Cardio IQ® Ion Mobility
The Latest Evolution in Lipoprotein Fractionation
Evolution of Lipoprotein Subfractionation

Fractionation of lipid subclasses has been used to gain additional insight for management of cardiovascular disease (CVD) in at-risk patients for over 15 years. LDL and HDL subclasses have strong scientific literature support,1-3, 5-15 with a legacy of NIH-funded studies that show subclasses are predictors of short- and long-term CVD risk, as well as clinical progressions, and multiple intervention events.

The insights provided by the lipid subclasses allow for a customized approach to CVD risk management that may ultimately lead to improved patient outcomes.

Since the initial analytical ultracentrifuge characterization of lipoprotein subclasses by Dr. John Gofman at the University of California, Berkeley,1 a number of lipid fractionation methods have been developed, including density gradient ultracentrifugation, particle analysis by spectrophotometry, and gel, gradient gel, and 2-D gel electrophoresis.

While these various techniques each had unique strengths, they all represented some degree of compromise between capturing all lipoprotein types, separating the lipid subclasses with high resolution, and delivering direct quantification of the amount of particles within each lipoprotein subclass.

Cardio IQ® Ion Mobility is the latest technology evolution, with a pedigree reaching back to the first lipoprotein characterization work at University of California, Berkeley.
The Latest Technology: Cardio IQ® Ion Mobility

Cardio IQ Ion Mobility fractionation is the latest technological evolution in advanced lipid subclass measurement. It combines high resolution separation of the full spectrum of lipoprotein particles, along with direct quantification of particles in each lipoprotein subclass.

Cardio IQ Ion Mobility separation allows lipoprotein particles to be characterized without any modification of the particles. Lipoprotein particles are electrophoretically separated in a gas-phase, distinguishing lipoprotein particles on the basis of size (see Figure 1). Size-selected particles are detected and counted by light scattering.

Cardio IQ Ion Mobility provides:

- Direct, accurate, and reproducible measurement of lipoprotein particles
- Insights that allow customization of therapy for potential improvement in patient outcomes

Cardio IQ Ion Mobility Advantages

Cardio IQ Ion Mobility represents the future of advanced lipoprotein analysis in clinical practice. By moving beyond the past, the novel approach of direct and reliable measurement, this test provides physicians with increased insights to better manage treatment decisions for their patients.

Cardio IQ Ion Mobility is strongly supported by literature and experts, as the leading method for lipoprotein size assessment. It is being proposed as the new standard in the field.

Cardio IQ Ion Mobility is the next generation in lipoprotein subclass separation.

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- Direct, accurate, and reproducible measurement of lipoprotein particles
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Clinical Utility

The landmark 2008 Malmö study provided evidence using Cardio IQ® for Mobility subfractionation, that LDL particle number (LDL-P) and Small/Med and Med/Lar particles were associated with higher CVD risk.

Further research published in June and September of 2015, again using Ion Mobility technology, provided data that the measurement of LDL-P can identify otherwise undiagnosed risk patients at risk for 10 years.4 Both clinical studies provide evidence that LDL-P by Mobility provides additional insight over and above standard risk factors for the residual risk of patients.

Ion Mobility Analysis of Lipoprotein Subfractions Identifies Three Independent Axes of Cardiovascular Risk


The Malmö Diet and Cancer Study investigators explored the question of whether risk factors that had been associated with intermediate CVD risk, independently predicted the occurrence of cardiovascular outcomes. The study population consisted of 11,186 healthy men and women aged 70 years or younger at enrollment, and 88 (4.6%) participants had a first cardiovascular event during 16.2 years of follow-up. LDL-P, LDL-small and LDL medium were associated with increased cardiovascular risk. After full adjustment for standard risk factors including a lipid panel, LDL-P predicted a 16% increase in cardiovascular events per each standard deviation increase of LDL-P (adjusted HR per SD, 1.16, 95% CI 1.02-1.32, p = 0.028). Most risk factors for intermediate risk patients.

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Low-Density Lipoprotein Particle Number in Association With Cardiovascular Events Among Those Not Classified Into Statin-Benefit Groups


Atherogenic Lipoprotein Subfractions Determined by Ion Mobility and First Cardiovascular Events After Random Allocation to High-Intensity Statin or Placebo. The Justification for the Use of Statins in Prevention: An Intervention Trial Evaluating Rosuvastatin (JUPITER) Trial


The JUPITER study is a large placebo-controlled randomized, double-blind clinical trial that enrolled asymptomatic individuals, (women ≥ 55 years of age, or men ≥ 50 years) without prior CVD and with LDL-C <130 mg/dL and hs-CRP ≥ 2.0 mg/L. The study was designed to measure rosuvastatin (Crestor) in primary prevention of cardiovascular disease (original publication 2008). Exclusion criteria included triglycerides ≥ 500 mg/dL, current use of hormone therapy, and previous or current use of lipid-lowering therapy or immunosuppressant agents. Ion Mobility was performed on baseline and month 12 samples (n=11,186).

