Nutrition in Clinical Practice: The Missing Link in Your Patient’s Path to Wellness

Gulf Coast Integrative Healthcare
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What to Expect

• How nutrition fits into clinical practice
• New treatment options for commonly seen conditions
• How to assess the patient for nutrition related conditions
• Differences between testing methods
• Interpretation of test results
Clinical Practice

• Early 1900’s
  – More rural, predominantly agrarian society
  – Most doctor visits were related to acute injuries

• Current Clinical Environment
  – Less agrarian, more urban
  – Most doctor visits are related to chronic disease states
Clinical Practice Statistics

- Number of Visits per Year per Condition
  - Hypertension - 44.7 million
  - Diabetes – 25.5 million
  - Cancer – 28.7 million
  - Digestive Diseases – 33.3 million
Leading Causes of Death

- Heart disease: 652,486
- Cancer: 553,888
- Stroke (cerebrovascular diseases): 150,074
- Chronic lower respiratory diseases: 121,987
- Accidents (unintentional injuries): 112,012
- Diabetes: 73,138
- Alzheimer's disease: 65,965
- Influenza/Pneumonia: 59,664
- Nephritis, nephrotic syndrome, and nephrosis: 42,480
- Septicemia: 33,373

www.cdc.gov
How Big is the Problem?
Early Stages of Chronic Disease

• What Presents to Your Clinic
  – Fatigue
  – Digestive Complaints
  – Hormonal Dysfunction
  – Insulin Resistance
  – Musculoskeletal Complaints
Fatigue

• Linked to most clinical diagnoses

• Possible Causes
  – Anemia
    • B12, Folic acid, Vitamin A, Zinc, Copper
  – Lack of Sleep
    • B6, Magnesium
  – Energy Production Cycles
    • B1, B2, B3, B5, B8, Carnitine, Magnesium, Lipoic Acid, Cysteine, Coenzyme Q10
STAGE I

Digestion and Assimilation

FATS
- Fatty Acids, Glycerol
- Cholesterol

CARBOHYDRATES
- Glucose & Other sugars

PROTEINS
- Amino Acids
- Keto Acids

INTERMEDIARY METABOLISM

Pyruvate ↔ Lactate

B1, B2, B3, B5, Lipoate

Acetyl CoA

STAGE II

Oxaloacetate

Aspartate

Citric Acid Cycle

cis-Aconitate

Cysteine, Fe++

Isocitrate

Malate

B3

Fumarate

B2

Succinate

α-ketoglutarate

B1, B2, B3, B5, Lipoate

STAGE III

Electron Transport and Oxidative Phosphorylation

NADH

Dehydrogenase

Coenzyme Q10

ATP

Energy for muscle and nerve function and for building new tissue

ADP + P1

Hydroxymethylglutamate

O2

H2O
Digestive Complaints

• Common Complaints
  – Diarrhea
  – Constipation
  – Inflammatory Bowel Disorder
  – Irritable Bowel Syndrome
  – Cramping
  – Flatulence
  – GERD
Gastrointestinal Anatomy
Smooth Muscle Function

• Magnesium
  – Involved with relaxation of smooth muscle
    • “Calcium Channel Blocker”
  – Regulates balance
  – Must be considered in relation to calcium
Intestinal Villi

• Glutamine
  – Improved enterocyte differentiation and proliferation
  – Reduced hyperpermeable mucosa

• Vitamin A
  – Endothelial regeneration

• Antioxidants
  – Inflammation reduction
Hormonal Dysfunction

- Thyroid Function
  - 3 Steps
    - Production
    - Conversion
    - Receptor Sensitivity
Thyroid Hormone Production

- Tyrosine
- Iodine
- Copper
- Iron
Thyroid Hormone Conversion

- 5'-deiodinase enzyme
  - Selenium Dependent

![Chemical structures of Thyroxine and Triiodothyronine](image.png)
Thyroid Receptor Activity

- Zinc
- Tyrosine
Insulin Resistance

- Insulin Production
  - Zinc
- Insulin Receptor Sensitivity
  - Alpha Lipoic Acid
  - Vitamin D
- Insulin Resistance Associated Hypertension
Insulin Production and Zinc
Insulin Receptor Sensitivity

