

What Tests Are Important And Why

#### RECOMMENDED TESTS MINIMUM

- Complete blood count
- Comprehensive metabolic panel
- G6PD if giving high dose vitamin C/H2O2/Ozone
- Urine dipstick
- Check with your laboratory for values of any lab tests



#### SUPPLEMENTAL TESTS TO BETTER GUIDE TREATMENT

- Amino acids
- Organic acids
- Intracellular minerals
- MTHFR
- NMR Lipoprofile
- Iodine



#### **GENERAL TEST CLASSIFICATION**

- Renal function tests help to determine:
  - Allowable fluid load
  - Nutrient or drug dose
  - Infusion rate
- Liver function tests are essential because:
  - What nutrients or drugs are safe
  - What nutrients or drugs are indicated



#### **COMPLETE BLOOD COUNT**

- White blood cell count
- RBC
- Hgb
- MCV
- Platelet count



#### WBC



- Normal 5-10 X 10<sup>3</sup> /mm<sup>3</sup>
- Optimal 5-7.5 X 10<sup>3</sup> /mm<sup>3</sup>
- Low immunosuppression, toxic metals, acute or chronic infections
- High viral (lymphocytes) or bacterial (neutrophils) infection, myeloproliferative (less mature)
- IV Rx: Vit. C, A, Zn, HCl



#### HGB & RBC



- Normal M 14-18 g/dL , F 12-16 g/dL
- Optimal M 14-15 g/dL, F 13.5-14.5 g/dL
- Low: anemia, need to classify, see MCV. If hemoglobinopathy be careful with vit. C, keep other dosages moderate
- High: Polycythemia: primary, tx similar to Myeloproliferative. Secondary, either chronic lung or environmental.
- Rx: vit. C, antioxidants



#### MCV



- Normal 80-95 /mm<sup>3</sup>
- Optimal 82-89.9 /mm<sup>3</sup>
- Low: iron, B<sub>6</sub> or Cu deficiency. Iron best given deep i.m. Z-trak method. Thalassemia, support with nutrition, DO NOT give iron.
- High: B<sub>12</sub>/folic acid and SAM-E deficiency, best to treat with these nutrients. If not responding, consider mercury toxicity



#### PLATELET COUNT

- Normal 150-400 X 10<sup>3</sup>, Optimal same
- < 50 or > 700 X 10<sup>3</sup>: be aware of possible bleeding/bruising at infusion site
- Rx Low: glutathione





# **B12**

- Options for B12 assessment:
  - Consider in frank macrocytosis
  - Serum B12
  - Methylmalonic Acid (MMA)
  - "Right Shift" (Hyper segmented neutrophils)



# **BLOOD GLUCOSE**

- Normal fasting 70-105 mg/dL
- Optimal 80-100 mg/dL
- Low: high dose vit. C can induce hypoglycemia, have patients snack or set up infusion in D5W.
- High: be aware of diabetic complications, sodium effects on hypertension, renal function
- Rx chromium





#### ALBUMIN

- Normal 4-5.5 g/dL
- Optimal 4-5 g/dL
- Low: liver disease, kidney disease, malnutrition, over hydration, inflammation, hypochlorhydria, oxidative stress, low vitamin C, hormone dysregulation (thyroid, testosterone, estrogen, aldosterone, and insulin)
- Rx: combination amino acids
- High: dehydration



#### AST

- Normal 5-40 IU/L
- High: MI, cardiac cell injury, liver disease, skeletal muscle disease, pancreatitis
- Low: B6 or Zinc deficiency possible
- IM injections may elevate levels



#### **A**LI

- Normal 5-35 IU/L
- Sig. Inc.: hepatitis, hepatic necrosis, ischemia
- Mod. Inc.: cirrhosis, cholestasis, tumor, drugs, obstructive jaundice
- Mild Inc.: myositis, pancreatitis, MI, inf. Mono
- Low: B6 or Zinc deficiency possible
- IM injections may elevate levels



