How to interpret your blood test results

Review your lab test results

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Overview

Laboratory tests are tools helpful in evaluating the health status of an individual. It is important to realize that laboratory results may be outside of the so-called "normal range" for many reasons. These variations may be due to such things as race, dietetic preference, age, sex, menstrual cycle, degree of physical activity, problems with collection and/or handling of the specimen, non-prescription drugs (aspirin, cold medications, vitamins, etc.), prescription drugs, alcohol intake and a number of non-illness-related factors, Any unusual or abnormal results should be discussed with your physician. It is not possible to diagnose or treat any disease or problem with this blood test alone. It can, however, help you to learn more about your body and detect potential problems in early stages when treatment or changes in personal habits can be most effective.

Our lab, like almost all labs, sets the normal result range for a particular test so that 95% of our healthy patients fall within the normal range. That means that 5% of our healthy patients fall outside of the normal range, even when there is nothing wrong with them. Thus an abnormal test does not necessarily mean that there is something wrong with you. Statistically if you have 20 or 30 individual tests run as part of a panel, chances are 1 or 2 will be slightly outside the normal range. Part of what you see your doctor for is to interpret whether or not these changes are significant.

This review is a brief summary and is not intended to be comprehensive or replace discussion of your results with your health care team.

Glucose: This is a measure of the sugar level in your blood. High values are associated with eating before the test, and diabetes.

The normal range for a fasting glucose is 60 -109 mg/dl. According the the 1999 ADA criteria, diabetes is diagnosed with a *fasting* plasma glucose of 126 or more. A precursor, Impaired Fasting Glucose (IFG) is defined as reading of fasting glucose levels of 110 - 125. Sometimes a glucose tolerance test, which involves giving you a sugary drink followed by several blood glucose tests, is necessary to properly sort out normal from IFG from diabetes.

Be aware that variations in lab normals exist. Also, Europeans tend to use a 2 hour after eating definition of diabetes rather than a fasting glucose. Using the European standards tends to increase the number of people who are classified as having diabetes.

Electrolytes: These are your potassium, sodium, chloride, and CO2 levels.

Potassium is controlled very carefully by the kidneys. It is important for the proper functioning of the nerves and muscles, particularly the heart. Any value outside the expected range, high or low, requires medical evaluation. This is especially important if you are taking a diuretic (water pill) or heart pill (Digitalis, Lanoxin, etc.).

Sodium is also regulated by the kidneys and adrenal glands. There are numerous causes of high and low sodium levels, but the most common causes of low sodium are diuretic usage, diabetes drugs like chlorpropamide, and excessive water intake in patients with heart or liver disease.

CO2 reflects the acid status of your blood. Low CO2 levels can be due to either to increased acidity from uncontrolled diabetes, kidney disease, metabolic disorders, or low CO2 can be due to chronic hyperventilation.

Waste products:

Blood Urea Nitrogen (BUN) is a waste product produced in the liver and excreted by the kidneys. High values may mean that the kidneys are not working as well as they should. BUN is also affected by high protein diets and/or strenuous exercise which raise levels, and by pregnancy which lowers it.

Creatinine is a waste product largely from muscle breakdown. High values, especially with high BUN levels, may indicate problems with the kidneys..

Uric Acid is normally excreted in urine. High values are associated with gout, arthritis, kidney problems and the use of some diuretics.

Enzymes

AST, ALT, SGOT, SGPT, and GGT and Alkaline Phosphatase are abbreviations for proteins called enzymes which help all the chemical activities within cells to take place. Injury to cells release these enzymes into the blood. They are found in muscles, the liver and heart. Damage from alcohol and a number of diseases are reflected in high values.

Alkaline phosphatase is an enzyme found primarily in bones and the liver. Expected values are higher for those who are growing (children and pregnant women) or when damage to bones or liver has occurred or with gallstones. Low values are probably not significant.

