



# GOLD NANO-PARTICLE AS DRUG-DELIVERY SYSTEM IN CANCER TREATMENT

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## ABSTRACT

The cancer cells are often in very different sizes and some may be larger than normal while others are smaller. Cancer cells are often abnormally shaped and the nucleus of the cell may have an abnormal appearance. The Cancer is almost caused by the multi step sequence of events. The important root cause of cancer is a weak immune system. So the best way to treat cancer cells is to deal, with the root cause of cancer and not cutting the cancer out (or instead organs). The approach of orthodox medicine is to severely damage the immune system with chemotherapy as well as operation. The difference becomes even terrible because the immune system gets damaged completely and will be fail to eliminate the cancer cells. Conventional cancer treatment also kills many healthy cells and can damage organs, the lymph system etc. Thus cancer cells always seem to come back after surgery or chemotherapy. This is called regression.

Thus major interest has been focused on use of nano particle based drug delivery system. The main advantage of using nano particles in medical diagnosis is because the size and characteristics of nano particles can be easily manipulated. It can be used for both passive and active drug targeting. Nano particles have greater surface area per weight than larger particles which causes them to be more reactive to some other molecules.

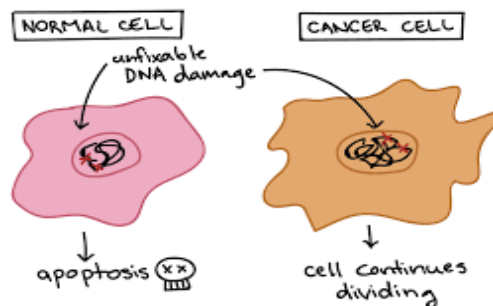
Now researchers have focused their attention on using gold as nano particle. Gold nano particles optical and electronic properties can be easily tunable by changing the size, shape, surface chemistry or aggregation state. Binding gold nanoparticles to a specific antibody for cancer cells could make cancer detection much easier. Gold nanoparticles are very good at scattering and absorbing light. Many cancer cells have a protein, known as Epidermal Growth Factor Receptor (EGFR), all over their surface, while healthy cells usually fail to communicate robustly with the protein. Through the process of conjugation, or binding, the gold nanoparticles called anti-EGFR, researchers were capable to obtain the nanoparticles to attach themselves to the cancer cells. More over Gold particles are also very good at capturing X-rays. So if gold nanoparticles could be made to penetrate into the cancer cells and were then heated by a beam of X-rays, they could destroy those cancer cells from within. Thus gold nanoparticles are very much useful in medical diagnosis.

**KEY WORDS:** cancer cells, immune system, regression, drug delivery system, nano particles, gold.

## INTRODUCTION:

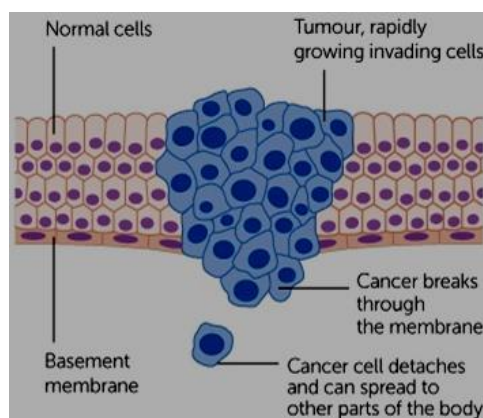
The set of associated diseases is termed as cancer. In each and every sort of cancer, a few of the cells in the body start to divide continuously and extend into adjacent tissues.

Generally, human cells develop and divide to form novel cells as the body desires them. When cells mature or get damaged and die. Now the new cells take their place. On the other hand, when cancer is formed cells turn into further abnormal or damaged cells survive when they should die, and new cells form when they are not needed. These additional cells divide continuously forming tumors.



