin Concentration under Conditions of Blood Loss

Naftalovich R., Naftalovich D. *Med Hypotheses*. 2011 Oct;77(4):665-7.

This paper discusses a current misinterpretation between different parameters of hemoglobin concentration measurement and its amplification under conditions of blood loss. The paper details the distinction between microcirculatory hematocrit and the hematocrit of the macrocirculation to analyze clinical use of real-time patient hemoglobin concentration measurement by noninvasive point-of-care devices such as the Rainbow Pulse CO-Oximetry™ (Masimo Corp., Irvine, CA).

The hemoglobin concentration or hematocrit values have clinical significance such as for diagnosing anemia or as indicators to when a blood transfusion is needed. The device infers hemoglobin concentration from spectrophotometry of the fingertip and therefore the measured absorption is due to hemoglobin present in capillaries as well as in larger vessels, and the device accordingly reports the hemoglobin concentration as 'total hemoglobin' in a proprietary SpHb parameter. SpHb and macro hemoglobin concentration are different parameters. However, the numerical resemblance of SpHb values to values of macro hemoglobin concentrations, combined with the widely used unspecified term "Hb" in the medical setting, suggests that SpHb values are often interpreted by the clinician as macro hematocrit values. The claim of this paper is that under conditions of blood loss the portion of the SpHb total hemoglobin measure that is contributed from microcirculation increases, due to the decrease of macro hematocrit while microcirculatory hematocrit remains constant when above a critical value.

The device is calibrated from phlebotomy drawn blood (from a vein in the arm), which is the gold standard in blood collection, and hence this changing contribution of microcirculatory hemoglobin to the SpHb value would distort the gap between macro hemoglobin and total hemoglobin, SpHb. The hypothesis is that if clinicians indeed interpret the SpHb values as macro hemoglobin values then there is an unreported discrepancy between SpHb to macro hemoglobin concentrations during blood loss due to the increasing effect of microcirculatory hemoglobin measurement on the mixed parameter, SpHb.