GGT is also elevated in liver disease, particularly with obstruction of bile ducts. Unlike the alkaline phosphatase it is not elevated with bone growth or damage.

AST/SGOT , ALT/ SGPT are also liver and muscle enzymes. They may be elevated from liver problems, hepatitis, excess alcohol ingestion, muscle injury and recent heart attack.

LDH is the enzyme present in all the cells in the body. Anything which damages cells, including blood drawing itself, will raise amounts in the blood. If blood is not processed promptly and properly, high levels may occur. If all values except LDH are within expected ranges, it is probably a processing error and does not require further evaluation.

Bilirubin: is a pigment removed from the blood by the liver. Low values are of no concern. If slightly elevated above the expected ranges, but with all other enzymes (LDH, GOT, GPT, GGT) within expected values, it is probably a condition known as Gilbert's syndrome and is not significant

CPK is an enzyme which is very useful for diagnosing diseases of the heart and skeletal muscle. This enzyme is the first to be elevated after a heart attack (3 to 4 hours). If CPK is high in the absence of heart muscle injury, this is a strong indication of skeletal muscle disease.

Proteins

Albumin and Globulin measure the amount and type of protein in your blood. They are a general index of overall health and nutrition. Globulin is the "antibody" protein important for fighting disease.

A/G Ratio is the mathematical relationship between the above.

Blood Fats

Cholesterol is a fat-like substance in the blood which, if elevated has been associated with heart disease.

Total Cholesterol: A high cholesterol in the blood is a major risk factor for heart and blood vessel disease. Cholesterol in itself is not all bad, in fact, our bodies need a certain amount of this substance to function properly. However, when the level gets too high, vascular disease can result. A total cholesterol of less than 200, and an LDL Cholesterol of 100 or less is considered optimal by the National Heart, Lung, and Blood Institute. The levels that your doctor will recommend depend upon whether you are at high risk for cardiovascular disease.

As the level of blood cholesterol increases, so does the possibility of plugging the arteries due to cholesterol plaque build-up. Such a disease process is called "hardening of the arteries" or atherosclerosis. When the arteries feeding the heart become plugged, a heart attack may occur. If the arteries that go to the brain are affected, then the result is a stroke.

There are three major kinds of cholesterol, High Density Lipoprotein (HDL) , Low Density Lipoprotein (LDL), and Very Low Density Lipoprotein (VLDL).

LDL Cholesterol is considered "bad cholesterol" because cholesterol deposits form in the arteries when LDL levels are high. An LDL level of less than 130 is recommended, 100 is optimal, values greater than 160 are considered high risk and should be followed up by your physician. Those persons who have established coronary or vascular disease may be instructed by their doctor to get their LDL Cholesterol well below 100. You should ask your doctor which LDL target he or she wants for you. There are two

ways to report LDL. The most common is simply an estimate calculated from the Total Cholesterol, HDL, and triglycerides results. This may say "LDL Calc" . A directly measured LDL Cholesterol is usually more accurate, but more expensive and may require that your doctor specify the direct LDL.

HDL cholesterol is a 'good cholesterol' as it protects against heart disease by helping remove excess cholesterol deposited in the arteries. High levels seem to be associated with low incidence of coronary heart disease.

Triglyceride is fat in the blood which, if elevated, has been associated with heart disease, especially if over 500 mg. High triglycerides are also associated with pancreatitis. Triglyceride levels over 150 mg/dl may be associated with problems other than heart disease. Ways to lower triglycerides: 1) weight reduction, if overweight; 2) reduce animal fats in the diet: eat more fish; 3) take certain medications your physician can prescribe; 4) get regular aerobic exercise; 5) decrease alcohol and sugar consumption— alcohol and sugar are not fats, but the body can convert them into fats then dump those fats into your blood stream 6) restrict calories - carbohydrates are converted to triglycerides when eaten to excess.

VLDL (very low density lipoprotein) is another carrier of fat in the blood.