#### ALKALINE PHOSPHATASE

- Children levels: 350 U/L
- Adult level: 25-100 U/L
- Low: zinc deficiency, magnenesium, Vit C/scurvy, B 6 folic acid, hypophosphatemia, celiac disease, malnutrition, hypochlorhydria, hypthryroidism, pernicious anemia, hypoparathyroism, excess vitamin D levels
- High: Oral contraceptives, Obstructive pancreatitis, Hepatitis/Mononucleosis/CMV, CHF, parasites, shingles, low vitamin D, healing fractures, RA, sepsis and GI diseases



#### GGT

- Normal M or F > 45 years 8-38 U/L
- F < 45 years 5-27 U/L
- Sensitive indicator of hepatobiliary disease.
- Indicator of heavy and chronic alcohol use.
- Increased after MI due to secondary liver insult, increased in EBV infections, infectious mono



#### BUN

- Normal 7-27 mg/dL
- Optimal 10-16 mg/dL
- Low: may decrease in chronic liver disease or inadequate protein intake
- High: primarily concerned with renal disease and ability to excrete IV metabolites. See creatinine for dosage recommendations.



#### CREATININE

- Normal 0.5-1.5 mg/dL
- Optimal 0.8-1.1 mg/dL
- Low: low muscle mass, cachexia
- High: primarily concerned with renal disease, some athletes supplementing with creatine will have increase.
- Doubling of creatinine suggests 50% reduction in glomerular filtration rate



#### URIC ACID

- Normal 2.3-8.2 mg/dL
- Optimal M 3.5-5.9 mg/dL, F 3.0-5.5 mg/dL
- High: Gout, atherosclerosis, oxidative stress, RA, renal disease, leaky gut syndrome, pre-eclampsia
- Low: Deficiency of molybdenum, B12, folic acid, copper; toxic metals, late liver disease
- B5 can help reduce eliminate uric acid from the body



#### CALCIUM

- Normal 9.0-10.5 mg/dL
- Vitamin C is a weak chelating agent, so in order to preserve Ca values it is useful to add 1 ml 10% Ca gluconate for each 10 grams vitamin C used
  - Calcium chloride may be used at about 1/3 the dose of calcium gluconate



#### ELECTROLYTES

NA, K, CL, CO<sub>2</sub>

- Dehydration will usually present with varying degrees of electrolyte imbalance; Lactated Ringers works well for this, 500 ml plain or with some nutrients added.
- Caution in patients with renal disease, especially sodium, potassium.
- More severe electrolyte imbalances need to be corrected with specific electrolytes, guided by HOSPITAL lab measurements, arterial blood gases.



#### ANION GAP (AG) INCREASED AG = "MUDPLIERS"

- **M** = Methanol intoxication (via conversion to formic acid)
- **U** = Uremia
- D = Diabetic or alcoholic ketoacidosis
- **P** = Paraldehyde
- L = Lactic acidosis
- I = Isoniazid, Iron overload, Ischemia
- **E** = Ethylene glycol intoxication
- R = Rhabdomyolysis
- S = Salicylate overdose



- Also consider a decrease in "unmeasured cations": Mg++, Ca++, K+
- 2 formulas may be used to calculate the AG, so be sure to get an idea of which formula the lab computer is using.

• 
$$AG = (Na + K) - (Cl + CO2)_{OR} AG = Na - (Cl+CO2)*$$



## **POTASSIUM (K)**

- Normal 3.5-5.3 mEq/L
- Panic value <2.5 or >7.0 mEq/L
- Optimal 4.0-4.5 mEq/L
- K level 3.5 commonly associated with deficiency
- Most common cause of low K in patients is water or NaCl infusion without adequate K replacement
- Glucose infusion in patients with heart disease can drop K levels as much as 0.4 mEq/L
- Remember hemolyzed sample with create a false elevation



#### G6PD

- Normal 2.4-5.1 U/mL of RBC or 8.6-18.6
  U/gram hemoglobin
- Low: G6PD deficiency. Vitamin C in sufficient concentration can cause RBC hemolysis
- Normal: May be falsely normal for 6-8 weeks after a hemolytic episode
- Increased: Untreated pernicious anemia, hyperthyroid, viral hepatitis, post MI



