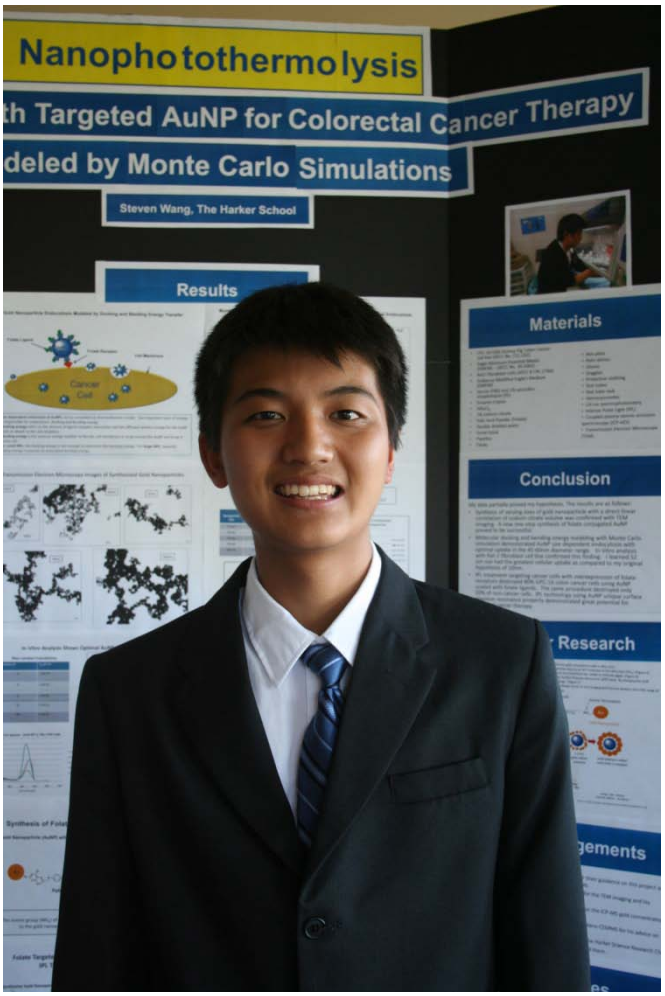
Eighth grader inspired by Prof Mansoori's research and mentoring to do Science Fair project on Cancer Nanotechnology

Hi Dr. Mansoori,

My name is Steven Wang and I am an eighth grade student at The Harker School in California. I read your research papers entitled, "Cancerous Cells Targeting and Destruction Using Folate Conjugated Gold Nanoparticles (*Dynamic Biochemistry, Process Biotechnology and Molecular Biology, Vol. 4(1) 6-12, 2010.*)" and "A Comparative Study of Two Folate-Conjugated Gold Nanoparticles for Cancer Nanotechnology Applications (*Cancers 2010, 2(4), 1911-1928; doi:10.3390/cancers2041911*)" and they were so interesting that I decided to do a science fair project on gold nanoparticles. My project involves synthesizing gold nanospheres with folic acid powder dissolved in sodium citrate. I used a intense pulse light that was FDA cleared for consumers and was able to achieve significant cell death in my GPC-16 colon cancer cells as compared with my Rat-2 fibroblast cells. I am writing to you because I am interested in any advice you have about the advantages or novelty of using the Intense Pulse Light (IPL) treatment as opposed to lasers or other light delivery such as optical fibers as mentioned in your paper. I would also welcome any advice you have on recommended protocols for synthesizing nanorods or nanoshells. Thank you so much for taking the time to read my email.

Sincerely,
Steven Wang



Quote:

"After reading many articles about nanotechnology, I found Dr. Mansoori's work on gold nanoparticles at the University of Illinois at Chicago really inspiring. I also appreciated his advice about photothermal therapy. I was excited to learn that my project entitled, "Nanophotothermolysis: IPL Treatment with Targeted AuNP for Colorectal Cancer Therapy Modeled by Monte Carlo Simulations" was selected for "Project of the Year" at the California State Science Fair."

Project information:

Objectives/Goals

Chemotherapy causes harmful side effects by destroying healthy cells in addition to cancerous ones. Attaching cancer seeking ligands to nanoparticles can direct drugs to cancer sites to boost drug efficacy and reduce toxicity. Since the folate receptor is upregulated in cancer with limited distribution in normal cells, folate conjugated gold nanoparticles (AuNP) can be synthesized for cancer targeting. AuNP also have a unique surface plasmon resonance property which converts light photons to heat for cancer cell destruction in a new process called nanophotothermolysis. I hypothesize that IPL treatment will be effective in destroying significantly more colon cancer cells than normal fibroblast cells when incubated with optimal sized folate conjugated AuNP.

Methods/Materials

I created a computer modeling algorithm with Monte Carlo Simulations to determine optimal AuNP kinetics for endocytosis by testing 9 parameters in 10,000 simulation runs. I synthesized gold nanospheres with inversely proportional amounts of sodium citrate to HAuCl4 in 13nm, 26nm, 52nm and 104nm sizes. After characterizing uptake of nanospheres in Rat-2 fibroblast cells using UV-Vis spectra and TEM, I prepared samples for ICP-MS. I developed a method to create optimal sized folate-AuNP. I applied IPL treatment to GPC-16 cells and Rat-2 fibroblast cells with folate-AuNP using a filtered xenon flash lamp of wavelengths between 400 to 1100 nm and fluence of 6 joules/cm2. I prepared Trypan blue cell viability assays measuring cell counts with a hemocytometer and recorded the results.

Results

In silico molecular docking and bending energy modeling predicted AuNP size dependent endocytosis with optimal uptake of nanoparticles size in the 40-60nm range. In vitro analysis with UV-Vis spectra and ICP-MS measured greatest gold concentration uptake of gold AuNP with diameters of 52 nm. IPL treatment targeting cancers cells with overexpression of folate receptors destroyed 80% cancers cells with folate conjugated AuNp and only 20% of the normal fibroblast cells.

Conclusions/Discussion

A new energy transfer model simulating size dependent endocytosis accurately predicted optimal size range and correlated with in vitro results. The combination of folate conjugated AuNP with nanophotothermolysis treatment effectively destroyed cancer cells with little effect on normal cells demonstrating great potential for targeted cancer therapy.

Summary Statement

I created a new molecular modeling algorithm, developed a one-step synthesis for folate-AuNP incubated with normal and cancer cells, and measured the effect of nanophotothermolysis on cancer cell viability.