Cardiac Risk Factors

C Reactive Protein (CRP): This is a marker for inflammation. Traditionally it has been used to assess inflammation in response to infection. However we use a highly sensitive C Reactive Protein which is useful in predicting vascular disease, heart attack or stroke.. The best treatment for a high C reactive protein level has not yet been defined, however statin drugs, niacin, weight loss, quitting smoking, and exercise all appear to improve C- Reactive Protein

Homocysteine: Homocysteine is an amino acid that is normally found in small amounts in the blood. Higher levels are associated with increased risk of heart attack and other vascular diseases. Homocysteine levels may be high due to a deficiency of folic acid or Vitamin B12, due to heredity, older age, kidney disease, or certain medications. Men tend to have higher levels. Our lab normals are 4 - 15 micromole/l , but if you have had previous vascular disease we may recommend medications to reduce it below 10. You can reduce your homocysteine level by eating more green leafy vegetables and fortified grain products or cereals. The usual treatment is folic acid with or without Vitamin B-12.

Lipoprotein (a) or Lp(a) : Elevated lipoprotein(a) (Lp[a]) concentrations are associated with premature coronary heart disease (CHD). The exact mechanism is not yet clear, but it appears that there is a strong genetic component to elevated Lp(a) levels that correlates with coronary disease. Persons with diabetes and a high Lp(a) level appear to be at increased risk of asymptomatic coronary disease.

Note that a few insurance companies refuse to pay for cardiac risk factor testing. As of this writing, Aetna stands out as a company that refuses to cover testing for homocysteine or Lp(a) on the basis that it is "experimental" or "investigational". We have asked for a comprehensive review of their policy since it deviates from the norm.

Minerals

Calcium is controlled in the blood by the parathyroid glands and the kidneys. Calcium is found mostly in bone and is important for proper blood clotting, nerve, and cell activity. An elevated calcium can be due to medications such as thiazide type diuretics, inherited disorders of calcium handling in the kidneys, or excess parathyroid gland activity or vitamin D. Low calcium can be due to certain metabolic disorders such as insufficient parathyroid hormone; or drugs like Fosamax or furosemide type diuretics.

Calcium is bound to albumin in the blood, so a low albumin level will cause the total calcium level in the blood to drop. You doctor can easily determine if this is significant or not.

Phosphorus is also largely stored in the bone. It is regulated by the kidneys, and high levels may be due to kidney disease. When low levels are seen with high calcium levels it suggests parathyroid disease, however there are other causes. A low phosphorus, in combination with a high calcium, may suggest an overactive parathyroid gland.

Thyroid

There are 2 types of thyroid hormones easily measurable in the blood, thyroxine (T4) and triiodothyronine (T3). For technical reasons, it is easier and less expensive to measure the T4 level, so T3 is usually not measured on screening tests.

Please be clear on which test you are looking at. We continue to see a tremendous amount of confusion among doctors, nurses, lab techs, and patients on which test is which. In particular, the "Total T3", "Free T3" and "T3 Uptake tests" are very confusing, and are not the same test.

Thyroxine (T4) . This shows the total amount of the T4. High levels may be due to hyperthyroidism, however technical artifact occurs when estrogen levels are higher from pregnancy, birth control pills or estrogen replacement therapy. A Free T4 (see below) can avoid this interference.

T3 Resin Uptake or Thyroid Uptake. This is a test that confuses doctors, nurses, and patients. First, this is not a thyroid test, but a test on the proteins that carry thyroid around in your blood stream. Not only that, a high test number may indicate a low level of the protein! The method of reporting varies from lab to lab. The proper use of the test is to compute the free thyroxine index.

Free Thyroxine Index (FTI or T7) : A mathematical computation allows the lab to estimate the free thyroxine index from the T4 and T3 Uptake tests. The results tell us how much thyroid hormone is free in the blood stream to work on the body. Unlike the T4 alone, it is not affected by estrogen levels.

