RED BLOOD CELL INDICES, PLATELETS AND THE RESPIRATORY THERAPIST

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Red blood cell indices and platelets are not something that the average respiratory therapist looks at when he or she is doing a chart review. But sometimes great information comes in small packages! Hopefully, the following discussion will give you a new appreciation for the "other" part of the complete blood count (CBC).

Red Blood Cell Indices

Red blood cell indices include RBC size (MCV; mean corpuscular volume), weight (MCH: mean corpuscular hemoglobin concentration), hemoglobin concentration (MCHC: mean corpuscular hemoglobin concentration), and size differences (RDW, the RBC distribution width. Sometimes other names are used to refer to the above indices such as erythrocyte indices and corpuscular indices.

The calculations for the various indices are done by automated cell counting machines in the laboratory, however; if one needs to calculate them by hand, simple mathematics is all that is required. The MCV= Hct x 10 / RBC count. The MCH = Hb x 10 / RBC count, and the MCHC = Hb x 100 / Hct, where Hb is hemoglobin, and Hct is hematocrit. So you see, the only things you need to know in order to calculate these values is the hemoglobin, hematocrit, and red blood cell count. Before we get carried away with the math, lets back up and look at the meaning of each of these indices:

MCV indicates the size of the RBC in µ3 (conventional) or SI units. Adult range 80-98, newborn range 96-108, child range 82-92. Cell sizes would be either macrocytic if larger than normal, normocytic if within normal range, or microcytic if smaller in size than the normal range.

MCH indicates the weight of hemoglobin in the RBC regardless of the size and is recorded in pg (conventional) or SI units. Adult range 27-31, newborn range 32-34, and child range 27-31. In macrocytic anemia the MCH is elevated, and it is decreased in hypochromic anemia.

MCHC indicates the hemoglobin concentration per unit volume of RBCs and is recorded as a % or g/dl (conventional) or SI units. Adult range 32%-36% (0.32-0.36), newborn range 32%-33% (0.32-0.33), child range 32%-36% (0.32-0.36).

RDW is the RBC distribution width and is the size (width) differences of RBCs. RDW is measured by automated cell counters which look at the width of the size distribution curve on a histogram. Adult range is 11.5-14.5. The RDW is one of the most useful tools in the CBC to the respiratory therapist in early prediction of anemias because it will become abnormal before the MCV changes and before signs and symptoms of anemia occur in the patient. An elevated RDW indicates iron deficiency, folic acid deficiency, and vitamin B12 deficiency anemias.

A quick comparison of the RDW and MCV can be useful in differentiating between three fairly common anemias the respiratory therapist run into. Consider the following:

	RDW	MCV
Iron-deficiency anemia	High	Low
Vitamin B12 anemia	High	High
Sickle cell anemia and trait	High	Normal

There are many other anemias and RBC disorders, over 200 in fact, and I would refer you to a good hematology book to see all the variations within the indices and disease states, but this synopsis hopefully gives you a new way of looking at the patients chart! One final word on indices; you notice that as the infant grows into an adult the indice values generally get smaller. This is in keeping with the entire blood cell maturation process of immature cells being larger and mature cells being smaller.

Let us now turn our attention to the platelet before we leave the CBC completely. Whether one bleeds is based on a number of components, among them the blood vessel tissue integrity, the presence of certain protein clotting factors such a fibrinogen, prothrombin, proconvertin, and many others, as well as an adequate number of circulating platelets. These little sticky wonders not only cause our coronary arteries problems at times when they clump excessively along with other arteriosclerotic activity, but then turn right around and save our life at the time when we may be bleeding excessively and need them most. Platelets (thrombocytes) are the basic elements in the blood that promote coagulation. Platelets (2-4µm) are much smaller than erythrocytes (7-8µm). They clump and stick to rough surfaces and injured sites when blood coagulation is needed. The normal platelet count in adults is 150,000-400,000 µl (mean, 250,000 µl) 0.15-0.4 x 1012 /l (SI units). Premature: 100,000-300,000 Newborn: 150,000-300,000 Infant: 200,000-475,000. A decrease in circulating platelets of less than 50% of the normal value will cause bleeding; if the decrease is severe (less than 50,000 µl), hemorrhaging might occur.