• Alpha Lipoic Acid
  – Activates signaling molecules in the insulin receptor pathway
    • Most pronounced uptake in the skeletal muscle and adipocytes

• Vitamin D
  – Attenuates increases in glucose and insulin over time
    • Deficiency promotes increased renin-angiotensin II expression
Insulin Resistance Associated Hypertension

- Magnesium
  - Low availability of intracellular magnesium
    - Diminishes tyrosine kinase activity
    - Increases the vascular constriction mediated by calcium
  - Hypomagnesemia is a frequent finding in Insulin Resistance / Diabetes
    - Hypercholesterolemia, Hypertriglyceridemia
Musculoskeletal Conditions

• Collagen Synthesis
  – B1, B2, B3, B5, B6, Folic acid, B12
  – Zinc, Copper

• Muscles soreness and degradation
  – Carnitine, Glutamine
  – Vitamin D
Specific Supplement Use

This group of long term-term multiple dietary supplement users consumed a broad array of vitamin/mineral, herbal, and condition specific dietary supplements on a daily basis. They were more likely to have optimal concentrations of chronic disease-related biomarkers, and less likely to have suboptimal blood nutrient concentrations, elevated blood pressure, and diabetes compared to non-users and multivitamin/mineral users.

Nutr J 2007 Oct 24;6:30
Drug Induced Nutrient Depletions
• Medications can influence nutrient status by inhibition of:
  • Absorption
  • Synthesis
  • Transport
  • Storage
  • Metabolism
  • Excretion
• When a certain metal is required for a reaction or function to occur, a deficiency of that mineral will hinder or prevent that function, the failure of that metabolic function is DISEASE.

• Dietary replacement of deficient vitamins and minerals is essential for health. There is no modality, no protocol that can or will correct mineral deficiencies or the vitamin deficiencies that cause disease, except ingestion of that vitamin or mineral.
• Evaluating patients for nutritional deficiencies secondary to medication administration:
  – Helps reduce a patient’s risk of potential side effects
  – Reduces doctor’s risk of medico-legal liability
    • NCMIC Case
    • Canadian case
    • Far East and statins
Cardiovascular

- ACE inhibitors
  - Zinc
- Angiotensin II Receptor Antagonists
  - CoQ10, Mg, Zn, P, Potassium, and Na
- Beta Blockers
  - CoQ10
- Diuretics
  - B1, 6, Folate, CoQ10, Ca, Mg, Zn, P, Potassium, and Na
Coenzyme Q10

• Symptoms of CoQ10 deficiency:
  – Congestive heart failure, high blood pressure, angina, mitral valve prolapse, stroke, cardiac arrhythmias, cardiomyopathy, lack of energy, gingivitis, and generalized weakening of the immune system.

• Some studies suggest that congestive heart failure is primarily a CoQ10 deficiency.
  – Biosynthesis is a 17-step process that requires riboflavin, niacinamide, pantothenic acid, pyridoxine, cobalamin, folic acid and vitamin C.
Magnesium

- Magnesium is co-factor in >200 enzymatic reactions.
- It is estimated that 75% of Americans ingest less than the RDA.
- Magnesium deficiency is associated with increased incidence of atherosclerosis, hypertension, strokes, and heart attacks.
  - Magnesium deficiency allows levels of calcium to increase, which can cause cardiac muscle spasm.
Magnesium

• Benefits of supplementation:
  – Inhibits platelet aggregation
    • Aspirin
  – Thins blood
    • Warfarin
  – Blocks calcium uptake
    • Ca-channel blocker
  – Relaxes blood vessels
    • ACE inhibitors
Zinc

• Zinc is involved in over 300 enzymatic reactions.
  – Alkaline phosphatase – bone metabolism
  – Carbonic anhydrase – CO2 excretion
  – Zn – SOD
  – Cytochrome C – electron transport
  – Carboxypeptidase – digestion of proteins

• Signs of deficiency:
  – Acne, impaired sense of smell & taste, delayed wound healing, anorexia, decreased immunity, frequent infections, depression, photophobia, night blindness, problems with skin, hair, and nails, menstrual problems, joint pain, and nystagmus
Diabetes Mellitus

