# Engineered Exosomes for the Multimodal Imaging Directed Photo-Immunotherapy of Colorectal Cancer

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**Background:** Rio Grande Valley experience severe cancer health disparity. A novel therapeutic modality may serve as better therapeutic option. Nanohybrids endowed with multifunctionality, longer circulation time, large surface area have emerged as an active preference for cancer research. However, rising concern of nanomaterials toxicity and scalability issues has slowed their translation to clinics. Exosomes (Exo) are endogenous endocytic origin 40-100 nm vesicles found in various body fluids, which in comparison to synthetic nanoparticles, are biodegradable, highly biocompatible as well as immunocompatible in nature. Although bulk isolation of exosomes from human body fluids is still a problem and engineering of exosomes to harness its potential is still in infancy.

**Methods:** The Exo were isolated from dairy milk using EDTA precipitation method, and superparamagnetic iron oxide nanoparticles (MNPs) were synthesized by ammonium hydroxide co-precipitation method. The Exo were sonicated (60 sec) with MNPs and near-infrared (NIR) light-absorbing dye indocyanine green (ICG) and then incubated overnight at 37 $^{o}$C. The characterization of ICG@Exo-MNPs was done using several techniques. The targeting nature of ICG@Exo-MNPs was determined on colorectal cancer cells SW480 and SW680. The phototransduction and in-vitro photothermal therapy were performed using 1W, 808 nm NIR laser.

**Results:** The ICG@Exo-MNPs nanohybrid found to have size around 100 nm with good dispersity. The coating of exosomes and magnetic field actuation increased the targeting efficacy of ICG@Exo-MNPs in colorectal cancer cells by 10% in SW40 and 30% in SW680. ICG@Exo-MNPs killed the SW480 cells to more than 80% within 2 min. of NIR light irradiation.

**Conclusions:** This study shows enhanced photothermal therapeutic behavior of ICG@Exo-MNPs for near-infrared fluorescence imaging directing killing of colorectal cancer cells.

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