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Laboratory Values for Nutritional Assessment

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<div style="text-align: left; line-height: 1.5;">My last post principles of nutritional laboratory testing focuses on the purpose of nutritional laboratory testing, the specimen type, and the interpretation of laboratory data, this will lead us to various laboratory tests, their values, interpretation, reference range, limitations, and implications. It can also be seen as clinical chemistry.</div>

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<h2 style="text-align: left; color: #0e101a; background: transparent; margin-top: 0pt; margin-bottom: 0pt;">Protein Markers</h2>

<h3 style="text-align: left; color: #0e101a; background: transparent; margin-top: 0pt; margin-bottom: 0pt;">Test: Normalized Protein Catabolic Rate (nPCR)</h3>

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<div style="text-align: left; line-height: 1.5;">Principles: nPCR is determined by measuring the intradialytic appearance of urea in body fluids plus any urea lost in the urine in patients with residual renal function.</div>

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<div style="text-align: left; line-height: 1.5;">Interpretation: Useful in assessing Dietary Protein intake (DPI) in patients who are in a steady-state on hemodialysis, as a means toward determining adequate nutrition status.</div>

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<div style="text-align: left; line-height: 1.5;">Reference Range: 0.81-1.02 g UN/kg per day</div>

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<div style="text-align: left; line-height: 1.5;">Limitations and Implications: nPCR is considered superior to sAlb for monitoring nutrition protein status. In hemodialysis, the PCR can also reflect inadequate dialysis. For chronic (or continuous

ambulatory peritoneal dialysis patients the nPCR values has not been consistently predictive of outcome

Test: Urine creatinine (U: Cr)

Principles: urine creatinine ratio concentration in fasting, first-void urine used to compare amino acid catabolism (BUN) with muscle mass (creatinine)

Interpretation: The U: Cr is used in comparing other markers like microalbumin, albumin, GFR ratios.

Reference Range: low >12, Medium 6.0-12.0, High < .60

Test: Urea Urinary Nitrogen

Principles: The protein pool (visceral and somatic) N is catabolized to urea; urine urea represents ~80% of N catabolized; requires accurate estimate of protein intake; thus, usually used only for PN or tube-feeding patients.

Interpretation: UUN is compared with the actual N intake. Nitrogen Balance = Nitrogen intake (Protein g/day/4.25) - Nitrogen Losses (UUN (g) + 4)

Reference Range: ? = Catabolism, 0 = Catabolism, 1 = Anabolism (3-6 g/24 hr = optimal use range)

Limitations and Implications: 24-hour urine collection must be quantitative (complete); UUN not

appropriate in renal insufficiency; does not account for wound leakage, cell losses, or diarrhea; inaccurate in metabolically stressed patients.

Inflammatory Markers

Test: Albumin (ALB)

Principles: Easily and quickly measured colorimetrically; large body pool (3-5 g/kg body weight), -60% is outside the plasma in the extravascular pool; long half-life of 3 weeks.

Interpretation: Decreased levels can occur following acute and chronic inflammatory states; often associated with other deficiencies (i.e., zinc, iron, and vitamin A) reflecting that ALB transports (many small molecules)

Reference Range: 3.5-5 g/dL (35-50 g/L)

Limitations and Implications: Stable half-life -3 weeks. A negative phase reactant, impacted by inflammatory stress, protein-losing conditions and hemodilution. Hepatic proteins are indicators of morbidity and mortality.

Test: Transferrin (Tf or TFN)

Principles: The iron-bound globulin protein that responds to the need for iron.

Interpretation: Tf increased with low iron stores, and prevents the buildup of highly toxic excess unbound iron in circulation. In iron overload states Tf levels decrease. Because B6 is required for iron to bind to Hgb, B6 deficiency promotes increased Tf from the increase circulating iron that binds to Tf; smaller extravascular pool than albumin.

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Reference Range: Adult male: 215-365 mg/dL (2.15-3.65 g/L) Adult female: 250-380 mg/dL (2.50-3.80 g/L) Newborn: 130-275 mg/dL (1.3-2.75 g/L) Child: 203-360 mg/dL (2.03-3.6 g/L) Pregnancy and estrogen HRT associated with high Tf.

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Limitations and Implications: Lead can biologically mimic and displace iron thus releasing Fe into circulation and high Tf. Tf is a negative acute phase reactant diminished in chronic illness and hypoproteinemia.

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Test: Retinol-binding protein (RBP)**Principles:** Transport retinol; because of low molecular weight, RBP is filtered by the glomerulus and catabolized by the kidney tubule; half-life = 12 hours.

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Interpretation: Measure of inflammatory status.

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Reference Range: 2.6-7.6 mg/dL (1.43-2.86 mmol/L)

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Limitations and Implications: Sensitive to stress response; vitamin A and zinc deficiencies, and hemodilution; increased in chronic renal disease.

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Test: Fibrinogen**Principles:** Acute-phase reactant protein essential to the blood-clotting mechanism/coagulation system.

