

Patient Variables in Lipid Testing

There are many factors that can influence the results of lipid tests so that they do not reflect the patient's usual lipid levels. These variations are often caused by blood collection technique, pre-existing blood collection factors, blood storage conditions and laboratory transportation factors. In order to ensure accurate results, it is important to understand and control these factors as much as possible.

Factors That Contribute to the Patient's Usual Cholesterol Level

- Age and gender** Cholesterol levels vary with age and sex. Adult males between 20 and 45 years of age generally have higher levels than females of the same age. Under the age of 20, females tend to have higher cholesterol levels than males. Cholesterol levels tend to rise with age in both males and females.
- Within day variation** An individual's serum cholesterol values can vary about 2-3% within the same day.
- Seasonal variation** Cholesterol levels vary 3-5%, depending on the season. Levels tend to be lower in the summer and higher in the winter. HDL Cholesterol levels follow a similar trend.
- Diet and alcohol** Cholesterol levels are increased by eating too much saturated dietary fat, cholesterol and calories. For that reason, testing should be performed when a patient has been on their normal diet for the previous two weeks.
- Exercise** Regular vigorous exercise affects plasma lipid levels. Exercise lowers the concentration of triglycerides, very low density lipoprotein (VLDL) cholesterol, and low density lipoprotein (LDL) cholesterol, and raises high density lipoprotein (HDL) cholesterol levels over time.
- Drugs** Certain drugs, besides lipid lowering agents, can affect blood lipid levels; for example: some drugs used to treat high blood pressure may increase triglycerides and decrease HDL cholesterol; oral estrogens (birth control pills) can lower total cholesterol and raise HDL cholesterol.
- Posture** Cholesterol levels can decrease significantly when a person goes from a standing to a sitting or lying down position. There can be a 6% decrease after sitting for 10-15 minutes. The NCEP recommends that patients should sit quietly for about 5 minutes before the sample is drawn.
- Fasting** Total cholesterol levels and HDL cholesterol can be measured in nonfasting individuals and recent food intake affects plasma total cholesterol concentrations less than 1.5%. However, plasma triglycerides can increase markedly after eating.
- Venous occlusion** Cholesterol concentrations have been found to increase an average of 10-15% after a tourniquet was applied for five minutes. Increases of 2-5% have also been observed after only 2 minutes.
- Anticoagulants** Some anticoagulants, such as fluoride, citrate and oxalate dilute the plasma with water from the red cells in the sample. They can decrease plasma cholesterol levels by up to 10%.
- Recent heart attack or stroke** Cholesterol and LDL levels fall considerably after a myocardial infarction or stroke and remain low for several weeks. Cardiac catheterization does not seem to have a significant effect on cholesterol levels.
- Trauma and acute infection** Cholesterol levels can decrease by as much as 40% after severe trauma and remain depressed for several weeks. Cholesterol levels are also lower for shorter periods in response to severe pain, surgery and short term physical strain. Acute bacterial and viral infection leads to temporarily altered cholesterol levels which return to the usual levels upon recovery.
- Pregnancy** Cholesterol levels can increase by as much as 20-35% during pregnancy because of increases in LDL and VLDL.

Heparin has a negligible effect on cholesterol concentration and EDTA decreases cholesterol and triglyceride levels by about 3%. Lipid tests on the Cholestech LDX® System should not be run on samples anticoagulated with fluoride, citrate, oxalate or EDTA.

NCEP Recommendations

The following recommendations have been selected from the report of the Laboratory Standardization Panel (LSP) of the National Cholesterol Education Program (NCEP), "Recommendations for Improving Cholesterol Measurement." In order for the patient's cholesterol value to be clinically useful, the influence of preanalytical factors must be appreciated. The LSP recommends the following:

- While certain preanalytical factors are not entirely controllable (e.g., state of health, dietary habits, activities, medication), every effort must be made to measure a person's lipids and lipoproteins only when the person is in a metabolic steady state; otherwise the values may not represent the patient's usual cholesterol level.
- Individuals should be on their regular diet and their weight should be stable for at least 2 weeks before their lipids or lipoproteins are measured.
- Cholesterol measurements should be made no sooner than 8 weeks after occurrence of myocardial infarction, or any form of trauma, including surgical trauma, acute bacterial or viral infection or illness, and short term physical strain.
- Patient preparation and blood collection procedures should be standardized according to these guidelines:
 - Make note of whether the patient has fasted for at least 12 hours or has engaged in physical activity within the past 24 hours for any analysis other than total cholesterol.
 - If only total cholesterol and HDL cholesterol are to be measured, either fasting or nonfasting samples can be used. However, the variability of cholesterol fractions may be increased postprandially. Thus, if triglycerides and lipoproteins are to be measured, the patient should be instructed to take nothing by mouth (other than water and prescribed medications) for at least 12 hours before the blood sample is taken.
 - The patient should sit quietly for about 5 minutes before venipuncture. If the sitting position is not possible, the same position should be used each time the patient is tested.
 - Prolonged venous occlusion should be avoided. If a tourniquet is used, the sample should be obtained within 1 minute of tourniquet application. Release the tourniquet as soon as possible during venipuncture. If difficulties are encountered, use the other arm, or release the tourniquet for a few minutes before attempting a second venipuncture.

**To assist you with any further questions, please call
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