- Sulfonylureas
  - CoQ10
- Biguanides
  - CoQ10, Folate, B12

- Depletion of Folate, B6 and B12 raises serum homocysteine levels.
  - Elevated homocysteine has been shown to cause endothelial damage and induce atherosclerosis.
GERD

• Proton Pump Inhibitors
  – B12
• Histamine H2 Antagonists
  – Ca, Folate, Fe, B12, D, and Zn
• Antacids
  – Ca, P, and Potassium
Vitamin B12

• Intrinsic factor is essential for B12 absorption.
• Deficiency inhibits DNA synthesis affecting growth and repair of cells
• Symptoms:
  • Fatigue
  • Peripheral neuropathy
  • Macrocytic anemia
  • Tongue and mouth irregularities
  • Depression, confusion and memory loss
  • Poor blood clotting and bruising
  • Dermatitis and skin sensitivity
  • Loss of appetite
  • Nausea and vomiting
Calcium

• Functions:
  – Bone development
  – Transmission of nerve impulses
  – Contraction of muscle tissue
  – Regulates ion transport
  – Blood clotting
  – Increased insulin sensitivity
Calcium

- Must be in a form that can be absorbed.
  - Calcium carbonate is only 5-7%
  - Calcium citrate ~50%
  - Calcium malate ~70%

- High protein diets leach calcium

- Dairy proteins reduce the body’s ability to absorb calcium.
Anti-inflammatories

- **Salicylates**
  - Folate, Fe, Potassium, Na, and Vit C
- **NSAIDs**
  - Folate
- **Acetaminophen**
  - Glutathione
- **Corticosteroids**
  - Ca, Folate, Mg, Potassium, Se, C, D, and Zn
Selenium

- Component of glutathione peroxidase
- Supports DNA repair
- Symptoms include:
  - Destructive changes to heart and pancreas
    - Cardiomyopathy
  - Sore muscles
  - Increased RBC fragility
  - Weakened immune system
Glutathione

- Depletion decreases hepatic detoxification capacity
  - Glutathione S-transferase

- Increased free radical damage
  - Glutathione peroxidase reduces oxidative damage in mitochondria and RBC’s

- A sulfur containing compound composed of Cys, Gly, and Glu
Hormonal

- BCP’s
  - Folate, 2, 3, 6, 12, C, Zn, Trp, and Tyr
- HRT
  - Mg, B2, B6, C and Zn
Folate, B6 and B12

• Symptoms of deficiency:
  – Megaloblastic anemia
    • Fatigue
  – Elevated homocysteine
    • Shown to be the most important independent risk factor to cardiovascular disease.
    • Methylated forms appear to be most effective
  – Cervical dysplasia
  – Birth defects
  – Folate must be converted to tetrahydrofolic acid which is niacin and vitamin C dependent.
Antibiotics

• General
  – *Bifidobacteria bifidum*, *Lactobacillus acidophilus*, Inositol, Biotin, 1, 2, 3, 6, 12, & K
  – Penicillins
    • Potassium
  – Tetracyclines
    • Ca, Mg, and Fe
  – Aminoglycosides
    • Beta carotene, Ca, Fe, Mg, Potassium, A, & Na
  – Sulfonamides
    • Folate, Mg
  – Antivirals
    • Carnitine, Cu, B12 & Zn
Inositol

- A member of the B-complex
- An essential component of phospholipids
- Helps mediate cellular responses to external stimuli
  - May be helpful in diabetic neuropathy
  - May benefit depressive, obsessive and compulsive disorders
Copper

- Deficiency is common
  - <50% RDA obtained in diet
- Component of ceruloplasmin
  - A blood-based antioxidant
- Involved in:
  - Synthesis and function of Hgb
  - Absorption of Fe
  - Production of elastin
  - Cu-SOD
  - Proper cholesterol metabolism
Carnitine

• Important in fatty acid transport across the mitochondrial membrane.
  – Energy production

• Symptoms include:
  – Elevated blood lipids
  – Abnormal liver function
  – Muscle weakness
    • Including cardiac
  – Reduced energy
  – Impaired glucose control
Biotin

