HOW TO INTERPRET YOUR LAB RESULTS

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November 8, 2017

South Peninsula Hospital
Specialty Clinic

ROUTINE LAB TESTING

Glucose

Serum Chemistry

Liver Function Tests

Lipids

TSH

HbA1c

Vitamin D

CBC

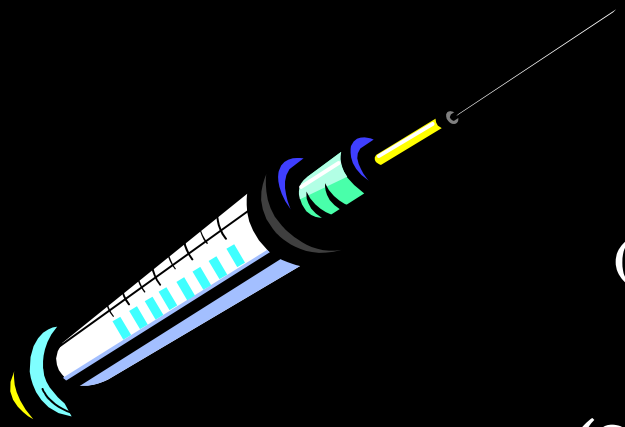
BLOOD SUGAR

Glucose provides energy

High blood glucose could be associated with pre-diabetes or diabetes

Insulin is produced in the pancreas and helps glucose move from blood to cells

TYPES OF GLUCOSE TESTS



Random Blood sugar

(non fasting)

Fasting Blood sugar

(nothing to eat or drink except H2O for 8 hrs)