The study resulted in the development of JUPITER subfraction technology. The JUPITER trial was undertaken to determine if patients who were at high risk for cardiovascular events were benefiting from treatment with rosuvastatin. The study confirmed that after 12 months of treatment, patients in the JUPITER trial who received rosuvastatin had a significant decrease in the number of LDL particles, Small and Medium LDL subfractions from Ion Mobility, along with elevated levels of LDL-P and other lipoprotein subfractions by Ion Mobility measured. The associations of LDL-P and lipoprotein subfraction levels with incident CVD events (myocardial infarction, coronary revascularization, ischemic stroke, or CVD death) were assessed with adjustment for age, sex, LDL-cholesterol, HDL-cholesterol, triglycerides, ApoB, systolic and diastolic blood pressure, antihypertensive medication use, and smoking.

After a mean follow-up of 16.2 years, 88 (4.6%) participants had a first CVD event. LDL-P, LDL-small, and LDL-medium were all associated with an increased risk of CVD events. LDL-P, adjusted HR per SD, 1.16, 95% CI 1.02-1.32, p = 0.028. The study revealed in the placebo arm that the measurement of LDL-P by Ion Mobility provides additional insight over and above standard risk factors for the residual risk of patients.

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Treatment Options

The Cardio IQ® Ion Mobility analysis provides personalized, high-resolution subclass separation of the full lipoprotein profile that is critical to determining the distribution of LDL, particles from atherogenic small LDL to large LDL, and of small, dense, particles to larger, less dense particles. This allows healthcare practitioners to tailor treatment and optimize the aggressiveness of therapy in a manner that is personalized to the patient.

The Cardio IQ® Ion Mobility Report

The 4 key subclasses from the Cardi IQ® Ion Mobility analysis of the full lipoprotein profile are displayed on the summary page of the report. This allows healthcare practitioners to tailor treatment and optimize the aggressiveness of therapy in a manner that is personalized to the patient.

Test Name
- Lipid Panel
- Lipoprotein Subfractions
- Apolipoproteins
- Heart Failure
- Inflammation
- Optimal

Patient Information
- Age: 63
- Gender: M
- Fastiging: Y
- Collected: 07/23/2014

Results and Risk Category

- LDL-CHOLESTEROL: 89 mg/dL
- CHOL/HDLC RATIO: 1.04
- LDL PARTICLE NUMBER: 5
- HDL CHOLESTEROL: 55 mg/dL
- CHOLESTEROL, TOTAL: 150 mg/dL
- NON-HDL CHOLESTEROL: 78 mg/dL
- TRIGLYCERIDES: 218 mg/dL
- APOLIPOPROTEIN B/A1: 1.04
- APOLIPOPROTEIN B: 1.0
- APOLIPOPROTEIN A1: 78
The Cardio IQ® Ion Mobility Report

The detailed page graphically depicts the ion mobility profile trace and the full spectrum of HDL and LDL lipid subclasses in high resolution. This report, the Ion pattern and LDL peak size for easier interpretation.

Patient Information
Specimen Information
Client Information

Age: 63
Fasting: Y
Gender: M
Collected 07/23/2014
High

Test Name | Units | Result and Risk Category | Result from Risk Category Ranges
--- | --- | --- | ---
LDL Pattern | | A | A | N/A | B
LDL Peak Size | Angstrom | 220.1 | >222.5 | 218.2-222.5 | <218.2
High Tertile cut-points are based on a reference range population. Risk of CVD events is based on a reanalysis (unpublished) of the data presented in Musunuru et al. ATVB 2009;29:1975-80.

Test Name | Units | Result with Risk Category | Result from Risk Category Ranges
--- | --- | --- | ---
LDL Pattern | | | |
Cardio IQ® Ion Mobility: A More Powerful Approach of Lipid Subclass Characterization

By taking into consideration a more powerful risk assessment based on total LDL particles and key lipid subclasses, healthcare practitioners can identify residual risk not revealed by the Lipid Panel or the Lipoprotein Phenotype Pattern B.

Priorities in Interpretation and Management of Key Clinical Indicators

1. What is the total LDL particle number? Does it indicate residual risk?
   - Consider degree of risk when formulating aggressiveness of therapy
   - Follow progressive lowering of particle number to:
     - Gauge patient response to therapy and optimize as needed, and
     - Track progress toward goal.

2. What is the quantitative amount of Large HDL subclass within respective risk category?
   - Consider HDL-raising strategy
   - Follow progressive increase of particle concentration to:
     - Assess patient response to therapy and adjust as needed, and
     - Assess patient response toward goal.
Cardio IQ® Ion Mobility:
Lipoprotein Analysis Without Compromise

Cardio IQ Ion Mobility:
• Measures the full spectrum of lipoprotein subfractions and reports those that provide the strongest indicators for cardiovascular risk
• Provides direct, accurate, and reproducible measurement of lipoprotein particles
• Offers insights that allow customization of therapy

Ion Mobility characterization of lipoproteins enables comprehensive insights for physicians to manage treatment decisions for their patients.

References

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