Biochemical profiling of endogenous nanoparticles by Raman Spectroscopy in breast cancer

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Extracellular vesicles (EVs) constitute a heterogeneous group of membrane-based vesicles released into the blood by virtually every cell. In recent years, they have garnered significant scientific attention as a potential source of biomarkers for cancer diagnosis and prognosis. However, this potential remains largely unused due to the challenging nature of EVs as targets in biomedical research. Comprising various biomolecules such as proteins, lipids, nucleic acids, and small metabolites, EVs form intricate structures that require substantial effort for full characterization.

Raman spectroscopy (RS) is a photonic method rooted in the interaction between light and molecules present in a sample. When illuminated by light, molecules vibrate and emit photons (referred to as Raman photons) with lower energy compared to the incoming light. The energy, known as Raman shift, and the intensity of these emitted photons offer specific insights into the chemical groups within the sample. This information can be harnessed to analyze the overall biochemical composition of a sample, even when minimal material is available.

Consequently, our study demonstrates the applicability of RS not only in distinguishing the biochemical composition of the primary classes of endogenous nanoparticles found in blood, such as lipoproteins and EVs, but also in discerning the compositional differences between EVs from breast cancer patients and those from healthy individuals.