- Involved in carboxylation, decarboxylation and deamination reactions of amino and fatty acids.
- Deficiency S/Sx:
  - Hair discoloration/loss
  - Depression
  - Scaly dermatitis
  - N/T of extremities
  - Muscle pain
  - Cardiac irregularities
Cholesterol

• HMG CoA Reductase Inhibitors
  – CoQ10

• Fibrates
  – CoQ10 & E

• Bile Acid Sequestrants
  – Beta carotene, A, D, E, K, Ca, Mg, P, Folate, B12, Fe, Zn, and essential fatty acids (omega 3 & 6 fatty acids)
Vitamin A

- Involved in cellular differentiation, immune function, vision, bone development, growth and reproduction
- Adequate Vitamin A is associated with reduced risk of epithelial cancers.
- Amino transferase enzymes must be monitored closely with supplementation
Vitamin D

• Vitamin with hormonal effects
• Regulates Ca and P absorption and utilization.
  – Osteomalcia – “adult Rickets”
• Stimulates macrophage activity
Vitamin E

• Prevents peroxidation of unsaturated fatty acids.
  – Components of phospholipid membrane
    • Highest in RBC’s, neurons, and lung epithelium

• Deficiency signs include susceptibility to infections, poor wound healing, and fatigue

• Antioxidant cascade
  – Protects Vitamin A
  – Regenerated by Vitamin C
Coenzyme Q10

• Deficiency S/Sx:
  – Congestive heart failure
  – High blood pressure
  – Angina
  – Mitral valve prolapse
  – Stroke
  – Cardiac arrhythmias
  – Cardiomyopathy
Functional Analysis of Vitamins, Minerals & Antioxidants - An Intracellular Approach
Overview

• What is FIA™ Testing?
• How does FIA™ work?
• Why is FIA™ better?
• Case Presentations
What is FIA™?

Functional Intracellular Analysis™
Functional Intracellular Analysis™

*Functional*
because it assesses how a person’s own cells actually *utilize* various nutrients.
Functional Intracellular Analysis™

*Intracellular*

because the growth rates of each patient’s own white blood cells are evaluated when exposed to a series of very specific nutrient environments
Functional Intracellular Analysis™

*Analysis*

because the results are interpreted as nutrient deficiencies in a patient
Why FIA™ is important...

“Because suboptimal vitamin status is associated with many chronic diseases, including cardiovascular disease, cancer and osteoporosis, it is important for physicians to identify patients with poor nutrition or other reasons for increased vitamin needs.”

Journal of American Medical Association  June 19, 2002
Why FIA™ is important…

Multiple deficiencies without previous supplementation: 38%

Multiple deficiencies with previous supplementation: 43%

Subjects showing no deficiency: 19%

Source: Clayton Foundation for Research; University of Texas Biochemical Institute
Why FIA™ is important…

Functional Intracellular Deficiencies

- Zinc
- Folate
- Calcium
- Vitamin B12
- selenium
- Vitamin B1
- Glutathione
- Vitamin E
- Lipolic acid
- Vitamin D
- Vitamin B2
- Magnesium

Source: SpectraCell Laboratories
Why FIA™ is important...

Many Factors affect Nutrient Status

<table>
<thead>
<tr>
<th>Dietary Intake</th>
<th>Metabolism</th>
<th>Gender</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absorption</td>
<td>Excretion</td>
<td>Socioeconomics</td>
</tr>
<tr>
<td>Transport</td>
<td>Hormonal Status</td>
<td>Culture/Ethnicity</td>
</tr>
<tr>
<td>Storage</td>
<td>Genetic Influences</td>
<td>Pregnancy</td>
</tr>
<tr>
<td>Receptors</td>
<td>Disease</td>
<td>Exercise</td>
</tr>
<tr>
<td>Activation</td>
<td>Lifestyle Factors</td>
<td>Tobacco / Alcohol</td>
</tr>
<tr>
<td>Inhibition</td>
<td>Pharmaceuticals</td>
<td>Age</td>
</tr>
</tbody>
</table>
What does FIA™ measure?

