Gold Nanoparticles as a Cancer Treatment

Celia Dunn *Biomedical Engineering, University of Rhode Island*
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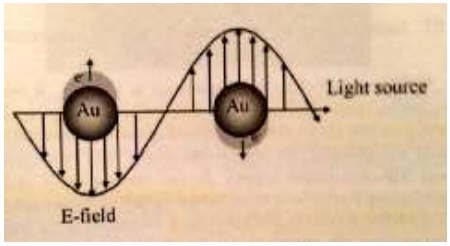
Abstract— **Gold Nanoparticle technology is being developed to treat inoperable tumors. By combining gold nanoparticles with laser technology, scientists can cause explosions within the cancer cells and spare healthy cells.**

I. Introduction

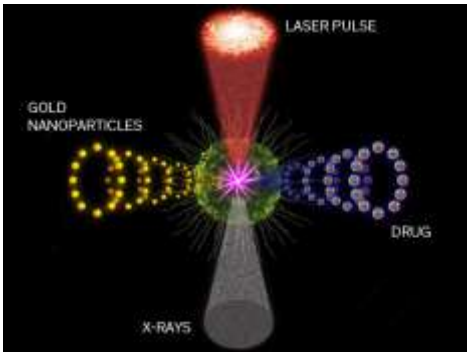
Cancer is defined by the American Cancer Society as, "a group of diseases characterized by uncontrolled growth and spread of abnormal cells" [1] that can result in death. There are over 50 different types of cancer. Over 12 million people in the world are impacted by these diseases [2]. There are almost 2 million diagnoses in the U.S. alone with about a 35 percent death rate, and Existing treatment methods include, "surgery, radiation, chemotherapy"… [1] A new form of treatment is being developed to help treat tumors that are inoperable. This paper discusses two different experiments conducted, both using gold nanoparticles and near-infrared light (NIR).

II. Methods

In 2010, Dr. Li and Dr. Gu from Swinburne University of Technology ran experiments that were based on amplifying hyperthermia in cells [3]. This was a less invasive cancer treatment that exposed the cancer tissues to high levels of heat which caused cell damage and resulted in cell death. This process was called hyperthermia. Cancer cells have much higher metabolic rates than normal cells and therefore were impacted by hyperthermia more. Gold nanoparticles amplified hyperthermia especially when combined with a near-infrared light source. Gold nanorods, nanoshells, were typically used because their larger cross sections absorbed more NIR than other shapes. When the NIR hit the gold nanoparticles in the cell it caused "rapid conversion of absorbed light by the gold nanoparticles to thermal energy, which [heated] and [killed] the cell". [3]



Scientists Rice University have since used gold nanoparticles to develop "quadrapeutics" [4]. This term came from the four parts involved with the cancer cell destruction: laser pulse, x-ray, gold nanoparticles, and a drug (typically 3-6 percent of typical radiation dose). This approach didn't depend on the heat produced by near-infrared light. Instead, it focused on causing intracellular explosions [5]. This happened by first injecting gold nanoparticles that would be attached to the cancer cell surface, and then digested by the cell. Second, low-energy NIR laser pulses would be delivered and turn the gold nanoparticles into plasmonic nanobubbles. Third, a low drug dose would be administered and the plasmonic nanobubbles would blow up and cause the intracellular explosions. This did not destroy as many nearby healthy cells as the research with the higher heat NIR.



III. Results

Dr. Li and Dr. Gu's experiment concluded that "nanoparticles can be promisingly utilized to enhance hyperthermic cancer treatment", however "there is still a lot of work to be done before this technique is clinically applicable" [3]. The Rice University researchers concluded that "quadrepeutics" is a successful form of cancer treatment. Their experiment proved to be 17 times more efficient than chemoradiation therapy [4]. In their preclinical trials they successfully eliminated tumors in mice within one week of the administered "quadrepeutics" [5].

IV. Discussion

In conclusion, both experiments were successful. The safety concerns associated with using nanoparticles and laser beams, is that the nanoparticles could infect the healthy cells and kill them along with the cancer cells. This would cause major damage to organs and tissues surrounding the tumor if administered incorrectly. In the future it would be great to see this technology pass clinical trials and be used in hospitals. This would be a cure for inoperable tumors, and other hard to treat cancers such as, lung, brain, and prostate cancer.

References

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