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Interpretation: Decreased fibrinogen related to prolonged Pro Time (PT) and Partial Thromboplastin Time (PTT); produced in the liver; rises sharply during tissue

inflammation or necrosis; association with CHD, stroke, myocardial infarction, and peripheral arterial disease.

Reference Ranges: 200-400 mg/dL If <100 mg/dL, increased risk of bleeding. Should be monitored in conjunction with blood platelet levels involved with coagulation status.

Limitations and Implications: Good test and retest reliability, and covariance are stable over time; diets rich in Omega 3/6 fatty acids reduce fibrinogen blood levels.

Metabolic Indicators

Test: Hemoglobin A1C (HgbA1C)

Principles: Glycosylated hemoglobin; dependent on blood glucose level over the life span of RBC (120 days); the more glucose the Hgb is exposed to, the greater the % HgbA1C.

Interpretation: Assessment of the mean glycemic blood level and of chronic diabetic control detecting for the previous 2-3 months.

Reference Ranges: Non-diabetic adult/ child: 4%-5.9% Controlled diabetes (DM): 4-7% Fair DM control: 7-8% Poor DM control: .8%

Limitations and Implications: HgbA1 measurement is a simple, rapid, and objective procedure. Home testing available.

Test: Insulin, fasting

Principles: Pancreatic hormone signaling cell membrane insulin

receptors to initiate glucose transport into the cell; test fasting 7 hours, or 1 or 2 hours postprandial; usually ordered with blood glucose test.

Interpretations:
Elevated levels associated with hyperinsulinemia related to metabolic syndrome; diagnosis of insulin-producing neoplasms; excess insulin associated with inflammatory conditions.

Reference Ranges: Adult values: Fasting 6-27 ?
IU/mL

Limitations and Implications: Good to test and retest reliability, and covariance is stable over time. Insulin antibodies may invalidate the test.

Test of Carbohydrate Absorption

Test: Lactose tolerance test

Principles: Lactose loading (50 g) followed by blood sampling at 5, 10, 30, 60, 90, and 120 min after dose; glucose produced from lactose is assayed.

Interpretation: Lactase deficiency associated with >20 mg/dL increase in serum Glucose

Reference ranges: Normal serum glucose Lactose increase >20 mg/dL

Limitations and Implications: The test is not specific (many false positives) or sensitive (many false negatives).

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bottom: 0pt;">Test: Fructose Sensitivity</h3>

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<div style="text-align: left; line-height: 1.5;">Principles: Blood lymphocyte specimen grown with a mitogen to measure growth by incorporating tritiated radioactive thymidine into the DNA of the cells A functional test of fructose metabolism.</div>

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<div style="text-align: left; line-height: 1.5;">Interpretation: Functional intracellular metabolic test of possible genetic errors compromising fructose metabolism like fructose-6-phosphate.</div>

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<div style="text-align: left; line-height: 1.5;">Reference Ranges: >34% patient’s growth response test media measured by DNA synthesis compared to optimal growth observed in 100% media. (valid for male and female of 12 years or older).</div>

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<div style="text-align: left; line-height: 1.5;">Limitations and Implications: Rule out fructose sensitivity in hypoglycemia of unknown etiology, overweight, obesity.</div>

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<h2 style="text-align: left; color: #0e101a; background: transparent; margin-top: 0pt; margin-bottom: 0pt;">Tests of Lipid Status</h2>

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<h3 style="text-align: left; color: #0e101a; background: transparent; margin-top: 0pt; margin-bottom: 0pt;">Test: High-Density Lipoproteins (HDL-c)</h3>

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<div style="text-align: left; line-height: 1.5;">Principles: LDL-c (and VLDL-c) are precipitated from the serum before measurement of residual HDL-c particle size; direct measurement of HDL-c is now done in some laboratories.</div>

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<div style="text-align: left; line-height: 1.5;">Interpretation: HDL-c is called “good cholesterol” to indicate that it is protective against atherosclerotic vascular development.</div>

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Ranges: Generally, levels should be above 40 mg/dL. The higher the better

Limitations and Implications: Some precipitation methods cause underestimation of HDL. HDL can be divided into classes: HDL1, HDL2, and HDL3; Elevated HDL3 correlates with the risk of CVD.

Test: Triglycerides (TGs)

Principles: Lipases release glycerol and fatty acids from TGs;

Interpretations: The association between TGs and CHD has been shown. Elevated TG increases blood viscosity.

Reference Ranges: <150 mg/dL normal >500 mg/dL high

Limitations and Implications: Fasting specimen is essential; sugar concentrated foods and alcohol ingestion can increase TG level; some anticoagulants may affect TG level; carnitine dependent fatty acids synthesis.

Bibliography

L, K., & L, R. (2017). Laboratory Values for Nutritional Assessment and Monitoring. In K. L, & R. L, Krause's Food and the Nutrition Care Process (pp. 984-987). Missouri:

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