Piecing Together Nutrient Deficiencies to Get the Bigger Picture

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Become a better story teller

- The 5 most common nutrient deficiency patterns
- Understand the meaning of nutrient deficiencies at a deeper level
- Help patients understand without getting bogged down in details
- Increase your speed of micronutrient test interpretation
- Simplify treatment strategies by eliminating the need to supplement individual nutrient deficiencies
Share the story, skip the details

- Do you remember the story or know the details?
- Why do we remember stories?
  - They have a personal element
  - There is a connection
  - People relate, most stories have a struggle
  - Struggle gives meaning, it gives value
  - Stories are more easily recalled and make sense even without all of the details
- Details are easily forgotten
  - We are used to hearing details and facts, we forget them
- How do we relate this to interpretation of testing?
The patient take away

- Patients are easily distracted
  - “Information overload”
- They need something they can continue to reference
- Refresh their memory of why they are following through with the recommendations that you have made
- People are more likely to take an action from an emotional stimulus
- People are less likely to take action on logic
  - Logic is not emotionally stimulating
The interpretation story

**The Story**

- Looking at combinations of nutrients
  - Synergistic nutrients
  - Large groupings of nutrients
  - Strengthens the rationale of the presentation to the patient
  - Not basing the story off of a single nutrient
  - More of a connection to the patient when you share with them

**The Details**

- Isolating single nutrients
  - Appropriate to look at as the clinician
  - Easy for the patient to become fixated on individual nutrients
  - Tendency to want to prioritize one nutrient over another
  - Less connection when you are just giving facts
Building the story with the interpretation

The 5 most common nutrient deficiency patterns:

1. Dysglycemia
2. Dysbiosis
3. Autoimmunity
4. Chronic sympathetic neurological state
5. Chronic oxidation
Dysglycemia

- Hypoglycemia / hyperglycemia
- Reduction in insulin secretion
  - Not just Type I Diabetes
- Insulin receptor insensitivity
- Breakdown in second messenger systems
- Impairment of glucose uptake
- Decreased uptake of glucose by adipocytes
- Increased urinary excretion of minerals
Zinc

In adipose tissue, zinc facilitates insulin signaling. Circulating zinc levels are altered in obesity, diabetes, and PCOS; and zinc supplementation can ameliorate metabolic disturbances in PCOS.

Front Endocrinol (Lausanne). 2017 Mar 2;8:38.

Zinc (Zn) is a trace element with anti-diabetes mellitus (anti-DM) effects. Zn complexes exhibit stronger insulin-like activity than Zn ions.

Zinc

- Metabolic syndrome (MS) involves pathophysiological alterations that might compromise zinc status.

- There were significant associations between zincuria and fasting blood glucose concentration, waist circumference, triglyceride concentration, glycated hemoglobin concentration, homeostatic model assessment-insulin resistance (HOMA-IR) and high-sensitivity C-reactive protein concentration in the Metabolic Syndrome group.

Nutrients. 2017 Feb 22;9(2).
Chromium

This article concentrates on three trace metals (selenium, vanadium, and chromium) that may play crucial roles in controlling blood glucose concentrations possibly through their insulin-mimetic effects.


Our results indicate that combining peroral supplementation with Cr and Mg improves IR more effectively than Cr or Mg alone, and this may be attributable to increased induction and repression, respectively, of GLUT4 and GSK3β expression.

Chromium

Our results indicated that plasma chromium concentrations were inversely associated with T2DM and pre-DM in Chinese adults.

Nutrients. 2017 Mar 17;9(3).
Magnesium

Body mass index, glycated hemoglobin, serum glucose, insulin concentrations, and homeostatic model assessment of insulin resistance (HOMA-IR) were negatively associated with SMC (serum magnesium concentration).

Nutrients. 2017 Mar 17;9(3).
Dysglycemic Pattern

Hyperglycemic

- Minerals
  - Cr, Vn, Zn, Mg, Mn, Se, Cu
- B Vitamins
  - B₁, B₃, B₈
- Fat-soluble
  - Vitamin D
- Water-soluble
  - Vitamin C

Hypoglycemic

- Nutrients in increasing order of relevance:
  - B₅
  - Cu
  - Glutamine
  - Vitamin C
  - Serine
What’s the alternative?