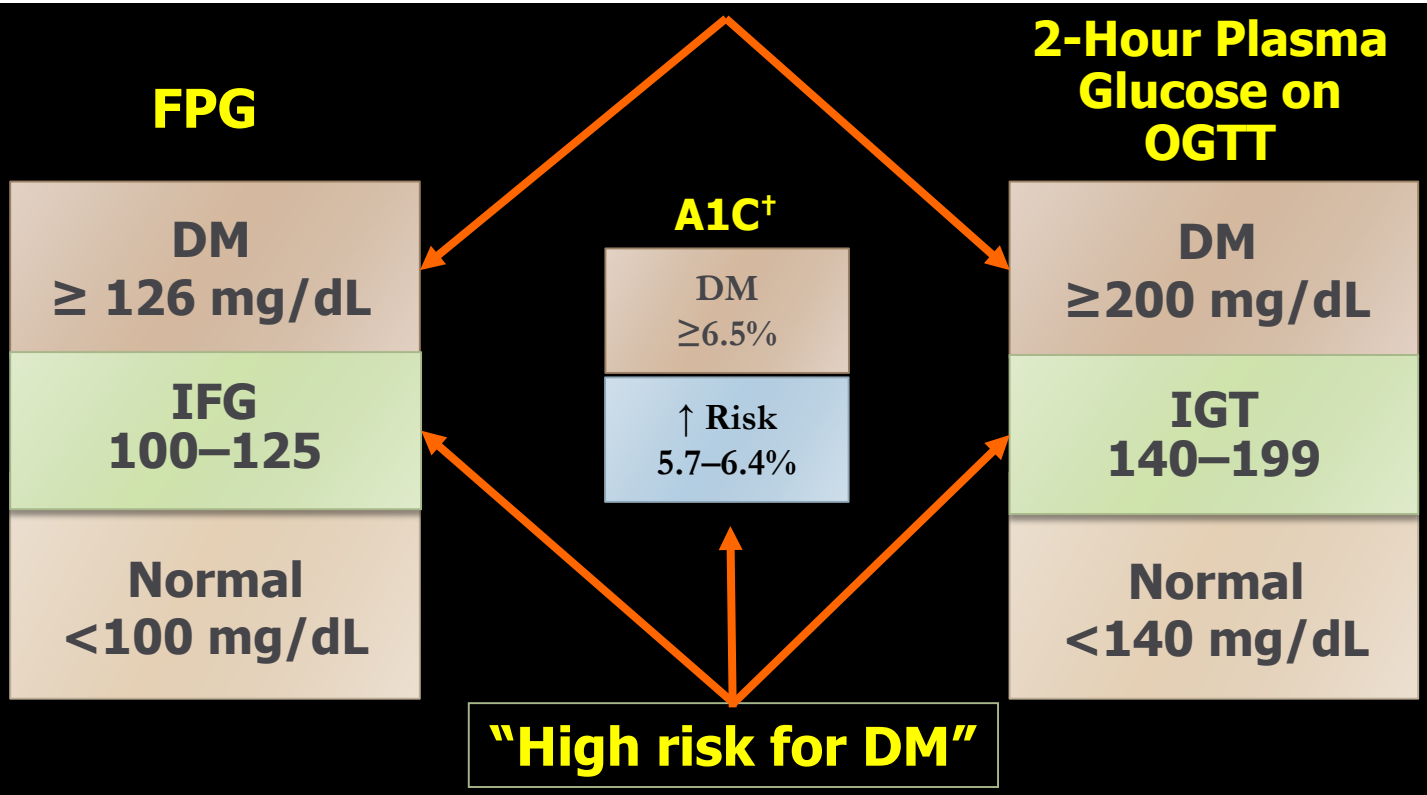
Glucose Tolerance Test

(Start with fasting glucose then after carb drink, measure glucose over time)

Hemoglobin A1c

(Measures glucose control over 3 months)

SCREENING AND DIAGNOSIS OF DIABETES



† A1C may not be an accurate tool in African, Asian, Hispanic, and other non-European ancestry; elevated TSH has been associated with falsely abnormal A1C.

1. ADA. Diagnosis and Classification of Diabetes Mellitus. *Diabetes Care*. 2010;33 (suppl 1):S62-S69. 2. Dagogo-Jack S. *Nat Rev Endorinol*. 2010;6:589-93. 3. Kim MK, et al. *Diabetes Care*. 2010;33:2546-48.

BLOOD CHEMISTRY TESTS

Electrolytes

Sodium

Potassium

Chloride

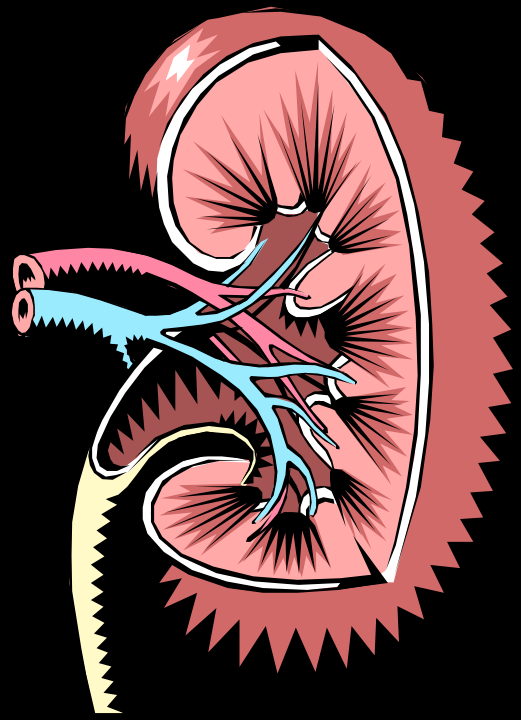
Bicarbonate

KIDNEY FUNCTION TESTS

Blood Urea Nitrogen

(BUN)

Creatinine



BLOOD UREA NITROGEN

The BUN measures the amount of *urea nitrogen* in the blood.

Urea is *formed in the liver* as the end product of *protein metabolism* and is transported to the kidneys for excretion.

Nearly all renal diseases can cause an inadequate excretion of urea, which causes the blood concentration to rise above normal.

CREATININE

Creatinine is a breakdown product of *creatine phosphate* used in skeletal muscle contraction.

Creatinine, as with blood urea nitrogen, is excreted entirely by the kidneys and blood levels are therefore proportional to renal excretory function.

