



January - February 2014

HTMA – A Tissue Biopsy

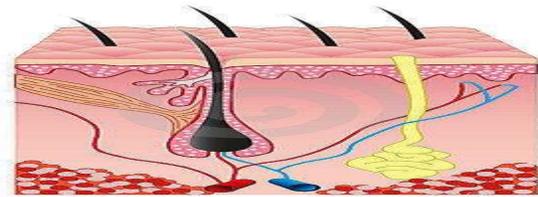
By David L. Watts, Ph.D., Director of Research

Recently a client called to ask a question about what the HTMA reveals. Basically, the question was, does the HTMA test represent the status of the intracellular elements or extracellular elements? I answered the question by saying that the HTMA is a tissue biopsy and therefore, the mineral results are actually a representation of total tissue concentrations. However, I realize that this might need further explanation, and I am sure other practitioners may also benefit from a more comprehensive answer.

Formation of the Hair Shaft

To begin, I should probably start with a brief review of how the hair is formed and the minerals are sequestered in and onto the hair shaft. The development of the hair follicle begins at about the twentieth week of gestation. Hair growth and location of hair formation is influenced by genetics, sex, age, race, and hormones. It is also affected by illness, medications, nutritional status, environmental toxins and even the immune system. Hair formation begins at the base of the hair follicle in the area known as the papilla. There is a blood supply to the papilla that provides nutrients to the matrix cells surrounding the papilla. The matrix is derived from stem cells, and contains several types of cells that are the most dynamic and active cells in the body, and are responsible for the formation and growth of hair. Via the papilla, the cells that make up the matrix receive a blood supply that provides nutrients to these cells and carry waste products away. These continually dividing cells form the medulla, cortex and cuticle of the hair shaft. As production continues, ultimately the hair shaft formed from the matrix cells is pushed upward from below the skin and grows above the dermis. Constituents that were present in the circulating blood, during development of the hair are contained and preserved in the hair shaft itself, providing a record of those events.

Therefore, in answer to the question, does the concentrations of minerals in the hair shaft represent intracellular or extracellular minerals, we can say that in the strictest sense that it does represent intracellular minerals incorporated into the constantly dividing matrix cells that ultimately form the hair shaft.



However, in a broader sense the hair shaft itself is also exposed to lymph, extracellular fluids, sebaceous glands, sweat glands and surrounding tissue of the dermis and epidermis. The hair shaft may also contain constituents or minerals from these sources as well. So, in the broadest sense the minerals incorporated into and onto the hair shaft in total contain both intracellular and extracellular minerals. Therefore, the hair test can be considered a representation of the tissue mineral levels that are present from all these sources.

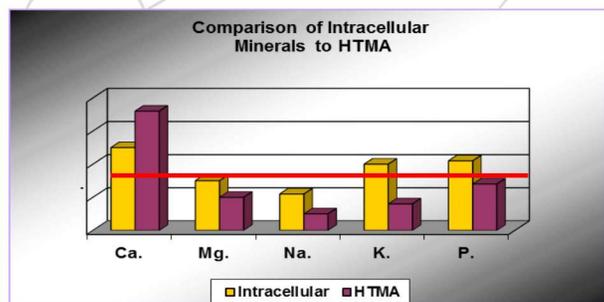
Comparison Study of Intracellular Mineral Results and HTMA Results.

Many years ago TEI independently compared hair tissue mineral samples with intracellular mineral specimens obtained from the analysis of buccal cells. Epithelial buccal cells contain nuclear and cytoplasmic constituents and were typically analyzed by a reference laboratory specializing in intracellular mineral testing

using proprietary procedures and electron-scanning microscopy.

This small study involved doctors who collected both the hair specimens and buccal specimens from a number of patients, submitting the hair specimens to TEI and the buccal specimens to the independent lab. The results of these tests are shown in the graphic below and which will also require further explanation.

The report from the buccal cell testing include the following elements, calcium (Ca), magnesium (Mg), sodium (Na), potassium (K), phosphorus (P) and chloride (Cl) as well as the ratios between Ca/Mg, P/Ca, K/Mg, K/Ca, K/Na, and P/Mg. The results were extrapolated and depicted in a graphic form for comparison of the intracellular mineral levels and ratios to HTMA mineral ratios. As you will note, the graphic only displays the mineral levels and ratios. For ease of comparison, the actual test results are not included from either test for two reasons, first, the units of measurement differ between the two tests, and secondly, the extreme concentration differences found with each test method. The yellow bar graphs show the intracellular buccal cell mineral results, while the red graphs show the HTMA mineral results of the very same individual. The red line indicates the median test results.



Interpretation:

Visually the levels of minerals compared to the mean are shown for both test results based upon the respective reference intervals. More importantly, the ratios between the minerals from both analysis's can also be viewed. As noted previously, some mineral ratios of the intracellular (IC) buccal test are inversely interpreted or compared to HTMA ratios, due to concentration differences in the two types of specimens.

