Glioma Liquid Biopsy by Applying Machine Learning to Subsets of Extracellular Vesicles

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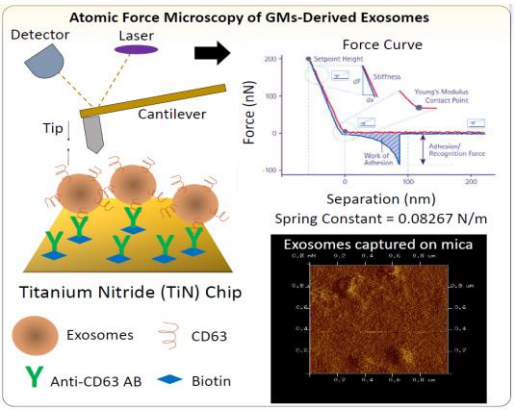
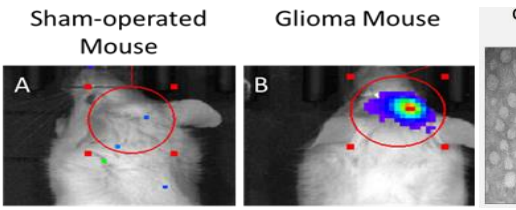
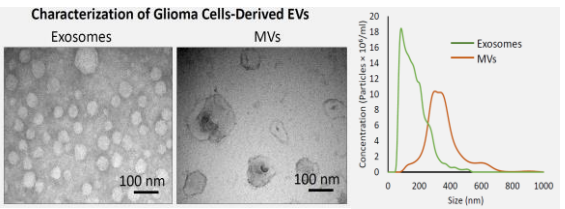
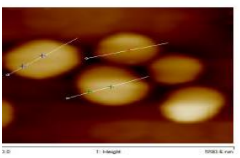
Background Glioma is a lethal brain cancer with an average survival time of approximately 1.5 years, with a dearth of absolute treatment interventions. Therefore, there is a demand to develop a robust approach for its early diagnosis. Notably, glioma cells (GMs) secrete tremendous number of extracellular vesicles (EVs), which can cross the blood-brain barrier. In addition, they can recapitulate the content of their parent GMs, making them apt as a platform for developing EV-based biomarker. However, owing to the heterogenous nature of EVs, the study of all physical parameters including roughness, stiffness, and adhesion force simultaneously for a huge number of different subsets of EVs, including exosomes and microvesicles (MVs) have been a major challenge. ***Objective*** To develop an artificial intelligence (AI)-based method for segregating GMs-derived EVs for the non-invasive liquid biopsy of glioma.

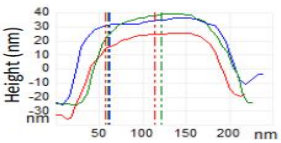


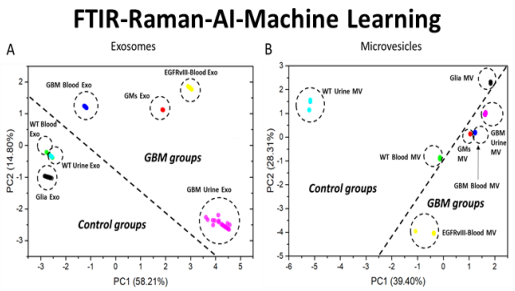
Methods Two different subsets of EVs, namely exosomes and MVs were isolated from wild-type and glioma xenograft mouse model, followed by their characterization with nano-tracking analysis (NTA), transmission electron microscopy (TEM), and immunogold-EM for the presence of markers of exosomes and MVs. The constituents of EVs were analyzed using Fourier transform infrared (FTIR), and Surface-enhanced Raman spectroscopy (SERS), followed by application of principle component analysis (PCA), and AI algorithm-based technique, EVs-IR-SERS-AI to segregate various subsets of EVs. Further, 80% of data were used as training set, and 20% of the data were employed for the validation.

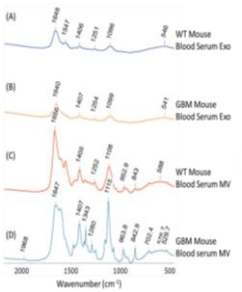


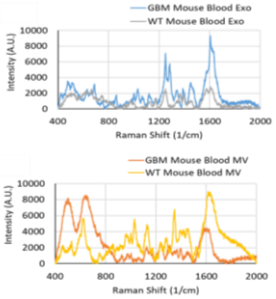












Results The physical parameters of GMs-derived EVs are found to be distinct compared to that from control group. The application of AI on the physical parameters of EVs could predict the subsets of EVs.

Conclusions EVs-IR-SERS-AI can be a potential technique for analyzing the physical parameters and segregate different subsets of EVs, which can be applicable for the liquid biopsy of glioma.

References

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