Not surprisingly, guanylurea (Metformin transformation product) has also been detected in surface water, groundwater, and drinking water.

Available information on ecotoxicoological effects of metformin suggests that metformin is a potential endocrine disruptor and thus further emphasising the threat this drug could pose to our environment.

Emerging mechanism: the perfect storm

Metabolism Disrupting Chemicals and Metabolic Disorders

Environmental chemicals with endocrine activity can alter programming of metabolism; this fact, along with the importance of diet during development and throughout life on metabolism, and the role for exercise in controlling weight and glucose metabolism, leads to the perfect storm for metabolic disease.

Reproductive Toxicology 68 (2017) 3–33.
Mechanisms of Adipocyte Formation and Sites of Action of Metabolism Disruptors.

1. Increased adipogenic commitment
   - BADGE
   - Firemaster 550
   - Fludioxonil
   - Quinoxyfen
   - Tributyltin
   - Triflumizole

2. Increased adipocyte differentiation
   - Acetamiprid
   - BADGE
   - BDE-47
   - BPA
   - DES
   - Dioxin
   - Forchlorfenuron
   - PCB-77
   - Pymetrozine
   - Quinoxyfen
   - Spirodiclofen
   - Tebupirimfos
   - Triphenyltin
   - Triflumizole

3. Increased adipocyte proliferation (in vivo)
   - BPA
   - DES
   - Nicotine
   - PCB-77
   - Tributyltin

4. Increased lipid uptake (in vivo)
   - BPA
   - Nicotine
   - PCB-77
   - Tributyltin
Regulation of pancreas beta cell control of blood glucose and sites of action of metabolism disruptors.
Regulation of hepatic lipid metabolism and sites of action of metabolism disruptors.
**Associated nutrient deficiencies**

**Increased adipocyte activity / altered beta cell activity**
- **Minerals**
  - Cr, Vn, Zn, Mg, Mn, Se, Cu
- **B Vitamins**
  - B₁, B₃, B₈
- **Fat-soluble**
  - Vitamin D
- **Water-soluble**
  - Vitamin C

**Hepatic lipid metabolism**
- **Lipotropic agents**
  - Choline, Inositol
- **Methylation nutrients**
  - B₂, B₆, Folate, B₁₂, Serine, Mg, Zn
- **Nutrients to support conjugation**
  - Glutathione, Glutamine
- **Role of probiotics**
  - B vitamins, Vitamin K
Be the story teller

- Detect the dysglycemia or predisposition for it with the pattern of deficiencies
- Allow secondary patterns to tell the underlying cause
- If there is not a secondary pattern, why did the patient develop the nutrient deficiencies that are placing them at risk?
- The story: beginning, plot, climax, ending
- This is how the nutrients deficiencies developed
- These are the symptoms that resulted and lead you to a significant point to take action (climax)
- How are you going to help them resolve it (ending)?
Dysbiosis

- Effects on nutrients
  - Malabsorption
  - Increased competition for nutrients
  - Lack of production by commensal microbiota
  - Increased demand in the intestinal environment
Small Bowel Bacterial Overgrowth: Presentation, Diagnosis, and Treatment

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Introduction

When overgrowth of bacteria occurs in the small bowel proximal to the distal ileum, symptoms of vitamin mal-absorption, malnutrition, and weight loss may occur. This clinical entity is known as blind loop, stagnant loop syndrome, or small bowel bacterial overgrowth (SBBO) syndrome. In this syndrome, the enteric flora of the proximal small intestine resemble those of the healthy colon [1]. The high concentration of bacteria interferes with normal small bowel nutrient absorption, and patients develop malnutrition and such gastro-enterologic symptoms as diarrhea, steatorrhea, and macrocytic anemia, which can significantly impair quality of life. Patients at risk are those with dysmotility.
Small bowel bacterial overgrowth (SBB0) syndrome is associated with excessive numbers of bacteria in the proximal small intestine. The pathology of this condition involves competition between the bacteria and the human host for ingested nutrients. This competition leads to intraluminal bacterial catabolism of nutrients, often with production of toxic metabolites and injury to the enterocyte. A complex array of clinical symptoms ensues, resulting in chronic diarrhea, steatorrhea, macrocytic anemia, weight loss, and less commonly, protein-losing enteropathy. Therapy is targeted at correction of underlying small bowel abnormalities that predispose to SBB0 and appropriate antibiotic therapy. The symptoms and signs of SBB0 can be reversed with this approach.
Additional nutrients

