

ABSTRACT

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Photodynamic therapy (PDT), a newly emerging technology for cancer treatment is extensively studied. We designed a set of systematic experiments to study the efficacy of PDT *in vitro* and *in vivo*. Different cell lines and photosensitizers (PSs) were used during this study to evaluate targeted and untargeted PDT outcome. Initially 5-aminolevulinic acid based PDT efficacy was investigated on human cervical (HeLa cells) and laryngeal cancers (Hep2c cells) cells *in vitro*. The toxicity of laser light itself and the PS alone to these cells were found to be negligible. The incubation time, PS concentration and light doses were optimized for the two cell lines. The cell viability of HeLa and Hep2c were reduced to 15 % when exposed to optimum parameters of PS and light doses. Further an *in-vivo* efficacy of PDT with fractionated drug light interval (DLI) and diluted Photogem (a photosensitizer) concentration was studied. It was found that the quality of necrosis initiated by PDT was improved with this new approach of drug delivery. Iron oxide nanoparticles, capped with tween-80 and with covalently bonded polyethylene glycols (PEG) layer on outer surface, were synthesized and 5-ALA was encapsulated for effective delivery of PS and ultimately to enhanced outcome of PDT. *In vitro* studies performed on HeLa cells showed that cellular damage was around 80% with improved uptake of PS. It was observed that cell death achieved with 10^{-6} times less concentration of PS encapsulated with nano-construct was almost same as found previously with free PS molecules. Polymeric nano-cells were synthesized for targeted *in-vitro* PDT studies for the sake of improvement of the efficacy of combination therapy. Pancreatic cancer cells (AsPc-1) were evaluated for intracellular complete inhibition of vascular endothelial growth factor (VEGF). Nanocells were loaded with benzoporphyrine derivative (BPD) PS and humanized antibody (Avastin). It was observed that targeting VEGF protein in intracellular spaces effectively inhibits its up regulation than extracellular as observed over 72 hours post PDT thus increasing the efficacy of combinational therapy.