## **G**6PD

- Consider prior to H202, over 10 grams IVC, Ozone
- Pre treatment: NAC and Glutathione preserves or improves NADPH availability
  - Because RBC's lack ability to regenerate glutathione in the presence of G6PD deficiency
    - Any increase in H202 will damage cell
  - PO
  - IV
- Meter if you would like to do in house testing http://www.accessbio.net/eng/products/products03.asp



#### TOTAL BILIRUBIN

- Normal 0.1-1.5 mg/dL
- Increased: liver may not be able to effectively metabolize high doses of IV constituents, depends on cause: obstruction, cholestasis, hepatitis, cancer.
- Watch dosage of niacin
- Avoid IV vitamin A



#### URINALYSIS- URINE DIP

- Specific gravity Normal 1.005-1.030, Usually 1.010-1.025
- Low: Renal disease tends to diminish concentration capability, leads to consistent values of around 1.010. Over hydration also shows low values.
- High: dehydration





#### URINALYSIS- URINE DIP

- Glucose
- Normal is negative
- Positive: Indicates that blood glucose is over the renal threshold, about 170 mg/dL. Test blood with glucose meter. Adjust protocol appropriately, e.g amino acids can increase blood glucose. Have patient treat with insulin if needed



#### URINALYSIS- URINE DIP

- Protein
- Normal is negative
- Positive: Renal disease, acute infection, trauma, hypertension, malignancy, poisoning, toxemia.
- Urine dip protein testing shows many false positives; either retest on a different day or measure 24 hour quantitative protein



## **RENAL FUNCTION TESTING**



- Glomerular filtration rate (GFR) is the best method for determining renal function
- The most accurate method for measuring GFR is the renal clearance of <sup>125</sup>I-iothalamate
- 24-hour measured creatinine clearance overestimates GFR by 19%,



#### **RENAL FUNCTION TESTING**

 Cockcroft-Gault formula overestimates GFR by 16%.

#### Why the overestimates?

- Elderly patients with normal serum creatinine values and decreased muscle mass may have as much as 30% decrease in GFR despite a normal creatinine clearance
- Infants and young children exhibit low serum creatinine so GRF estimation by creatinine clearance is difficult and inaccurate



#### GFR – A BETTER METHOD

- Andrew Levey, et. al. developed an accurate method to predict GFR (Levey, AS et. al. Ann Intern Med 1999;130:461-470)
  - Validated in cohort of patients that differed from the cohort used to derive it
  - Predicts GFR over a wide range
  - Useful for changing the dose of medications excreted by glomerular filtration



#### GFR – A BETTER METHOD

- Identifies renal insufficiency
- Can detect progression of renal disease
- Detects end-stage renal disease
- Levey's formula uses demographic data and commonly available serum variables





#### THE LEVEY FORMULA



- GFR = 170 X  $[P_{CR}]^{-0.999}$  X [Age] $^{-0.176}$  X [0.762 if patient is female] X [1.180 if patient is black] X [BUN] $^{-0.170}$  X [Alb] $^{+0.318}$
- Legend: P<sub>CR</sub> = serum creatinine (mg/dL); BUN = blood urea nitrogen (mg/dL); Alb = serum albumin (g/dL)



#### **GFR ESTIMATION** THE BOTTOM LINE



- 1. GFR =  $0.69 \times 100/P_{CR}$
- 2. GFR = 0.84 X [Cockcroft-Gault equation]
- **3.** GFR = 0.81 X [Creatinine Clearance]
- 4. GFR = Levey Equation
- 5. GFR = >60 or the numerical value given by the reporting lab (using NIH guidelines), may be normal with diminished renal function



#### WEB SITE FOR LEVY FORMULA

www.nephron.com/cgibin/mdrd.cgi



## AMINO ACIDS BY PLASMA OR BLOOD SPOT

#### Amino acids

- An increased level of a particular amino acid is a strong sign that there is a problem with the body's ability to metabolize that amino acid
- Decreased levels of amino acids in the blood may indicate inadequate nutrition or certain medical conditions
- Plasma amino acids, examples Metametrix Clinical Laboratory Amino Acids 40 Profile – Plasma, Great Plains Laboratory Amino Acids Plasma Test
- Blood spot profile, example Metametrix Clinical Laboratory, Amino Acids 20 profile – Blood spot