Intracellular status of 28 Important Micronutrients

<table>
<thead>
<tr>
<th>VITAMINS</th>
<th>MINERALS</th>
<th>ANTIOXIDANTS</th>
<th>SPECTROX®</th>
<th>CARBOHYDRATE METABOLISM, FATTY ACIDS &amp; METABOLITES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitamin A</td>
<td>Calcium</td>
<td>Coenzyme Q10</td>
<td>Lipoic Acid</td>
<td></td>
</tr>
<tr>
<td>Vitamin D</td>
<td>Magnesium</td>
<td>Glutathione</td>
<td>Oleic Acid</td>
<td></td>
</tr>
<tr>
<td>Vitamin E</td>
<td>Selenium</td>
<td>Cysteine</td>
<td>Choline</td>
<td></td>
</tr>
<tr>
<td>Vitamin B1</td>
<td>Zinc</td>
<td>Glutamine</td>
<td>Inositol</td>
<td></td>
</tr>
<tr>
<td>Vitamin B2</td>
<td>Chromium</td>
<td>Serine</td>
<td>Fructose Sensitivity</td>
<td></td>
</tr>
<tr>
<td>Vitamin B3</td>
<td>Copper</td>
<td></td>
<td>Glucose/Insulin Metabolism</td>
<td></td>
</tr>
<tr>
<td>Vitamin B6</td>
<td>Asparagine</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vitamin B12</td>
<td>Carnitine</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biotin</td>
<td>Glutamine</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Folate</td>
<td>Serine</td>
<td></td>
<td></td>
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<tr>
<td>Pantothenate</td>
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</tbody>
</table>

What is measured by FIA™:

- VITAMINS: Vitamin A, Vitamin D, Vitamin E, Vitamin B1, Vitamin B2, Vitamin B3, Vitamin B6, Vitamin B12, Biotin, Folate, Pantothenate
- MINERALS: Calcium, Magnesium, Selenium, Zinc, Chromium, Copper
- ANTIOXIDANTS: Coenzyme Q10, Glutathione, Cysteine
- SPECTROX®: Total Antioxidant Function
- CARBOHYDRATE METABOLISM, FATTY ACIDS & METABOLITES: Lipoic Acid, Oleic Acid, Choline, Inositol, Fructose Sensitivity, Glucose/Insulin Metabolism
Why use lymphocytes?

• Lymphocytes provide a long term nutritional marker
• Contain a genetic marker (nucleated cell)
• Closely tied with immune function
• Representative of overall health
Why is FIA™ better…

...than Serum Analysis?

Serum testing measures nutrients levels in a very short window

FIA™ testing measures LONG-TERM nutrient status over 3 – 6 MONTHS

Serum testing measures nutrient status outside of the cell in the serum

FIA™ testing measures nutrient status WITHIN the patient’s own cells determining ABSORPTION
...than Serum Analysis?

Serum measures static nutrient levels, regardless of utilization

**FIA™ testing measures nutrient FUNCTION, a truer indication of cellular health**

Serum measurements assume everyone has the same nutritional needs

**FIA™ testing = BIOCHEMICAL INDIVIDUALITY** - the optimal nutrient level for one person may be sub-optimal for another, thus accounting for differences in age, illness, medications and genetic factors.
Clinical Study

Use of FIA™ in normalizing homocysteine in dialysis patients by directed repletion with apparent reduction of access thrombosis

- Hyperhomocysteinemia is associated with deficiencies in vitamin B6, B12 or folic acid.
- Elevated homocysteine is an independent risk factor for thrombosis
- Elevated homocysteine levels are common in dialysis patients
- Access thrombosis is very common in dialysis patients

**Goal:** To determine if correction of *functional* nutritional deficiencies lowers homocysteine levels

Dialysis & Transplantation, Volume 30, Number 8, August 2001, Dr. Fred Crawford
Clinical Study continued

- 24 Total Patients
- Functional deficiencies measured using FIA™
- Serum deficiencies measured
- Individual repletion programs initiated and deficiencies corrected
- Homocysteine levels measured
  - Pre supplementation average homocysteine level (24.6 μmol/L)
  - Post supplementation average homocysteine level (12.8 μmol/L)

Dialysis & Transplantation, Volume 30, Number 8, August 2001, Dr. Fred Crawford
**Conclusion 1:** Serum testing did not reveal the cellular deficiencies that FIA™ revealed.