Free T4 : This test directly measures the free T4 in the blood rather than estimating it like the FTI. It is a more reliable , but a little more expensive test. Some labs now do the Free T4 routinely rather than the Total T4.

Total T3: This is usually not ordered as a screening test, but rather when thyroid disease is being evaluated. T3 is the more potent and shorter lived version of thyroid hormone. Some people with high thyroid levels secrete more T3 than T4. In these (overactive) hyperthyroid cases the T4 can be normal, the T3 high, and the TSH low. The Total T3 reports the total amount of T3 in the bloodstream, including

T3 bound to carrier proteins plus freely circulating T3.

Free T3: This test measures only the portion of thyroid hormone T3 that is "free", that is, not bound to carrier proteins.

Thyroid Stimulating Hormone (TSH) : This protein hormone is secreted by the pituitary gland and regulates the thyroid gland. A high level suggests your thyroid is underactive, and a low level suggests your thyroid is overactive.

Glycohemoglobin (Hemoglobin A1 or A1c, HbA1c) : Glycohemoglobin measures the amount of glucose chemically attached to your red blood cells. Since blood cells live about 3 months, it tells us your average glucose for the last 6 - 8 weeks. A high level suggests poor diabetes control. Standardization for glycohemoglobin from lab to lab is poor, and you cannot compare a test from different labs unless you can verify the technique for measuring glycohemoglobin is the same. The only exception is if your lab is standardized to the national DCCT referenced method. You can ask your lab if they use a DCCT referenced method.

FYI, at Amarillo Medical Specialists we do use a test method that is DCCT referenced.

Hormones

Insulin : Insulin is secreted by the pancreas in response to eating or elevated blood sugar. It is deficient in persons with type 1 diabetes, and present at insufficient levels in persons with type 2 diabetes. The natural evolution of type 2 diabetes causes insulin levels to fall from high levels to low levels over a course of years. Thus insulin levels in persons with type 1 and type 2 diabetes overlap significantly, and insulin levels are not very useful in determining type 1 vs type 2. Insulin levels vary widely from person to person depending upon an individuals insulin sensitivity (or conversely, their insulin resistance.) Insulin levels also vary widely according to when the last meal occurred. Insulin resistance is a risk factor for coronary disease, thus assessing an individual's insulin resistance may have some value using the HOMA-IR calculation. Insulin levels are also elevated in patients with true hypoglycemia, however the interpretation of these levels is difficult. Insulin levels, when measured by itself at a random time is rarely useful.

C-peptide : This is a fragment cleaved off of the precursor of insulin (pro-insulin) when insulin is manufactured in the pancreas. C-peptide levels usually correlate with the insulin levels, except when people take insulin injections. When a patient is hypoglycemic, this test may be useful to determine whether high insulin levels are due to excessive pancreatic release of insulin, or from an injection of insulin.

Estradiol : This is the most commonly measured type of estrogen measured. In women it varies according to their age, and whether they are having normal menstrual cycles. Hormone levels are also changed when taking birth control pills or estrogen replacement.

Complete Blood Count (CBC)

The CBC typically has several parameters that are created from an automated cell counter. These are the most relevant:

White Blood Count (WBC) is the number of white cells. High WBC can be a sign of infection. WBC is also increased in certain types of leukemia. Low white counts can be a sign of bone marrow diseases or an enlarged spleen. Low WBC is also found in HIV infection in some cases. (ed. note: The vast majority of low WBC counts in our population is NOT HIV related.)

Hemoglobin (Hgb) and Hematocrit (Hct) : The hemoglobin is the amount of oxygen carrying protein contained within the red blood cells. The hematocrit is the percentage of the blood volume occupied by red blood cells. In most labs the Hgb is actually measured, while the Hct is computed using the RBC measurement and the MCV measurement. Thus purists prefer to use the Hgb measurement as more reliable. Low Hgb or Hct suggest an anemia. Anemia can be due to nutritional deficiencies, blood loss, destruction of blood cells internally, or failure to produce blood in the bone marrow. High Hgb can occur due to lung disease, living at high altitude, or excessive bone marrow production of blood cells.