#### CLINICAL APPLICATIONS – AMINO ACID TESTING

- Amino acid derangements
  - Chronic fatigue, usual treatments not working
  - Frequent headaches
  - Mental, neurological, or learning issues
- Example Histidine
  - Histadelia depression that does not respond to drug therapies
  - Histapenia, commonly associated with increased Cu, low Zn. Racing thoughts, hallucinations, paranoia



## **ORGANIC ACIDS**

- Organic acid molecules are byproducts of cellular metabolism, food digestion, and metabolism of gastrointestinal flora
- Useful for evaluation of intestinal yeast and bacteria health effects
  - Important in neurological, gastrointestinal, and movement disorders
  - Toxic metabolites of microorganisms can cause or worsen behavior & movement disorders, hyperactivity, energy levels, immune function
  - Can indicate increased intestinal permeability
  - ADHD



### VITAMIN D TESTS

- To evaluate vitamin D status order serum 25-OH vitamin D
  - Optimal level in range of 50-80 nmol/L
  - Recent research suggests that PTH levels and calcium absorption are not optimized until serum 25-hydroxyvitamin D levels reach approximately 80 nmol/L (32 ng/mL)

#### 1,25-dihydroxyvitamin D

- Useful if calcium is high or patient has a disease that may produce excess amounts of vitamin D, e.g. sarcoidosis, some forms of lymphoma
- Low values seen in renal failure



#### INTRACELLULAR MINERALS

- Optimal intracellular levels of minerals are required for normal cell function
- Blood mineral levels do not correlate well with intracellular levels
- Sample requirements depend on lab
  - Blood (WBC are tested), SpectraCell Laboratories
  - Epithelial cell scraping from the sublingual area, IntraCellular Diagnostics



#### MTHFR

- MTHFR is enzyme that converts 5,10methylenetetrahydrofolate to the product 5methyltetrahydrofolate
  - May lead to hyperhomocysteinemia and hypohomocysteinemia
- Manage labs
  - MTHFR, sulfur pathway, vitamins, minerals, thyroid (T3/T4)
- Increased risk for autism, cardiovascular & cerebral vascular disease, heavy metal toxins, Lyme, thrombosis, methotrexate toxicity, etc...



#### NMR LIPOPROFILE

- Cardiovascular disease historically evaulated by measuring LDL-C, HDL-C and triglycerides
- LDL-C has poor correlation with risk for CVD events
- About two-thirds of CVD patients have optimal levels of LDL-C but high Low Density Lipoprotein particle number (LDL-P actual particles of LDL concentration)
- LDL-P lowering useful as primary goal of therapy due to stronger association with cardiovascular risk, i.e., efficacy of treatments can be better evaluated.
- Low risk is < 1000 nmol/L, risk increases linearly to the range of very high risk at > 2000 nmol/L
  - LDL-P size is important, small dense LDL is antherogenic



## IODINE

- Random urine sample is the accepted test (blood may also be used)
  - Iodine value is optimal between 100 and 200 µg/liter. The Journal of Clinical Endocrinology & Metabolism Vol. 92, No. 3 1019-1022
- Iodine loading test as described by Guy Abraham, MD, does not have sufficient scientific basis
- Iodine skin absorption test is not reliable (Lugols')
- Labs: T3-T4 conversion, calcium levels and Vitamin D3 levels for further determination.



#### NUTRIENT EVALUATION LABS

- Blood Tests
  - Many vitamins, minerals, antioxidants, amino acids.
  - May be useful in customizing or making changes in your infusion.
- Hair
  - Not reliable for internal evaluations
  - Questionable with lead and mercury
  - Frequently tests extraneous sources
- Skin scanners
  - Variability and accuracy still in question



#### LABS

- Doctors Data Inc <u>www.doctorsdata.com</u>
- Genova <u>www.genovadiagnostics.com</u>
- Metametrix <u>www.metametrix.com</u>
- Spectracell <u>www.spectracell.com</u>
- Great Plains <u>www.greatplainslaboratory.com</u>
- Bio-Center <u>http://biocenterlab.org</u>
- LipoScience <u>http://www.liposcience.com</u>

