Research/Clinical Abstract

Development of Surgery Guided NIR Fluorescent Probe Nanoparticles for Cancer Imaging

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Background: Early-stage detection is crucial for successful breast cancer treatment and can significantly reduce breast cancer associated death rates. There are several diagnostic approaches available for early breast cancer diagnosis but lack tumor specificity and expose patients with radiation. Therefore, there is a crucial need to develop newer and safer imaging modalities. Indocyanine green (ICG), an FDA approved Near InfraRed (NIR) fluorescent probe-based imaging for early cancer detection and image guided surgery, has gained noticeable attention for the clinical applications as it has high sensitivity, low cost, and real-time visualization/imaging capabilities without ionizing radiation. However, ICG has several limitations associated with its photostability, high concentration toxicity, and short circulation time. To overcome this hurdle, we have recently engineered a novel poly (vinyl pyrrolidone) and tannic acid (PVP-TA) based nanosystem to carry ICG to the cancer cells/tissues.

Methods: Pursuing the novel nanotherapy approach, our lab has developed PVP-TA based ICG (PVT-ICG) fluorescent nanoparticles *via* self-assembly process. Our optimized PVT-ICG nanoformulation was further characterized for its physicochemical properties. An IVIS imaging system was further used to measure NIR fluorescence of novel PVT-ICG. Moreover, Human cancer (Breast, Pancreatic, Liver and Prostate) tissue microarrays (TMAs) were histochemically stained to assess cancer cell targeting/specificity of PVT-ICG.

Results: PVT-ICG indicated particle size and surface charge ideal for cancer cell/tissue delivery. PVT-ICG, further, demonstrated improved photostability and fluorescent intensity. Additionally, TMA studies exhibited enhanced internalization and cancer targeting/specificity of PVT-ICG nanoparticles compared to free ICG dye in all cancers.

Conclusions: Collectively, our findings suggest that this NIR fluorescent probe PVT-ICG has great potential for becoming a novel and safe imaging modality for breast cancer cells/tumors which can result in early diagnosis leading to improved cancer management.