Mean Corpuscular Volume (MCV) - This helps diagnose a cause of an anemia. Low values suggest iron deficiency, high values suggest either deficiencies of B12 or Folate, ineffective production in the bone marrow, or recent blood loss with replacement by newer (and larger) cells from the bone marrow.

Platelet Count (PLT) : This is the number of cells that plug up holes in your blood vessels and prevent bleeding. High values can occur with bleeding, cigarette smoking or excess production by the bone marrow. Low values can occur from premature destruction states such as Immune Thrombocytopenia (ITP), acute blood loss, drug effects (such as heparin) , infections with sepsis, entrapment of platelets in an enlarged spleen, or bone marrow failure from diseases such as myelofibrosis or leukemia. Low platelets also can occur from clumping of the platelets in a lavender colored tube. You may need to repeat the test with a green top tube in that case.

Urinalysis

Urine tests are typically evaluated with a reagent strip that is briefly dipped into your urine sample. The technician reads the colors of each test and compares them with a reference chart. These tests are semi-quantitative; there can be some variation from one sample to another on how the tests are scored.

pH : This is a measure of acidity for your urine.

Specific Gravity (SG) : This measures how dilute your urine is. Water would have a SG of 1.000 . Most urine is around 1.010, but it can vary greatly depending on when you drank fluids last, or if you are dehydrated.

Glucose: Normally there is no glucose in urine. A positive glucose occurs in diabetes. There are a small number of people that have glucose in their urine with normal blood glucose levels, however any glucose in the urine would raise the possibility of diabetes or glucose intolerance.

Protein: Normally there is no protein detectable on a urinalysis strip. Protein can indicate kidney

damage, blood in the urine, or an infection. Up to 10% of children can have protein in their urine. Certain diseases require the use of a special, more sensitive (and more expensive) test for protein called a microalbumin test. A microalbumin test is very useful in screening for early damage to the kidneys from diabetes, for instance.

Blood: Normally there is no blood in the urine. Blood can indicate an infection, kidney stones, trauma, or bleeding from a bladder or kidney tumor. The technician may indicate whether it is hemolyzed (dissolved blood) or non-hemolyzed (intact red blood cells). Rarely, muscle injury can cause myoglobin to appear in the urine which also causes the reagent pad to falsely indicate blood.

Bilirubin: Normally there is no bilirubin or urobilinogen in the urine. These are pigments that are cleared by the liver. In liver or gallbladder disease they may appear in the urine as well.

Nitrate: Normally negative, this usually indicates a urinary tract infection.

Leukocyte esterase: Normally negative. Leukocytes are the white blood cells (or pus cells). This looks for white blood cells by reacting with an enzyme in the white cells. White blood cells in the urine suggests a urinary tract infection.

Sediment: Here the lab tech looks under a microscope at a portion of your urine that has been spun in a centrifuge. Items such as mucous and squamous cells are commonly seen. Abnormal findings would include more than 0-2 red blood cells, more than 0-2 white blood cells, crystals, casts , renal tubular cells or bacteria. (Bacteria can be present if there was contamination at the time of collection.)

Questions about your own tests ? If you are a patient of Amarillo Medical Specialists, please call us at the office so we can help explain your results. If you are not a patient of AMS, you should call the doctor that ordered your tests to explain them to you.

We are very sorry that we cannot handle the large number of requests for information about lab tests from persons who are not AMS patients.

Editor's comment: We appreciate, and are honored by the continuing interest that this page has enjoyed worldwide! You comments are welcome if you see a typographical or technical error here. As a result of the large number of email questions received from all over the world, we are unable to reply to email questions about individual lab values. AMS patients are encouraged to call us by phone. Thanks so much for your understanding.

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