The creatinine is frequently interpreted in conjunction with BUN

CARBON DIOXIDE CONTENT

The carbon dioxide content (CO2) measures the carbonic acid (H_2CO_3), dissolved CO_2 and bicarbonate ion (HCO_3) that exists in the serum.

Because the amounts of H_2CO_3 and dissolved CO_2 in the serum are so small, the CO2 content is an *indirect* measure of the HCO_3 anion

Therefore, clinicians most often refer to the CO2 measurement in the BMP as the "bicarbonate level" or "bicarb level"

Abnormalities/diagnoses include acid base disturbances

TOTAL CALCIUM

The total serum calcium is a measure of both

- Free (ionized) calcium
- Protein bound (usually to albumin) calcium

Therefore, the total serum calcium level is affected by changes in serum albumin

As a rule of thumb, the total serum calcium level decreases by approximately 0.8 mg for every 1 gram decrease in the serum albumin level.

LIVER FUNCTION TESTS

High enzymes can signal liver damage (meds, viral hepatitis, alcohol, NAFLD)

- ALT (SGPT)
- AST (SGOT)

- Bilirubin- direct and indirect

- Alkaline Phosphatase

- LDH

TOTAL PROTEIN

Albumin and globulin constitute most of the protein within the body and are measured in the total protein test

ALBUMIN

Albumin comprises ~ 60% of the total protein within the extracellular portion of the blood (Hb is the most abundant protein in whole blood)

Transports many important blood constituents

(drugs, hormones, enzymes)

Albumin is synthesized in the liver and therefore is also a measure of hepatic function

ALKALINE PHOSPHATASE (ALK PHOS OR ALP)

Alkaline phosphatase is an enzyme present in a number of tissues, including liver, bone, kidney, intestine, and placenta, each of which contains distinct isoenzyme forms

Isoenzymes are forms of an enzyme that catalyze the same reaction, but are slightly different in structure

The two major circulating alkaline phosphatase isoenzymes are bone and liver.

Therefore, elevation in serum alkaline phosphatase is most commonly a reflection of liver or bone disorders.

BILIRUBIN, TOTAL

The total serum bilirubin level is the sum of the conjugated (direct) and unconjugated (indirect) bilirubin.

Normally the unconjugated bilirubin makes up 70-85% of the total bilirubin

Remember that bilirubin metabolism begins with the breakdown of red blood cells in the reticuloendothelial system and bilirubin metabolism continues in the liver

Elevation in total bilirubin may therefore be a reflection of any aberrations in bilirubin metabolism or increased levels of bilirubin production (such as hemolysis)

ASPARTATE AMINOTRANSFERASE (AST)

AST is an enzyme that is present in hepatocytes and muscle cells (both skeletal muscle and cardiac)

Elevations in AST are most commonly a reflection of liver injury

May also be elevated in heart or skeletal muscle injury

FAT IN BLOOD: LIPIDS

Fat is a source of energy

Carries some vitamins

Helps make hormones

Helps make cell membranes

Fats are carried wrapped in lipoproteins

LIPIDS

Cholesterol

HDL (good cholesterol)

LDL (bad cholesterol)

Triglycerides

Non HDL

Two Different Prevention Approaches
Two Different Perspectives

Circulation
JOURNAL OF THE AMERICAN HEART ASSOCIATION

2013 ACC/AHA Guideline on the Treatment of Blood Cholesterol to Reduce Atherosclerotic Cardiovascular Risk in Adults: A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines

Neil J. Stone, Jennifer G. Robinson, Alice H. Lichtenstein, C. Noel Bairey Merz, Conrad B. Blum, Robert H. Eckel, Anne C. Goldberg, David Gordon, Daniel Levy, Donald M. Lloyd-Jones, Patrick McBride, J. Sanford Schwartz, Susan T. Shero, Sidney C. Smith, Jr, Karol Watson and Peter W. F. Wilson

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Journal of Clinical Lipidology (2014) 8, 473–488

Journal of
Clinical
Lipidology

Original Articles

National Lipid Association recommendations for patient-centered management of dyslipidemia: Part 1 – executive summary☆

