INE INSTITUTE OF NUTRITIONAL ENDOCRINOLOGY

Blood Chemistry: Blood Sugar

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Medical Disclaimer: The information in this presentation is not intended to replace a one-on-one relationship with a qualified health care professional and is not intended as medical advice. It is intended as a sharing of knowledge and information from the research and experience of Dr. Ritamarie Loscalzo, drritamarie.com, and the experts who have contributed. We encourage you to make your own health care decisions based upon your research and in partnership with a qualified health care professional.

Blood Sugar Markers

- ✓**Glucose - fasting:** Ideal 75 - 85
- ✓**Triglycerides:** Ideal 50 - 100
- ✓**Insulin:** Ideal 2 - 5

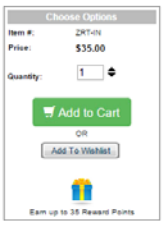
Follow-up if glucose above the optimal range or if clinical findings suggest blood sugar issues:

- ➢Hemoglobin A1C
- ➢Glucose meter

If fasting glucose is high and hemoglobin A1C is normal, it may be a vitamin B1 deficiency (which also has CO2 <25, LDH <140)

Home Testing for Insulin

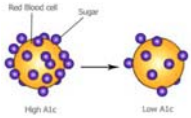
Fasting Insulin Blood Spot Test



http://www.drritamarie.com/go/BloodSpotInsulin

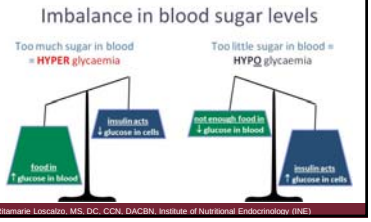
Hemoglobin A1C

- ✓ Indirect measure of blood sugars over a **120-day period**
- ✓ Glucose gets **attached to hemoglobin** when levels of blood sugar are high
- ✓ **Glycosylation is irreversible** – you'll only see a change after 120 days when all RBCs have replaced themselves
- ✓ Good **long-term measure** of glucose control
- ✓ Run when glucose is high or low or follow-up for diabetes
- ✓ **Optimal range:** 4.5 - 5.0 %
- ✓ Can be **decreased in hypoglycemia** or hemolytic anemia, blood loss, and pregnancy



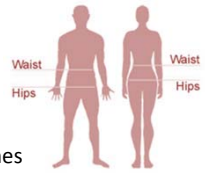
Blood Sugar Imbalance Conditions

- ✓ **Hypoglycemia**
  - ➢ Low Blood Sugar
- ✓ **Insulin Resistance**
  - ➢ Metabolic Syndrome
- ✓ **Diabetes**
  - ➢ Type 1
  - ➢ Type 2



Insulin Resistance

- ✓ High glucose (> 100, less than 120)
- ✓ Possible hemoglobin A1C > 5.7
- ✓ Fasting insulin > 5
- ✓ Increased weight around the waist
  - ➢ Waist: hip ratio > or equal to 1 in a male, or waist > 40 inches
  - ➢ Waist: hip ratio > or equal to 0.8 in a female, or waist > 35 inches



Syndrome X
aka Metabolic Syndrome

- ✓ Increased risk of cardiovascular disease
- ✓ Triglycerides > 110 or 1.24 mmol/L
- ✓ Total cholesterol > 220 or 5.69 mmol/L
- ✓ HDL cholesterol < 55 or 1.42 mmol/L
- ✓ Glucose > 100
- ✓ Fasting insulin > 5
- ✓ High blood pressure
- ✓ Hemoglobin A1C > 5.7
- ✓ Increased weight around the waist
  - ➢ Waist: hip ratio > or equal to 1 in a male, or waist > 40 inches
  - ➢ Waist: hip ratio > or equal to 0.8 in a female, or waist > 35 inches

Assessment of Diabetes

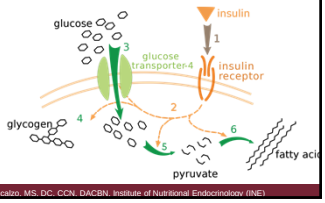
- ✓ **High Glucose:** > 120 on 2 tests
- ✓ **Hemoglobin A1C:** > 6.5 [1]

1 http://www.drritamarie.com/go/Ref6RoleA1CAssayDiabetes

- ✓ **Triglycerides:** > 110 usually
- ✓ **Cholesterol:** > 220 usually
- ✓ **HDL:** < 55 usually
- ✓ **Blood Pressure:** increased

Normal Insulin Function

- ✓ After a meal, the increased glucose and/or amino acids in the blood **cause the pancreas to secrete insulin**.
- ✓ Insulin binds to the cell membranes and **triggers glucose receptors** in cell membrane.
- ✓ Glucose, amino acids, fats, magnesium, and other nutrients **transported into the cell**.
- ✓ Once the nutrients are cleared from the blood, **the pancreas stops secreting insulin.**

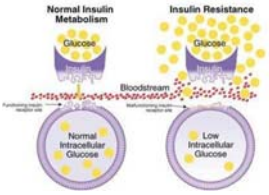


Effects of Insulin Binding

- ✓ Preferential use of **glucose over fat** as fuel
- ✓ **Inhibits the burning of fat** by the cells
- ✓ Inhibits growth hormone
- ✓ Slightly depresses thyroid effects by **blunting conversion of T-4 to T-3**

Insulin Resistance Effects

- ✓ Either the **circulating insulin does not bind** to the insulin receptors on the cell…
- ✓ Or it binds, but its effects are deficient and the **nutrients are not efficiently cleared** from blood.
- ✓ Pancreas continues to **secrete more insulin** causing high levels of insulin for a long period of time before nutrients are cleared.
- ✓ Results in deficient function in insulin resistant cells (liver, fat, untrained muscle).



