Postprandial vs Fasting Lipids

Thomas Dayspring MD, FACP

We need to discuss measuring fasting lipids vs postprandial. Does it matter? Is one better than the other? Unless you order direct LDL-cholesterol tests, lipids must be fasting to have an accurate calculation LDL-C. All of the lipid guidelines recommend initiation of treatment based on LDL-C levels.

Lipids (cholesterol and triglycerides) are oils and not soluble in aqueous solutions like plasma. Thus, lipids are transported inside of protein wrapped vehicles called lipoproteins. The proteins wrapping and making soluble the lipids are called apolipoproteins, of which there are many. No human has free cholesterol or TGs in their plasma. Realize when you look at lipid results on a lipid profile, you are looking at lipid not lipoprotein concentrations: values of the cholesterol content inside various lipoproteins per deciliter of blood (LDL-C, VLDL-C, HDL-C) or TG (which is the TG content in all of the lipoproteins in a deciliter of blood). Actually:

Total cholesterol (TC) is the sum of:
HDL-C + LDL-C + IDL-C + VLDL-C + Lp(a)-C + chylomicron-C + remnant-C

The atherogenic cholesterol (that capable of arterial wall macrophage ingestion) is that carried in the above particles that have apoB on their surface. That would be all of the above except HDL particles (an apolipoprotein A-I particle). Collectively all of the apoB particles are termed beta-lipoproteins. NCEP guidelines suggest identifying beta-lipoproteins by using the surrogate non-HDL-C level. Simply put non HDL-C is the cholesterol that is not in an HDL particle. Non-HDL-C is a simple calculation:

Non-HDL-C = TC minus HDL-C
Non-HDL-C obviously is all of the cholesterol not carried in HDL particles
Non-HDL-C = LDL-C + IDL-C + VLDL-C + Lp(a)-C + chylomicron-C + remnant-C
Non-HDL-C = beta-lipoprotein cholesterol
Non-HDL-C is a superior surrogate for apolipoprotein B levels than is LDL-C

We are never taught that beta-lipoprotein particles other than LDL are just as atherogenic if present in increased quantities and if their diameter is < 70 nm. Such particles enter the artery wall, just like LDL particles. NCEP states remnant lipoproteins (smaller VLDLs and chylomicrons and IDLs) convey atherogenicity substantially beyond that predicted by LDL-C. It is easy to frequently miss remnant lipoproteins when doing risk assessment. Since remnants are mostly TG-rich postprandial particles, they are easy to miss if lipid profiles are done fasting. They would be missed less often if you did postprandial TG testing. Yet if we do postprandial lipids we do not get accurate calculated LDL-C results (see explanation below). A normal human should never have a TG much above 170-200 mg/dL postprandially. Anyone who does, has to have a pathologic explanation: usually genetic and/or more likely insulin resistance.

Looking at what contributes to total cholesterol levels, one can see that the bulk of the TC level is carried in LDL and HDL particles and measured by summing LDL-C and HDL-C. The other beta-lipoproteins (VLDLs, remnants, chylomicrons) are rather transient lipoproteins and contribute little to the TC level. The LDL particle has a half life of 3 days or more and HDL particle a half life of 5 days. Thus these two particles that carry most of the cholesterol are in a steady state and their concentration and their cholesterol load do not fluctuate minute to minute, meal to meal. It takes time (days) for them to accumulate or change.

Of course it is the cholesterol in the other (transient) particles (VLDL, chylomicra, IDL, remnants) that is transient and very much related to fasting as they are TG rich lipoproteins and as such, in normal people these particles contribute very little to TC. However, in hypertriglyceridemic patients, the number of these particles increase and they are not as transient: they circulate longer due to their numbers and their delayed catabolism. Once they shrink in size (after lipolysis) they are then called remnants.

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So why do we fast when we do lipid profiles? Most laboratories determine LDL-C from a formula dependent on TG. Almost none of your LDL-C levels are done by direct measurement. If you are doing LDL-C direct measurements, then fasting is not required. Most labs use a TG-dependent formula to calculate LDL-C (Friedewald Formula)

LDL-C = TC minus (HDL-C + VLDL-C)
Labs do not directly measure VLDL-C, they calculate it by dividing serum TG by 5

The rationale is that VLDL particles (under normal circumstances) carry most of the plasma TG. A normally composed VLDL should have 5 times more TG than cholesterol, so TG/5 should be a reasonable equation to calculate VLDL-C. You can see the fallacy of this equation: as TG levels rise (and particle composition becomes abnormal) the equation is inaccurate as the VLDL particle lose that normal TG/Cholesterol composition of 5 to 1.

So if a lab uses this Friedewald formula to calculate LDL-C then fasting is required. However if you fast you loose a very simple blood test (postprandial triglycerides) to determine remnant lipoproteins and which suggest insulin resistance.

Is there an answer to this dilemma: Sure, do the NMR LipoProfile which identifies all of the abnormal lipoproteins. You do not have to guess lipoprotein concentrations which you are in effect doing by looking at lipids. Should we do apo B levels? That would work, but not as accurately as the all-informative as the NMR determined atherogenic particle concentrations. The apoB assay is an immunoassay and subject to several false negatives. So if you are going to spend money on advanced testing NMR cost is money much better spent that apo B.

Last but always an option:

Do postprandial lipid profiles: If non-HDL-C is up patient is at risk: TG are irrelevant
If TG is elevated, you know why non-HDL-C is up: there are remnants present and TG are changing the composition of the HDLs and LDLs

NCEP Goal of therapy in patients with high TG: Normalize non-HDL-C

Advise: Do advanced lipoprotein testing. If not, you can do little wrong by doing fasting or postprandial lipids and understanding Non HDL-C. Since our patients can't fast all day long, do not make them! This can really help gynecology practices in lipid screening.