**Conclusion 2:** Homocysteine levels were reduced 48%. Incidence of access thrombosis was also dramatically reduced.
Case Study

5 year old female with severe neuromuscular symptoms

- Symptoms
  - Difficulty holding head erect
  - Inability to balance with eyes closed
  - Lack of muscle tone
- Significant deficiency in B2 (riboflavin) revealed by FIA™
- Urinary excretion of B2 did not uncover deficiency
- Supplemented with 10mg B2 daily for several weeks
- Symptoms gone after repletion
  - Normal physical evaluation
  - Normal function in exercise and play

This case demonstrates that FIA™ often reveals nutrient deficiencies not otherwise revealed by other non-functional methods.
Case Study

6 year old male with atypical organic brain syndrome and mild retardation (IQ = 68)

- Prescriptions: dylantin & mysoleine to reduce seizures to 10 per day
- Functional deficiency in B2 (riboflavin) and glutamine revealed by FIA™
- Repletion: 25mg of B2 and 2g of glutamine per day
- Results
  - 10 weeks: Seizures changed to psychomotor and petit mal seizures
  - 16 weeks: No seizures reported

This case confirms the ability of lymphocytes to reflect metabolic functions in other tissues (brain).
Case Study

54 year old female with diabetic neuropathy

- Prescribed neurontin and amitriptyline for neuropathy
- Despite drugs, symptoms (burning & intermittent numbness) were increasing in severity
- SpectraCell results showed functional deficiency in vitamin B12 and choline (Note: patient had been taking multivitamin prior to test)
- Follow up FIA™ showed deficiencies were corrected
- 1 ½ years after initial FIA™:
  - symptoms gone
  - clinical examination showed marked improvement
  - neurontin and amitriptyline were discontinued per physician
- Follow up FIA™ test done every 3 months to monitor nutritional status

This case illustrates how taking a multivitamin may not prevent nutrient deficiencies.
SpectraCell Interpretation

- Not black and white
- More information than initially appears
- Multiple ways to interpret results
What to Consider

1. An outright deficiency
2. A marginal deficiency
3. Status of nutrient relative to the rest of the sampled population
4. Multiple nutrient deficiency patterns
Outright Deficiency
Outright Deficiency

- Require immediate attention
- Suggest gaps in metabolic function
- Often can be related to the patient’s complaints
- The more severe the deficiency, the greater the dosage needed for therapeutic restoration
  - Not likely restored through food alone
Marginal Deficiency
Marginal Deficiency

• Needs a second consideration
• Do the patient’s complaints suggest that this nutrient may be of benefit to them?
• Will my primary treatment options induce deficiencies in marginal nutrients by upregulation of downstream metabolic pathways?
Nutrient Status Relative to Population - Deficient
Nutrient Status Relative to Population - Excess
Nutrient Status Relative to Population

• These may indicate nutrient deficiencies that are consistent within a population
  – May be related to a geographical area
• Depends on the complaint of the patient
• Also consider if the nutrient is on the upper side of the bell-shaped curve
  – May indicate a toxicity
  – Important with minerals
Multiple Nutrient Patterns
- Adrenal Fatigue
Multiple Nutrient Pattern
- Over-trained Athlete
Multiple Nutrient Pattern - Hepatic Dysfunction
Multiple Nutrient Pattern - Hepatic, Insulin Resistance
Multiple Nutrient Patterns

- Provide insight into the systemic state of the patient
- Allows the test to become a diagnostic
- Targeted assessment of individual systems
Clinical Case Studies
• 39 y/o female with c/c of low energy and mild depression
- 55 y/o female who was retiring
- She has started working with a personal trainer
- Meds: Lipitor and Synthroid

<table>
<thead>
<tr>
<th>Test Name</th>
<th>In Range</th>
<th>Out of Range</th>
<th>Reference Range</th>
<th>Lab</th>
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<tr>
<td>LIPID PANEL</td>
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<tr>
<td>TRIGLYCERIDES</td>
<td>108</td>
<td>&lt;150 mg/dL</td>
<td>RGA</td>
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<tr>
<td>CHOLESTEROL, TOTAL</td>
<td>144</td>
<td>&lt;200 mg/dL</td>
<td>RGA</td>
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<tr>
<td>HDL CHOLESTEROL</td>
<td>63</td>
<td>&gt; OR = 40 mg/dL</td>
<td>RGA</td>
<td></td>
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<tr>
<td>LDL-CHOLESTEROL</td>
<td>59</td>
<td>&lt;130 mg/dL (calc)</td>
<td>RGA</td>
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</tbody>
</table>

DESI RABLE RANGE <100 MG/DL FOR PATIENTS WITH CHD OR DIABETES AND <70 MG/DL FOR DIABETIC PATIENTS WITH KNOWN HEART DISEASE.

