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, with a legacy of NIH-funded studies that show lipid subclasses are predictive of short- and long-term CVD risk, atherosclerotic progression, 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, a number of lipid fractionation methods have been developed, including density-gradient ultracentrifugation, particle analysis by spectrum, and gel, gradient gel, and 2-D gel electrophoresis.

While these various technologies 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 lipid 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.

Analytical Ultracentrifuge
John Gofman
UC-Berkeley
1949

Gradient Gel Electrophoresis
Ron Krauss
UC-Berkeley, Lawrence Berkeley National Lab
1982

Segmented Gradient Gel Electrophoresis
1997

Ion Mobility VI
Ron Krauss & Henry Benner
UC-Berkeley, Lawrence Berkeley National Lab
2001

Ion Mobility V2
Ron Krauss & Henry Benner
Nichols Institute
2009

Ion Mobility V3
Ron Krauss & Henry Benner
Nichols Institute
2013

1949

Nuclear Magnetic Resonance
1992

Density-Gradient Ultracentrifugation V1
1994

Density-Gradient Ultracentrifugation V2
1997

2-D Gel Electrophoresis (Limited to HDL)
2007

Continual Advancement

2013
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 lipid subclass fraction.

Cardio IQ Ion Mobility separation allows lipoprotein particles to be characterized without any modification of the particles that could potentially impact their apparent size. Ionized lipoprotein particles are electrophoretically separated into 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 Advantages

Cardio IQ Ion Mobility represents the future of advanced lipid analysis in clinical practice. By moving beyond the past compromises of other advanced lipid subclass measurements, this tool provides physicians with increased insights to better manage treatment decisions for their patients.

Cardio IQ Ion Mobility is strongly supported by literature and experts in the field\(^3\)\(^,\)\(^5\)-\(^10\) as the leading method for lipoprotein size assessment. It is being proposed as the new standard in the field. Dr. Ron Krauss, developer of segmented gradient gel technology, developed Cardio IQ Ion Mobility as the next generation in lipid subclass separation.

Cardio IQ Ion Mobility provides:

- Direct, accurate, and reproducible measurement of lipoprotein particles\(^8\)
- Insights that allow customization of therapy for potential improvement in patient outcomes
Clinical Utility

The landmark 2008 Malmö study[^3] provided evidence, using Cardio IQ® Ion Mobility subfractionation, that LDL particle number (LDL-P), and Small and Medium LDL particles were associated with higher CVD risk.

Further research published in June and September 2015, again using Ion Mobility technology, provided data that the measurement of LDL-P can identify intermediate-risk patients at risk for CVD events.[^4][^5] Both clinical studies provide evidence that LDL-P by Ion Mobility provides additional insight over and above standard risk factors for intermediate-risk patients.

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Treatment Options†

Treatment via pharmaceutical options, such as statins, niacin, or fibrates, as well as lifestyle changes, has been impactful in correcting ALP, i.e., reducing LDL-particle numbers, changing the distribution of LDL-particles from atherogenic small LDL to larger LDL-particles, and shifting small HDL particles to large HDL particles associated with cardio-protective mechanisms (see Figure 2). The high-resolution subclass separation provided by Cardio IQ Ion Mobility allows healthcare practitioners to follow the change in the lipid profile as the patient responds to therapy. This provides the opportunity to evaluate treatment efficacy and optimize the aggressiveness of therapy in a manner that is personalized to the patient.

†This information is provided for informational purposes only and is not intended as medical advice. A physician’s test selection and interpretation, diagnosis, and patient management decisions should be based on his/her education, clinical expertise, and assessment of the patient.

The Cardio IQ® Ion Mobility Report

To provide the data that contribute most to the determination of an individual’s cardiovascular risk, Quest Diagnostics provides the Cardio IQ Report (see Figure 3).

The 4 key subclasses from the Cardio IQ Ion Mobility analysis that are most important for clinical management are displayed on the first summary page of the Cardio IQ report in the lipoprotein subfractionation section.

- LDL Particle Number
- LDL Small
- LDL Medium
- HDL Large

Figure 2. Key clinical management subclasses and treatment strategy

Figure 3. Summary showing key LDL and HDL clinical management factors

This example represents the resulting report for an order of 91716(X) Lipid Panel and 91604(X) Ion Mobility.
The detail page graphically depicts the Ion Mobility profile trace and the full spectrum of HDL and LDL lipid subclasses in high resolution. It also reports the LDL pattern and LDL peak size for easier interpretation.

**Figure 4.** Cardio IQ® Ion Mobility detail

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;29:1975-1980.
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 the respective risk category?**
   - Consider HDL-raising strategy
   - Follow progressive increase of particle concentration to:
     - Assess patient response to therapy and optimize 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