Negative Effects of Insulin Resistance

- ✓ **Deficient function** in insulin resistant cells due to insufficient energy production
- ✓ **Excess anabolic effects:** increased body fat, especially around the middle
- ✓ **Oxidation in non-insulin-resistant cells** exposed to excess insulin - i.e. damage to blood vessel linings
- ✓ **Systemic inflammation:** elevated inflammatory marker
- ✓ **Hypertension:** "thick" blood, water retention, suppressed fat burning
- ✓ **Adverse systemic effects** of blunted growth hormone and thyroid hormone

What Causes Insulin Resistance?

- ✓ **Genetic predisposition:** By age 60, 40% of Americans have at least 3 markers and 60 - 70% have at least one
- ✓ **Omega-3 deficiency:** DHA (Docosahexaenoic acid)
- ✓ **⇑ Omega 6:3 ratio** or trans fats in cell membrane
- ✓ **Deficiencies** of chromium, magnesium, zinc, B-vitamins, and possibly boron and lithium
- ✓ **Lack of resistance exercise,** manual labor, and trained muscle mass
- ✓ **Sugar,** processed foods, starches, fruit juices and soda
- ✓ **Stress** via hypercortisolemia
- ✓ **Insufficient protein** or protein malabsorption

Blood Sugar Tracking

✓ Glucometer

http://www.drritamarie.com/go/GlucoseMeter

✓ Hemoglobin A1C

http://www.drritamarie.com/go/HemoglobinA1C

Home Glucose Tolerance Test

1. Measure fasting blood sugar.
2. Eat a test meal. Write down exact ingredients, including amounts of each food or beverage.
3. Measure blood sugar immediately after meal.
4. Measure blood sugar ½ hour after meal.**
5. Measure blood sugar 1 hour after meal.
6. Measure blood sugar at 2, 3, 4, 5 and 6 hours after meal.

*** even better to measure every 15 minutes for 90 minutes*

Do with several representative test meals.

Glucose Tolerance Test Results

✓Max should be 110

✓Ideal peak 99 - 100

✓Blood sugar never dips below starting point

Consequences of Insulin Resistance

- ✓ Cardiovascular disease
  - ➢ Effects on triglycerides
  - ➢ Up regulates cholesterol synthesis
  - ➢ Effects on coagulation
  - ➢ Lowers HDL
- ✓ Hypertension
- ✓ Weight loss resistance – leptin resistance
- ✓ Fatty liver and impairs detoxification
- ✓ Leads to androgen dominance – PCOS
- ✓ Reduction in glutathione and phase II liver detoxification
- ✓ Cancer: pancreatic, colon, and breast

Medications That Hinder Insulin Regulation and Blood Sugar

Hyperglycemia

- ✓ Corticosteroids
- ✓ Phenytoin (anti-seizure meds)
- ✓ Estrogen (birth control pills, estrogen replacement therapy)
- ✓ Thiazides (diuretics)

Hypoglycemia

- ✓ Alcohol
- ✓ Insulin
- ✓ Propranolol (hypertension RX)
- ✓ Oral diabetes medications

Latent Autoimmune Diabetes in Adults (LADA)

- ✓ **Glutamic Acid Decarboxylase Antibodies** (GADA): Causes increased glutamate and decreased GABA in pancreas
- ✓ **Insulin Antibodies:** Attack insulin
- ✓ **Islet Cell Antibodies:** Attack insulin producing cells in pancreas
- ✓ **Zinc transporter autoantibodies** (ZnT8): Attack the protein responsible for the uptake of zinc in the membrane of insulin secretory granules
- ✓ **Tyrosine phosphatase antibodies:** Attack the protein that regulates cytokine-induced pancreatic beta cell apoptosis
- ✓ **C-Peptide:** Low - measures residual beta cell function by determining the level of insulin secretion

Blood Sugar Case - Hypoglycemia

CATEGORIES	Units	PATHOLOGICAL RANGE Min	PATHOLOGICAL RANGE Max	FUNCTIONAL RANGE Min	FUNCTIONAL RANGE Max	CURRENT 27/02/10
Lab Corp Markers						
Glucose, serum	mg/dl	65.0	110.0	75.0	89.0	74
TSH	mIU/L	0.3	5.7	1.8	3.0	7.17
Thyroxine (T4)	ug/d	4.5	12.5	6.0	12.0	
T3 Uptake	mg/dl	27.0	37.0	28.0	38.0	
Free Thyroxine Index	mg/dl			1.2	4.9	
Total Triiodothyronnine (TT3)	ng/dL			100.0	180.0	
Free T4	ng/dL			1.0	1.5	1.227
Free T3	pg/mL			300.0	450.0	275.32
LDH	U/L	89.0	215.0	140.0	180.0	273