Symbiotic action of intestinal bacterial flora; synthesis of nicotinic acid, pyridoxine, folic acid and vitamin $B_{12}$ by intestinal flora.


In humans it has been shown that members of the gut microbiota are able to synthesize vitamin K as well as most of the water-soluble B vitamins, such as biotin, cobalamin, folates, nicotinic acid, pantothenic acid, pyridoxine, riboflavin and thiamine.

Increased demand

Apical glutamate – similar to glutamine – can decrease induced paracellular hyperpermeability. Extracellular conversion of glutamine to glutamate and subsequent uptake of glutamate could be a pivotal step in the mechanism underlying the protective effect of glutamine.

The role of glutamine

The presence of a need for glutamine strengthens the case for dysbiosis given the significance of glutamine in enterocyte restoration.
Significance of low Vitamin K

A significant portion of vitamin K is produced by the gut microbiota. Therefore, with either borderline or overt deficiencies, dysbiosis must be considered, as should the possible lack of plant intake, which would also promote this imbalanced state.
Nutrients associated with immune regulation

- Omega 3s: ALA, DPA, EPA, DHA
- Prebiotics, probiotics
- Polyphenols
  - Flavonoids
- Micronutrients
  - Vitamin D
  - Glutathione, Asparagine
  - Vitamin A
  - Selenium, Zinc
Vitamin D metabolites and immune modulation: endocrine, paracrine, and autocrine responses.

P.E. Norman, and J.T. Powell Circulation Research.
2014;114:379-393
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Asparagine

- Asparagine (N)-linked glycan
- Malformed N-glycans
  - Triggers innate recognition
  - Reveals that autoimmune tissue destruction can develop in the absence of adaptive immunity
  - Abnormal N-glycans mimic those commonly expressed by lower eukaryotes and prokaryotes, thereby providing an initiating signal for innate immune cell activation and subsequent pathologic autoimmunity.

*Immunology and Cell Biology* (2007) 85, 572–574
Glutathione

Depleted levels of the tripeptide reduced glutathione (GSH) have been linked to numerous conditions and its intracellular level is acknowledged as an indicator of immune system function.

Chronic sympathetic state

- Catabolic effects
- Increased demand for neuroendocrine activity
  - Hormones: B$_5$
  - Neurotransmitters: Copper
- Increased demand for ATP
  - Glycolytic, lipolytic, gluconeogenic, Kreb’s Cycle and ETC cofactors
  - B Vitamins, Mg, Mn, CoQ10
  - Glutamine
- Prolonged effects
  - Downregulation of the hippocampal region: Serine
  - Insulin receptor sensitivity downregulation: Vitamin C
Oxidative stress

- Individual antioxidants provide insight into areas of oxidative stress
- Reduction of oxidative burden is the therapeutic goal
- Commonly referenced polyphenols:
  - Resveratrol, Curcumin, Quercetin, Catechins
- Oxidative stress promotes induction of chronic disease
Vitamin E

Vitamin E refers to a family of compounds that function as lipid-soluble antioxidants capable of preventing lipid peroxidation. Naturally occurring forms of vitamin E include tocopherols and tocotrienols.

Recently, through metabolomics studies, we identified that α-tocopheryl nicotinate occurs endogenously in the heart and that its level is dramatically decreased in heart failure, indicating the possible biological importance of this vitamin E ester.

Antioxidants (Basel). 2017 Mar 13;6(1).
What story will you tell?

- Tell the complete story of what your patient presents with.
- Help them understand the full picture, not the details.
- Make the presentation of the big picture relate to how they feel most affected.
- Link multiple nutrients together to simplify the conversation with the patient.