<table>
<thead>
<tr>
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<th>In Range</th>
<th>Out of Range</th>
<th>Reference Range</th>
<th>Lab</th>
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<tr>
<td>CHOL/HDL RATIO</td>
<td>2.3</td>
<td>&lt;4.4 (calc)</td>
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<td>GGT</td>
<td>29</td>
<td>3-60 U/L</td>
<td>RGA</td>
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<td>LD</td>
<td>149</td>
<td>100-250 U/L</td>
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<td>MAGNESIUM</td>
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<td>RGA</td>
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<td>PHOSPHATE (AS PHOSPHORUS)</td>
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<td>2.5-4.5 mg/dL</td>
<td>RGA</td>
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<td>URIC ACID</td>
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<td>IRON AND TOTAL IRON BINDING</td>
<td>104</td>
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<td>RGA</td>
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<td>CAPACITY</td>
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<tr>
<td>IRON, TOTAL</td>
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<td>RGA</td>
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<td>IRON BINDING CAPACITY</td>
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<tr>
<td>% SATURATION</td>
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<td>15-50 % (calc)</td>
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<td>COMPREHENSIVE METABOLIC</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PANEL W/EGFR</td>
<td></td>
<td></td>
<td></td>
<td>RGA</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Test Name</th>
<th>In Range</th>
<th>Out of Range</th>
<th>Reference Range</th>
<th>Lab</th>
</tr>
</thead>
<tbody>
<tr>
<td>GLUCOSE</td>
<td>110 H</td>
<td>65-99 mg/dL</td>
<td></td>
<td>RGA</td>
</tr>
</tbody>
</table>

FASTING REFERENCE INTERVAL

<table>
<thead>
<tr>
<th>Test Name</th>
<th>In Range</th>
<th>Out of Range</th>
<th>Reference Range</th>
<th>Lab</th>
</tr>
</thead>
<tbody>
<tr>
<td>UREA NITROGEN (BUN)</td>
<td>17</td>
<td>7-25 mg/dL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CREATININE</td>
<td>0.9</td>
<td>0.5-1.2 mg/dL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GFR ESTIMATED</td>
<td>&gt;60</td>
<td>&gt; 0.8 = 60 mL/min/1.73m²</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BUN/CREATININE RATIO</td>
<td>19</td>
<td>6-25 (calc)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SODIUM</td>
<td>140</td>
<td>135-146 mmol/L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>POTASSIUM</td>
<td>4.6</td>
<td>3.5-5.3 mmol/L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHLORIDE</td>
<td>103</td>
<td>98-110 mmol/L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CARBON DIOXIDE</td>
<td>23</td>
<td>21-33 mmol/L</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
- 27 y/o male Olympic Weightlifter
- Anterior knee pain
- Tried numerous soft tissue techniques
- OTC Ibuprofen

<table>
<thead>
<tr>
<th>Test Name</th>
<th>In Range</th>
<th>Out of Range</th>
<th>Reference Range</th>
<th>Lab</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LIPID PANEL</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TRIGLYCERIDES</td>
<td>217 H</td>
<td>&lt;150 mg/dL</td>
<td>RGA</td>
<td></td>
</tr>
<tr>
<td>CHOLESTEROL, TOTAL</td>
<td>226 H</td>
<td>&lt;200 mg/dL</td>
<td>RGA</td>
<td></td>
</tr>
<tr>
<td>HDL CHOLESTEROL</td>
<td>11 L</td>
<td>&gt; OR = 40 mg/dL</td>
<td>RGA</td>
<td></td>
</tr>
<tr>
<td>LDL-CHOLESTEROL</td>
<td>172 L</td>
<td>&lt;130 mg/dL (calc)</td>
<td>RGA</td>
<td></td>
</tr>
</tbody>
</table>

DESIURABLE RANGE <100 MG/DL FOR PATIENTS WITH CHD OR DIABETES AND <70 MG/DL FOR DIABETIC PATIENTS WITH KNOWN HEART DISEASE.