Terry A. Jacobson, MD*, Matthew K. Ito, PharmD, Kevin C. Maki, PhD, Carl E. Orringer, MD, Harold E. Bays, MD, Peter H. Jones, MD, James M. McKenney, PharmD, Scott M. Grundy, MD, PhD, Edward A. Gill, MD, Robert A. Wild, MD, PhD, Don P. Wilson, MD, W. Virgil Brown, MD

2014 ACC/AHA Guidelines
Treatment focus to reduce atherosclerotic risk
Attempt to identify 4 statin groups

- Does the patient have a history of CAD or CVA?
- Is the LDL > 190 mg/dl?
- Does the patient have diabetes, 40-75 years old, with LDL 70-189 mg/dl?
- Does the patient have global ten-year risk score > 7.5% for primary prevention of risk assessment?

http://tools.cardiosource.org/ASCVD-Risk-Estimator/

NCEP INTERIM REPORT: LDL-C GOALS

Risk Level	Risk Category	LDL-C Goal (mg/dL)
Moderately High Risk	≥2 Risk Factors; 10-Year Risk 10%-20%	<130 <100†
High Risk	CHD or CHD Risk Equivalents; 10-Year Risk >20%	<100
Very High Risk	Established CVD Plus • Multiple Major Risk Factors • Severe and Poorly Controlled Risk Factors • Multiple Risk Factors of the Metabolic Syndrome • Acute Coronary Syndromes	<100 <70†

*When LDL-C–lowering drug therapy is used, the intensity of therapy should be sufficient to achieve a 30%-40% reduction in LDL-C; **Therapeutic lifestyle changes (TLC) should be initiated when LDL-C is at or above goal; any high-risk or moderately high-risk patient who has lifestyle-related risk factors is a candidate for TLC regardless of LDL-C level; †Optional LDL-C goal; ‡Consider drug options.

ELEMENTS OF THE CBC

RBC's: Red Blood Cells

WBC's: White Blood Cells

Platelets

WHAT IS MEASURED?

Red blood cell data

Total red blood cell count (RBC)

Hemoglobin (Hgb)

Hematocrit (Hct)

Mean corpuscular volume (MCV)

Red blood cell distribution width (RDW)

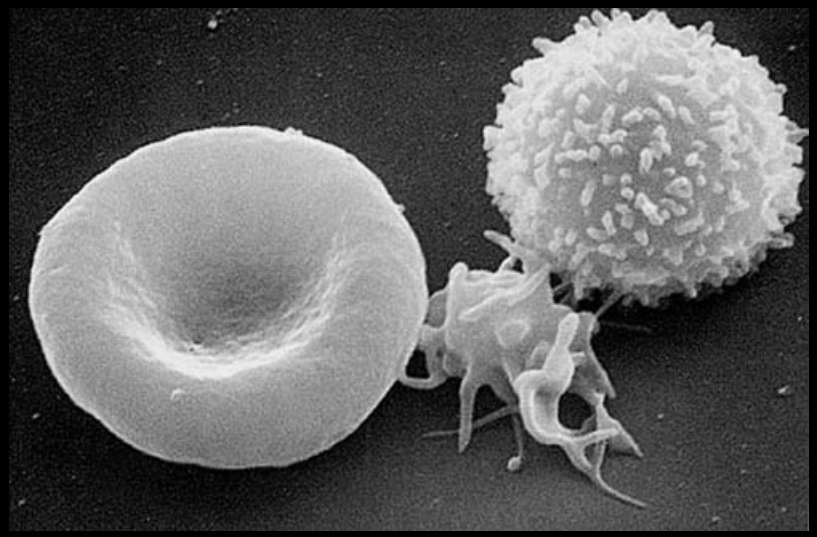
White blood cell data

Total white blood cell (leukocyte) count (WBC)

A white blood cell count differential may also be ordered

Platelet Count (PLT)

RED BLOOD CELL TESTS



- Erythrocytes

  "cytes" = cells
- Shaped like a bagel with hole covered
- Red Blood Cell count:

  total number of RBCs
- Hemoglobin (HGB): protein in RBC's that actually carries 02