Buccal Cell Mineral Ratios	HTMA Mineral Ratios	Correlation (+ -)
Mg/Ca - Low	Ca/Mg - High	+
P/Ca - Low	Ca/P - High	+
K/Mg - High	K/Mg - High	+
K/Ca - Low	Ca/K - High	+
K/Na - High	Na/K - Low	+
P/Mg - High	P/Mg - High	+

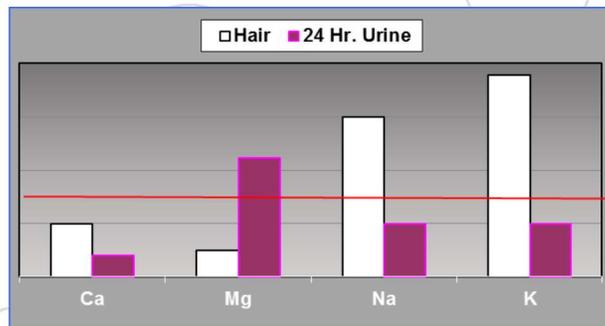
Further explanation of some of the IC mineral ratios compared with HTMA ratios Mg/Ca: Calcium is considered largely an extracellular (EC) element, although it is also found intracellularly in smaller quantities. Magnesium is considered largely an intracellular (IC) element and is found in relatively high concentrations within cells but is also present EC as well. Therefore, the IC ratio is the comparison of the higher concentration of magnesium to lower concentrations of calcium normally found or expected within cells. The IC magnesium is low relative to the amount of calcium in this patient. In other words excessive calcium has accumulated within the cell. The HTMA depicts the ratio determination of Ca/Mg, which is high in this patient. This indicates a relative magnesium deficit allowing an increase in the cellular concentration of calcium to develop. Both test results show a low magnesium level and both show a relative high concentration of calcium to magnesium. A number of the IC results are therefore, inversely correlated with HTMA findings. Comparison of several IC to HTMA mineral tests confirms a correlation of minerals found in both types of samples. More importantly both tests reveal the relative mineral concentrations that can lead to significant health consequence and that can be readily assessed in a noninvasive manner and used to provide a specific and targeted nutritional therapeutic approach.

HTMA and 24- Hour Urine Excretion Studies

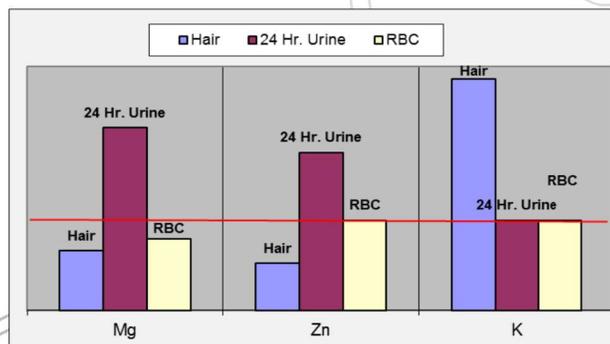
At TEI we have also compared other analytical tools with the HTMA test in order to discern what information is provided by each test medium. However, we no longer provide these tests at our laboratory as we now specialize in and continue to develop the HTMA exclusively. One of these past tests can be seen in the graphic below, which shows a 24-hour urine compared with HTMA. Again, quantitative results are not presented but are simply graphed, based upon the median of each test result for ease of comparison. Both the hair tissue samples and twenty-four hour urine collections were obtained from the same individuals and submitted for analysis by their doctors.

The white bars in this graphic reveals the HTMA findings while the red bars show the 24-hour urine mineral excretion results. This particular patient is classified as sympathetic dominant. This HTMA pattern as described in much of our literature indicates increased adrenal and thyroid activity as indicated by a low Ca/P, low Ca/K and elevated Na/Mg ratios. Adrenal, thyroid and other hormones affect the retention and excretion of sodium and potassium and other elements as well. This chart graphically reflects the correlation of adrenal dominance on the retention and excretion of sodium and potassium in particular. We can see the increased tissue or body retention of sodium and potassium in the HTMA.

Conversely, we can see that the 24-hour urinary excretion of sodium and potassium correspond to the influence of adrenal activity due to their reduced excretion. Also, urinary excretion of magnesium is increased and reflected in reduced retention in the HTMA findings.



The following graph is showing the relationship of certain nutritional minerals (magnesium, zinc and potassium) found in the urine, red blood cells (RBC) and HTMA. Magnesium is showing a low HTMA tissue concentration which correlates with high urinary excretion and the slightly low magnesium blood level that was observed. The results of zinc are similar in that urinary excretion is increased reflecting a loss resulting in reduced tissue zinc concentrations, while the RBC level is relatively normal. Potassium is elevated in the HTMA indicating retention, while urine and RBC levels are within a normal range.



Discussion

Mineral concentrations in these various tissues are regulated and influenced by a number of factors, including diet, endocrine, physiological, developmental, and pathological conditions. If the dietary intake of nutrients are insufficient it will be reflected in some test mediums, but not all. The homeostatic regulation of minerals that are in circulation are tightly controlled for obvious reasons and their levels can be independent of dietary intake. Therefore, the analysis of circulating minerals cannot

readily be used to assess nutritional status of minerals unless a severe deficit exists. The source of minerals in circulation other than their presence under normal physiological control and function cannot readily be determined since minerals are constantly being transported to and from storage sites, trans-located or, are being transported to eliminative organs.

Therefore, with proper specimen collection, analysis and careful interpretation, the HTMA can be readily used to assess the mineral status of the body.

Not only does the HTMA reveal the extracellular mineral levels, but can also provide an approximation of the intracellular mineral concentrations and their relative relationships.