<table>
<thead>
<tr>
<th>Test Name</th>
<th>In Range</th>
<th>Out of Range</th>
<th>Reference Range</th>
<th>Lab</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CHOL/HDLC RATIO</strong></td>
<td>20.5 H</td>
<td>&lt;5.0 (calc)</td>
<td>RGA</td>
<td></td>
</tr>
<tr>
<td>GGT</td>
<td>15</td>
<td>3-80 U/L</td>
<td>RGA</td>
<td></td>
</tr>
<tr>
<td>LD</td>
<td>138</td>
<td>100-250 U/L</td>
<td>RGA</td>
<td></td>
</tr>
<tr>
<td>MAGNESIUM</td>
<td>1.9</td>
<td>1.5-2.5 mg/dL</td>
<td>RGA</td>
<td></td>
</tr>
<tr>
<td>PHOSPHATE (AS PHOSPHORUS)</td>
<td>3.8</td>
<td>2.5-4.5 mg/dL</td>
<td>RGA</td>
<td></td>
</tr>
<tr>
<td>URIC ACID</td>
<td>4.0</td>
<td>2.7-8.2 mg/dL</td>
<td>RGA</td>
<td></td>
</tr>
<tr>
<td>IRON AND TOTAL IRON BINDING CAPACITY</td>
<td>56</td>
<td>40-190 mcg/dL</td>
<td>RGA</td>
<td></td>
</tr>
<tr>
<td>IRON, TOTAL</td>
<td>317</td>
<td>250-400 mcg/dL</td>
<td>RGA</td>
<td></td>
</tr>
<tr>
<td>IRON BINDING CAPACITY</td>
<td>18</td>
<td>15-50% (calc)</td>
<td>RGA</td>
<td></td>
</tr>
<tr>
<td><strong>COMPREHENSIVE METABOLIC</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PANEL W/EGFR</td>
<td>77</td>
<td>65-99 mg/dL</td>
<td>RGA</td>
<td></td>
</tr>
<tr>
<td>GLUCOSE</td>
<td></td>
<td>FASTING REFERENCE INTERVAL</td>
<td>RGA</td>
<td></td>
</tr>
<tr>
<td>UREA NITROGEN (BUN)</td>
<td>14</td>
<td>7-25 mg/dL</td>
<td>RGA</td>
<td></td>
</tr>
<tr>
<td>CREATININE</td>
<td>1.2</td>
<td>0.5-1.4 mg/dL</td>
<td>RGA</td>
<td></td>
</tr>
<tr>
<td>GFR ESTIMATED</td>
<td>&gt;60</td>
<td>&gt; OR = 60 mL/min/1.73m2</td>
<td>RGA</td>
<td></td>
</tr>
<tr>
<td>IF THE PATIENT IS AFRICAN-AMERICAN, PLEASE MULTIPLY THIS RESULT BY 1.21. THIS RESULT HAS BEEN CALCULATED ASSUMING THE PATIENT IS NON-AFRICAN AMERICAN.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BUN/CREATININE RATIO</td>
<td>12</td>
<td>6-25 (calc)</td>
<td>RGA</td>
<td></td>
</tr>
<tr>
<td>SODIUM</td>
<td>138</td>
<td>135-146 mmol/L</td>
<td>RGA</td>
<td></td>
</tr>
<tr>
<td>POTASSIUM</td>
<td>4.2</td>
<td>3.5-5.3 mmol/L</td>
<td>RGA</td>
<td></td>
</tr>
<tr>
<td>CHLORIDE</td>
<td>105</td>
<td>98-110 mmol/L</td>
<td>RGA</td>
<td></td>
</tr>
</tbody>
</table>
Take-Away Questions

1. What other tests that you order offers four ways to assess the patient?
2. What other test do you order that is diagnostic, but also specifies how to treat your patient?
3. Can you order another test that can be used in as many clinical scenarios?
4. What other test do you offer that uses living tissue as the testing specimen?