**Figure 1: Response of normal and cancer cells to apoptosis**

Cancer cells ignore signals that normally tell cells to stop dividing or that begin a process known as apoptosis, which the body uses to get rid of unneeded cells. Cancer cells can also manipulate the normal cells and blood vessels that are present in the vicinity and provide necessary nutrients for tumor development. This area is known as the microenvironment. These blood vessels also remove waste products from tumors. Although the immune system normally removes damaged or abnormal cells from the body, some cancer cells are able to “hide” from the immune system. Tumors can also use the immune system to stay alive and grow.



**Figure 2: Malignant Tumor**

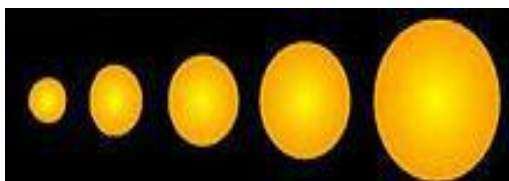
The conventional methods for treating cancer have proved to show or develop certain side effects in patients even after treatment is completed so in order to overcome this, now a day's researchers are focusing on drug delivery system using nano particles. The most preferable type of nano particle is gold. The reason for preferring gold is because gold exhibits certain special therapeutic properties at nano level. Also it is found that gold do not exhibit any sort of side effects or will cause any harm to the organs or tissues in the body.

#### ***OPTICAL AND ELECTRONIC PROPERTIES OF GOLD NANOPARTICLE:***

Gold Nanoparticles interaction with light is strongly dictated by their environment, size and physical dimensions. Oscillating electric fields of a light ray propagating near colloidal nano particles interact with the free electrons causing a concerted oscillation of electron charge which will be in resonance with the incidence of visible light. These resonant oscillations are known as surface Plasmon. For small (~ 30nm) mono disperse gold nano particles the surface Plasmon resonance phenomenon causes an absorption of light in the blue-green portion of spectrum (~450nm) white red light (~200nm) is reflected, yielding a rich red color. As particle size increases, the wave length of surface Plasmon resonance related absorption shifts to longer, redder wavelength. Red light is then absorbed and blue light is reflected, yielding solution with a pale blue or purple color. The particle size continues to increase towards the blue limit. The wave length of the Surface Plasmon resonance moves into the IR portion of the spectrum and may be even the size or shape of the nanoparticle, leading to particles with tailored optical properties of different applications.



**Figure 3: Suspension of gold nanoparticles**



**Figure 4: Gold nanoparticles of different nm size**

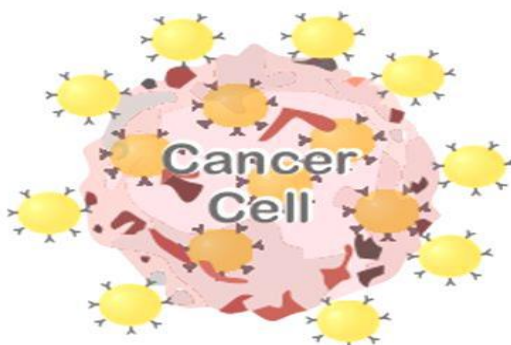
#### **DRUG DELIVER SYSTEM:**

Drug delivery system is a theory which is deeply incorporated with dosage form and means of administrating the course. Drug delivery technologies alter drug

discharge profile, absorption, distribution and elimination to provide advantage and safety for the patient ease and fulfillment.

### ***GOLD NANO PARTICLES:***

Cells are very good at protecting their precious contents and as a result, it is very difficult to penetrate. One effective way of doing so is to use nanoparticles of pure gold, coated with a thin layer of a special polymer. The gold nanoparticles have 600 percent greater affinity for cancer cells when compared to normal healthy cells. The 35 nm nanoparticles work efficiently. Researchers tested their technique using cell cultures of two different types of oral cancer and one nonmalignant cell line. The strong absorption spectrum of the gold nanoparticles is found to distinguish between cancer cells and noncancerous cells.