RED BLOOD CELL TESTS

Hematocrit (HCT): measures the % of blood volume taken up by RBC's

Mean Corpuscular Volume (MCV): average volume (size) of RBC's

Mean Corpuscular Hemoglobin (MCH):
amt/concentration of hgb in average cell

- Platelets: help stop bleeding by forming clots. Low plt count: thrombocytopenia

HEMOGLOBIN

The hemoglobin concentration is a measure of the amount of Hb in the peripheral blood, which reflects the number of RBCs in the blood

Decrease in Hgb concentration =

Anemia

Increase in Hgb concentration =

Polycythemia

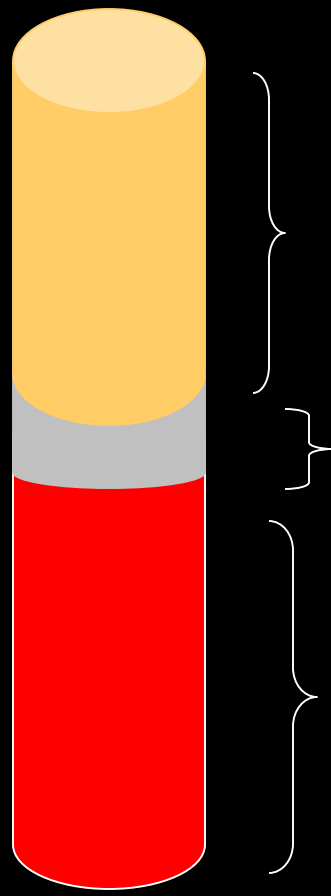
HEMATOCRIT

Hematocrit is a measure of the percentage of the total blood volume that is made up by the RBCs

The hematocrit can be determined directly by centrifugation ("spun hematocrit")

The height of the red blood cell column is measured and compared to the column of the whole blood

CENTRIFUGED BLOOD (NORMAL)



Plasma

Buffy coat (WBCs and Platelets)

Red blood cells

Normal Hct in adult males
40-54%
Normal Hct in adult females
34-51%

MEAN CORPUSCULAR VOLUME

The MCV is a measure of the average volume, or size, of an RBC

It is determined by the distribution of the red blood cell histogram

The mean of the red blood cell distribution histogram is the MCV

USE OF MCV RESULT

The MCV is important in classifying types of anemias

Normal MCV = normocytic anemia

Decreased MCV = microcytic anemia

Increased MCV = macrocytic anemia

WHITE BLOOD CELLS

WBC's are fighter cells

Some make antibodies

Some fight directly

Divided into types by how they look and what they do

WBC DIFFERENTIAL (DIFFERENT TYPES OF WBC'S)

5 types of white blood cells

Neutrophils

fight bacterial infections;

low count=neutropenia

Lymphocytes:

Kill viruses + regulate immune system

B cells make antibodies

MORE TYPES OF WBC'S

Monocytes or Macrophages

Fight infections by phagocytosis

Elevation can signifies infection

Eosinophils

Involved with allergies and reaction to parasites

Basophils

Seem to be involved in long term allergic response; not well understood

PLATELET COUNT (PLT)

A count of the number of platelets (thrombocytes) per cubic milliliter of blood

A decreased number of platelets =

Thrombocytopenia

An increased number of platelets =

Thrombocytosis

MCH AND MCHC

Both MCH and MCHC are of little clinical diagnostic use in the vast majority of patients

MCH is the hemoglobin concentration per cell

MCHC is the average hemoglobin concentration per total red blood cell volume

TSH

Thyroid Stimulating Hormone

A *screening test* for thyroid function

Normal values 1-2

Acceptable up to 3.5

Elevated TSH suggestive of low thyroid hormone

Suppressed or reduced TSH suggestive of elevated thyroid hormone

VITAMIN D

Metabolized in the liver, skin and kidneys

Functions as a hormone

Regulates numerous functions including calcium levels

Institute of Medicine (NIH)

Normal value 20-50