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In the area of basic sciences, academic performance on a standardized oral comprehensive exam was compared for students in a PBL curriculum versus a lecture-based curriculum. (Login 1994-96). Students were graded using both a standardized scoring system and a subjective faculty assessment. The mean exam scores didn't turn out to be significantly different; there was however, a huge (269%) increase in positive examiner comments with regard to students' ability to think and communicate.

On another front, a number of educators who were grad school students in a course on Theories of Teaching and Learning were interviewed with regard to their perception of problem-based learning. Overall, all had a favorable attitude, stating they had "achieved more than just prescribed learning." They too had mixed feelings in the beginning, but by the end, they were enjoying it very much.

There's one final important point to note. Even though PBL had its origins in medical education, it seems that no one's been able to study the effects of Problem Based learning on the quality of patient care.

As I stated in my last article, conducting high quality research on the effectiveness of PBL is challenging for many reasons. There are simply too many variables to be considered. The very fact that PBL takes on various forms and is interpreted in so many different ways makes it extremely difficult to evaluate. For instance, some institutions incorporate some element of problem-solving in the curricula and call it PBL when in fact it is not. There are different operational definitions, various approaches to implementation, whether it was the entire curricula or a single course, a wide range of study designs and different outcome criteria. But all in all, as an educational innovation, the literatures gives a collective "thumbs up" to Problem-Based Learning.

Over the years, one thing has become very apparent: Education is best when it is an interactive process. The academic community has come to accept that traditional education needs to become more interactive. Problem Based Learning certainly lends itself well to this notion, but how educators go about it depends on the subject at hand, the available resources and the level of students. Whether that's best accomplished via PBL or the other learning innovations we've read about, still remains to be seen.

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Thrombocytopenia means platelet deficiency or a low platelet count. It is commonly associated with leukemias (lymphocytic, myelocytic, monocytic), anemias (aplastic, iron deficiency, pernicious, folic acid deficiency, sickle cell), liver disease (cirrhosis, chronic active hepatitis), kidney diseases, cancer (bone, gastrointestinal tract, brain). The most common place therapists will see increased levels of thrombocytes in COPD patients with polycythemia. Other conditions that increase platelet counts are trauma (surgery, fractures), postsplenectomy, acute blood loss (peaks in 7-10 days), metastatic carcinoma, pulmonary embolism, high altitudes, tuberculosis, severe exercise. Epinephrine will also increase the platelet levels. Other drugs will have the effect of decreasing platelet counts. These drugs include, but are not limited to, antibiotics (chloromycetin, streptomycin), sulfonamides, aspirin, quinindine, quinine, diamox, amidopyrine, thiazide diuretics, and certain vaccine injections, as well as chemotherapeutic agents. It is important for us when working with a patient with known low platelet count that we do all we can to protect them from injury. This is particularly important for the therapist who works in pulmonary rehabilitation. A patient can fall from a treadmill and literally shear off an outer layer of skin and bleed like the proverbial "stuffed pig".

So what is the simple take-home message about indices and platelets? Indices give good information about potential hypoxemia and hypoxia. The RDW is a useful early indicator of anemia even before the patient has symptoms. The platelet count has special importance for the pulmonary rehabilitation therapist. And all therapists should pay more attention to it because a variety of drugs and medications can affect the platelet activity and count.

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Sleep Text Review... *Continued from page 60*

treatment with clonazepam, 1.5 milligrams at bedtime, promptly and completely controlled her problem.…Her brother and a grandmother also had sleepwalking persisting into adulthood.

In this book, physician and scientist, Schenck, tells his story of helping discover the "dream-enacting" disorder. RBD is now recognized as one of the most important clinical discoveries on sleep since the time REM sleep was discovered in 1953. Dr. Schenck has also helped discover other parasomnias, and in this book he also discusses the science of parasomnias, and its connection with the brain sciences, clinical medicine, psychology, law and literature.

This book should interest people impacted by parasomnias or other sleep disorders; and those interested in sleep, dreams, and human behavior from various perspectives; students and professionals in medicine, nursing, sleep technology, biology, neuroscience, law, psychology, sociology, anthropology, and other fields. It should be an addition to every sleep disorders center library collection so that it may help raise the awareness in all professionals involved in sleep disorders diagnosis. Paradox Lost… includes Schenck's opinions and insights but also clearly demonstrates his understanding and compassion for the complexities faced by RBD patients and their families. By reading this excellent book, caregivers may become more engaged in spotting signs of the harrowing disorder in their patients, or recognize RBD as a comorbidity to the primary disease of interest.