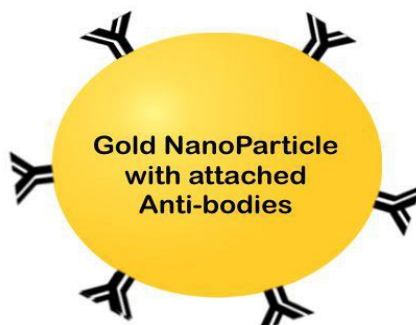


**Fig 5: Gold nanoparticles attached to cancer cell.**

Cancer is an innately complex disease to treat. Occasionally cancer cells continue even after eliminating tumors. At times fraction of a tumor cannot be removed since the cancer cells fix to a crucial organ. Cells can fit in to the foreign substance in various forms, but the method used here is receptor-mediated endocytosis. Here, the foreign object connects to a position lying on the cell called a receptor. Receptors have active ends on both sides of the cell membrane, each of which attaches to certain molecules. The external side is specific for particular bit that is necessary for the cell, while the internal part join to the proteins and signaling molecules that control cellular procedure based on outcome on the exterior cell surface.

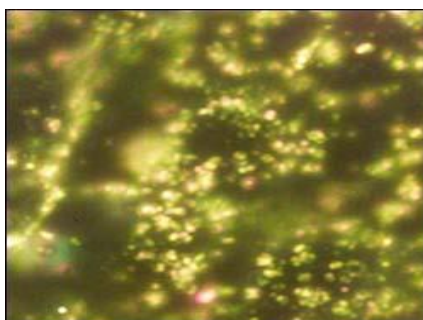
#### **a) Preparing the Nanoparticles:**

The gold nanoparticles have to connect to a cancer cell more straightforwardly than a healthy cell; or else the laser pulse would break healthy tissue. To achieve this, the researchers coated the particles in an antibody that will recognized and connect to the precise form of cancer. These antibodies join to the receptor at the cell membrane.



**Fig 6: Gold nanoparticle with antibodies.**

The researchers also found that there was an optimal size to the gold particles. If the particles were less than 10 billionths of a meter (10 nanometers) in diameter, the cell would quickly clear them out. The elements which were more than 100 nm were unable to be initialized by the cell. The researchers have created the nanoparticles of around 60 billionths of a meter in diameter which could show positive results.



**Figure 7: Gold nanoparticles in detecting cancer.**

These antibody-coated gold nanospheres were set up to place themselves with in cancer cells far more voluntarily than in healthy cells. Approximately the cluster size in healthy cells was found to be 64 nm, while that of cancer cells was around 300 nm.

One advantage is that tumors regularly contain leaky vascular systems, so when the gold particles are infused intravenously close to the known cancer, they quickly multiply and are integrated all through the cancerous area. The scientists noted that 24 hours of time was required following the injections to let gold clusters to form in the cells.

#### **a) Blowing Up the Cancer Cell**

After the gold nanoparticles get integrated into the cancer cells, the researchers exposed the tissue to laser pulse for 30 picoseconds. This laser light is



most favorable since it go through the tissue in good health and it is not resonant with the gold nanoparticles. This means that when the light hit the nanoparticle it do not absorb it and directly start warming the massive gold nanoparticles resulting in overheating the cell.

The gold nanoparticles will not perform well on altering the laser pulse to thermal energy on their own, so any nanobubbles produced will be comparatively irrelevant. As a result, few spheres together in a healthy cell will not cause any damage. The cluster of nanoparticles inside the cancer cells efficiently alters the laser pulse to thermal energy. This results in vaporization of the surrounding fluid, a quick expansion and disintegrates, leading to the destruction of the cancer cell.

#### ***Further scope:***

Now researchers are focusing their attention on gold nano particles as it is thought that gold nanoparticles itself have certain therapeutic properties. Apart from this few researchers are also working on Nano diamond particles in detection and curing cancer and also in certain complicated medical diagnosis.

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