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Tracking neuroretinal degeneration in early diagnosis of diabetic retinopathy

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Metabolic disease like diabetes mellitus (DM) with hormonal defect shows pathological impacts on vital organs in the form of retinopathy, nephropathy and neuropathy along with macro/micro-vascular complications. The early stage detection of diabetic retinopathy (DR) with possibility of neurodegeneration is not only a concern of effective therapeutic management but also a crucial field of diagnostic research. Conventional diagnostic practices employing color fundoscopy, fluorescein angiography (FA) and optical coherence tomography (OCT) are not always effective in addressing such diagnostic challenge. Exploration of definite image attributes and spectropathological multi-omics signatures including biophysical signatures of body fluids like serum/tear may provide valuable diagnostic information for early stage of DR as its' pathology involves aberrations in both retinal structures and systems metabolism. Hence this study tried to extract precise retinal attributes from correlated fundoscopy, FA and OCT of diabetics with or without retinopathy and targeted body fluids through Fourier transform infrared spectroscopy, Raman and nuclear magnetic resonance spectroscopy and gas-chromatography coupled with high-resolution mass-spectroscopy and quantitative proteomics for finding Omics signatures of DM and DR targeting neuroretinal degeneration. Novel biophysical properties of serum under exposure of gold nano-particles were also explored. The serum in dilutions has again depicted unique gold nano-colloid aggregation pattern and fractal dimension of such DR. FTIR and Raman spectroscopy of serum samples showed altered expressions of lipids and β-sheet containing proteins in DR indicting subsequent neuroretinal degeneration and neo-angiogenesis while NMR findings revealed changed levels of ribitol, glycerol-phosphocholine, and uridine-diphosphate-n-acetyl glucosamine hinting alteration in vital metabolic pathways. Lipidomic signatures served as complementary proof for neuroretinal degeneration in DR. Thus, this work can be considered as an integrated attempt to demarcate multidimensional diagnostic signatures for DR at early stage in addition to pave the path for correlating retinal structural changes with molecular pathology of body fluids towards finding theragnostic markers.

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